Social Collaboration for Corporate Innovation Management

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for Cornelia

"To ask about the meaning of life is an error -

it is life that asks the questions."[1]

[1] Translation of the German phrase „*Die Frage ist falsch gestellt, wenn wir nach dem Sinn des Lebens fragen. Das Leben ist es, das Fragen stellt*.", Viktor Frankl, 1905 - 1997, Austrian neurologist and psychiatrist, https://www.aphorismen.de/zitat/67321 (last access: 24.4.2017).

Abstract

This dissertation explores the potential of using social media to achieve a higher degree of effectiveness in innovation management in a corporate context. To date, the general discussion has mainly focused on certain aspects of social media, like for instance the mass-scale networking of users of different self-portrayal and interaction platforms such as Facebook, LinkedIn, or Xing, or the 'wisdom of the crowd' effect for large-scale idea platforms or as a marketing tool to reach target groups with dedicated messages.

The scientific value of the presented PhD thesis lies in the targeted research of the prerequisites that are deemed necessary for the implementation of social media as an in-house communication platform in the context of corporate innovation management. Extensive experience has been gained by the author in the area of technology, product, and innovation management in numerous management positions. The barriers to effective innovation performance within firms which have been experienced and identified are the main motivation factors for this PhD thesis.

The key research question is whether or not social media can enhance companies' innovation expertise if these tools are applied as an in-house information and communication platform. Social media mechanisms are principally based on information sharing. In a corporate environment, however, shared information does not necessarily translate into equal benefits for all those involved. Such a mismatch could lead, according to the hypothesis of this work, to essential drawbacks for staff members, and consequently hinders an effective innovation processes.

An essential problem, at least within the business world, is that the innovation process is generally viewed as a linear innovation-steering model and that it is often believed that the simple usage of IT-tools can solve intra-organisational communication issues and even is enough to get access to the always very personal expertise of employees. In addition the intertwined relationship of technology usage and social behaviour within firms is often underestimated. This doctoral thesis seeks to address the essential issues associated with modern knowledge management, innovation management and organisation management, especially in relation to computer supported cooperative work (CSCW), when implementing new online social media tools within firms.

To provide empirical evidence of the identified phenomena, a mix of different empirical evaluation methods was applied in a dedicated research project within the real innovation context of AIT Austrian Institute of Technology, Austria´s largest applied research and technology organisation (RTO) devoted dedicated to innovation management as their prime focus of activity. These include the observations of the behaviour of scientists, especially during the project generation phase. Staff members´ behaviour of the AIT Digital Safety & Security Department was subject to thorough observation, including the analysis of over 700 innovation projects, as well as structured interviews with the middle management and online questionnaires for all employees of the Department. Based on this multi-layer research design, the main reasons behind the identified innovation barriers were duly investigated. Thus, understanding the inherent resistance to innovation management processes is key to the effective design of communications tools and for their improved acceptance within a company.

Based on these empirical results, the aforementioned hypothesis could be verified. A personal reluctance towards the wider open communication of half-baked ideas within the organisation in general and the management in particular is the rule rather than the exception in innovative processes. Without the establishment of a widely accepted "sharing culture" within organisations, social media will not be able to have an impact on improving the overall innovation performance of an organisation.

To summarize, effective innovation management means: i) allowing scope for creativity through the possibility of bottom up freedom to engage and work for the staff members; ii) additionally ensure the possibility to steer innovation activities according to economic and compliance rules, which are usual in the business world; iii) to support the open information exchange with lowest administrative overhead and tools with highest usability; and finally most important iv) to develop a company culture which is based on open information sharing.

Zusammenfassung

Die vorliegende Dissertation untersucht das Potenzial des Einsatzes von Social Media zur Erzielung einer höheren Effektivität im Innovationsmanagement im wirtschaftlichen und unternehmensinternen Kontext. Üblicherweise werden soziale Medien vor allem unter dem Aspekt der Vernetzung von BenutzerInnen diverser Selbstpräsentations- und Interaktionsplattformen – wie Facebook, LinkedIn oder Xing – oder aus der Perspektive der „Weisheit der Vielen" für Ideenplattformen betrachtet.

Diese Doktorarbeit bezieht ihren wissenschaftlichen Stellenwert aus der Erforschung nötiger Rahmenbedingungen für die Implementierung von Social Media-Funktionen im Innovationsmanagement als unternehmensinterne Kommunikationsplattform. Die zahlreichen Erfahrungen des Autors dieser Studie in verschiedensten Führungspositionen, in Bereichen des Produkt-, Technologie- und Innovationsmanagements, und die dabei diagnostizierten Barrieren bei der Umsetzung von Innovationsleistungen lieferten die Motivation für diese Dissertation.

Die zentrale Forschungsfrage lautet, ob und wie die neuen sozialen Medien die Innovationskompetenz von Unternehmen steigern können, wenn diese Werkzeuge in Unternehmen als Informations- und Kommunikationsplattform eingesetzt werden. Social Media-Mechanismen bauen grundlegend auf dem Prinzip der Informationsteilung auf. Im unternehmerischen Umfeld bedeutet geteilte Information jedoch nicht zwingend gleichwertige Vorteile für alle Beteiligten. Vielfach erfolgt gezielte und selektive Informationsweitergabe unter den MitarbeiterInnen, wodurch effektive Innovationsprozesse entscheidend gehemmt werden.

Ein grundsätzliches Problem besteht in der Geschäftswelt vor allem darin, dass viele Unternehmen immer noch versuchen, Innovation linear im Unternehmen zu steuern und Kreativität in einem Forschungskontext zu verankern, eine effektive Verzahnung dieser beiden Welten aber oft nicht funktioniert. Vor allem der enge inhärente Zusammenhang von Technologieentwicklung und Benutzerverhalten und die dabei entstehenden wechselweisen Einflüsse sind im unternehmerischen Alltag oft unverstanden. Die vorliegende Doktorarbeit möchte diese Lücke schließen und setzt sich intensiv mit den Aspekten der Informationsweitergabe und des Kommunikationsverhaltens in Unternehmen auseinander. Damit werden Kernaspekte des modernen Innovations-, Wissens- und Organisationsmanagements behandelt.

Zur empirischen Beweisführung der erkannten und im größeren Erklärungszusammenhang verlinkten Phänomene wurde im realen Organisationskontext des Departments Digital Safety & Security im AIT Austrian Institute of Technology ein Mix an Forschungsmethoden zum Einsatz gebracht. Das Verhalten der Mitarbeiter des Departments wurde in einer Fallstudie analysiert, die mehr als 700 Innovationsprojekte berücksichtigte. Interviews mit dem mittleren Management und Online-Umfragen unter den MitarbeiterInnen des Departments lieferten entsprechende Daten. Mit diesem mehrschichtigen Untersuchungsdesign wurden die Gründe für Innovationsbarrieren erhoben. Das Verstehen der inhärenten Widerstände im Innovationsmanagement ist der Schlüssel für die richtige Gestaltung der Kommunikationswerkzeuge und für ihre verbesserte Akzeptanz.

Mit den empirischen Ergebnissen konnte die eingangs formulierte Hypothese verifiziert werden. Persönliche Zurückhaltung bei der Informationsweitergabe bildet in innovativen Prozessen die Regel und nicht die Ausnahme – und dies sogar unter Bedingungen einer innovationsfreundlichen Unternehmenskultur. Ohne die Etablierung einer durchgehend akzeptierten „Sharing Culture" können soziale Medien zu keiner Verbesserung der Innovationsfähigkeit führen.

Zusammenfassend braucht ein effektives Innovationsmanagement: i) zugelassene Kreativität, welche durch Eigenbestimmtheit und Freiheit des Denkens der MitarbeiterInnen geprägt ist; ii) Möglichkeiten einer Top-down-Ansteuerung der Innovationsaktivitäten, um wirtschaftliche und Compliance-Regeln aussteuern zu können; iii) die Unterstützung eines offenen Informationsaustausches durch geringste bürokratische Hürden und effektivste Werkzeuge mit größter Benutzerfreundlichkeit – sowie schließlich wohl am wichtigsten iv) eine Unternehmenskultur, welche einen offenen, vertrauensvollen Informationsaustausch unterstützt und damit erst möglich macht.

Declaration of Authorship

I, Helmut Leopold, hereby certify that this doctoral thesis has been written by myself, and the work reported herein is my own and I have documented all sources and material used. The work reported in this thesis has not been submitted for a degree in this, or any other form.

I was admitted as a research student for the degree of PhD in October 2009 at Lancaster University, Lancaster, United Kingdom.

The work was carried out during the years 2010-2016 at AIT Austrian Institute of Technology, Department Digital Safety & Security[2], Vienna, Austria under the scientific supervision of Lancaster University, School of Computing and Communications, Lancaster, United Kingdom.

Parts of this work have been published under my personal authorship, respectively co-authorship during this time period. This was always made clear through explicit references in the reported work. The following publications have been made:

- Peter Reichl, Ivan Gojmerac, Helmut Leopold, Georg Stonawski, "Research as a Service: The Role of Competence Centers in Bridging Industry and Academia", in: *Managing and Leading Creative Universities – Foundations of Successful Science Management*, Springer Book, 2017[3].

- Helmut Leopold, Helmut Schwabach, Christian Flachberger, Alexander Almer, *Inno4Sec - Demand-oriented innovation concept for the Austrian security research*, report and recommendation in the context of the Austrian security research programme KIRAS, study for the Austrian Ministry for Transport, Innovation and Technology (BMVIT), 4. October 2014; project home page: http://www.kiras.at/projects/detail/?tx_ttnews[tt_news]=300&cHash=3fb32c91199d27387da5f886c43850e2&L=1[4], [Leopold2014c]; parts of Chapters 2, 3, and 6 are used as theoretical background for this study. This study was prepared under my project lead of a national research project to design an innovation process for cooperative security research activities in Austria.

- Helmut Leopold, "Innovating Innovation - From Recycling to User Driven Innovation", *APA-Science, Austrian Press Agency ZukunftWissen, Culture & Society*, 23. April 2012; http://science.apa.at/site/kultur_und_gesellschaft/detail.html?key=SCI_20120423_SCI39911359276424942[4], [Leopold2012d]; parts of Chapter 2.

- Helmut Leopold, "Next gen innovation management through social collaboration", *OVE e&i elektrotechnik und informationstechnik Journal*, Springer, heft 2.2012, March 2012, pp. 60-66, [Leopold2012a]; summary of Chapter 2 and Chapter 3.

- Helmut Leopold, "Social Media Platform Overview", *OVE e&i elektrotechnik und informationstechnik Journal*, Springer, heft 2.2012, March 2012, pp. a28-a30, [Leopold2012c]; parts of Chapter 3.

- Helmut Leopold, "Von der freien Entwicklerszene lernen", in: *net culture lab - An innovation initiative from Telekom Austria AG*, Roland Alton-Scheidl, Jana Herwig (eds.), lab.netculture.at[4] „net culture lab Katalog", 17.4.2008, pp. 8-13 [Leopold2008b][5].

[2] The views expressed in this doctoral thesis are those of the author and do not necessarily reflect the views of AIT Austrian Institute of Technology.

[3] This book has been submitted for publishing.

[4] Last access: 24.4.2017.

[5] This innovation initiative was driven and supported by the author of this PhD during his affiliation at Telekom Austria.

Some parts of this PhD study have been published as editorial prefaces of the social media newsletter of the OVE society[6] for information and communication technology (GIT), www.ove.at/gesellschaften/git/newsletter[7] - "*Social Media"*, as well as on a special issue of the e&i elektrotechnik und informationstechnik journal:

- "Social Physics as a basis for Social Media or efficiency does not always guarantee an increase in productivity", May 2015, https://www.ove.at/fileadmin/user_upload/Gesellschaften/GIT/GIT-Newsletter/Social_Media/2015/ove_aktuell_Social_Media_Mai_2015.pdf[7] [Leopold2015f]; summary of Section 5.2.1.

- "Technology – more a social than a physical phenomenon", October 2014; https://www.ove.at/fileadmin/user_upload/Gesellschaften/GIT/GIT-Newsletter/Social_Media/2014/GIT_Newsletter_10_2014_full.pdf[7] [Leopold2014b]; summary of Section 6.1.3.

- "Management of Technology Implementation – a social challenge", April 2014; https://www.ove.at/fileadmin/user_upload/Gesellschaften/GIT/GIT-Newsletter/Social_Media/Newsletter_2014-04__Management_von_Technologieeinfuehrungen.pdf[7], as well as *OVE e&i elektrotechnik und informationstechnik Journal*, Springer, Heft 3.2014, April/May 2014, p. a49-a50, [Leopold2014a]; summary of Section 4.6.1.

- „The currency of the new century is Attention", October 2013; https://www.ove.at/fileadmin/user_upload/Gesellschaften/GIT/GIT-Newsletter/Social_Media/2013/GIT_Newsletter_10_2013.pdf[7], [Leopold2013b]; summary of Section 2.12.

- "Online Social Media for a modern Crisis and Disaster Management", April 2013, https://www.ove.at/fileadmin/user_upload/Gesellschaften/GIT/GIT-Newsletter/Social_Media/2013/GIT_Newsletter_4_2013.pdf[7], as well as *OVE e&i elektrotechnik und informationstechnik Journal*, Springer, Heft 3.2013, April/May 2013, p. a34, [Leopold2013a]; parts of Chapter 4.

- "Marketing and innovation processes", November 2012, https://www.ove.at/fileadmin/user_upload/Gesellschaften/GIT/GIT-Newsletter/Social_Media/2012/GIT_Newsletter_11_2012.pdf[7] [Leopold2012i]; parts of Chapter 4.

- "Networked society in companies", May 2012, https://www.ove.at/fileadmin/user_upload/Gesellschaften/GIT/GIT-Newsletter/Social_Media/2012/GIT_Newsletter_5_2012.pdf[7] [Leopold2012h]; parts of Chapter 4.

- "Social Media", editor of the special edition ´Social Media´, *OVE e&i elektrotechnik und informationstechnik Journal*, Springer, Heft 2.2012, March 2012, p. 59, [Leopold2012g]; parts of Chapter 4.

- "Increased productivity through social media (Produktivitätssteigerung durch Social Media)", December 2011, https://www.ove.at/fileadmin/user_upload/Gesellschaften/GIT/GIT-Newsletter/Social_Media/2011/GIT_Newsletter_12_2011.pdf[7] [Leopold2011]; parts of Chapter 4.

During the elaborating of this PhD, a dedicated online social media software platform has been developed as an organisational internal communication platform in 2010-2012, to support creative and information exchange processes within the AIT Department Digital Safety & Security under my responsibility and strategic leadership. This company internal online social media platform is called

[6] Austrian Electrotechnical Association, www.ove.at (last access: 24.4.2017).

[7] Last access: 24.4.2017

"SoCol (Social Collaborator)" and encompasses typical social media function as discussed in Chapter 4 and summarised in Section 11.4 in the Appendix.

This online social media application was also used as a communication platform tool for the Austrian electrotechnical association OVE with the brand "techbook"[8] and it was as well used as a proof of concept platform for supporting the ongoing learning processes for security processes at airports in the context of the dedicated research project "Airport Security and Productivity (ASaP)"[9].

Finally an innovation process for developing and managing applied research projects within the AIT Department Digital Safety & Security has been defined and implemented in the organisation by me during the elaboration of this PhD study. Well defined forms, processes, and communication tools and a cultural framework have been defined and elaborated during the course of the PhD (see Chapter 7 and Section 11.3), which are now part of the core organisational business processes of the AIT Department as a cornerstone of the Department´s innovation process.

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[8] *„OVE-GIT positioniert sich neu und bestellt neue Geschäftsführerin",* 31.1.2011, http://www.computerwelt.at/news/wirtschaft-politik/detail/artikel/54766-ove-git-positioniert-sich-neu-und-bestellt-neue-geschaeftsfuehrerin/ (last access: 24.4.2017).

[9] Research project of the Austrian security research progam KIRAS, 1.9.2008-31.8.201. The project evaluated, among other objectives, the usage of a modern social media application to support the buttom-up information and expertise exchange among security personnel responsible for the check-in security processes at airports (workpackage 5) [ASaP2011]; project home page: http://www.kiras.at/gefoerderte-projekte/detail/?tx_ttnews%5Btt_news%5D=216&cHash=b336a5a89bb953d2e8c9fef245db53f8; press release: http://www.ait.ac.at/fileadmin/cmc/downloads/PAs/2012/AIT_2012_Erfolgreicher_Abschluss_des_KIRAS_Projektes_ASaP_22112011_v15_final_abgestimmt.pdf (last access: 24.4.2017).

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I also express my warmest gratitude to my second supervisor Dr. Mark Rouncefield, Senior Research Fellow, School of Computing and Communications, Lancaster University. His guidance into the world of social science as well as to focus on specific subjects has been so valuable. The same gratitude goes to my second supervisor for the first two years of my study, Professor Mike William Chiasson, University of British Columbia, Okanagan, Canada, whose comments and discussions on innovation management and online social media systems have been so helpful for this work. I would also like to thank Herman Wasserbacher, Managing Director of IFES, a leading Austrian marketing research firm and Mag. Christine Schuster from IFES for their support in performing the questionnaire among the employees at AIT. A special thanks goes to Anton Plimon, Managing Director of AIT Austrian Institute of Technology, for making it possible to carry out this work at AIT.

It would not have been possible to complete this thesis without the help and support of many colleagues and friends. In particular the comprehensive philosophical discussions with Wolfgang Grabuschnig, Bakk. phil., and Mag. Andreas Keri on innovation and technology management were an inspiring source for this study. I'd like to give special thanks to Johannes Zeitlberger with his start-up u.enterprise which accompanied my PhD study with the software implementation of the online social media platform “SoCol”. I am grateful to Mag. Lara Luchesa, Helen Smith, BA, MA, and Dr. Paul Smith for their support in improving my English throughout the study. Finally many thanks to Matthias Pinsker for his efforts in supporting me implementing the project life-cycle process in the AIT Department Digital Safety & Security.

Doing a PhD is more about life than work. I am grateful to my wife, Cornelia, for accepting so many holidays and weekends to be used to work on my PhD.

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Overview

The only reliable way to gain a competitive advantage over other market rivals is permanent innovation. The main question, however, is how can we create a robust framework within our companies to promote and drive innovations more easily, motivate and inspire employees to develop a more innovative attitude and mindset, and support the management to take future-proof decisions. This study intends to discover whether the hype around new online social media (as innovation nurturing) is deserved and whether it offers a new approach to overcome some of the classical innovation and knowledge management problems within firms.

Chapter 1 is the introduction and provides the motivation for the work. The study is performed within a real-life organisational context at AIT Austrian Institute of Technology, Austria´s largest applied research and technology organisation (RTO), within the Department Digital Safety & Security[10]. For this PhD an ethnographic approach is used, i.e. observing and interviewing people in their workplace. In CSCW this is usually termed "ethnomethodologically informed ethnography" because it is an observational approach that pays especial attention to the details and sequences through which various kinds of "work gets done". The essential issues of ethnography and ethnomethodologically ethnography are summarized and the used instruments are described: i) observation of the behaviour of the employees; ii) semi-structured interviews with the middle-management; and iii) the analyses of the information hiding behaviours of the employees during creative and project generation phases by questionnaires.

Further on, essential issues for the research methodology are introduced such as how performing interviews, and the generalisation problem of qualitative research results, i.e. the basic question to what extent the findings a research study based on ethnography can be generalized to other organisations. And the important issue of the reflexivity of the researcher as part of the research environment is discussed.

This chapter clarifies also how the ethical principles are followed for the research project. Essentially, it involves two essential areas: i) the people affected by the empirical studies may not experience any disadvantage; and ii) since the researcher is itself part of the system, the research design has to assure that the research complies with ethical principles. Through an ongoing discussion of the innovation process within the organisation and its ongoing adaptation, an inherent reflection takes place. In the same way the research results are discussed in order to improve the innovation process within the organisation. Thus, according to Luhmann, an institutionalized 2nd order observation is achieved and thus ethical behaviour ensured in the course of the research project.

Finally the research question is stated on which this PhD study is focusing.

To start the discussion, **Chapter 2**, "*Innovation and Technology Management*" summarises the basic understanding of innovation especially in the business context and clarifies the essential concepts and terminology as a basis for the subsequent elaboration. Creativity, innovation power by combination, and the role of market drivers for innovation are discussed. Different forms of innovation within a business context are elaborated and the mechanisms of disruptive and incremental innovation, as well as proprietary and infrastructure technology are clarified. The innovation dilemma of large organisations is highlighted and innovation management processes in

[10] AIT is the applied research centre of the Republic of Austria. The Department Digital Safety & Security has a strong ICT focus and is oriented to contribute to R&D in ICT for critical infrastructure issues.

complex environments are discussed. The concepts of self-organisation and emergence, and the importance of non-linearity in complex systems are highlighted. A discussion on strategic planning processes which do not guarantee operational results is provided, and finally the necessity of linear processes in order to complement creative processes within corporations is clarified in this Chapter.

Chapter 3, *"Knowledge Management – From Data to Expertise",* summarizes the essential issues of knowledge management within organisations. The different types of knowledge, such as explicit, implicit, and tacit knowledge are clarified. The processes of how knowledge is developed – from information sharing till expertise sharing, and the difference between individual knowledge and organisational knowledge as a result of a learning process, is elaborated which results in "social capital" within organisations. The weakness of existing knowledge development models such as the SECI model is discussed. Finally in this chapter an overview of technology supported knowledge management approaches is provided, and the intertwined relationship between IT usage and cultural processes at the workplace, as discussed in the knowledge management literature, is summarized.

In **Chapter 4,** "*Utilising Social Media within Firms: from Online Collaboration to Next Generation Innovation Management*", the characteristics of social networking are discussed and the essential concepts that differentiate Web 2.0 from Web 1.0 are highlighted. The meaning of the term "media" in this context is clarified and it is elaborated why we could call media "social". The characteristics and functions of social networks are highlighted, especially in the context of the ubiquitous connectivity of human beings by modern Information and Communication Technology (ICT) and powerful broadband networks. Specifically focus was on those aspects of communication mechanisms which justify the so-called "social" aspect in communication processes. Based on this understanding, the core functions that define online social media platforms are summarized.

Chapter 5, "*Driving Factors for Organisational Performance*", is a summary of the important framework conditions that influence a company's performance and thus success – from an employee's motivation and cooperation point of view. In this context, functioning informal organisational processes as well as the main employee's motivation factors are highlighted as the determining element for business success. This operates in relationship to a corresponding positive cultural atmosphere that is characterized by leadership, in positive respectful corporate culture, transparency, common feeling and a high level of interest in communication within the company. The characteristics of data and information as basic elements for communication processes within organisations are presented. This leads to specific employee behaviour based on intrinsic and prosocial motivation as well as to the very essential aspect of outcome expectation by any human interaction. As part of this discourse the main aspects which counteract a successful information and knowledge exchange as potential barriers are summarized such as partial knowledge, the cost of codification, sticky knowledge, missing trust and the risk of jeopardizing existing relationships. Finally, the crucial effect of self-efficacy as one the most important driving force for innovative work behaviour is highlighted.

In **Chapter 6**, "The *Implementation of Creative Ideas in Organisations*", a comprehensive discussion of the issues which determine the successful implementation of ideas within organisations is provided.

As a basis for this the strong interlinking between technology and usage of technology is discussed as a necessary permanent mediation between technology and users, referring to the concepts of sense making and technology mediation. This plays an important role for technology acceptance in general and for software (SW) technology which supports communication or even business processes within

firms in particular. Thus, the different impacts of different kinds of SW to support business processes are discussed and finally the technology mediation and sense making mechanisms in the context of computer supported cooperative work (CSCW) technology are highlighted.

Further on, the factors which stimulate uncertainty and conflicts in organisations when new technology is introduced are discussed which finally results in a certain resistance within the company against new technologies, and which potentially jeopardize the implementation of new ideas and subsequently innovations in organisations. Finally, a model of innovation resistance from the literature is provided.

Chapter 7, "*Innovation Management at AIT Department Digital Safety & Security"*, summarizes the gate based designed innovation management process for the R&D project life-cycle management at the AIT Department - called "Project Life-cycle Process (PLP)", which have been developed and fine-tuned during the course of this PhD study.

Chapter 8 provides the "*Empirical Analysis on Employees' In-House Communication Behaviour in the Context of Corporate Innovation*". In order to validate the different views from the literature and to understand the expectations of the employees within organisations, a case study was performed at the AIT Austrian Institute of Technology, in the Department Digital Safety & Security. This case study encompassed the observation of employees´ behaviour during the project generation phases, as well as summarizing the experiences made during the implementation of innovation processes within the organisation and different kind of questionnaires for the employees and semi-structured interviews with the middle management. Based on that eleven concrete theses have been defined which are the basis for the specification of 32 questions for the employee questionnaire. This questionnaire identified the main issues to be considered when implementing innovation processes within firms.

For example, 80% of the employees indicate that they are presenting their idea even in a very early stage to their colleagues. Employees are more cautious when communicating with the management. However, 24% of the employees still are indicating that they are definitely willing to discuss even half-baked ideas with the management; a huge portion is unsure and thus there is a potential to motivate them by appropriate organisational measures.

Further on, there is a tension between effort to prepare information for effective communication process and expected added value. Basically we identified that 1/3 behave very openly and see an added value which pays off the effort for the presentation, 1/3 see the effort as too much compared to the added value, and 1/3 are unsure. This is the background, that there is a basic tendency not to present premature ideas or project proposals in a wider context within the organisation.

Chapter 9 summarizes the "*Conclusion*" of the study. In order to achieve an effective innovation culture within an organisation, it is essential to ensure creativity capabilities as well as management control at the same time and, even more, it is essential that those two concepts are in strong relationship to each other and closely interweaved. An innovative company has to ensure four fundamental issues: i) creative capabilities based on emergence and self-control and support of communication and information exchange among the involved actors within the company; ii) a controlled environment to be able to consider and influence the firm´s business environment bottom up; iii) to support the open information exchange with lowest administrative overhead and tools with highest usability; and finally iv) a basic positive culture enabling employee motivation and willingness to cooperate and sharing of expertise. It is important to understand, that the management of organisational tasks are equally essential as creative emerging structures and that well defined processes can support both objectives.

Thus, it is all about creating an environment, where creativity meets controlled environments. Based on the findings of this study, eight recommendations to form an innovative organisation are finally formulated.

Chapter 10 lists the references and **Chapter 11** is the appendix containing background information such as the detailed results of the performed questionnaire, the developed forms for the gate based project life-cycle process elaborated during the course of this PhD study, as well as the social media functions implemented in the dedicated used social collaboration tool “SoCol” during the course of this PhD. Finally the used abbreviations and a list of key words is provided.

Key Words: innovation management, knowledge management, organisation management, knowledge sharing, expertise sharing, computer supported collaborative work (CSCW), groupware, online social media, organisational factors, social factors, planning, creativity, complex systems, self-organisation, grounded theory, ethnography, ethnomethodology

1. Introduction

1.1. Preface - Motivation

"You do not need to understand the world, you only need to cope with it." [11]

Albert Einstein, 1879 - 1955

1.1.1. The Digital World Challenges our Innovation Processes

The only reliable way to gain a competitive advantage over other market rivals is continuous innovation. The main question, however, is how can we create a robust framework within our companies to promote and drive innovation more easily, motivate and inspire employees to develop a more innovative attitude and mindset, and support the management to take future-proof but also innovative decisions. Especially the new digital information and communication technologies (ICT) are changing the existing eco-system and business models fundamentally [Leopold2015b]. The true potential of new technologies and developments is often completely misunderstood even by top managers as well as experts. David Pogue, founder of Yahoo Tech and writer for the New York Times said in 2006[12]: "*Everyone´s always asking me when Apple will come out with a cell phone. My answer is: probably never*", or Robert Metcalfe´s, founder of 3Com and inventor of Ethernet, with its prediction 1995, written in InfoWorld 1995[12]: "*I predict the Internet will soon go spectacularly supernova and in 1996 catastrophically collapse.*" And nobody could have ever imagined the speed at which Facebook would gather momentum[13]. Bill Gates also presented the first tablet PC to the market in 2002[14], but it took 8 more years until Steve Jobs successfully launched such a product[15].

There are so many developments and the possibility of determining which one will reach a critical mass within a certain time frame depends on processes that can no longer be managed by a single company, since the successful implementation of new technologies in the market and within firms is influenced by a number of internal and external factors.

In addition, it is important to note that often, the new breed of technologies such as the Internet and Facebook has been, and are still being, successfully developed and commercially implemented outside large corporations, and are therefore beyond the scope of traditional businesses. On the one hand, such developments have been realized via an "open innovation culture" as described by Chesbrough [Chesbrough2003], with a corresponding venture-capital infrastructure or driven by

[11] Translation of the German phrase from Albert Einstein: "*Man muss die Welt nicht verstehen, man muss sich nur in ihr zurechtfinden*", http://www.helles-koepfchen.de/albert_einstein/weisheiten_und_ansichten.html (last access: 24.4.2017).

[12] Scientific American, *Use It Better: The Worst Tech Predictions of All time*, January 18, 2012, http://www.scientificamerican.com/article/pogue-all-time-worst-tech-predictions/ (last access: 24.4.2017).

[13] Many more examples of wrong technology development and market developments are summarized in [Sloane2006] Paul Sloane, *The Leader´s Guide to Lateral Thinking Skills - unlocking the creativity and innovation in you and your team*, 2nd edition, 2006.

[14] heise online news, "*Bill Gates kündigt erste Tablet-PCs für den Herbst an"*, 23.5.2002, http://www.heise.de/newsticker/meldung/Bill-Gates-kuendigt-erste-Tablet-PCs-fuer-den-Herbst-an-61098.html (last access: 24.4.2017).

[15] The first iPad was released on April 3rd, 2010, http://en.wikipedia.org/wiki/IPad (last access: 24.4.2017).

other investment programs such as the military and universities (see the Internet development[16]) or even subsidized by other infrastructure investments such as building the energy infrastructure combined with the installation of telecom fibre optic cables[17]. On the other hand, in our new digital networked information society, new products and services can today often be created without large-scale infrastructure investments or complex bundled expertise in large-scale R&D corporate units, as demonstrated by app developments all over the world[18].

Many market drivers for these new developments have been changed fundamentally during the last twenty years by the strong liberalization effort of the European Union, resulting in a considerable market pressure for incumbent telecom operators and enabling the development of new information and communication technologies (ICT) as well as new business models.

Since the author of this study had extensive personal experience during his affiliations at Telekom Austria, the incumbent telecom network operator in Austria, in several management positions (1998-2008), as well as within AIT Austrian Institute of Technology (2009-2017), the national applied research centre of Austria[19], this work is motivated by the personal observations concerning

[16] Main stakeholder for the Internet development was the Defense Advanced Research Projects Agency (DARPA). DARPA is an agency of the U.S. Department of Defense responsible for the development of emerging technologies for the military.

[17] Telekom Austria FTTH initiative Arnoldstein in 2004. Die Internetzukunft kommt mit der Fernwärme, press release, APA-OTS, 10.12.2004, https://www.ots.at/presseaussendung/OTS_20041210_OTS0264/die-internetzukunft-kommt-mit-der-fernwaerme (last access: 24.4.2017).

[18] Of course, there have been huge investments be made to implement the worldwide Internet and broadband infrastructure including physical communication links, networking equipment and servers. These vast infrastructure investments have been based on various infrastructure business cases and enabling technologies such as digital telephony (fixed line and mobile), broadband internet access based on xDSL as well as FTTX, e-mail communication services or digital TV services. For example the interactive TV (called "IPTV" to describe the usage of the IP communication protocol for the transport of TV content) service launches of the network operators, 2004-2008, were mainly driven to leverage the existing communication infrastructure and not necessarily as a content business case on its own (Personal experience of the study author during his affiliation at Telekom Austria, the incumbent telecom network operator in Austria. Telekom Austria was one of the first operators with an early IPTV service launch, http://www.a1.net/newsroom/2006/11/20061117_telekom-austria-innovationsstratege-helmut-leopold-unter-die-top-50-der-europaeischen-technologiemanager-gewaehlt/, last access: 24.4.2017). Based on the existing communication infrastructure for broadband Internet access, the realisation of software based applications become possible without large infrastructure investment beforehand. Networking infrastructure is available to reach potential customers, and in addition tools, skills and capabilities are widely available at the user´s side to implement new applications and even create new content. By connecting suppliers with the customers new market places have been established, as described by the "*long-tail principle*" for new media by Chris Anderson in 2004 [Anderson2004, Anderson2006]. Applications such as Google Maps, YouTube, Skype, and many other open source tools have been available for subsequent use. Consequently a world-wide developing community has implemented several hundred thousands of applications; and all of them are available for millions of developers to build new applications by re-using and combining [Mulligan2014]. According to Gartner, there have been more than 100 billion downloads in 2013 (http://www.gartner.com/newsroom/id/2592315, last access: 24.4.2017).

[19] AIT Austrian Institute of Technology is the largest national applied research centre of Austria. The key objectives of AIT as a research and technology organisation (RTO) are the achievement of international leading-edge scientific research results and, based on that, the generation of an added value for both industrial actors and the economy in general. By implementing this vision AIT acts as a bridge between basic research, usually

innovation capabilities of the concerned organisations. At several points during the discussion, the author is making reference to personal experiences in this context.

The author of this study observed two essential phenomena[20]: On the one hand, although many innovations have been generated within the organisation, products have been designed and even tested in proof of concept projects; finally they have not been marketed successfully, although sufficient funding would have been available. Several innovative projects have been created, but many of the approaches experienced delayed market launches by several years or were even not brought onto the market at all. On the other hand a much greater personnel effort has been spent in corporate internal discussions, procedures and processes than in studying of the market, customers and competitors. In addition it is remarkable that although there was a company-wide innovation process in place offered to involve all parts of the company in an open discussion and decision process, this was often not exploited in this way. The information exchanges through the innovation process were subject to constant discussion and criticism. The product management did not want to discuss openly with the technical experts, the management wanted to take decisions without detailed interaction with dedicated departments, teams were reluctant to share openly their knowledge and available information, etc.[21].

The introduction of new technologies such as broadband Internet, interactive television, and VoIP lead to a permanent discussion within the organisation. But, more often the company internal competences and the internal power structures were in dispute than market and competitors.

Examples of such non successful innovation activities in the telecom market in Austria 1999-2008 are[22]:

- Already 2004 an interactive TV service was launched in a village in Austria in Engerwitzdorf, called "Colourful TV Engerwitzdorf"[23] [Miletich2005, Koschnick2008, p.

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conducted at the academic level on universities, and product development at the corporate level. A description of the organisation is provided in Section 1.3 below.

[20] Practical experience of the author during his affiliation at Telekom Austria in several management positions 1998 – 2008.

[21] The most remarkable event was the launch of a new product of Telekom Austria by the product management organisation which was on purpose not discussed with the technical counterparts within the organisation. This was driven by the objective to push the technical organisation to accept new technology platforms without any discussion and negotiation within the company. The product launch resulted in a complete standstill of the network with serious impacts on the market. Finally, the product launch had to be stopped and board members had to officially excuse the failure ("*Telekom Austria entschuldigt sich bei AON-Kunden"*, 4.2.2000, http://derstandard.at/157020/Telekom-Austria-entschuldigt-sich-bei-AON-Kunden, last access: 24.4.2017).

[22] All of the following examples mentioned are based on public media sources.

[23] The author was creator, initiator and responsible project manager for this project, during his affiliation with Telekom Austria. The project gained some attention in the public press:

„ZDF proudly presents: "Buntes Fernsehen Engerwitzdorf" – ein innovatives Telekom Austria Pilotprojekt", 30.5.2008, http://www.a1.net/newsroom/2008/05/20080530_zdf-proudly-presents-buntes-fernsehen-engerwitzdorf-ein-innovatives-telekom-austria-pilotprojekt/ (last access: 24.4.2017).

"*Local net TV takes off in Austria",* BBC News, 25.3.2005, http://news.bbc.co.uk/2/hi/technology/4378945.stm (last access: 24.4.2017);

21, Tremetzberger2010, p. 58]. This project focused on short movies produced by local people in a village. Instead of broadcasting this content, as is usually done within cable TV (CATV) networks, the consumption of these movies was made possible by interactive means, based on the broadband xDSL[24] and IP based infrastructure from Telekom Austria. This interactive content platform was running in Austria before YouTube began its service[25]; although just as a proof of concept project. Interestingly it has to be noted, that considerable criticism by different stakeholders (representatives of the union, IT operation employees, customer service employees are some examples) demonstrated that they are not supporting the innovative new product direction.

- Back in 1999, new end user equipment with a screen was tested within Telekom Austria to provide a suitable multimedia terminal for the just growing number of Internet connections ("Internet-Screenphone WebTouch One" from Alcatel)[26]. Applications for this multimedia terminal were e-mail service and address-book for residential users. However, finally this system was never brought to the market, even though the product had been fully developed. It is remarkable that this multimedia equipment was designed with a narrowband ISDN connector to the Internet only, although Alcatel already heavily sold broadband Internet access based on ADSL and Ethernet technology all over the world. This reflected the company internal dispute among different organisational units within Alcatel at that time.
- Fujitsu-Siemens brought in 2002 a special set-top-box (STB) for interactive TV services on the market[27]. This STB was technically very sophisticated but finally the new product did not gain market acceptance, mainly due to the fact that the equipment was designed with far too many functions and thus was too expensive when compared to products which were already available on the market.
- Voice over IP (VoIP) was proposed in 2003 within Telekom Austria[28] as a new technology platform for the convergence of telephony, Internet and multimedia services by the engineering department[29]. Although the service was offered to business customers, marketing and product management were basically jeopardizing this new technology and

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„*Austrians embrace local net TV*", Spencer Kelly, BBC Click Online, 3.6.2005, http://news.bbc.co.uk/2/hi/programmes/click_online/4606099.stm (last access: 24.4.2017);

„*Buntes Fernsehen Engerwitzdorf: Medienpreis ´Goldener Delfin´ mit neuem Rekord"*, pressetext nachrichtenagentur, 23.11.2006, http://www.pressetext.com/news/20061123018 (last access: 24.4.2017).

[24] Different versions of broadband Internet access via the copper pairs of a telephone access network: ADSL, SDSL, and VDSL.

[25] YouTube is an American video-sharing website. The service was launched in February 2005, https://en.wikipedia.org/wiki/YouTube (last access: 24.4.2017).

[26] http://www.pressetext.com/news/19991011022, 11.10.1999 (last access: 24.4.2017).

[27] http://www.telecompaper.com/news/envivio-fujitsu-siemens-launch-mpeg4-enabled-stbs--317242, 13.9.2002 (last access: 24.4.2017).

[28] https://www.pressetext.com/news/20030930005, 30.9.2003 (last access: 24.4.2017).

[29] The author was initiator and responsible for the VoIP service implementation during his affiliation with Telekom Austria as Head of R&D Department.

did not fully support a mass market product launch. Until 2008 there was no VoIP product launch for the mass market, although technical platforms offering the functionalities were already available within the organisation.

- Already 2006 Telekom Austria communicated initially HDTV readiness in their infrastructure[30] and 2008 offered Telekom Austria HDTV infrastructure capabilities for commercial broadcast TV services in Austria[31], but it took 8 more years till Telekom Austria offered HDTV channels in the context of their IPTV service offering[32]. Some TV stations were available in HDTV quality via satellite services already in 2008. However, a nationwide HDTV service via terrestrial wireless TV from the broadcaster ORF was launched in September 2016[33,34].
- 2008 a prototype for an intelligent content recommendation service for TV customers has been presented to the market[35], but till today did not result in a commercial market product.
- In 2001 the author of this study presented a prototype service of an interactive IPTV system platform to the public[36]. However, it took additional five years till the organisation managed a market launch of the service finally on March 2006[37].
- 2007 a „time-shift TV" prototype function has been presented by Telekom Austria to the market[38], but 10 additional years were necessary till Telekom Austria launched a commercial service[39].

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[30] http://www.a1.net/newsroom/2006/12/20061222_telekom-austria-innovationsmanagement-zeigt-auf-der-itnt-neue-anwendungen/, 22.12.2006 (last access: 24.4.2017).

[31] *„Telekom Austria und ORF realisierten technische Netzkonfiguration für HDTV",* Pressetext Austria, 17.1.2008, http://www.pressetext.com/news/20080123016 (last access: 24.4.2017).

[32] http://www.broadbandtvnews.com/2016/03/08/telekom-austria-launches-ott-service-a1-now/, 8.3.2016 (last access: 24.4.2017).

[33] https://futurezone.at/digital-life/orf-baut-hdtv-angebot-weiter-aus/58.804.172, 2.4.2014 (last access: 24.4.2017).

[34] http://noe.orf.at/news/stories/2797572, 19.9.2016 (last access: 24.4.2017).

[35] *"Ein Quantensprung für Fernsehkunden*", economy journal, No. 51, page 9, 15.1.2008, http://economy.at/zeitung/archiv/heft/51, page 9 (last access: 24.4.2017).

[36] Interview of the author of this study for the Austrian Broadcast station ORF in their news magazine Eco.

[37] Telekom Austria plans commercial IPTV launch in March, 22.2.2006, https://www.telecompaper.com/news/telekom-austria-plans-commercial-iptv-launch-in-march--509188, IP-TV der Telekom Austria hat nur einige tausend Kunden, 4.7.2007, https://derstandard.at/2722465/IP-TV-der-Telekom-Austria-hat-nur-einige-tausend-Kunden, Fernsehen: Angesagte Revolution, 14.10.2006, https://www.profil.at/home/fernsehen-angesagte-revolution-153959 (last access: 24.4.2017).

[38] http://derstandard.at/2845168/Die-Mitternachts-ZiB-zum-Fruehstueck, 22.6.2007, http://www.a1.net/newsroom/2007/03/20070313_telecom-media-convergence-iptv-zukunftsvisionen-von-telekom-austria-beim-iptv-world-forum-in-london/, 13.3.2007 (last access: 24.4.2017).

[39] https://www.a1blog.net/2017/01/18/a1-tv-view-control/, 18.1.2017 (last access: 24.4.2017).

- A prototype of a new TV remote control concept has been developed based on user control functions by hand gestures embodied into an orientation aware cube which served as a tangible user interface[40] [Ferscha2008]. No market launch has been done by Telekom Austria, although the Wii game console showed the powerful capabilities of such a user control interface technology.
- 1999-2000 a strong discussion took place within Telekom Austria, whether the upcoming broadband-access technology ADSL is really a sustainable technology. Big business consultancy firms clearly did not believe in sound business models of the new technology[41].

Thus, it can be derived from these examples that a new technology only then is accepted on the market when the time is right and that technology developments are always determined by dedicated selection processes in the market and within companies.

It is important to understand the potential jeopardizing aspects for a successful market launch of a new innovation, such as:

- Lack of essential technological components to cover the whole system requirements. For example, to produce cost effective applications and content for interactive multimedia services software; or available software to adapt in an easy way content for different screen sizes, etc., as it is available today.
- Lack of an eco-system. For example a high market penetration of cameras (e.g. the huge market success of GoPro cameras) or qualitative high-end cameras in mobile phones for easy content production; wide commercial availability of digitized data (addresses, online sites of restaurants, shops, etc.); a general culture for producing and post content, etc.
- Macro-economic market structure. Often markets are too fragmented (as is the case for the European telecom market for example) to justify the necessary expenses for start-ups to achieve a sustainable revenue level (this could have been a reason why Facebook originated in the United States and not in Europe).
- Micro-economic market structure. Sometimes different competences do not fit together within one organisation, such as for example nationally organised network operators and development of devices and applications for a global market.
- And then there is finally the question of core competencies within an organisation in the context of the corporate culture. Different business issues are relevant for different visions, strategy and culture of the organisation. Safe established business areas versus risky unsafe areas. Such an uncertainty can also be stimulated due to the lack of critical skills. For example media literacy for a telecom network operator or marketing and sales competencies for an industrial R&D oriented company, such as AIT Austrian Institute of Technology.

[40] „*Besser würfeln, nicht drücken*“, Der Standard, Forschung Special, 30.1.2007 und 31.12007, http://derstandard.at/2748522/Besser-wuerfeln-nicht-druecken, http://www.pervasive.jku.at/Press/standard_310107_16.pdf (last access: 24.4.2017).

[41] Personal experience of the author of this study through extensive discussions with the consulting firm working for Telekom Austria.

However, the practical experience of the author in his daily management processes has shown that the issues summarized so far have been rarely discussed within the organisation. Internal structures and processes were much more often the focus of discussions, and even disputes within the organisation, than the analysis of the market effects around the organisation. This goes in line with the missing understanding of strategic planning and its relationship to operational processes within organisations [Mintzberg1994] (this will be discussed in more detail in Chapter 2).

1.1.2. Innovation Management within the new always-on Digital Networked Society

Information and communication technology (ICT) development has built a powerful information management infrastructure spanning our globe. A new peer-to-peer communication concept has established itself on a large scale over the past few years based on the exponential development of a broadband Internet infrastructure. This new communication concept in combination with an "always on" mode has given rise to a new form of dialogue within our society, which places inherent social behavioural and communication patterns on a new online communication basis.

The related online social media platforms are one of the most remarkable developments that definitely change our communication practice[42]. Therefore, a new and simple way of exchanging and disseminating information seems to have emerged, which paves the way for creativity and innovation moving forward. As a result, data should now be made available on a larger scale and with a higher quality, also for management decision-making, innovation processes and product developments with a view to helping companies generate innovations in an easier and more effective manner and successfully bring them onto the market. In this context, it is expected that the source for new ideas for developing new products will change, and thus R&D processes will change accordingly [Economist2012, page 33, chart 12]:

- A slight increase of the customer's role from 15% to 18% 2020.
- The role of online communities will change its importance from 6% to 19% in 2020.
- The importance of customers will slightly increase from 21% to 30% in 2020.

Thus leads to the situation, that non R&D employees will play a more important role in the future and consequently the value of classical R&D within organisations will decrease from 38% to only 18% in 2020 [Economist2012].

It is interesting that even if these online communications mechanisms are becoming increasingly popular, numerous companies seem to face unparalleled challenges when trying to effectively exploit these mechanisms to achieve their corporate objectives. Companies often do not allow these forms of communication tools in their organisation. According to Bitkom, 78% of the Internet users in Germany are active in social networks but only about 16% of the SMEs are active users of social media applications[43] [Arns2012]. Too great is the fear of potentially wasting time or even that peer-to-peer communication may jeopardize existing hierarchical structures within organisations.

This PhD thesis addresses the question of how new online social mechanisms can effectively support companies' innovation power. The work will give an answer to the question of why companies are

[42] An overview of online social media platforms is published in [Leopold2012c].

[43] Annette Speck, Keine Angst vor Social Media, 24.9.2014, http://www.springerprofessional.de/keine-angst-vor-social-media/5291930.html (last access: 24.4.2017).

facing such difficulties in trying to leverage this new social phenomenon of a globally interconnected and always-on society to ultimately reach their corporate targets. The answers will help next-generation managers gain a competitive edge over the long-term by achieving ever-lasting innovation leadership in the global competition arena.

The general discussion in a business context considers online social media mainly as a phenomenon of mass networking, mass collaboration, and the wisdom of crowds [Surowiecki2004, Noubel2007, Bradley2011][44] (see also Section 4.4.3). Knowledge management was previously mainly understood as an approach to gather information, and save and categorize information. "Just in time knowledge management" concepts which build upon self-organisation and self-management models within complex environments such as organisations are a much more promising approach (see Section 5.3.4 for more detail). To summarize, it is important to note that the mechanisms for a modern innovation management which build on comprehensive collaboration through effective IT system support through the new online social media applications are often not sufficiently understood in management, and are not considered properly in organisational processes. In addition there is often a missing understanding of the intertwined relationship between technology usage and social behaviour at the workplace within firms.

To provide empirical evidence of the identified phenomena, which are all interlinked in a larger explanation context, a mix of different empirical evaluation methods was applied within the real innovation context of AIT Austrian Institute of Technology. These include the observation of scientists, especially during the project generation phase[45], structured interviews with the middle management, and online questionnaires for the employees of a Department. The behaviour of staff members of the AIT Digital Safety & Security Department was researched, including the analysis of some 700 project generation activities during the time frame of six years (2010-2015). Based on this research design, the main reasons behind the identified innovation barriers were investigated in the context of internal communication and information flow within organisations. Understanding the inherent resistance to innovation management is essentially important for the effective design of communications tools and for their improved acceptance within a company.

To summarize, this work investigates whether the hype around new online social media (as innovation nurturing) is deserved, and whether it offers a new approach to overcome some of the classical innovation and knowledge management problems within firms. The ultimate aim of this PhD is to identify and explain factors that influence the use of online social media functions and tools as a shared medium for community collaboration for innovation, product- and technology management within organisations.

[44] "Mass collaboration" is the ability of large numbers of people, who may have no pre-existing relationships, to effectively collaborate around a shared purpose.

[45] "Project generation phase" describes the phase by which a project is developed in order to work on a specific idea. The result of the project generation phase could be an offer for a sales activity, or the project proposal for a funding programme, or a concrete start of a product implementation. This process phase will be discussed in more detail during this study.

1.2. Research Question

"The greatest danger in times of turbulence is not the turbulence; it is to act with yesterday´s logic." [46]

Peter Drucker, 1909 - 2005

The ever-shorter cycles of economic and social transformation in the global economic landscape pose unprecedented challenges to the next generation. Creativity, innovative strength and productivity are the new slogans for successfully positioning both corporations and business locations in the arena of global competition. If companies are to achieve the necessary commercial success and sustainable profit, continuous innovation is an imperative, as ultimately it is innovative power, i.e. the number and quality of innovations, which determines a company's economic success over its competitors.

One of the main corporate conundrums is therefore how to enhance a company's innovation performance. This challenge is four-fold[47]: i) it is essential to foster creativity and the generation of new ideas; ii) it is necessary to correctly assess and select the limited number of corporate resources available, such as human resources, specific skills and investments; iii) the ideas have to be effectively shaped and deployed in line with corporate strategy, and finally iv) the innovation has to be successfully implemented on the market.

The basic question, however, is how. How can a company access and leverage complementary sources of knowledge in a simple and non-bureaucratic manner during the creative and design phases? How can a company ensure that innovations are successfully implemented and will make an economically sustainable contribution to the business?

One essential approach could be to build on the vast amount of knowledge that is usually available within organisations, but not always visible and thereby not easily accessible. Instead of collecting and hoarding information for "just in case" purposes (as is usually done in classical knowledge management approaches within firms), it is deemed more efficient to take into account "just in time" knowledge management concepts [Snowden2002]. In this way, we build upon self-organisation and self-management models within complex environments, such as organisations to enable knowledge transfer to a formal knowable domain on a very effective basis.

Thus, this study analyses an effective knowledge management as a basis for next generation innovation management, which builds on the new and evolving online social-media-based communication mechanisms.

But in order to leverage the potentially available extensive knowledge within an organisation, we have to understand which factors affect the principle information exchange within organisations; what is the motivation for information exchange and which factors are jeopardizing potential effective information exchange within teams or groups within an organisation. This understanding is the prerequisite for the use of the potential innovation enabling aspect of social media tools.

To be more concrete, this thesis addresses the following research question:

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[46] http://amiquote.tumblr.com/post/6762585320/the-greatest-danger-in-times-of-turbulence-is (last access: 24.4.2017).

[47] This goes in line with Schumpeter's view. He referred to three essential phases: invention process, innovation process and finally the diffusion process [Mahdjoubi1997].

"Whether and how the new online social media tools can increase the innovation competence of firms, by using these tools as an internal information and communication platform?"

This raises the following subsequent question:

"*Which basic characteristics constitute social media processes? How can these new communication approaches generate an added value, and can they help to increase productivity in firms?"*

And in order to be able to answer this question, to elaborate in more detail on:

"Which issues enable, and which prevent an effective information exchange within working teams in organisations, thus helping or jeopardizing the potential positive aspects of online social media?"

Thus the goal of this PhD is to investigate, through the study within a real-life project scope, the opportunities and challenges faced when an organisation attempts to deploy an online social media platform as an internal communication tool. In this context it is essential to develop an understanding of the possible issues that jeopardize any attempts to implement successfully an effective communication tool within an organisation. These issues are examined in this thesis to derive a set of management recommendations for supporting technology implementation projects in this context.

1.3. Real Organisational Environment as the Research Test Bed

1.3.1. Organisational Structure and Business Rationale

The research is performed in a very specific and unique environment. The study of the motivation and finally dedicated behaviour of the employees in their information exchange attitude is done in a real-life organisational environment; i.e. within one department of AIT Austrian Institute of Technology[48].

AIT Austrian Institute of Technology is the largest national applied research centre of Austria with some 1300 employees and a yearly turnover of some 140 Mio Euro. 2009-2016 the organisation was structured in five departments covering essential markets and technology areas: Energy, Mobility, Health & Environment, Innovation Systems, and Digital Safety & Security.

The key objectives of AIT are the achievement of international leading-edge scientific research results and, based on that, the generation of an added value for both industrial partners and the economy in general. By implementing this vision, AIT acts as a bridge between basic research, usually conducted at the academic level on universities, and product development at the corporate level. Thus, AIT has to combine both worlds in one organisation at the same time: to build upon its own creativity and innovation capabilities, while achieving high-quality technology results for the industries.

The performance of the organisation in its applied research activities is measured by three essential success factors based on a global benchmark: i) scientific success factors (publications, patents, etc., like a university); ii.) economic indicators – the business model of the company requires, that 60% of the overall costs have to be co-financed by the market; and iii) by regular (bi-yearly) external evaluations which judge the scientific work output as well as the commercial output. Thus the productivity of the organisation is per definition based on innovation performance; i.e. based on an

[48] www.ait.ac.at (last acccess: 24.4.2017)

excellent scientific work, to develop technologies which attract the needs of the market. The defined business model requires that 60% of the costs have to be financed from external sources. In more detail 30% of the overall costs have to be financed by external funding on a project basis, such as European funded projects, and 30% have to be financed by dedicated industrial contracts.

The following organisational structure was the concrete framework for the field study:

- Department: Digital Safety & Security
- Business context: applied research in the context of information and communication technologies (ICT); that is, developing new technologies – hardware as well as software - as a basis for product development as well as product launches in cooperation with dedicated business partners
- Business objective: to build upon our own creativity and innovation capabilities, while achieving high-quality technology results for industry
- Business process: commissioned pure project business with industrial customers, cooperative funded research projects, and AIT-internal research projects
- 250 people, highly educated, academic - employees and contract researchers
- Seven teams with team-leaders, called Business Unit Managers, as well as two sub-teams with group leaders, so-called Thematic Coordinators
- Several business support functions for the department such as marketing and communications, business development, and business process management
- The researcher, i.e. the author of this PhD, is part of this organisational system as the Head of the Department Digital Safety & Security and thus is also the line manager for the seven teams (Business Units) and thus has a power relation to the middle management as well as to the 250 employees. This dedicated "reflexivity issue" is discussed in Section 1.5 below.

Due to the fact, that a huge number of cooperations have to be implemented for scientific as well as innovation reasons as well as considerable commercial projects have to be performed, it is a considerable challenge for the organisation to manage a huge number of projects. Within the Digital Safety & Security Department some 300 running projects have to be managed yearly and about 120 new projects have to be started each year[49], even for a small department of 250 researchers only[50]. Each individual project requires several formal contracts, more than ½ a dozen formal approvals and confirmation steps especially for funded projects, and in the same order the need of preparing reports.

Finally two important measures which support and manage the innovation process within the Department, build the basis for this PhD work:

- In order to foster the organisation's internal communication process in creative innovation phases, a dedicated home-grown online social media software platform was developed as an organisational internal communication platform in 2010. This online social media platform is

[49] Considering a good success rate from European funding programs of 20%, for each starting project there has to be five project proposals elaborated. Based on a sound innovation process management, in fact, the AIT Department Digital Saftey & Security achieved success rates that are greater than 20% from 2013 – till 2016.

[50] Employees and contract researchers.

called “SoCol”[51]. The supported communication mechanisms are according the basic online social media functions as discussed in Chapter 4. A description of the implemented functions is provided in Section 11.4.

- For enabling creativity, as well as developing and managing applied research projects within the AIT Department Digital Safety & Security, an innovation process has been defined and implemented by the author of this study during the elaboration of this PhD. Information exchange processes, supporting creativity processes, formal approval processes, reporting processes, project and programme management processes and technology development processes are supported by a dedicated methodology and specific tool support. Well-defined forms, processes, and communication tools have been defined and elaborated and a cultural framework has been established during the course of this PhD (see Chapter 7 and Section 11.3 for a description of the defined processes and tools). These defined concepts, as well as dedicated tools, finally became part of the core organisational business processes of the AIT Department as a cornerstone of the Department´s innovation process.

1.3.2. History of Previous Collaboration Tools in the Research Environment

The Department Digital Safety & Security was formed as a kind of post-merger from several different previous team in 2009. The main communication infrastructure used was essentially based on the typical communication systems such as e-mail, telephony and classical Intranet IT services (central file storages, etc.). As part of this PhD work, at the beginning a dedicated home grown online social media platform was developed and implemented in the organisation, which served as an essential research infrastructure which has been adapted continuously during the course of this PhD. An overview of the finally implemented functions of the developed online Social Media platform “SoCol” is provided in Section 11.4 in the Appendix.

1.4. Research Methodology: Grounded Theory in Ethnography

This PhD aims to explore the way of using of online social media tools in organisations inductively through an interpretative research approach, assuming that an interpretative understanding of human experiences can be derived from data collected in real-life settings, according the Grounded Theory.

1.4.1. Grounded Theory

“*Grounded Theory*” is a research methodology in qualitative social research based on a methodological systematic approach, which is used to derive theories and thesis from available data[52] [Glaser1967, Strauss1994]. Based on the assumption that one’s own interpretation of the collected data is only one among many, the overriding objective of this research methodology is to elaborate reasonable and comprehensible interpretations that are able to withstand further scientific reviews and reality checks. By grouping data into categories and tagging them with codes, the discovered phenomena are described using the initial theories and hypothesis and as more data are collected and data analyses repeated and refined over and over again, researchers try to reach a

[51] This online social media platform was developed under the responsibility of the author of this study during the course of this PhD study by the start-up u.enterprise.

[52] Anselm Strauss and Barney Glaser were the founder of the Grounded Theory in the 60-ies in Chicago [Flick2004].

confirmation of their original thesis (theoretical saturation) based on the newly collected and analysed data deriving from the initial thesis.

This methodology is based on guidelines and basic rules that support the plurality and multiplicity of research work as social data are usually very complex and thus require complex analysis methods. Each single researcher has individual talents and, thanks to this methodology, is able to develop his/her own research style to analyse phenomena in social research. Different types of experiences, theoretical context knowledge, detailed knowledge of specialist literature and the way researchers extract theoretical concepts from the collected data are fundamental building blocks of the grounded theory's research methodology.

Against this backdrop, the data gathering process is based on the repetition of the following procedure: "data collection – codification - description". This research methodology is grounded on the initial formulation of a hypothesis (assumption, idea), which in turn results from practical experiences and theoretical knowledge gained from literature (induction). In a second step, further implications are derived from the starting hypothesis (deduction), which is then subject to final scrutiny to check its validity (verification).

"Theoretical sensitivity", which means being sensitive about potential theoretical correlations and being able to give meaning to the available data and to separate what is pertinent from what is not pertinent, plays an essential role in this context. In this way, a researcher can conceptualize and formulate a theory based on the collected data.

The selection of appropriate areas of analysis takes place in line with the initially developed hypothesis and can be further adjusted in the course of a research project according to newly gained insights and newly achieved knowledge. Targeted data sampling plays a pivotal role in this context, as the focus of data collection should be on those data that are expected to provide important information to be able to effectively address the research question. Multiple sources of data can be triangulated to increase the validation of data through cross verification. Finally, random data sampling can also represent an important research approach to allow certain openness towards new discoveries.

Last but not least, ongoing documentation should record the researcher's permanent dialogue and analysis progress, while allowing researchers to effectively structure and keep track of the overall process (so-called memos). Besides, such memos are meant to provide evidence of the development from the collected data to the formulated theory. "Theoretical saturation" is ultimately achieved when new data do not bring about any new insights, which means that a (temporary) endpoint in the theory development process has been reached.

1.4.2. Ethnographic Approach

For studying the social behaviour in organisations when using specific IT-tools and organisational processes, ethnography is a usual followed research method. *Ethnography* is following a methodology of stringent observations to derive knowledge, opposite to other research concepts where a theory is applied to analyse real systems. Ethnography is a data collection method in which the researcher is part of the organisational environment and gains an understanding of the actual work practices by observing. During the process of observation, the ethnographer creates records of descriptions of his observations which are than the basis for subsequent analyses. For an ethnographer it is essential to enter an environment for observations without any pre-defined expectations and pre-judgements. However, an ethnographer is not only collecting data by

observation for subsequent analysis, he also becomes part of the system over time. As he is permanently interacting with the objects under observation he is making experiences during his observation processes he becomes part of the system under consideration.

> "*Ethnography means recording the life of a particular group and thus entails sustained participation and observation in their milieu …"* [Charmaz2006, page 21].

To achieve this, ethnography includes usually additional data from interviews, questionnaires, business data, etc.

The study in the context of this PhD is based on empirical research and is aimed at understanding the barriers to effective implementation of innovation processes within organisations and thus, the appropriate use of online social media for innovation management processes within organisations. Thus, the analysis of the collected data is "grounded" on the data and is not derived from a pre-existing theory.

In order to elaborate on the research question, a flexible approach was used to collect and analyse qualitative data and construct a theory grounded on the data found during different processes of observation and interaction with the researched system. This approach allowed to adapt to specific attempts during the data gathering and analysis process, while focusing more quickly on dedicated research findings, rather than analysing a wide spectrum of issues.

From the very beginning of the research process, theoretical analysis was based on research data. The data collection process was streamlined on an ongoing basis throughout the entire research process based on the findings in intermediate steps. This approach was essential, as a very dedicated research set-up had to be considered. The research took place in a real-life organisational context and focused on one very narrow issue among the many different possible business processes within an organisation: the information exchange process among employees during a project preparation phase.

Besides, it is important to note that the researcher is closely intertwined with the research environment, as he has a management position within the researched organisation and the employees involved in the research study have various inter-relationships among themselves on both a professional and personal level. The main objective was to learn what occurs in the research setting: thus, the research process was permanently adjusted (data gathering methods and analyses) based on the findings the researcher came across during the research process.

1.4.3. Ethnomethodologically informed Ethnography

Unlike the ethnography, *ethnomethodology*[53] focuses on the analysis of the methods of daily actions in a society of groups of people or in organisations. Ethnomethodology attempts to identify the self-evident nature of "common-sense" based procedures in certain social groups. Particularly important aspects are the hidden procedures how a society is coming to such implicit culturally embedded attitudes. Thus, the informal non-verbal communication processes are of fundamental importance.

In order to use social science research methods to support the scientific analysis of CSCW (computer supported collaborative work) processes it is important to entangle ethnographic with ethnomethodological research designs. The observation in the field, based on previously clarified

[53] An important founder of ethnomethodological social science was US sociologist Harold Garfinkel (29. October 1917 - 21. April 2011).

theoretical foundations ("historicity of societies"), as well as the identification of the hidden interactive control structures within societies (cultural diffusion and ongoing adaptation of cultural practices) are both necessary to be able to understand and explain the behavioural patterns in society [Shapiro1994].

Especially in the context of an organisational environment and the usage of IT-systems, we have to study the technology as it is being used, instead as considering it as a separate component of the system which can be treated and analysed separately. By this approach, it is possible to recognise embodied interactions and practises of this very strong intertwined technology and usage of technology aspect [Crabtree2000].

1.4.4. Qualitative Research Approach for this PhD Work

This study was performed in the real-world context of the Austrian Institute of Technology (AIT), in the Digital Safety & Security Department, with a clear focus on the company´s internal innovation process during the "project generation phase" (see Section 1.3 above for a description of the organisation as the research environment).

A qualitative research method was applied for this study as it provides the possibility to add new findings to the research activities during the data gathering process. This flexibility allows to follow leads that emerge during the course of the study.

> "*Qualitative research relies on those who conduct it. … We are not scientific observers who can dismiss scrutiny of our values by claiming scientific neutrality and authority. Neither observer nor observed come to a scene untouched by the world*." [Charmaz2006, page 15].

The data we collect from observations or interviews comes from sources that served a specific purpose and are part of a dedicated cultural framework, which is very specific in time and depends on the actual situation of the organisation [Charmaz2006, page 16].

- For this PhD study, several combined and sequential data collection methods were applied in order to overcome the potential distortions or intrinsic biases in qualitative research results. Thus, multiple sources of data have been triangulated to increase the validation of data through cross verification: Initially, employees had to fill out a questionnaire in order to understand their basic views on communication processes within organisations as well as their attitudes towards using social media tools in both their business and private life - Questionnaire "Future at work" (see Section 11.1). The most important finding of this initial research phase was that there is some reluctance to using electronic information exchange tools within organisation and to sharing information outside of the small circle of a working team.
- Based on these initial findings, an extensive literature survey in the areas of innovation management, organisational management, knowledge management, computer supported cooperative work (CSCW), cognitive science and online social media, was undertaken to identify potential theses based on employee's behavior and attitude during information exchange processes in the context of innovation processes. Based on these findings, an initial thesis with regard to employee´s behavior end communication dynamics within organisations was formulated.
- Following the observation of employee´s behavior during the project generation phase, a dedicated quantitative set of data was collected based on the statistical analysis of the time

duration of the project generation phase. During the time frame 2010 – 2015, the project generation phase[54] of some 700 project generation activities have been analysed. Each year about 130 project proposals have been elaborated. The activities for this project generation activities were the basis for the subsequent analyses.

- To further elaborate on these preliminary findings, the middle-management was interviewed to provide background information as well as contribute their personal views on the potential motivations of the employees based on their individual observations.

  Instead of using a pre-defined set of questions, the perceptions and opinions of the managers were collected based on the priorities defined by the interviewed people. The interviewed managers explained based on their individual and subjective views the reasons behind the observed behavior of the employees (The statistical analysis showed unrealistically short time duration for project preparation in the organisation; see Section 8.2 below).

  The interview results were recorded in memos and coded accordingly; i.e. the collected qualitative data (background descriptions, individual observations, formulated beliefs, etc.) were sorted out, grouped and labeled and finally summarized in dedicated initial theses. This coding exercise was essential for the subsequent research step as it helped defining further data collection processes and approaches.

- Based on these results and initial findings, we sought further data to answer, clarify, or even falsify the initial theses. Thus, the findings of the interviews with the management provided the basis to better define the questionnaire to be answered by all employees – Questionnaire on information hiding (see Section 11.2).

The process of a stepwise fine-tuning of data gathering and building abstractions on each individual research step is shown in Figure 1.1 below.

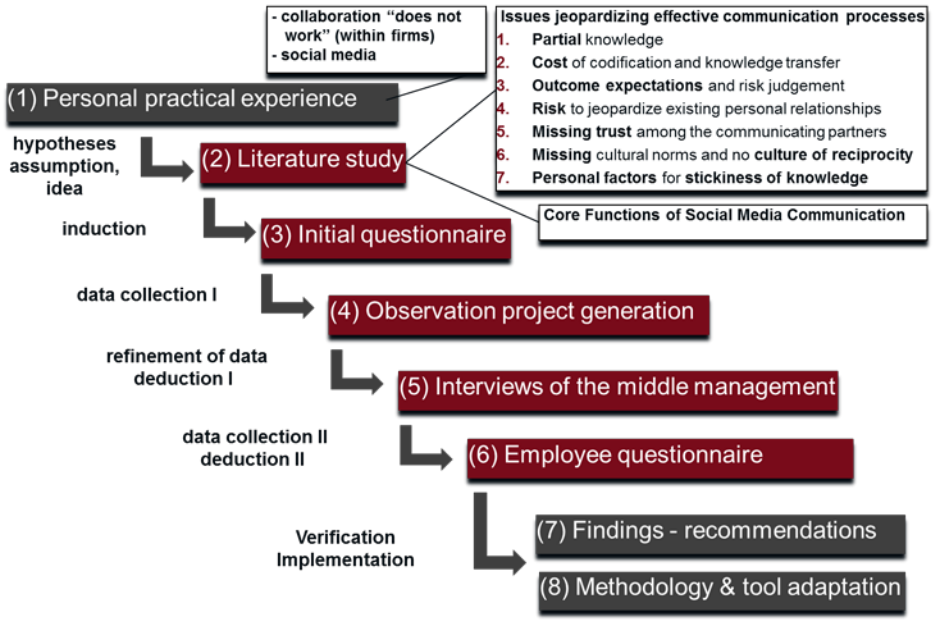

Figure 1.1: Research Methodology: Grounded Theory Principles – Ethnographic Approach

[54] The "project generation phase" is the process from the initial idea to the definition of a project proposal. This process will be discussed in detail during this study.

By following this research methodology, we derive a culmination in the abstract and theoretical understanding of the observed and experienced employees' behavior with regard to the exchange of information in a dedicated business process within an organisation.

Particularly the intertwining of the different approaches – i) observation of the behaviour of the employees during the generation phase of a large sample of applied research projects; ii) semi-structured interviews on the attitudes of the middle-management; and iii) the analyses of the information hiding behaviours of the employees during the creative phases of an innovation process within an organisation is a fundamental basis to understand the barriers to implement favourable project designing and innovation processes and thus to understand the effectiveness of online social media usage within innovation management processes.

To summarize, the definition of the initial research objective was based on the personal experience of the researcher of this study. The refinement and concretisation of the research objective and the specification of the research approach were done after an extensive literature study of relevant scientific fields. Data collection methodology has been adapted and improved step wise by performing questionnaires, interviews and observation. Thus, the research methodology was essentially following the "grounded theory" principles.

At several points in this PhD work, the practical experience of the author was added to the theoretical findings in order to exemplify the discussion.

1.4.5. Interviews as a Crucial Element in Qualitative Research

Besides observation and collecting of quantitative research data interviewing is an essential method for the selected research methodology of this PhD. By the qualitative interview, the interviewer reconstructs aspects of social reality. In order to achieve usable research results principles of openness, process character, explication and reflexivity are important issues to be considered [Lamnek2003, Hester1994].

It is important to note that since there is no real "openness" without preliminary experiences or considerations of the researcher. Thus, it is necessary to make the patterns of pre-judgments explicit visible before performing the interview in order to be able to take these potentially limiting factors into account when analyzing the interview results. Own opinions based on specific value systems of the researches have to be prevented. Instead the system of relevance of the interviewees has to be identified and to be understood.

The "process character" of an interview is referred to a structure where the questions are defined in a way that not all questions are defined in detail at the beginning of the interview but to define starting points and to react flexible during the course of the interview. This requires a high degree of flexibility from the interviewer.

The principle of "explication" refers to the explicit asking of the interviewer in the case of uncertainty. With explanations from the interviewee it becomes possible to get more comprehensive interpretations of specific facts.

"Reflexivity" in the interview is of essential importance for the final analysis of the collected research data in order to take into account the potential impacts due to the intertwined situation of interviewer-interviewee relationship. How to deal with the reflexivity problem is discussed in more detail in Section 1.5 below.

1.4.5.1 Different forms of Interviews

There are different forms of interviews discussed in the literature [Lamnek2003] with dedicated characteristics which are summarized briefly in the following.

The “standardized interview” is a quantitative interview variant.

The “focused interview” is used whenever subjective perceptions are researched and investigated. The process of the interview usually follows a combination of methods. First, the situation is analyzed, then hypotheses are developed which determine the development of the interview guide. Based on such an approach, it is possible to decide on specific issues to be asked in more detail. During the interview, the hypotheses are tested and new hypotheses are developed. Characteristics of such interview types are:

- interviewees should not be influenced;
- the specific views and definitions of situations by the interviewees have to be considered;
- usually there is a wide range of issues covered;
- the social framework of the context of the interviewees is essential;

The “half-standard interview” was developed to reconstruct subjective theories. In this context, subjective theory means that it can be assumed that the interviewees have a sound knowledge on the examined topic. This knowledge can be addressed partially by open questions and partially only by specific strategies.

The “problem-centered interview” is a narrative-based variant. Based on a theoretical preliminary examination of the research area, a thematic focus will be defined and the interview guide will be developed. This consists exclusively of open questions, which offer narrative impulses. The theoretical concept of the area of investigation is provisional and must remain open for modifications resulting from the interviews. With this form of the interview, the interviewer has to ensure not introducing the theoretical pre-understanding into the interview situation, but merely setting the specific narrative incentives. The problem-centered interview encompasses four phases:

- explanation phase
- general investigation
- specific investigation
- ad-hoc questions

By an “expert interview” the interviewee is not interviewed as person but as an expert in a very well defined field. All the other issues of the usual life are not part of the investigation.

1.4.5.2 Validity and Reliability of Interviews

A fundamental problem by conducting interviews is the question of the appropriate method to ensure the “validity” and the “reliability” of the results of the interview so that they can be used as “useful data" [Hester1994].

Because of the reliability/validity problem in qualitative research there is an ongoing dispute within social science whether interviews are a serious research methodology. The legitimacy of interviewing as a method of sociological research can easily be criticised as a bad methodological practice since

interviews are potentially locally managed interactional occasions and thus any claim for the reliability or validity of interview data can be questioned.

There are different schools in sociology that prioritize the “validity” and the “reliability” of qualitative research results in a different way. 'Positivists' treat interviews as a source of information of social and cultural “variables”. These variables can be considered as descriptions of the social life of the interviewed person, which are independent of the interview situation [Hester1994]. However, interviews have an interactional character in principle and such an interaction can´t be separated from the interviewer-interviewee relationship. The fact that interviews are conducted through a talk between interviewer and interviewee is an implicit problem for achieving reliable data as a result from interviews [Hester1994] referring to. An interviewer will always have some preoccupation and the interview results may not reflect reliable descriptions of the investigated social life of the interviewed person. To overcome this problem in principle standardized questioning, establishing rapport and avoiding asking leading questions are methodological approaches in the interview designs [Hester1994].

Contrary to this view there are so called interpretivists, which start with the assumption that it is necessary in principle to investigate in a flexible manner during the interview situation to capture and understand the social context of the interviewed person, in order to ensure the “validity” of interview data [Hester1994].

1.5. Reflexivity of the Researcher within the Research Set-Up

It is essential to understand and to consider the relationship between the researcher and the researched environment. Throughout the whole survey process of this PhD an inherent reflection on essential findings was performed. This research study took place against the backdrop of an ongoing discussion process aimed at improving the organisation’s business processes. In regular meetings, so called “Project Boards”, the management jointly with key support functions discussed various findings, observations and issues regarding basic corporate processes (see Chapter 7 for a detailed description of this business process).

However, any kind of qualitative research design has to consider the potential distortion of research outcomes due to the unintended influences from the researcher as well as research participants. This is especially relevant for qualitative research methods based on interviewing, where interviewers are an integral part of the researched system and a social relationship has been established between interviewer and interviewees.

We briefly discuss in the following the principle reflexivity issue in any social environment as well as the dedicated reflexivity issue in the context of interviews performed for qualitative research.

1.5.1. Social Constructs are Relative

Analysing and understanding the behaviour of individuals in the society Émile Durkheim[55] described, based on a holistic view of sociology, that society can influence and shape individuals. Max Weber[56] underlined that a society is a connection of humans together with the social actions. In a society based on individuals with actions among themselves, people are usually seeking for reference points

[55] France, April 15th, 1858 - November 15th, 1917.

[56] Germany, April 21st, 1864 - Juni 14th, 1920.

for their self-positioning. Social institutions such as family, religion, business colleagues, etc., are such communities to position themselves.

Social theories of the modernity heavily relied on the concept of “reflexivity”. Leading researchers in this field are Anthony Giddens[57] and Pierre Bourdieu[58] which developed sociological theories to explain the behaviour and practice of individuals and to understand the system of interactions with others in the community. According to Bourdieu all methodologies are social constructs and all social constructs are relative. Since sociologists sometimes do not have enough objectivity to determine the truth, Pierre Bourdieu used the concept of “reflexive sociology”; i.e. to apply dedicated methods to come in contact with other people and carefully considers issues such as “habitus”, “field”, and “symbolic capital”.

A “field” is a system of social positions structured in terms of power relationships. Thus a field is a social arena of permanent endeavour over the appropriation of certain “capital”. Capital being whatever is taken as significant for social relationships (monetary capital is just an usual example). Bourdieu theorizes the objective social structures into the subjective perception of social structures. The individual actor develops dedicated behaviour in response to the objective conditions they encounter a social environment; i.e. in the concerned field forming a specific “habitus”.

Bourdieu extended the idea of capital to categories such as social capital, cultural capital, and symbolic capital. For Bourdieu each individual occupies a position in a multidimensional social space; he or she is not defined by social class membership, but by the amounts of each kind of capital he or she possesses. Symbolic capital such as prestige, honour, the right to be listened to, etc., is a crucial source of power. Symbolic capital is perceived through socially inculcated classificatory schemes. Bourdieu calls a behaviour based on such symbolic capital as “symbolic violence” (e.g. when a daughter brings home a boyfriend considered unsuitable by her parents). See Section 3.5.2 below for a more detailed discussion on “social capital”.

Bourdieu opposed the so called rational action or choice theory as grounded in a misunderstanding of how social agents operate. Social agents do not continuously calculate according to explicit rational and economic criteria. Social agents operate according to an implicit practical logic. Social agents act according to the “rules of the game". The "rules" are basically the “habitus” and the "game" being the “field”.

1.5.2. Reflexivity - Research Design in Qualitative Research Methods

Any kind of qualitative research design has to consider the potential distortion of research outcomes due to the unintended influences from the researcher as well as research participants. This is especially relevant for qualitative research methods based on interviewing, where interviewers are an integral part of the researched system and a social relationship has been established between interviewer and interviewees.

“Reflexivity” is a concept which addresses the impact to the accuracy of qualitative research outcomes. Reflexivity describes the social interaction implied by the interviewer-interviewee relationship. This relationship is usually characterized by an asymmetrical power relation of the research interviewer and the interviewed person [Kvale2002]. The interviewer-interviewee interaction may be impacted by various parameters such as demographics, e.g. age, gender, and

[57] United Kingdom, born January 18th, 1983.

[58] France, August 1st, 1930 – January 23rd, 2002.

race, or socio-economic status (social origins), the researcher´s position the intellectual field, cultural background, political orientation [Hester1994, Lamnek2003].

In a face to face relationship between the interviewer and interviewee, it is hard to avoid the differences in capital and habitus. Researchers should avoid applying their thoughts on the respondents' answers because the goal of sociology is to discover the hidden mechanisms of domination [Ho2016].

It is important to understand the interviewer's role in the interview context and how to use this knowledge to enhance the trustworthiness, transparency, and accountability of the research [Finlay2002]. This act of reflection enables the interviewer to thoughtfully consider this asymmetrical relationship and speculate on. Linda Finlay describes five ways deal with the reflexivity problem, i.e. to overcome the ways the interviewer-interviewee interaction may have been influenced [Finlay2002]:

- Introspection: This goes already back to Maslow which stated that "*there is no substitute for experience*". He emphasized the importance of the self-dialogue and the inner discovery of researchers. Those who begin their explorations based on empirical values try to use their own humanity as the basis for psychological understanding. Self-reflection, intuition and one's own thinking can be used as primary evidence. This should influence the design of the research question already; i.e. focusing on issues motived from inner values.

  However, a bias against one's own emotions and experiences can also lead to a dangerous imbalance in the achievable research results. It is therefore necessary to avoid overriding the privileged position of the researcher, in order not to override the views of the interviewed persons. The researcher needs the right balance between self-experience and personal view.

- Inter-subjective reflection: Here, the researchers explore the mutual meanings that arise from the research relationship. They focus on the situational as well as on the negotiated nature of the research group, on psycho-dynamic convictions and influences, and on unconscious processes structure the relationships between researchers and examinations.

- Mutual collaboration: Here the researchers and the research efforts are engaged in their own research in repeated cycles of joint reflection and the exchange of social experiences. Such research relationships can greatly improve the results obtained.

- Social critique: The methodology of social criticism is aimed at overcoming precisely the last aforementioned point in the sense of "how to manage the equality of opinion between researchers and participants". The problem of tensions arising from different social positions such as class, gender or race should be openly recognized.

- Discursive reconstruction: In the case of reflexivity as discursive reconstruction, the focus is on the ambiguity of the meanings in the language used and its impact on the presentation. Researchers wonder in this context whether one can establish the dynamic and manifold meanings represented in language. A proposal for the achievement of this claim aims at positioning the text elements in such a way that no single, comfortable interpretation is directly available.

Such a reflection enables the interviewer to design specific questions for the interviewee that help to clarify the interviewer's understanding of the outcomes.

Thus the interviewer should always be sensitive to his or her prejudices and subjectivities. An explicit formulation and documentation of all the possible effects which may have influenced the results of each interview, helps the interviewer to critically verify his or her research outcomes of the interviews and to make visible potential interviewer bias and preconceptions that may negatively influence research findings. This is usually called a “reflexive journal”. Such a quality assurance increases the credibility of the research outcomes, since the final research findings can be assessed concerning any objectivity and interpretations concerns of the research outcomes.

1.5.3. Triangulation

In order to become more confident with a qualitative research result, different methods can be used to increase the validation of data through cross verification from two or more sources. This is called “triangulation” in social sciences to indicate that two (or more) methods and empirical materials are used in a study in order to overcome the potential distortions or intrinsic biases in qualitative research results.

1.6. Generalisation

A basic question is to what extent the findings of such a research study based on ethnography can be generalized to other applied R&D or product development organisations or even to any organisations that deal with innovation and knowledge management [Sharrock2004].

1.6.1. Typicality Problem

A basic problem when generalizing the findings of a survey based on the observations made and the analyses carried out in the course of a concrete case study is about the so-called "typicality problem", i.e. the question as to what extent an investigated organisation can be rated as "typical"?

The main question is whether, and to what extent, the organisational unit under scrutiny in this ethnography research is somehow “typical” compared to other applied R&D or product development organisations, or it is somehow unique. Another important issue that needs to be clarified is whether the study has been carried out during a typical or an exceptional period of time?

The problem, however, is to determine and eventually measure what might hint towards “typicality”; i.e. answering the question: “What is a typical innovation management or knowledge management organisation?”

1.6.2. Typicality of the Analysed Organisation

The aim of the AIT organisation currently under scrutiny is to create technological and market innovations in different project constellations with several project partners. Elaborations of a project scope, the definition of project objectives and approaches as well as overall project management mechanisms are the main activities that usually need to be performed. Thus, all aspects of a typical product or technology development process have to be taken into due account and both company-internal (strategy, compliance, etc.) and external framework conditions (market driver, customer requirements, etc.) must be duly considered. Due to the strong relationship between the AIT’s project activities and external partners (both technology and market partners), the product or project development process is more complex than a usual in-house development project without external project partners. Thus, the observations made in the course of this case study result from more complex situations than it is usually the case. As a result, the investigated organisation can be

referred to as a typical product development or applied R&D organisation since all possible situations for innovation management processes within an organisation are covered.

1.6.3. Typicality of the Period of Time of the Research Study

This case study was carried out in the aftermath of a merger of previously strongly independent organisational units, thus, in a period of time, which was characterized by mistrust towards the management and other organisational units in general.

Due to this special situation, the development of a common understanding and a common feeling within the organisational unit (department) was one of the main management objectives. Several measures were defined and implemented to support this objective:

- common financial targets for the whole organisational structure (i.e. within a department);
- a wide range of activities to develop a common team spirit such as sport events, team-building events, etc.;
- project discussions and especially decisions within the department were made with the highest possible level of transparency based on dedicated processes and a change of attitude when presenting information in a easily understandable manner for other units within the department;

To summarize, it has to be considered that the research environment represented a very demanding environment to study information sharing attitudes. Thus, the research results can be applied for any other organisation with simpler framework conditions. However, two essential issues have to be understood to answer this question in principle: the number issue and the possibility of abstraction of the research results as discussed in the following.

1.6.4. Number Issue

The “number issue” is related to the “typicality problem”; i.e. the question whether any particular situation is a unique or a "typical" situation. Thus, the question is whether a single case study of an organisational unit provides a sufficient basis to make any generalizations about R&D organisations at large. However, in addition to statistical sampling, which is a complete different approach, there is no particular number of cases that allows for a better classification.

Additional case studies might be instrumental to focus on dedicated issues in greater details or verify other results, but without specifying a very clear objective, it is not possible to achieve a more accurate outcome simply based on a larger number of observational studies. The main goal of an ethno-methodological informed ethnography study is to generate a description of social actions; i.e. just to display the features of the system which produces them [Rouncefield2002].

For the mere purpose of deriving such a formal description from the observations made, how many times this case study has been carried out is irrelevant, as it does not really add any more substantial details to improve the description [Rouncefield2002].

1.6.5. Abstraction

Last but not least, there are several concerns about “abstraction”, which is the process of generalizing from particular case studies to situations that have not been studied yet. “Abstraction” enables us to deal with a new situation based on the lessons learned from other situations. This

involves specifying some criteria that can be used to combine elements together into classes. In this concrete case, we have to answer the question whether "R&D and product development organisations" are sufficiently alike to constitute a class so that our research findings have a more general relevance. A classification involves the use of a set of rules to allocate specific elements to cases. The rules may be derived from theoretical or from practical considerations.

In this context, the main problem arises from the notion of theoretical generalization, not only because there is some dispute as to whether or not ethnomethodology constitutes a theory at all but, more importantly, there are diverging opinions about the relation between theoretical generalizations and empirical instances [Rouncefield2002]:

> "*For whilst ethnomethodology might (controversially) be described as a descriptive theory or a theory for the understanding of social life there seems little doubt that it cannot, and will not, be characterised as an explanatory theory - indeed it specifically and explicitly disavows this stance. And certainly, the objective of ethnomethodologically informed ethnography is explicitly not to produce explanatory or causal theories but what might be characterised as 'perspicuous views' of settings."*

To summarize, due to the special research environment, a number of specific issues had to be taken into due consideration as discussed above. In the following sections it is clarified how the different areas are covered in the design and activities of the research process.

1.7. Consideration of the Specific Research Environment

1.7.1. The Researcher as Part of the Researched System

Since the researcher is the formal line manager in the organisational environment under scrutiny and therefore of the employees participating in the research study, there is a specific power relation to be considered.

- Guaranteed anonymity was the number one design parameter for all data collection processes.
- For processes, such as personal interviews, in which anonymity could not be guaranteed, a dedicated approach was followed in order to limit the influence of the study researcher on the collected data (as described in the following section).

1.7.2. The Anonymity of Data

The anonymity of the data, collected using different means was guaranteed by applying the following methodologies:

1. The collection of quantitative data for the project preparation process was based on the analysis of the organisation's business process, which is part of the company´s inherent set of activities aimed at improving corporate processes. However, the collected data did not allow drawing any conclusions about single individuals.
2. The questionnaires for the employees were designed and conducted in such a way as to ensure full anonymity for all survey participants:
    a. Questions were designed in such a way that even a cross-analysis of the questions asked did not allow for the identification of single individuals or of small groups of people.

b. Both the questionnaires and individual data collection were carried out by independent legal entities (market research firms) outside the research set-up und the company.

c. The definition of the questions and the questionnaire process were discussed and approved by the relevant managers within the researched organisation, including representatives of the trade unions and the data protection board (see also the Section 1.8 on ethics below).

1.7.3. Conducting the Interviews

The interviews, which were conducted with the middle-management of the organisation, had the following methodological characteristics:

- Ten interviews, i.e. direct conversations, were carried out only with a dedicated group of people. The interviewed persons mainly represent the middle-management of the researched organisation; i.e. they are the line managers of the employees participating in the survey. Some of the interviewed persons did not have direct people management responsibility but rather play central supporting roles and functions within the organisation such as communication and marketing (external and internal communication), business development and business process management.
- Each interview lasted between 30 and 45 minutes. Nine of the interviewed persons were man and one was a woman. Since all the issues discussed have no relation to gender issues, the gender issue was not viewed as relevant for this study.
- The interviews were carried out by the author of this study, who had a long-standing relationship with the interviewed employees as they worked together to manage and shape the organisation, sharing the same spirit and corporate strategy. Besides, the interviewees had the same objective, i.e. to better understand the motivation and behavior of their employees.
- In addition to this positive atmosphere, it is important to note that no dedicated questions were formulated to draw any conclusions from specific questions. The interviewees were just informed about the findings of the initial observation of employees' behavior based on the measurement of the time needed for project preparation activities within the organisation and they were asked in open questions about their individual opinions. The concrete formulation of the initial question for the interview as well as subsequent questions is shown in Section 8.3.

It is assumed that in addition to the direct observations made by the interviewed managers, dedicated strategies such as changing some specific organisational processes and structures could have been the driving forces for them. However, since the answers of these interviews provided only the basis to design the questionnaire for the employees participating in the survey, this was not seen as a problem, but quite the reverse. Any suggestion made by the middle management helped design the next step of the data collection process.

The process and the findings of the performed interviews are presented in detail in Section 8.3uj.

1.7.4. The Coding of Data

The main objective of analyzing and summarizing the responses to the interviews with the management was the formulation of a first theory (coding of the interviews), which in turn provided the basis for the definition of the questions intended for the online survey among the employees.

The individual responses and statements of the interviewees were recorded and marked, and then grouped and summarized in different thematic clusters. Thus, closely related statements were grouped in topic clusters and summarized by formulating a corresponding thesis. Therefore, the statements of the interviewees were anonymized and generalized.

This gave rise to the 14 formulated theses describing the communication behavior of the employees in the project generation phase.

The analysis of the interview answers and their summary led to the formulation of a first theory (emerging theory). This represented the starting point for the definition of the questions to be asked to the employees in the online questionnaire.

1.7.5. The Quality of the Data

The amount, depth and scope of the collected data were selected by the researcher of this study according to his requirements. Thus, they were deemed as sufficient to carry out the necessary analyses of the different steps.

- The collection of quantitative data regarding the project preparation performance was based on 700 project preparation activities, which were carried out within a time-frame of 6 years, while taking the different cultures of the working teams, the different technology fields and markets as well as the different cultural phases of the overall organisation into due account (based on the extensive time duration of the data measuring process). This provided a good statistical basis for the subsequent analysis.
- The questionnaires were conducted within a single department, thus addressing roughly 200 employees. Based on a response rate of more than 100 employees, the results of the questionnaires were of substantial quality.
- The interviews were carried out in the form of direct conversations with a very limited number of people – essentially 10 line managers of the department and some professionals with central support functions. Only those team-leaders and professionals with central support functions, who had had hands-on experience of employees' behavior, were selected and involved in the survey. All of the interviewed persons had a multi-year management experience within the organisation. Interviews with individual employees wouldn't have delivered a real added value at this stage. As for the data collected during these interviews, the number of interviewed persons did not necessarily increase the quality of the data, since no quantization of the data took place. The interviews were used to collect a list of opinions and potential theses to fine-tune the questions to be asked in the online questionnaires. The number of performed interviews was deemed as sufficient to meet the intended objective of the research study.

  Each of the interviews with formulated opinions, views and statements of the middle-management was recorded, transcribed and finally summarized by the author of this study. The management's individual views, which were brought up during the interviews, were summarized by coding and sorting out the answers in specific classes, which provided the

basis to define the questions for the subsequent online questionnaire. Thus, it is important to note that the quantity and accuracy of the gathered information or even the potential discrepancy among the collected answers were not relevant, as data was only used to formulate initial theses for the next level of the research process, the questionnaire.

1.8. Ethics in Qualitative Research – Adopted Measures for Data Collection

Ethical issues in research activities are an inherent component of social science and, consequently, of empirical research. They arise during all phases of the research process:

- topic selection and goal setting,
- study design,
- access to the research field,
- procedures for the collection and evaluation of data, and
- questions regarding the publication and utilization of research findings.

This means that a research project is required to undergo ethical review through the evaluation of one's own conduct. There are two main works that provide guidance in this context: The "Code of Ethics" of the German society for sociology (DGS) and the professional association of German sociologists (BDS) [BDS&DGS1993]", released in the German-speaking area, and the work of the American Sociological Association (ASA), 1999 [ASA1999]. Both works address this topic, which is of great relevance for us, in a similar manner. [Unger2014] has summarized the main contents of both works, while explaining specific differences, which are mainly attributable to cultural differences.

1.8.1. Study Design and Procedures for the Collection and Evaluation of Data

With a view to guaranteeing ethical behaviour when conducting empirical research, the following research-related ethical principles of sociologists' code of ethics were taken into account for this PhD study [BDS&DGS1993]:

- Objectivity and integrity of the researcher: Sociologists should strive for integrity and objectivity. Results should be presented without omitting or changing anything. Qualitative research requires that "… *the reflective capability of the researcher about his or her actions and observations in the field of investigation is taken to be an essential part of the discovery and not a source of disturbance that needs to be monitored or eliminated.*" [Flick2004, page 8].
- Risk assessment and damage prevention: Basically, those investigated should never experience any disadvantages or be exposed to any kind of risks due to research activities. They must be informed about all potential risks beforehand. In order to prevent potential detrimental effects for the persons or organisational units participating in a research project, researchers should be able to anticipate any unfavourable consequences or potential risks arising from the research activities for the studied individuals or groups of people. Employees involved in the research studies should never be exposed to any disadvantages or dangers that exceed the limits of what is deemed normal in everyday life.
- Voluntary participation: Participation in surveys should not be forced from a dependency relationship with the researcher.

- Informed consent: On the one hand, it must be ensured that participation is completely voluntary and, on the other, that sufficient information is provided about the objectives and methods of the study. In addition, concerted efforts have to be devoted to obtaining genuine informed consent from persons with a low education level and low social status as well as from minorities or marginal groups.
- Confidentiality and anonymization: Collected information might cause damage if they are misused, made publicly available or passed on to third parties. This means that people participating in a research project can suffer potential damage through the loss of their privacy. Especially thorough electronic data processing is imperative; i.e. careful precautions must be taken to protect privacy and personal data.

The different ethical aspects and how they were taken into account when designing the current research project are presented below.

1.8.2. Objectivity and Integrity on the Part of the Researcher

Since the researcher is a manager of the organisation “AIT Austrian Institute of Technology” and, therefore, the superior of those employees, who play an important role for this research topic, special importance has to be attached to this aspect. The dual role of the study author as researcher and at the same time being superior of the AIT employees, demanded in the project a special sensitivity to follow best ethical objectives.

The survey in the organisation on attitudes and behaviours of scientists to information openness and retention of information ("information hiding") to develop and improve the innovation strategy and innovation processes can be seen sociologically as a "monitoring process" according the system theory of Niklas Luhmann.

For Luhmann is observation *“the unity of the difference of distinction and indication*" [Luhmann1998]. He also describes the distinction between first-order observation and second-order observation. When the researcher carries out a categorization (distinction) as well as an associated name in the course of an investigation, he makes a first-order observation. Because such a first distinction cannot be made according to clear objective factors, but is always a subjective classification from the perspective of the observer, all other distinctive descriptions are hidden as a potential "blind spot". Since the observer cannot simultaneously observe in the observation itself, the "blind spots" are not recognized. Luhmann calls this "*first-order observation*".

To counteract this basic problem with a simple observation, a dedicated reflection processes is added to the process in order to observe the “observation". Luhmann calls this "*second-order observation*". This reflection process is achieved for this PhD study by the knowledge-management processes implemented in the organisation; i.e. in weekly meetings called "Project Board (PB)" as well as the permanent discussion of process indicators in the context of the implemented innovation process in the organisation "Project Life-cycle Process (PLP)".

These knowledge discourses in the organisation can be regarded as an institutionalized method of observation of the second order, because they can resolve the "blind spots" of the first-order observation, because they can add to the basic question "what?"; i.e. the question “What was observed?” – such as “the attitude of the staff”, "How-questions" (How was observed?). Thus, the second-order observation serves as a reflection immanent corrective to the study process.

Luhmann gives to organisations the ability to introspection and self-reflection. Organisations have an Autopoiesis, i.e. they arise and evolve on their own. Thus, they are, like the society as a whole, permanently monitored by observations of second order.

Thus, the potential "conflict of roles" of the researcher and supervisor are resolved positively in social science sense and the employee rights and privacy have been considered inherently in this study design. The objectivity and integrity of the researcher in this PhD work is guaranteed by the following measures:

- The basis for the collection of project data is a transparent and inherent component of organisational development. The process required for this purpose, a Project Life-cycle Process (PLP), was implemented in a completely transparent manner, step by step over many years and saw the involvement of both the middle management and the majority of the employees. Research objectives, implemented measures and potential problems were identified and discussed during weekly meetings (so called Project Board meetings) together with representatives of the middle management and all support functions involved. Data analyses were made available to all employees in a transparent manner. This also applies to those data that are used to manage the company.
- Personal interviews were carried out only with a small group of people – principally with the middle management elaborating the behaviour of their employees. It was explicitly made clear that the interviewed employees only needed to discuss those aspects that they viewed as relevant for the current research topic or they wanted to communicate to the management.
- On the one hand, research findings and resulting measures are usually communicated to all employees during corresponding events. On the other hand, the knowledge gained from such research activities is used to shape innovation processes outside the studied organisation, i.e. the AIT.

1.8.3. Risk Assessment and Damage Prevention

Four essential issues have to be considered to avoid negative consequences for the persons under observation as well as for negative effects for the research as such:

1. The improvement of workflows within the company should never cause any disadvantages to single employees but rather take employees' concerns with regard to the design of the innovation process into due account.
2. When single employees make sincere critical statements, their genuine concern could be misinterpreted and lead to a negative reaction by the management.
3. When different tendencies are recognized in different working groups or units, the organisation development can still be promoted; however, this might also support tactical response behaviour.
4. When employees are not confident that they can formulate and express their opinions in a sincere manner, while remaining totally anonymous, there is a serious danger that this might lead to socially desirable response patterns and therefore to a potential distortion of the research outcome.

For these reasons, it is vitally important to adopt a questioning method that does not allow drawing any conclusions on single persons, groups or company sites, not even by investigating the analysis methods of the collected data. Thus, the research design and inquiry process has been designed so that no conclusions on individuals for the examiner are possible; i.e. who has participated in it, and what positions were taken of those surveyed, is not attributable to individuals but only as statistical data available. The survey was therefore outsourced to a commercial polling institute which communicates only anonymous data and statistics to the examiner. In the course of the information process the chosen principles are communicated to the employees as well as discussed with the stakeholders[59]. The stakeholders can also validate the used processes.

1.8.4. Voluntary Participation

In the invitation to participate in surveys, it was explicitly pointed out that the participation is completely voluntary and anonymous (see the invitation letter in Section 11.2.2). Thus, the following aspects have been ensured in the data gathering process:

- It is explicitly pointed out in all electronic questionnaires for all employees within the organisation that participation is completely voluntary.
- The researcher has no possibility to determine the identity or draw any conclusions on the participants in the research study.
- Employees are simply invited to take part in the survey and give their contribution.
- The reasons behind this kind of data collection are clearly communicated: employees are asked to support this research project to gain relevant knowledge to design the processes within the organisation as well as innovation processes outside the organisation. This offers employees the opportunity to participate in complex organisation and product development processes.

1.8.5. Informed Consent

Given the high education level of all employees concerned (all employees have a university degree) as well as their multi-year involvement in internal innovation processes (since 2010 a dedicated innovation process, designed and implemented by the author of this study, is operated within the AIT Department Digital Safety & Security; which is the basis for this PhD work), it can be assumed that research survey participants have extensive experience in this regard and are well informed about the basic issues addressed by the research project.

Research participants were explicitly asked to give their prior consent to the interview. Questionnaire processes were defined in such a way as to prevent the possibility to control whether someone had participated in the questionnaire or not.

1.8.6. Confidentiality and Anonymization

The empirical research analysis (data collection via a questionnaire) was designed in such a way that no electronic data of the interviewed persons could be made available and the identity of the studied individuals could never be identified.

[59] AIT´s works council and data protection board.

During the survey, employees were explicitly informed via both a verbal and a written communication, providing background information, that participation is completely anonymous and voluntary. The survey design and corresponding privacy safeguarding measures were explained in explicitly.

For this reason, the questions were formulated by the author of this study, whereas the collection of the data itself was carried out by a renowned survey company. In this way, all electronic data – the identity and answers of the survey participants – were not collected and stored within the company. The survey company delivered only anonymous data to the researcher to analyse the collected data.

1.8.7. Works Council and the Data Privacy Advisory Board

An essential prerequisite for the data collection within the organisation was the validation of ethical conduct through the Works Council and the Data Privacy Advisory Board of the organisation. The objectives of the research project were communicated to the AIT Works Council, amongst others, through a briefing for the Chairman of the Works Council. The latter discussed the provided information in the corresponding committees of the Works Council. Important aspects for the Works Council regarded the prevention of any potential negative consequences for single employees. In concrete terms, this included the following aspects:

- safeguarding employees' anonymity, and
- conceiving the survey design in such a way that no conclusions could be drawn on single employees or organisational units.

Since the main focus of the research project is not a direct organisational development within the organisation but rather the possibility to gain further knowledge, questions such as membership in a specific organisational unit, work location, personal data like age, education, etc. were omitted.

It is important to understand that no prior formal approval by the Works Council is required by the firm's internal rules. Therefore, the survey could have been conducted without any kind of communication with the Works Council, as organisational development represents an inherent management task of the company. Nevertheless, there was a genuine risk that lack of information could give rise to misunderstandings and fears that might hinder effective cooperation with the employees.

In the end, the Works Council did not give or formulated an explicit consent, as there was no formal requirement for this. However, the Works Council agreed on communicating to all employees in written form that the Works Council had been previously informed[60].

In addition to the Works Council, the Data Privacy Advisory Board of the AIT also plays an important role in this regard. The Chairman of the Data Privacy Advisory Board was provided with background information about the research project during a meeting. Besides, he was sent the questionnaire for the survey beforehand and was also asked for feedback and final approval. The provided information was discussed during a formal meeting of the Data Privacy Advisory Board and finally approved. This approval was communicated in a written form. The head of the Data Privacy Board sent a written confirmation per e-mail at July 10th, 2015, referring to the relevant section of their board meeting

[60] The works council representative confirmed the following formulation used in the invitation letter for the employees: *„Die Fragen wurden mit dem AIT Datenschutzbeirat abgesprochen und der Betriebsrat wurde über die Durchführung dieser Umfrage im Vorfeld informiert." (e-mail from October 27th, 2015).*

protocol "*Questionnaire of the Department DSS*", that there is no need for action for the data protection board and the questionnaire can be done[61].

[61] Original comment of the AIT Data Protection Board referring to the planned questionnaire of the Department Digital Safety & Security (DSS) in German: „*Umfrage des Departments DSS. DSS plant im Rahmen eines beauftragten Projektes, den Test einer Umfrage im eigenen Bereich. Dieser Probelauf ist notwendig um eventuelle Anpassungen vornehmen zu können. Da keine personenbezogenen Daten der MA/Teilnehmer erhoben werden ist seitens des Datenschutzausschuss kein weiterer Handlungsbedarf gegeben. Der Datenschutzausschuss empfiehlt die Ergebnisse innerhalb des Departments bekannt zu geben.*"

2. Innovation and Technology Management[62]

"The extraordinary does not happen in smooth and ordinary ways."[63]

Johann Wolfgang Goethe, 1749-1832

2.1. Creativity and Invention – a Transcendent Result

Creativity is often equated with "out of the box thinking"; i.e. to overcome conventions, existing rules and laws and to create new approaches, views, perspectives and solutions that do not arise from a logical consequence or a process description (i.e. no rational logic), but which are just creative. New and unconventional problem-solving approaches are based on questioning established assumptions, breaking the rules, asking the right questions and analysing a problem from different angles and perspectives [Sloane2006]. Paul Sloane[64] calls this process of creativity, "lateral thinking" [Sloane2006].

A basic function of creativity is to allow not only logical relationships and thus results which are a deduction of logical steps, but to identify or create relations between facts or objects which are not in a logical or ostensible relationship; i.e. to bridge outstanding or superior (transcendent) new approaches, objects, etc., or in other words: "to create something new". Matthew May summarizes in [May2013] that creative breakthroughs are often based on the capability to make connections between seemingly independent things. A key ingredient to identify such connections is a mind which is open enough to consider solutions even outside of the original problem solving area[65].

Thus, "to create" can be described as "form something out of nothing". Thus, creative processes require freely combinable building blocks and unpredictable effects to enable the generation of innovation.

Steven Johnson[66] [Johnson2010] is referring to a complex environment as a basis for creative processes and innovative results (the nature of complex systems will be discussed in detail in Section 2.9). He makes interdisciplinary analogies to try to comprehend how new ideas are generated using comparisons with other fields such as the functioning of a human brain or the adaptation skills of complex natural habitats such as the rain forests and the coral riffs. Johnson argues that ideas need so-called "liquid networks", a creative milieu, an environment that nurtures innovation, a highly diverse network with a great variety of species from the eco-system, where ideas can connect, converge, be exchanged and recombined [Johnson2010].

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[62] A summary of this section is published in [Leopold2012a].

[63] Translation of the German phrase „*Das Außergewöhnliche geschieht nicht auf glatten, gewöhnlichen Wegen*" from Johann Wolfgang Goethe, https://www.aphorismen.de/zitat/584 (last access: 24.4.2017).

[64] Paul Sloane is author of several books on innovation and creativity and founder of the consulting firm "Destination Innovation".

[65] According to [May2013], Oracle Chef Larry Ellison mediates in order to enhance self-awareness, focus, and attention and asks his executives to do the same.

[66] Steven Johnson is bestseller author and editor in publications such as New York Times, Wall Street Journal and the Wired Magazine.

According to Johnson, good ideas are not generated by a single event but in a network, "*good ideas are networks*" and, in this sense, they are generated when individuals and ideas are brought together or as Johnson also puts it: "*Chance favours the connected mind*." It is not only the competition among individuals and companies that fuels innovation in product and service development but rather an open system based on communication and interaction. New ideas are always looking for "the adjacent possible". This means that a new technological idea tends to build on an adjacent technology to stretch the boundaries for a potential new invention. Thus, innovations build upon transformation and re-use and thus are permanent "recycled" [Johnson2010, Arthur2009].

Therefore we can conclude that novel ideas arise from openness and the sheer joy of experimenting, from heightened vigilance and curiosity, from the ability of tracing new connections, from exaggeration and moderation, from playful arbitrariness and ultimately from a constructive interaction with "co-thinkers". In addition, a good idea need complementing and apparently irrelevant information or, as Johnson puts it, "error and noise". Making mistakes plays a crucial role in the innovation process as it opens up new exploration paths. And a certain degree of "noise", which refers to imprecise, unclear and apparently useless ideas, can help sharpen our mind in a more effective way than totally predictable and sterile innovation approaches. The absence of noise-error means people aren't trying very hard to establish new routes. The more ephemeral aspects of innovation, serendipity and inspiration, are enabled by this "error and noise", are establishing new routes for the ground work of innovation.

Especially the fortunate coincidence, "serendipity", plays a crucial role in the creative process as it can lead more quickly to new and unprecedented connections and combinations of ideas. Randomness applies when environments are created that support unintentional connections at all levels: at the personal level, at the corporate level and across the comprehensive information network of a society. Embracing serendipity as a method means going to networking events, visiting trade shows, but also going for an inspiring walk, taking part in brainstorming sessions, sleeping over a problem, going to a coffee place with a constantly changing public, etc. All these practices fuel creativity when solving a problem[67].

This interdisciplinary and multi-perspective approach to innovation creates a new knowledge culture, where "serendipity" takes central stage. Already as far back as the 19th century, the world-famous French chemist Louis Pasteur had observed: "*Chance favours only the prepared mind*"[68] or as Shawn R. Drew summarizes it [Drew2010]: "*The more you know, the more you can capitalize on an opportunity*"; or "*Sudden flashes of insight don't just happen – they are the products of preparation*".

Concerning the combination of building blocks, Kevin Kelly[69] [Kelly2010] coins a term to refer to the entire sphere of technology: the "technium". He argues that technology as a whole is a living natural system, whose origins go all the way back to the beginning of life and that the evolution of

[67] Of course, just doing nothing doesn´t enable creativity. The objective to be creative or to find a dedicated solution has to be already in the mindset of a human being.

[68] Luis Pasteur, lecture at the University of Lille, 7.12.1854, https://de.wikipedia.org/wiki/Louis_Pasteur (last access: 24.4.2017).

[69] Kevin Kelly is a human biologist and anthropologist, whose interests focuses on cultural, behavioural, and biological facets of modern human variation and adaptability. He was executive editor of the wired magazine and has written for The Economist, Science, Time, The Wall Street Journal, and The New York Times among many other publications.

technology converges in much the same manner as biological evolution. He is stating, that "*technology wants to be developed on their own*" [Kelly2010]. The legitimacy and independence of the "technium" as an autonomous force of nature is based on long-term tendencies and patterns of evolution manifested by existing technologies and on the supposed probability of the further evolution of these tendencies going forward, which in turn is founded on the inextricable and reciprocal links and trajectories between the technological phenomena tracked down so far[70]. To complement this view, we will discuss Andrew Feinberg's view that technologies do not exist for their own sake, they fulfil a purpose only when they are applied by humans (see Section 6.1.2 below).

2.2. Innovation by Combination and Novelty in Technologies

The aspect of a structured innovation management process has already been addressed by Schumpeter[71]. He referred to three essential phases: invention process, innovation process and finally the diffusion process [Schumpeter2006], [Mahdjoubi1997][72]. Thus, for Schumpeter "innovation" is a process which turns an invention into commercial use. In addition Schumpeter argued back in 1910 [Arthur2009]: "*The essential source of innovation is combination. The economy continually creates the new by combining the old and in doing so, it disrupts itself constantly from within.*"

Brian Arthur [Arthur2009] defines "innovation" by referring to the novelty in technology. Such a novelty comes in several forms:

- Novel technologies themselves;

[70] Talking about the predictability of technological developments, Kelly refers to three basic patterns: adjustment, contingency, and inevitability. While adjustment to ever-changing environmental conditions is a natural transformation process, contingency and inevitability reflect the natural development pressure arising from the historic reality and the world's physical laws. A car cannot be invented before the wheel was invented and, according to the principle of inevitability, cars can only be driven if there are streets and not clouds. Another example is the development of the first computer 1837 by Charles Babbage, before the time of availability of electricity and transistors as general purpose technologies (https://de.wikipedia.org/wiki/Differenzmaschine (last access: 24.4.2017). Another good example is, that not Steve Jobs did invent the Tablet PC in 2010, it was 8 years earlier Bill Gates. Some technology building blocks were not mature enough and the Internet access infrastructure was not broad available at that time, thus preventing a huge market success. This means that a technology wants to be invented when the right time comes.

[71] Joseph Schumpeter was Austrian national economist and politician, born February 8th, 1883 in Triesch, Mähren, Austria-Hungaria, and he died January 1st, 1950 in Taconic, Connecticut, USA. On March 15th, 1919, Schumpeter became Austrian finance minister (Staatssekretär for finance in the government „Renner II") for 8 months. However, he was not part of the new government "Renner III" assigned October 17th, 1919; https://de.wikipedia.org/wiki/Joseph_Schumpeter (last access: 24.4.2017).

[72] Mahdjoubi [Mahdjoubi1997] summarizes Schumpeter´s view by referring to Paul Stoneman [Stoneman1995]: "*The Schumpeterian trilogy that divides the technological change process into three stages is often considered to provide a useful taxonomy. The first stage is the invention process, encompassing the generation of new ideas. The second stage is the innovation process encompassing the development of new ideas into marketable products and processes. The third stage is the diffusion stage, in which the new products and processes spread across the potential market. The impact of new technology occurs at the diffusion stage and thus the measurement of impact is very much a measurement of how the economy changes as new technologies are introduced and used*".

- New solutions within given technologies;
- And most importantly, many innovations apply existing technologies or new combinations of existing technologies. The main factor, by which novelty arises in technology, is the combination of existing technologies to deliver added value in existing markets or even to generate new markets.

Thus, a strong source of innovation originates from new combinations of existing technologies or by the adoption of certain technologies for new operating fields or markets. Combination suggests a route to be tackled by which novelty arises in technology. Combination links individual novel technologies back to particular technologies that existed before. Arthur summarizes: "*technology creates itself out of itself"* and calls this mechanism "*evolution by combination*", or more succinctly, "combinatorial evolution" [Arthur2009].

Thus, re-use and combination explains also the importance of interdisciplinary approaches for innovation processes and is one important factor for open innovation and web 2.0 – we need to know what is out there to recombine it.

Especially the identification of the combination of existing technologies, as well as the application of existing technologies in new areas and markets stimulates a basically problem on traditional organisational structures.

2.3. Technology Substitution through Change of Drivers

According to Paap [Paap2004, page 16], an existing technology will be replaced by a new one when there is unmet need in the marketplace and at the same time, existing technologies are incapable of effectively addressing it. Often these needs, which customers have, are not yet articulated by those customers. Thus new market drivers[73] may emerge over time to fulfil customer needs although customers have not yet articulated them.

Complementing this "market pull" view, we could formulate a more radical view, that there is not a need or market until the technology prompts it; which leads us to a "technology push".

[Paap2004] lists three main reasons for technology substitution based on these two forces: market need and technology capability:

1. The old technology has reached its end of life with regard to its driver. This is the most common form of technology substitution. Often managers tend to oversee the coming limitation of their existing technology in use.

   For example, the digital interactive IPTV service (researched and elaborated from 1992-2008 in the telecom industry), which was the intended new technology to complement classical

[73] According to [Paap2004], a "driver" is the performance characteristic which represents the major consideration when customers select a product. For example "bandwidth" is an essential driver for high-speed Internet access services. Thus it is an important parameter for customer acceptance and thus a so called "market driver". Inventions or available technologies are also essential market drivers, as well social changes which result in public purchasing programs, for example changes in the military sphere, public security, health, and education services. Thus, market drivers enable a new market to be developed, a new technology to emerge or stimulate new customer needs. And finally, even capabilities of the customers are important market drivers – here the cultural technology literacy plays an important role.

digital broadcast TV [Leopold1996, Intercomms2005b, Leopold2006a, Leopold2008a], or ADSL-based broadband Internet access to replace dial-in and ISDN based Internet access [Leopold1998]. ISDN technology was not prepared to offer higher bandwidth above 2 Mbit/s, flexibly and economically, and broadcast TV technology was not able to support the growing interactivity requirement of the new so called "lean forward" Internet users (describing the interactive behaviour of user compared to the passive "lean back" user of a TV broadcast service).

2. The old driver is outdated, a new driver emerges and the old technology has a lower performance in the context of the new market situation, compared to the new evolving technology. This is a more subtle form of market change compared to the case above. Paap provides an example by the floppy drive technology. As long as the growing storage capacity has been the main driver, 5 ¼ inch drive was the leading technology, compared to the 3 1/2 inch drive. As soon as the same capacity was offered by both technologies, other drivers like size of the medium or durability of the medium became the new determining drivers, thus stimulating a technology substitution on the market from 5 ¼ inch to 3 ½ inch.

3. The market environment changes creating new drivers. Examples of such market changes are the transformation of economic models (e.g. by standardization) or amendments to regulatory provisions.

Mostly it takes a fairly long time till new technological principles make their way against traditional technologies. This has different reasons like performance reasons of the new technology but also structural reasons like established organisations and processes as well as psychological reasons at the user side and leads to threatening dissonances between potential new and secure old technologies. This continuity and this power of resistance against novelty, Brian Arthur calls "adaptive stretch" [Arthur2009]. Adaptive stretch means the attempt to use a technology as long as possible. Especially in the context of technology replacement the adaptive stretch mechanism is an essential factor.

Ram elaborated the reasons for "innovation resistance" due to the various disruptive effects as a "normal response" of people when confronted with innovations" [Ram1987]. This will be discussed in more detail in Section 6.4 below.

2.4. Different Forms of Innovation in the Business Context

Usually companies try to compete on delivering products and services, which put them in a competitive advantage against their competitors (earlier on the market, better fulfilling market drivers, etc.). It is important to note that in the business context the traditional perception of innovation, which is often only technological or product oriented, is too narrow. In traditional organisations, research focuses most often on innovations in new technologies, product features or production processes. But also new service models which provide an enhanced customer experience and new marketing & sales concepts are important areas of innovation which enable a competitive advantage on the market. In order to achieve a competitive advantage, innovation takes place in different parts of the company's value chain:

1. Product features (core product attributes and related services),

2. production processes,

3. logistic processes,
4. sales, marketing and branding strategy,
5. enhanced customer experience, and most importantly
6. new business models of the company - services offered, outsourcing concepts, resources and focus of the company, organisational structures.

Business model innovation enables a greater competitive advantage and it is more difficult to be copied by competitors than when only on product innovation focused [Lindgardt2009] [Osterwalder2010] [Leitner2009].

But even more, it is important to note that companies are constantly challenged to review their business model approach in response to new market drivers. Since market drivers are changing, business models are permanently challenged by competitors. It constantly raises questions regarding which core competencies to focus on, how to achieve effective management of business partners - suppliers, R&D partners, customers, etc., and how to become effective in networks. This is followed by the open innovation processes [Chesbrough2003, Lichtenthaler2008, Lichtenthaler2011][74]. Thus, integration and coordination skills are becoming an essential core competence especially of large companies [Christensen2006].

2.5. Disruptive and Incremental Innovations

Disruptive technologies are technologies that bring about far-reaching market changes posing unprecedented challenges to companies, which have to come to terms with this technological transformation on the basis of their well-established business models and consolidated market position.

The term “disruptive innovations” builds upon Joseph Alois Schumpeter’s concept of “creative destruction” in his book “Capitalism, Socialism and Democracy” dating back to 1942 [Schumpeter1942], in the sense of technological innovations that tend to surpass and replace legacy technologies in the long run, make a considerable contribution to bringing forward permanent market changes. Disruptive innovations lead to completely new value generation processes that jeopardize, radically transform or even destroy companies or entire industries.

In this context, it is important to point out that companies are not necessarily the refuge of disruptive innovations (see Section 2.7 “Tyranny of success”). Disruptive innovations are usually brought about by new market entrants that offer completely new products and services and consequently trigger off cutthroat competition with existing market players. Classical examples of disruptive innovations are the invention of the printing press, the steam engine, and electrical power.

[74] Henry Chesbrough is considered as the researcher who coined the term “open innovation”. In his opinion, network relations between companies, universities, suppliers and competitors provide the basis for an open innovation system. In his view, the traditional innovation model which he called “closed innovation“, which follows a linear process throughout the development processes within firms – from creation via implementation to deployment, is not effective to consider the real market dynamics especially in modern times which is characterized by our increasingly networked society. He argues that the mere commercialization of internal ideas is not enough to safeguard a firm’s innovation leadership over the long term. Companies need to face up to this challenge based on an open innovation system which is based on ongoing interaction and communication with the external world. Thus, he favours networks which include several other stakeholders in an innovation process such as customers, suppliers, and research partners.

Recent disruptive innovations within the global telecom and media industry are the new generations of mobile devices, and easy to use applications that changed the global telecoms industry dramatically.

The company Apple Inc. with its new product portfolio is one of the most compelling examples for today's disruptive innovations. The computer firm has first revolutionized the music industry with products such as iPod and iTunes, then radically changed the telecommunication market with the iPhone and finally created a new computer generation with the iPad, which is bringing forward a new breed of IT service applications and usage patterns. In contrast to innovators like Apple, large global network operators, with billions of investment budgets and huge R&D efforts, did not develop innovations like Skype, Internet TV, Google or Wikipedia – although those new services are profoundly jeopardizing their existing business models.

The new generation of mobile phones, for instance, has not been developed by market leaders such as Alcatel, Siemens or Nokia. It was thanks to Apple that functionality, usability and design were combined in an impressive way and turned into a worldwide market success. Furthermore, the market launch of the first mobile music instruments was not attributable to the consumer electronics industry but rather to the combination of an easy-to-use end device (iPod) with a content service (iTunes), which brought about an incredibly disruptive development.

On the contrary, incremental innovations involve the ongoing improvement and adjustment of existing products with a view to gaining sustainable market success in an environment characterized by permanent competition. Incremental innovations lead, for instance, to the optimization of production processes, the creation of more attractive pricing schemes or the development of new functionalities to successfully differentiate products from market rivals.

2.6. From Proprietary to Infrastructure Technologies - Changing Market Rules

Nicholas Carr [Carr2004] explored the difference between proprietary and so called "infrastructure technologies". Proprietary technology is owned by people or organisations and is usually used in a specific application context only. An infrastructure technology is used by many different applications and is shared by several users and thus is considered as a commodity. Proprietary technology remains protected from the competitor and these technologies provide a competitive advantage on the market and can be the basis for a long-term strategy. Access to proprietary technology may be restricted through factors such as physical limitations, high costs, government regulations, lack of usage standards and a lack of skills by the users.

When a technology became an infrastructure technology, the competitive advantage diminishes, as all the competitors can easily adopt the new technology in a short time frame. High standardization, low cost, widely distributed skills for deploying and using the technology are factors which determine whether a new technology becomes an infrastructure technology.

Andrew McAfee [McAfee2006b] discusses so called "general purpose technologies (GPT)" such as electricity, transistor or laser which are available for many applications and can be easily handled. Thus, such technologies generate disruptive market changes.

Carr suggests that, in principle, all technologies tend to develop into low cost standard technologies exemplified by the rail system, cars, telephony and recently broadband Internet. A source for this trend is the competitive dynamics which results, according to Carr as well as Christensen, in an

"Innovators Dilemma", in systematic "*overshooting*" of product development. Overshooting refers to the process by which the performance of a technology moves to a level in which the product performance exceeds the requirements of the mass of the users. This situation is the entry point for alternative products based on cheaper technologies. Christensen summarized this effect [Carr2004]: "*The pace of technological progress in products frequently exceeds the rate of performance improvement that mainstream customers demand can absorb*".

Many equipment manufacturers can be very slow to accept the reality of overshooting. Equipment is made by manufacturers, who naturally intend to maximise their sales by selling as many products as possible; thus the technological advantage tends to diffuse quickly throughout the market. This trend ends usually at a point in which the whole market or industry experiences a collective improvement, without providing a competitive benefit to an individual organisation.

Particularly in the IT industry we have to consider software in principle oriented to this overshooting effect. Carr summarizes this issue [Carr2004]: "*Perpetuing the upgrade cycle of software by constantly advancing the state of the art has been critical to the economics of most makers of software*".

This mechanism describes also the "adaptive stretch" effect of technology substitution processes as described above in Section 2.3.

2.7. The Innovation Dilemma – Tyranny of Success

Clayton Christensen[75] [Christensen2011], Jay Paap[76] and Ralph Katz[77] have studied why so many companies fail to adjust to technological and market changes by rethinking their strategies [Paap2004]. They have identified a pathological trend, which they define as "tyranny of success": Originally innovative and successful enterprises mainly focus on preserving and safeguarding their positions and end up realizing far too late that former success factors are no longer effective in the face of disruptively changed technology standards and market landscapes.

Out of 25 large successful corporations in the year 1900 only two were able to survive market changes![78] Of the Fortune 500 organisations from 1975 only 30% ranked among the 500 most successful firms of the world in the year 2000 [Katz2010]. Understanding this trend involves unveiling the different effects of both incremental and disruptive innovations.

Initial success factors such as vision, strategic focus, organisational structure, main competence areas, incentive and remuneration schemes, corporate culture, etc. that played a crucial role in building a company's competitive advantage during one period, can rapidly turn into a hurdle for further sustainable economic success, as the technological or market environment change over time.

[75] Clayton Christensen is professor at the Harvard Business School. He developed a model to describe the process of disruptive innovation processes; www.claytonchristensen.com (last access: 24.4.2017).

[76] Jay Paap did his PhD at the MIT Sloan School and is president of Paap Associates, a management consulting-firm in Newton, Massachusetts.

[77] Ralph Katz is professor for management at the College of Business of the North-eastern University in Boston, Massachusetts, and research partner of the MIT Sloan School.

[78] Paap and Katz described this example in [Paap2004] by referring to a 1963 public presentation by Thomas J. Watson, IBM´s chairman.

Interestingly enough, we can observe, that even market-leading corporations which were well aware of the technological developments that might eventually have had a disruptive impact on their businesses and how they often were actively involved in the development of such new technologies, significantly contributing to their realization. However, when new technologies jeopardize or even cannibalize existing products and markets, companies have to face up to unprecedented challenges to safeguard their economic success over the long term. Paap describes in [Paap2004] some examples of developments in the industry. When, for instance, the Swiss watch industry developed the quartz watch, it was their Japanese counterparts that reaped the most benefits achieving the greatest market success [Paap2004]. The same applied to the successful commercialization of stainless steel razors by Wilkinson, a product to which the market leader Gillette had actively contributed [Paap2004], or to the worldwide introduction of Internet technologies over the past 15 years, which has posed unparalleled challenges to incumbent telecom operators. Even if the powerful telecom operators were actively involved in the development of these new technologies at a very early stage, and made huge investments in R&D, this new breed of disruptive technologies and business models has been successfully implemented and commercialized by completely different companies such as Microsoft, Apple and Google (as described as examples for disruptive innovation in Section 2.5).

2.8. Product Management – a core Business Process

2.8.1. Permanent Mediation between Technology Push and Market Pull

An effective product management effort within corporations deals with the permanent interplay between technology push and market pull. If a product development process is oriented towards products that generate an added value for the customers and are accepted by the market, the necessity of a permanent exchange between market and technology propositions becomes evident [Bessant2003, Massar2008].

This is important for the creative phase to bring together the right information and knowledge for the creation and finally the definition of an innovation but in the same way important for the operation of the organisation.

2.8.2. Product Development and Product Operation

We have to differentiate among two different business processes within the organisation:

- Product development, and
- product operation.

The successful launch of a new product requires a uniform standard of knowledge across all corporate units involved in the process. Each single organisational unit needs specific information. Various aspects need to be analysed from different perspectives and processed accordingly depending on the specific unit concerned, as the sales department requires a totally different set of product information than the IT operation or marketing department, the corporate communications unit or the top management.

It goes without saying that this is one of the key responsibilities of product management and no extra corporate processes should be put in place to this end. However, if one considers the extensive set of

communications measures required when managing a large number of products[79], it quickly becomes evident that dedicated processes are necessary in order to achieve a sustainable high quality information exchange and to synchronise the different organisational units in their activities for a common goal. Within large companies, where hundreds and thousands of products are processed on an ongoing basis, effective coordination between technical development, operational management, production, sales and marketing as well as top management is imperative to corporate success.

The accurate and high-quality processing of information along with effective cross-divisional collaboration for joint product development activities requires close interaction and strong commitment of all corporate units involved in the process. Every single organisational unit should have the possibility to plan and develop its resources in such a way that they can be optimally deployed to meet corporate objectives. This necessitates the exchange of high-quality information early on as well as the possibility to make clearly traceable management decisions or allow for an escalation at certain specific stages of the process.

To summarize the discussion above, we need a structured innovation management process in order to ensure an appropriate information quality as well as presentation to enable effective dissemination processes. We will discuss this in more detail below.

2.9. Innovation Management in Complex Environments

2.9.1. Complexity Science and Innovation Processes

In an economic context, an innovation process describes those procedures that are necessary for the development and market introduction of new products, which are applied to both the company´s in-house and external interactions. Normally, innovation processes are described using “phase models” and are therefore viewed as linear processes that follow a sequential pattern from the initial brainstorming to the final market launch. This is exemplified at best by the “Gate Process” according to Cooper [Cooper1993, Cooper2002] or the “Innovation Funnel” concept developed by Wheelwright and Clark [Clark1993], which describe the necessary selection process that product ideas have to undergo. From a multitude of initial concepts, only a few are brought to final fruition leading to product launches.

Obviously, it goes without saying that such strict sequential models do not reflect the real nature of corporate processes that take place both within and between companies. Innovation processes must be understood as non-linear, interconnected processes that are characterized by a high degree of parallelism, a large number of mutual interactions and unpredictable effects.

[79] For example Telekom Austria Wireline had 2002 a portfolio of over 800 products; larger network operators had even more than 1000 different product entities to be managed. These figures were the basis for the OSS/BSS programme “net@fact”, a programme initiated by the author of this study, during his affiliation at Telekom Austria, to improve the product management performance within the organisation. Strategic focus was the development of product platforms which enable product flexibility for end-user products but allow at the same time efficient technology implementations [Intercomms2005a]. An equivalent complexity can be found in applied research organisations. E.g., the AIT Department Digital Safety & Security generates roughly 120 new projects every year (this figure is based on the AIT internal performance analyses made in the context of this study).

Leitner [Leitner2009] points out that innovation processes can be described using the mechanisms and phenomena known in complexity science. By analysing different literary references and over 50 successful industrial innovations in Austria in the 90s, Leitner has been able to identify the factors that contributed to the innovation successes of these companies [Leitner2003]. Based on the analysis of successful industry innovations, Leitner underlines the additional aspects that may play a role in successful innovation within companies. These include

- randomness,
- a minimal degree of interference on the part of management and staff members who intentionally work "under cover",
- transfer tacit knowledge to explicit knowledge (see Sections 3.4 and 3.5 for a more detailed discussion),
- stimulate the motivation to share information and knowledge, and the
- combination of knowledge – both explicit and tacit - in a new order or in a new environment to create business innovations.

In the following paragraphs we will summarize the main findings of complexity science in the context of innovation management and the management of organisations at large. Based thereupon, we will explore and seek to explain the aspects most relevant to an innovative company, with a view to resolving the most evident contradictions between strict top-down orderliness and bottom-up creativity.

2.9.2. Innovation by Self-Organisation and Emergence in Complex Systems

When we look more closely at innovation processes and summarize all the aspects discussed so far, we have to conclude that a product development process within a firm, from its initial brainstorming up to the successful market introduction of a product, represents a complex procedure marked by a multitude of interactions between numerous players as well as by constantly alternating planning, development and correction phases. Moreover, such a complex procedure builds upon the ability to quickly respond to any new and unpredictable findings that may emerge throughout the process.

A system is deemed complex when it is characterized by a multitude of interacting players, which are built upon simple communications mechanisms at the individual level, while at the same time showing complex behavioural patterns at the aggregate level. This means that players (agents)[80] are interlinked with one another, exchange information and resources, and influence each other on a constant basis, resulting in reflexive feedback systems, which are based on non-linearity and, to some extent, even on instability.

In such self-reflexive networked systems, patterns emerge from the various interactions over time without any control of a central or hierarchical function. Thus, essential mechanisms of complex systems include [Leitner2009, page 3]

- self-organisation,

[80] Information Systems (IS) are usually described by three core elements: actors (people), artefacts (information and communication technologies), and activities (processes) [Kroenke2008]. The actors, in organisational activities, are management, employees and external stakeholders (see Section 4.3.13 below).

- emergence[81], and
- non-linearity.

Complexity science build on theories which are based on the concepts of chaos theories[82] and complex adaptive systems (CAS) theory for explaining the complex behaviour of processes in such self-reflexive networked systems and focuses on how patterns emerge from the various interactions between the actors over time [Leitner2009].

Classical complexity science explores the special dynamics and phenomena resulting from interacting entities in such complex systems as society, biology, and physics. One example is Niklas Luhmann´s social systems theory which is focusing on social systems as complex communication systems [Luhmann1971] (see Section 4.3.1 below). The "actor network theory (ANT)", which established itself in sociology in the 80s, describes the highly interconnected and complex properties of social systems.

Economists along with organisation, management, and innovation researchers, such as [Johnson2010], have applied the findings of complexity science to explain phenomena in their respective fields of study.

[Leitner2009] summarizes the most important organisation and management researchers who apply the mechanisms of complex systems in their work. They refer to the importance of a team's self-organising opportunities and multidisciplinary approaches; Ralph Stacey's[83] complex responsive process (CRP) theory of organisational dynamics [Stacey1995] underlines the emerging bottom-up effect as a fundamental innovation mechanism in addition to self-organisation. Brown and Eisenhardt [Brown1997] view limited structures as relevant elements that foster innovation; Dooley and Van de Ven [Dooley1999], describe the cyclical characteristics of innovation processes; Cunha and Gomes [Cunha2003] stress the ongoing interplay between planning and implementation phases within a product development process, along with the importance of short-term reactions to new findings (improvisation); and finally McCarthy et al. [McCarthy2006], describe an effective product development process as a "complex adaptive system of decisions" marked by self-organisation, non-linearity and emergence effects.

2.10. Plans, Planning and Situated Actions

Practical experience in companies often shows that great efforts are made to create comprehensive and often very detailed plans for everything. Many managers are assuming that a well-defined strategic plan implies a direct operational control of the company and ensures positive corporate

[81] Emergence describes a phenomenon, which is more based on results of cooperative aspects compared to competitive systems.

[82] "Chaos" is not to be understood as 'out of control' or to 'lack order'. "Chaos" in complex systems is meant to describe complex system behaviour, such as in physics where a certain pattern evolves over time. In mathematics, such non-linear system behaviour is described by the unpredictability of the further development; "step function" or "butterfly effect" are terms to describe this effect. Wikipedia is summarizing "chaos": "*When the present determines the future, but the approximate present does not approximately determine the future"* (https://en.wikipedia.org/wiki/Chaos_theory, last access: 24.4.2017).

[83] Ralph Douglas Stacey is a pioneer in studying complexity science for understanding human organisations and management processes (https://en.wikipedia.org/wiki/Ralph_Douglas_Stacey; last access: 24.4.2017).

results[84]. However, the usual experience of people in work processes, particularly in large organisations, as well as the empirical research demonstrates that there exists always a big difference between abstract idealized plans and ultimately actions undertaken by people in the respective specific situation. [Rouncefield2002] elaborated a comprehensive study on this subject.

The importance of plans, as an inherent part of any kind of cooperation among people, has been thoroughly discussed by Suchman [Suchman1983, Suchman1987]. Although Suchman defined plans as a basic function for the cooperation of people, she points out that defined plans do not at all ensure direct causal relationships of plans and individual operations; "*Plans are resources for situated action but do not in any strong sense determine its course*" [Rouncefield2002] referring to [Suchman1987].

Such a misunderstanding of the added value of strategic planning is essentially based on three wrong assumptions of strategic planning [Mintzberg1994]:

- that prediction even of complex processes among communicating people is possible;
- that strategists can be detached from the subjects of their strategies; and
- that a strategy-making process can be formalized.

Institutionalized planning and clearly defined procedures are a mechanism to coordinate distributed working mainly in large companies. Through the description and definition of specific tasks to be performed, even complicated processes for larger groups of people are more easily understandable and comprehensible. It is important to note that in smaller workgroups or small businesses where a high degree on spontaneous coordination and synchronization through direct verbal communication can be performed, such mechanisms are not necessary in this form.

Planning is about the coordination of the work of people, by separating individual workflows that can independently be carried out from one another, but in sum an entire result is achieved by the interaction of the individual tasks. As a result, on the one hand, the complexity of a work item can be reduced and, secondly, other objectives can be pursued as increasing efficiency, division of labour, prioritization of activities, etc.

This issue characterized the discussion of office automation in the 70s which aimed to automate specific planned routines [Rouncefield2002]. However, research showed repeatedly that by the attempt to perform originally simple routine processes, which were carried out by people, by machines, finally demanded always people with higher education and rich experience for comprehensive decision-making processes to successfully implement the intended work [Selznick1948, Mintzberg1994, Rouncefield2002]. This fact becomes particularly clear when one considers in detail how people deal in specific work situations with exceptions and sudden ambiguity in order to achieve the work objectives.

Therefore [Suchman1983] stressed the absolute necessity of an ethnographic orientation in the definition of plans in the organisational context. A defined routine in the office is a description of defined operations, but does not describe the final concrete structures and processes which are finally necessary for the successful implementation of the work. The research shows that we are trying to automate a "fiction". There are people who finally perform the work and not idealized

[84] Practical experience of the author in his management functions within Telekom Austria as well as AIT. This attitude is best described by the comment: "*Where's your plan B if Plan A does not work?",* as a criticism to a presented strategy plan.

models of work [Rouncefield2002]. It is the daily and recurring assessment and improvisation in the individual situation, which enables the successful execution of a work and what makes this finally to a "routine". The original expectations of the office automation were disillusioned and the use of artificial intelligence did not meet the intended objectives [Rouncefield2002].

This subject gets again a new relevance in the context of the emerging Industry 4.0 discussion and should limit the fear of a potential comprehensive automation of our production processes.

This interdependence of plans and ongoing necessary operational adaptations, influenced fundamentally from the beginning the discussion of the modelling of cooperative work processes and therefore the cooperated supported cooperative work (CSCW) research agenda. Cooperative work processes in companies (office procedures) were not suitable for defining specific action plans that could be implemented without reflection in order to provide the basis for a high level of automation, but must be understood as action directions that competent and responsible actors can make concrete decisions in individual cases take to finish the intended work successfully.

To summarize, plans have the following basic characteristics which have to be taken into account [Rouncefield2002]:

- "To follow a plan in real life" usually always means much more than it is possible to specify in advance.
- Plans are usually adapted to a particular user; i.e. matched to those persons who are supposed to implement the work; i.e. plans are "recipient designed". Thus, when defining a plan education, knowledge, work environment, etc. of the receiver is taken into account in order not to define all specific details in advance. It is assumed that an improvisation takes place during the implementation of the work.

2.10.1. Formal and the Informal Organisational Structures

The more the use of digital media and information technology (IT) is connected with the complexity of organisational processes, the more we have to take this essential issue of mismatch between plans and situated actions into account. Plans are abstract constructions which ultimately require always a specific application and thus interpretation in a specific situation [Rouncefield2002]. However, it is important to note, that formally defined processes are only than idealized and unrealistic representations of reality, when the models (i.e. plans) are interpreted literally and necessary background knowledge or original assumptions made are not considered in the definition of plans [Bittner1965, Rouncefield2002].

A key property of plans is that they can be adapted and modified in real-time. Incompleteness of knowledge, lack of information, often unforeseen events, etc., make it increasingly necessary to adapt original plans. Usually the concrete situation clarifies the dependencies and open aspects which have to be resolved for the final successful implementation of the originally defined plan. This missing information is often not formalized in the plan definition as well not in defined routines or processes in advance. It is often assumed that people in the organisation do have this competence. Thus, formal structures and defined processes are closely intertwined with informal mechanisms within organisations by definition (see a more detailed discussion on informal structures in organisations in Section 5.3 below).

Addressing this issue, Lucy Suchman postulated 1987 the concept of the "situated action" by describing the fundamental incompleteness of "instructions" [Suchman1987]. Also Garfinkel

described 1967 with his "irredeemable incompleteness of instructions" the fact that a lot of knowledge and work is needed to implement predetermined instructions [Rouncefield2002]. This can also lead to complicated and often contradictory actions within organisations. Thus, the goal of plans is essentially to formulate a direction; i.e. a set of defined actions which leads with a higher probability to the desired destination. Plans are always supplemented and complemented by concrete situational actions; i.e. plans therefore always include concrete measures to deal with specific unplanned situations.

This issue was also addressed in 1997 in the paper by Kjeld Schmidt [Schmidt1997] "Of maps and scripts - The status of formal constructs in cooperative work". Schmidt emphasized the lack of understanding of the mechanisms of formal structures and processes in cooperative working processes in companies.

Suchman has fundamentally influenced the CSCW research agenda [Rouncefield2002]. Effective interactions between humans and machines need the same interpretive skills as interactions between people. In the human interaction, many non-verbal, linguistic and situational aspects are used to enhance the intelligibility in communication. In the communication between humans and machines we are confronted with a minimum possible number of different states of the machine, which the limits the communication processes significantly [Suchman1987]. In a machine there is always a specific plan implemented. The user of the machine needs usually to find out this plan. However, in the absence of intuitive man-machine interfaces this is often very difficult, as surely everyone can already confirm its personal experience.

The specific issues of the interaction between man and machine are well described by Button and Dourish's 1996 "technomethodology" [Button1996]. They postulate that it is not possible to describe the behaviour of a technical system isolated from the final concrete application scenario. The final definition of technique is inherently dependent on the specific application scenario and thus ultimately determined by the concrete environment. This corresponds to the studies and perspectives of the inherent interdependence of technology and application of technology as discussed in detail in Section 6.1 “New Technology impact the Environment and Vice Versa” as well as Section 6.2 “Technology Mediation and Sensemaking”.

2.10.2. Plans have an Important Function in the Organisation, but not more

The relationship of plans in organisations and the continuous necessary actions to adapt plans constantly are summarized by [Randall2011] referring to [Dant1998]:

1. “*Plans provide a context for treating together different types of organisational activity*”
2. „*Plans can articulate local priorities and policies for the organisation*”
3. „*Plans situate the organisations within its larger organisational context*”. It is essential to have means to coordinate activities between different units of an organisation (teams, departments, groups, etc.)
4. „*Plans provide a resource for linking the activities of related organisations*”, thus enabling a synchronization of the work performed.
5. „*Plans provide a means for managing the public relations or “face” of the organisation*”. See also [Harper2000], which describes that just the existence of rules, procedures, documents, etc., are a resource for the presentation of competent working.

6. „*Plans provide an occasion for articulating values*". Organisations have to react to external expectations of owners, share-holders, supervisory boards and public opinions such as vision statements, formal expressions of the values of the organisation, etc.

2.11. The Necessity of Linear Processes within Corporations

2.11.1. Linear Processes to Complement Creative Processes

As mentioned already above, innovation processes have a highly dynamic nature and can be characterized by ongoing interactions among numerous players. Therefore innovation processes cannot be described as strictly linear procedures following a sequential pattern from initial brainstorming to final market launch. The dynamic processes of the real world, which lead to product decisions within corporations, cannot be classified using simple linear models. However, as discussed above the definition of (linear) plans fulfil important functions within an organisational environment.

Leitner [Leitner2009, page 2, last paragraph] criticizes Cooper [Cooper2002] for his focus on product portfolio management based on linear models, as he does not consider it effective for an innovation-prone company. Leitner, however, oversees one important aspect in this regard, namely that i) the complexity of a company has to be kept manageable; and ii) the rationale behind business processes and structures has to be duly considered and preserved.

It is important to note that companies are principally embedded into strict, linear organisational processes. A company is by definition a linear system. Infrastructure investments, human resource management, reporting, and the financial system, usually require a linear operating mode. Business processes such as strategy communication, mid-term budget planning, yearly budget planning, personnel resource planning, room planning, project planning, regular reporting, indicator-driven business reporting, etc., tend to follow strictly linear mechanisms and a predominantly top-down approach.

Effective decision-making processes depend on their ability to provide the necessary information to the management at the right time and in the most appropriate manner. Budget, personnel and strategy plans have to be reported on an ongoing basis using linear temporal structures. The same applies to the fulfilment of certain commercial responsibilities (duty of care), which must be documented on a permanent basis. Besides, operational units within companies are organised in rigid structures to comply with specific management standards. An example in this regard is provided by the fact that companies generally have the legal obligation to hire personnel on a permanent basis rather than on a project-by-project basis and to implement long-term personnel development plans even in the case of short-term work assignments.

In addition, the presentation of a company's economic development must follow a strictly linear chronological order. Companies have to fulfil certain strict requirements towards their shareholders with regard to reporting, controllability, comparability and clearly understandable communication patterns. State-owned companies in particular have to comply with high reporting standards. And finally there is no budget planning approval in organisations, without linear development plans.

Thus, linear business processes have to be implemented within a company in any case. It is, however, important to note that these linear processes should by no means be in contrast with non-linear mechanisms such as bottom-up creative processes, market interventions and R&D projects. The linear processes of the business logic need to be harmonized with innovation-friendly framework conditions such as liquid networks, adjacent possible, noise and error, and serendipity. A company

must always be in a position to safeguard innovation processes, while at the same time adjusting to ever-changing market situations and supporting other vital business processes. It is worth noticing at this point that innovations do not originate from sterile lab environments and do not follow linear and clearly predictable development processes [Quinn1985].

Consequently, in order to be able to manage an organisation in a complex economic environment, dynamic economic processes have to be presented in a predictable manner to allow better traceability of the achieved targets and the implemented corporate guidelines. Such targets and guidelines cannot be easily changed and follow the special logic of economic systems. This also gives rise to the representation of a company's success and system conformity based on specific indicators, using linear systems that have to be communicated on an ongoing basis, regardless of the dynamic processes underway within companies. This is based on the assumption that the applied indicators reflect reality. Organisation usually cannot directly change such framework conditions and therefore, mechanisms have to be found to help the management achieve the set targets and guidelines.

Thus, such linear models do not explain the processes that take place in the real world, but we need them to be able to work in conformity with the economic systems, while complying with its set of rules.

2.12. Effective Use of Company Resources and Attention Economy[85]

A wide-ranging product portfolio is difficult to manage for a company because coordination between the technical, sales, marketing, production, communication and customer service department poses considerable challenges. This is why an effective portfolio management process is absolutely indispensable which is based on a comprehensive effective information exchange within the organisation.

This goes in line with the "attention economy" [Davenport2001, Ferscha2014]. In rural economies and the factories of the industrial revolution, human labour was the central driving source. Then, in the information society, know-how was the most important resource. Today, in a world of overwhelming and often unnecessary information, we can see the increased value of "attention". This theory goes back to the Harvard professor William James[86]. He postulated that "attention" is the result of turning away from things in order to focus to others. In addition to this view, Herbert Simon[87] brought the aspect of economy into the discussion of attention. He discussed already very early the tension between the richness of amount of available information, and the limited available attention to single information pieces. Thus, Simon could be seen as the father of the term "attention economy". The German philosopher, architect and computer scientist Georg Frank

[85] A discussion of this subject has been published by the author of this study as OVE GIT Newsletter, "*Die Währung des neuen Jahrhunderts heißt Aufmerksamkeit* (*The currency of the new century is Attention)*", OVE society for information and communication technology (GIT), October 2013, Online Newsletter, OVE e&i elektrotechnik und informationstechnik Journal, Springer Verlag, 2013 [Leopold2013b].

[86] William James (1842-1910) was a New Yorker professor for psychology and philosophy at the Harvard University.

[87] Herbert Simon, 1916 - 2001.

published several papers in the nineties discussing "*attention economy*" and Davenport and Beck formulated a definition for attention [Davenport2001]:

> "*Attention is focused mental engagement on a particular piece of information. Information objects become aware to us by their focus on them and then we decide whether we act or not. Attention arises between a relatively unconscious phase in which the sensory input from the environment is analysed and the decision phase, in which we act based on the basis of the information which generated the attention. Without these two phases, there is no attention.*"

Attention spans have shrunk dramatically over the past decade. According to [Ferscha2014b] the attention spans of human beings decreased from 12 minutes in 1998 down to 5 minutes in 2008.

In a management position, a manager is always confronted with limited time and a non exhaustive information landscape for any decision making process. Thus "*management attention*" has to be considered as one of the essential drivers for an effective management of organisations. Thus, information preparation, offering and selection of information are crucial functions for a successful decision making process. The different factors for such an effective information exchange will be further discussed during this PhD.

3. Knowledge Management - From Data to Expertise

"The most important contribution management needs to make in the 21st Century is to increase the productivity of the knowledge work and the knowledge worker."

Peter Drucker, 1999[88]

Knowledge work[89] in the narrow sense describes all actions aimed not only at applying knowledge but also at revising and renewing knowledge by combining the information currently available in order to solve problems. This application of combined knowledge is the basis for successful innovation processes.

Ever since ancient times, philosophers have addressed the question what knowledge is and when is knowledge really true. Before we elaborate "knowledge" and knowledge management within an organisational context in more detail we discuss "knowledge" on a more principle philosophical level.

3.1. Knowledge – What do we Know?

"There are known knowns; there are things we know that we know. There are known unknowns; that is to say there are things that, we now know we don't know. But there are also unknown unknowns – there are things we do not know we don't know."

Donald Rumsfeld, United States Secretary of Defence,
Press Conference, February 12, 2002[90]

3.1.1. The Philosophic Theory of Knowledge

The philosophic theory of knowledge is referred to as epistemology[91] in discussing the nature and scope of knowledge. It is about what knowledge is, how it is acquired and how can we know what we know. It is also covering which statements about reality are to be deemed true and for which reasons, whether knowledge about reality can be attained at all and which forms of knowledge do exist.

In addition to epistemology, philosophers like Aristoteles introduced the term "techne" in order to highlight that it is most useful when the knowledge is practically applied; i.e. "techne" considers the creation of impact due to knowledge opposed to the disinterested understanding objective only. Thus, in the context of "techne", the application of knowledge has a practical result.

A further area in the philosophical discourse is the area of "phronesis". Phronesis is used since the ancient Greeks in philosophy to distinguish from episteme and techne the area of "practical wisdom". Phronesis is considering knowledge which cannot be based on scientific knowledge nor to technical know-how alone, but on practical knowledge; i.e. to have knowledge about how to achieve an objective without a scientific basement.

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[88] [Drucker1999, p. 135]

[89] The idea of "knowledge workers" was already described by Peter Drucker 1959 in his book "The Landmarks of Tomorrow". "Knowledge workers" are staff members responsible for the generation, management and dissemination of knowledge in different areas relevant for a firm.

[90] https://de.wikipedia.org/wiki/There_are_known_knowns (last access: 24.4.2017).

[91] From the Greek word "epistimi (ἐπιστήμη)" which means „science".

Very basically we can distinct between different kinds of knowledge based on the information provided. In this regard, we can differentiate for instance between analytical and synthetic statements. Analytical propositions do not add any information; e.g. "a square has four right angles" is an analytical sentence since the predicate concept is contained in the subject concept. In contrast, the mathematical operation "6 + 3 = 9" is a synthetic proposition since the final outcome is not contained in any element of the operation. Another distinction between different knowledge contents is based on the way knowledge is attained. A priori knowledge can be attained independently from our perceptions and the empirical experience of the outside world. Typically a priori knowledge includes logical, mathematical or semantic knowledge (= concept-based, relating to the meaning). A posteriori knowledge also referred to as "empirical knowledge", can be attained only based on the perception and empirical experience of the outside world.

This gives rise to the development of two different fundamental philosophical perspectives: empiricism and rationalism. Empiricism asserts that all our knowledge is ultimately based on a posteriori knowledge. Vice versa, "rationalism" states that all our knowledge is based upon a priori knowledge. Thus, especially with regard to the theory of knowledge, rationalists such as Descartes and empiricists such as Locke and Hume were worlds apart.

John Locke (1632-1704) asserted that "*nothing is in the intellect that was not first in the senses*" [Locke1872, Georgen2010][92]. This theory is based on the assumption that our consciousness is shaped by the idea of the qualities of an object, which in turn is derived from sense perception [Gaarder1993]. The qualities of an object can be broken down into primary and secondary qualities. Primary qualities are essential for an object as they are perceived by our sense organs and give rise to ideas that reflect the main features of this object such as form, scope, impenetrability, quantity. Secondary qualities include features such as color, smell, taste and are the sensory information we can perceive from primary qualities, they arise as a combination of primary qualities in our consciousness. This combination is no longer the result of experience but a product of the intellect. Here Locke turns away from his empirical concept. Thus, Descartes proposition of a systematic and methodological doubt is more consistent in this regard.

With similar arguments as Locke, David Hume (1711-1776) refers to the contents of our consciousness as perceptions and he divides perceptions between impressions and ideas. Ideas are the perceptions we have when we are dealing with an object or a sensation that are not currently present. Ideas are therefore derived from impressions.

Hume rejects, however, the notion of total rationality. He distinguishes between three types of beliefs: i) rational beliefs, which correspond, on the one hand, to logical truths and, on the other, to perspectives supported by experience; ii) natural beliefs, which cannot be justified rationally but simply reflect a fundamental need of our practical orientation; and iii) non-rational beliefs (faith), which are based on assumptions that cannot be justified through experience or are even in contradiction with experience. In this way, this Scottish epistemologist became a critic of both metaphysics and religion. In fact, Hume's ethics are based on experience and not on religion or reason.

[92] This proposition dates back to Thomas of Aquino, who in turn attributes it to Aristotle, https://en.wikipedia.org/wiki/Peripatetic_axiom (last access: 24.4.2017).

3.1.2. Assumption, Belief, Knowledge, Truth, Understanding

Knowledge encompasses the act of understanding. Attaining knowledge is the outcome of a human cognitive performance based on the interplay of perceptions, evaluations, comparisons and the use of reason [Georgen2010]. The results of these complex processes are assumptions, beliefs, opinions, knowledge, understanding and truth[93].

An "assumption" can be defined as an attitude dictated by probability, the act of assuming that something is probably true [Bartuschat1991, page 58, first chapter]. In contrast, an opinion is based on a personal belief, since the person who has an opinion is convinced of the truth of his/her own assumption.

Especially the assessment of knowledge based on beliefs is a central component of philosophical discussions. Based on the exclusively rational evaluation of an assumption or of an opinion, classical philosophy traditionally sees "knowledge" as an object that exists independently of human action and perception as a "justified true belief" [Durant-Law2012, Georgen2010].

Things that can only be acquired rationally cannot be explicitly verified since we gain knowledge of them only by rational consideration, by rational belief that this is exactly how they should be - and not any other way[94] [Bartuschat1991, page 60], and [Georgen2010].

Contrary to this concept of knowledge, which is based on rationality, there is also a concept of knowledge based on emotional experience, as Spinoza puts it. According to him, *knowledge is not what arises from a rational belief but instead from the way we feel about things* [Bartuschat1991, page 60, 2nd chapter].

Attaining knowledge is, therefore, a way of gaining insight based on the awareness of the truth when judging an objective fact or situation [Georgen2010, Jaspers2012][95]. The outcome of a knowledge process can be a perception, a judgment or a theory. Attaining knowledge or "understanding" is therefore the result of the mutual relationship between four elements: a person (the subject of the knowledge process), the object currently under consideration, the act of attaining knowledge by the subject and the knowledge outcome [Georgen2010].

When assessing knowledge based on beliefs, it becomes immediately evident that even if it might seem reasonable to consider such suppositions as given and thus to recognize them as knowledge, they cannot be proved to be true and therefore they remain an opinion. Essentially, a belief is constantly confirmed by future evidence experience. This poses a central question: What are good or reasonable grounds? According to which criteria do we distinguish between knowledge and opinions?

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[93] German „Vermutung" = assumption, conjecture, guess; German „Erkenntnis" = understanding; German „Warheit" = truth; German „Meinung – Glaube - Ansicht" = opinion, belief; German „Kenntnis" = knowledge, knowing.

[94] "*… Dinge die wir bloß mit der Vernunft erfassen, können von uns nicht eingesehen werden, sondern uns bloß durch verstandesmässige Überzeugung bekannt sind, dass es so und nicht anders sein muss."* [Bartuschat1991, zweites Kapitel, Seite 59-60].

[95] [Jaspers2012, p. 783] chapter IV, Theorie des Erkennens beschreibt Spinoza drei Erkenntnisstufen: *„1. Der Wahn in Meinung und Vorstellung nur genährt vom Hörensagen oder durch vereinzelte Erfahrungen; 2. Der wahre Glaube; und 3. klare und deutliche Erkenntnis*."

The so-called “Gettier problem” focuses on the question whether a “justified true belief” can result by chance. Thus, there should be other requirements that need to be met before a belief can be accepted as knowledge.

The fundamental philosophical assumption that real truths exist in principle is strongly debated by the philosophical school of phyrronian skepticism[96] and dates as far back as the origin of ancient philosophy [IEP2013].

“Truth” is the objective accordance between the way something is and what is said about it; this means that a statement is true when the things described in the statement really apply[97] [Kant2015, Scheffer1993]. This is also referred to as “objective truth”. Furthermore, one can distinguish between subjective and inter-subjective truths [Jaspers2012, p. 520]. In order to be true, things must apply not only for the concerned person but also for other people.

In this context, René Descartes (1596 - 1650) raised a fundamental question [Georgen2010]: "*Can anything at all be stated with absolute certainty? How reliable are such suppositions?*" Descartes identified a fundamental problem: on one hand, people perceive the objective existence of an external world but they can only rely on their subjective inner world and their sensory system to make decisions and judgments. How can we therefore claim to be able to make true statements about the outside world?

Our knowledge can therefore be right or wrong but never certain. Descartes postulates an unconfutable certainty: we can attain knowledge only based on permanent and systematic doubt[98] [Georgen2010, Stegmeyer2005], [Jaspers2012, p. 520[99]]. In this context, he claims that only the fact that one doubts can be ultimately accepted as true and while one doubts, he or she is thinking. This concept is summarized by the phrase: “*I think, therefore I am – cogito ergo sum*.“

Michael Welbourne provides in [Welbourne2001] a comprehensive introduction to the theory of knowledge from a philosophical standpoint and proposes a new theory of the nature of knowledge. He argues that knowledge is essentially a public phenomenon rooted in our communicative practices. A true belief is always one that can be questioned by others. He discusses the notion of

[96] In a philosophical view, skepticism is generally an attitude of doubt questioning any knowledge as absolute truth. Any assumptions, opinions or beliefs that are stated as absolute facts are questioned in principle. Usually we build our models on assumptions that we consider as absolute facts (i.e. axioms) to build on these axioms models of knowledge. We differentiate among different schools of philosophical skepticism: academic skepticism, a variant of Platonism that claimed knowledge of truth is impossible in principle; pyrrhonian skepticism does not claim that truth is impossible (which would be a truth claim), instead it recommends "suspending belief". Empiricism can be seen as a pragmatic compromise between philosophical skepticism and nomothetic science (IEP Internet Encyclopedia of Philosophy, http://www.iep.utm.edu/skepcont/, last access: 24.4.2017].

[97] Immanuel Kant, „Kritik der reinen Vernunft“, Kapitel III, Von der Einteilung der allgemeinen Logik in Analytik und Dialektik, Seite 58: “*Also ist das bloß logische Kriterium der Wahrheit, nämlich die Übereinstimmung einer Erkenntnis mit den allgemeinen und formalen Gesetzen des Verstandes und der Vernunft zwar die conditio sine qua non, mithin die negative Bedingung aller Wahrheit: weiter aber kann die Logik nicht gehen, und den Irrtum, der nicht die Form, sondern den Inhalt trifft, kann die Logik durch keinen Probierstein entdecken. Die allgemeine Logik löst nun das ganze formale Geschäft des…*” [Kant2015].

[98] “*Als Ausgangspunkt steht bei Descartes der absolute Zweifel an allem“* [Stegmeyer2005].

[99] [Jaspers2012, p. 520] section c) “Kants Skepsis”.

testimony as a source of beliefs and proposes to consider the surrounding social practices of human beings.

This view is even more relevant considering the actual phenomenon of the so called "post-truth area"[100].

3.1.3. From Known Knowns to Unknown Unknowns

Donald Rumsfeld, United States Secretary of Defense, said on a press conference on February 12, 2002[101]:

> *"There are known knowns; there are things we know that we know. There are known unknowns; that is to say there are things that, we now know we don't know. But there are also unknown unknowns – there are things we do not know we don't know."*

Let us briefly clarify the understanding of this statement in the following.

"Known knowns" are things we know that we know, for example, by using a dedicated skill to perform a task that we have learned to do so.

"Known unknowns" are things we know that we don't know, for example, when we are unable to solve a mathematical problem. Since we are aware of this lack of knowledge, we can react properly when this knowledge is required.

This applies also to situations, where we have a model but no sufficient data to prove the model, or where we have a lot of data but no model for explaining this data.

"Unknown unknowns" are things we don't know that we don't know; i.e. an issue or a problem that has not been and could not be imagined or anticipated[102]. In order to deal with unknown unknowns, it is essential to experiment and try to become familiar with the topic we don't know much. For example, we begin to read a lot of literature even if it is not yet the absolute correct information source at the beginning. Such a process may also begin with an unease or surprise discovery. Rumsfeld referred to the "unknown unknowns" in his statement to address the problem they were confronted with during the Iraq war[103].

Finally there is the fourth category, "unknown knowns", to refer to what we intentionally refuse to acknowledge that we know. This includes disavowed situations, processes, or practices that we pretend not to know about, just because we don't feel comfortable with them[104].

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[100] https://en.wikipedia.org/wiki/Post-truth_politics, and Ralph Keyes, The Post-Truth Era: Dishonesty and Deception in Contemporary Life, October 3rd, 2004, http://www.ralphkeyes.com/the-post-truth-era/ (last access: 24.4.2017).

[101] https://de.wikipedia.org/wiki/There_are_known_knowns (last access: 24.4.2017).

[102] There is also a specific term for this: "unk-unk" (www.waywordradio.org/unk_unk, last access: 24.4.2017).

[103] He was referring to the threats from any war which are of a nature we cannot even imagine.

[104] The "unknown known" is also a 2013 American documentary film about the political career Donald Rumsfeld, http://www.imdb.com/title/tt2390962/ (last access: 24.4.2017).

3.2. From Data to Knowledge within a Business Context

Usually, the relationship between data, information and knowledge is described as a hierarchical arrangement ranging from data to information, to knowledge and further on from knowledge to understanding (insight), to expertise [Ackerman2003a] and even to wisdom [Boiko2002, Davenport2000, Durant-Law2012].

Data is a symbolic representation in structured objects and may contain text, images or other forms of coded representations. It is important to note, that data are only values or symbolic representations which do not yet imply anything. Data is per-se not interpreted by the data user; i.e. data lacks context. If a context is added to data, information is formed which comprises values or symbolic descriptions that make a difference within a context [Ackerman2003a, page 42].

Thus, data becomes **information** when interpreted and put in a context by a user. Thus, information is data that is relevant in a dedicated application context. Information becomes **knowledge** when it is compared to other information or data and consequently used to describe, predict or adapt to a situation. Knowledge is the result of a reflexive process and is always an interpretation within a context. Thus, knowledge is created out of information but is specific to individual person. Knowledge enables us to judge a situation in order to achieve an output for a dedicated purpose [Davenport2000].

However, since usually we don´t have all the required data, information or knowledge to judge a new situation we have to consider potentially wrong judgements of course (see the discussion on partial knowledge in Section 5.5.1 below). Thus it is all about availability of the required data, information and knowledge at a specific point in time. Among others, this is one of the issues of knowledge management within the business context of firms.

3.3. Different Types of Knowledge

Usually "knowledge" within an organisational and business context is referred to "*know-how*" only. But it has to be noted, that there are much more different types of knowledge which have to be managed.

Building on such a knowledge, "*know-why*" is the next type of knowledge. Discussions about the reasons why we are living and attempting to understand natural phenomena and natural principles date back to ancient philosophy. Recent technology philosophers are discussing why technological development takes place and try to understand the implicit relationship between technology development and development of our society [Kelly2010, Jonson2010, Arthur2009].

The explanation of natural and social phenomena has always been a driving force for human science and research activities. Explicit know-why knowledge is therefore stored in documentation such as scientific papers and books. Based on the basic understanding why we know something, we have to understand what we know; i.e. it is important to clarify the meaning of "*know-how*" and "*know-what*" knowledge.

"*Know-how*" is procedural knowledge that describes how to perform or how to carry out a task to get something done; i.e. to receive an expected result [Sanchez2004]. Procedural knowledge can be directly applied to a task. It is usually personal in nature and also referred to as "skills", but can be held and accounted for by a community. Such skills enable the interpretation of and the provision of meaning to complex situations. Know-how knowledge is also the result of shared routines within a

team based on organisational structures or on informal social relationships. In relation to this, we also talk about "knowledge by description", to refer to a description of a certain circumstance, for instance, that a stone always falls on the ground or that it is impossible to walk on water or a description of a manual how to use a technical device.

"*Know-what*" knowledge is also referred to as declarative, or descriptive or propositional knowledge, since it describes the factual information of things or of processes. Know-what knowledge describes things by their attributes. Thus, know-what knowledge is based on facts and is expressed in declarative sentences or indicative propositions [Lenat1983].

In a legal and business system Intellectual Property (IP) includes both, "what" and "how" when discussing patents. However, there are further types of knowledge, especially when we consider the business context [Durant-Law2012].

"*Know-where"* knowledge is knowledge about where data and information is located. It is knowledge about locations, networking, correlations as well as relationships among people.

"*Know-who*" knowledge is a form of social knowledge about the persons who know-what, know-how and know-why within a social network of people. Know-who knowledge therefore deals with human resources. It can have an explicit element (defined roles within an organisation) or knowledge about customers or competitors or it can often be tacit - informal leaders in expert topics, informal relationships to colleagues (within the organisation and outside the organisation) business partners, friends, etc. This knowledge is mainly learnt in both formal and informal social practices, in specialized education environments and in day-to-day relationships.

"Know-who" knowledge is an essential factor for the learning organisation and deals with the ability to cooperate effectively with different types of people and experts (see discussion on the learning organisation below). It is the social view of how to get at the other knows – through knowing the people who know. Social network analyses (SNA) is the research activity to identify such relationships and to locate "knowledge hubs" represented by people in social networks.

"*Know-when*" knowledge describes the relation of knowledge to be applied in the context of timing. This is also a key issue but often emergent-surprising.

3.4. The Paradox: Knowledge as a Thing and a Flow - Explicit and Tacit Knowledge

An artefact describing information and knowledge are entities made by humans usually for subsequent use like text or images or electronic data. Such entities are for example explanations, descriptions, collections, but can also be ideas, concepts and even theories. The scientific literature offers different definitions. For example [Allen2004, Durant-Law2012] define "knowledge artefacts" as

> *"… the unit of knowledge, the primary instance, where knowledge first begins to exist. Artefacts focus knowledge – they record it, test it, translate it, demonstrate it and apply it. Artefacts are centers of gravity for knowledge; they concentrate it, make it tangible, instrumental, effective".*

A knowledge artefact is an object created by the articulation of knowledge like speaking, writing, drawing, etc.[105]. Before this process of articulation takes place, knowledge is not explicitly available and thus not easily transferable [Kluge2001, Snowden2002]. Knowledge that is hidden within individuals or groups and not immediately usable for subsequent use is called "tacit" or "implicit" knowledge[106] [Brown2002].

Thus, we have to distinguish between explicit and tacit knowledge [Durant-Law2012, Alwis2008, Ackerman2003a, Ackerman2003b, Sanchez2004, Creech2001].

"Explicit knowledge" is knowledge that can be easily articulated and, thus, codified in a systematic and formal language like written documents, reports, books, charts, spread-sheets, mathematical formulas, databases, etc. Thus, based on the articulated objects, explicit knowledge can easily be stored for subsequent use and can easily be communicated to others. Capturing and aggregating the explicit knowledge of individuals and organisations is a significant task and provides the basis on which cooperations can begin to operate.

"Tacit knowledge" is the understanding of how to do things which is not yet articulated and documented. It is the knowledge held by an individual based on information that is interpreted in the context of the individual's culture and values, personal views, opinions, personal beliefs and individual experience, as well as normative behavior, and defined roles within a group.

Thus, tacit knowledge is the context-specific knowledge of an individual. In other terms, it is "embodied knowledge" and includes also "intuition". Considerable effort is usually needed to articulate and record such hidden knowledge [Polanyi1962, Lam2000, Gertler2003, Durant-Law2012]. This becomes especially relevant, for cross-cultural communication, when bringing individuals from different organisations together within a network. It is very important that network participants must recognize the implicit knowledge norms of those they wish to influence. This is why social learning and effective change of behavior cannot be imposed from outside [Creech2001].

Tacit knowledge is created by people by exercising, involving trial and error experience, and through selective interpretation and reflection. Such activities are usually referred to as "learning", i.e. activities and experience turns into expertise over time [Creech2001, Eraut2000]. Once it is learned and therefore established, it may change only slowly over time. If people change the rationale behind the interpretation of facts, new knowledge is created [Durant-Law2012].

For an effective innovation system, it is essential to unlock tacit knowledge and make it available for further use by articulating artifacts. The transfer of tacit knowledge is facilitated essentially through shared processes (working together, helping each other, etc.). New dedicated online social media tools might enable new ways to intervene in the space between tacit/implicit and explicit knowledge.

Thus knowledge is beside articulated explicit knowledge at the same time an ephemeral, active process of relating [Snowden2002, Ackerman2003a]. This complex nature of knowledge is described

[105] This process of knowledge by application is expressed by the term „techne" from the Greek philosophers, opposed to the "episteme" of the disinterested understanding objective only (see Section 3.1.1 above).

[106] Michael Polanyi, born 1891 in Budapest, Austria-Hungaria and died in Manchester 1976, is one of the main contributor to the theory of tacit (implicit) and explicit knowledge; https://de.wikipedia.org/wiki/Michael_Polanyi (last access: 24.4.2017).

by the paradox that knowledge is at the same time a thing and a flow. It is important to note that this is not a contradiction. Both views are valid at the same time. This explains the important issue of the informal organisation for firms.

Thus, we always have to be aware of what we are looking for. If we look for artefacts, we will find artefacts; if we look for relationships, we will find relationships. This is a crucial point for the discussion of appropriate knowledge management (KM) processes and tools.

3.5. Knowledge as a Company Resource with Dedicated Characteristics

Wiig summarizes some key characteristics which differentiate knowledge from other organisation´s resources [Wiig1997]. Knowledge …

- is intangible and difficult to measure,
- is volatile, i.e. it can "disappear",
- is most of the time embodied in agents with wills,
- sometimes increases through use,
- has wide ranging impacts in organisations (e.g. "knowledge is power"),
- cannot be bought on the market at any time, it often has long lead times,
- is "non-rival"; i.e. it can be used by different processes at the same time.
- is not "consumed" in a process, i.e. thus it can be re-used; thus we can re-use knowledge in many different ways and forms and combinations; these combinations are one of the main driving forces as we discussed it under the context of "innovation generation" in previous sections.

Going into more detail we have to note, that knowledge is an essential company resource and asset with dedicated characteristics:

(1) Knowledge is either explicit - stored in artifacts -, or tacit and thus stored hidden in the human minds, or in behavioral practices of a group or a company. Explicit knowledge such as classical knowledge assets as reports, intangible assets, papers, books, descriptions, operational routines, technical specifications, technology is usually treated as a private good owned by the organisation.

(2) Knowledge is treated as a private good owned by an individual. This refers to tacit knowledge of human beings as discussed above. Tacit knowledge of individuals is not always immediately visible and usually "sticky" with the individual as described below. This refers to the fact, that knowledge is not easily separable from the human being and is only useful and actionable by those who are already knowledgeable [Hansen_Nohira1999].

Since knowledge is principally a justified true believe and has basically a strong relationship to a person's mind or even has to be considered in the framework of a social context with other persons, there is always some burden to unlock tacit knowledge. Pay, promotions and

bonuses might be an essential driving factor for employees. However, dedicated social means are required to get access to hidden knowledge and to make it explicit and available for subsequent use by others.

(3) However, there is a third concept of knowledge on which usually organisation spent only little attention. In addition to the private treatment of knowledge as mentioned above, knowledge can also be treated as a public good owned and maintained by a community. Wasko [Wasko2000] describes this dedicated concept of knowledge which has a strong impact on the stickiness of knowledge in relation to individuals. This follows the view of Brown and Duguid [Brown1991] that knowledge is socially generated, maintained, and exchanged within communities of practice (see Section 4.3.9 below).

When knowledge is considered as a public common good there are other relevant drivers for knowledge transfer and communication compared to privately owned knowledge where self-interest is the main driver. Wasko [Wasko2000] highlights, based on empirical research, that employees participate primarily out of community interest based on generalized reciprocity and prosocial behavior.

Since knowledge is an intangible resource that can be shared and distributed throughout many people in the organisation without losing its value and not being consumed in the process of transfer [Wiig1997], knowledge can be treated as public good. "*A public good is a commodity that can be provided only if group members contribute something towards its provision; however, all persons my use it…. When people consider knowledge a public good, people are motivated to share it with others due to sense of moral obligation rather than an expectation of return."* [Wasko2000, p. 156].

3.5.1. From Individual Knowledge to Organisational Knowledge

Individual learning occurs when people exchange but also combine their personal knowledge with others [Kogut1992]. Organisational learning is the process through which an organisation stores, retrieve and augment their intellectual properties and thus re-constructs knowledge for subsequent use when needed [Ackerman2003a]. This is usually seen as the classical knowledge management approach within organisations which describes the processes and structures established in order to support learning within and by the organisation [Ackerman2003a]. Besides this classical knowledge management approach, organisational learning is essentially based on a social constructive approach to knowledge. This means that specific processes and structures are needed that individual knowledge becomes organisational knowledge [Ackerman2003a, page 29].

When knowledge is perceived as a private good and owned by individuals, employees are more likely to exchange their knowledge for "intangible" returns such as reputation and self-esteem [Wasko2000].

Besides "externalizing knowledge", i.e. the process of exchanging personal knowledge with others, it is also essential to consider mechanisms to "objectifying knowledge"; i.e. the process how knowledge becomes an objective reality, and finally to "internalizing knowledge"; i.e. how specific knowledge available in the organisation is used by individuals [Ackerman2003a, page 29].

Different to knowledge of individual persons, organisational knowledge is capable of surviving turnover in individual actors.

3.5.2. Social Capital

"Knowledge management" encompasses different mechanisms of interactions in the context of the social setting of an organisation, thus forming the so called "social capital". Social capital has three aspects: a structural, a cognitive, and a relational dimension [Ackerman2003b]:

- The structural dimension of social capital reflects the need for individuals to reach out to others within an organisation to seek out resources that they may not have at their disposal. It consists of network ties and their configuration and organisation.
- The cognitive dimension covers the social-cognitive aspects of an organisation; i.e. such as shared language and common narratives.
- The relational dimension is based on the assumption that individuals believe that their actions will be appropriately reciprocated and that individuals will meet their expected obligations; thus it is based on trust, norms, obligations, and a shared identification.

Ackerman clearly postulates, that this structural, shared cognitive, and relational dimensions are the relevant social aspects that must be taken into account for designing a modern knowledge management system [Ackerman2003b].

3.6. Knowledge Management Approaches

Different business processes impose different mechanisms for knowledge management. [Kogut1993] describes a firm as

> "*a social community specializing in the speed and efficiency in the creation and transfer of knowledge*".

[Begona-Iloria2008] states that

> *"... knowledge management implies a series of policies and guidelines that enable the creation, diffusion and institutionalization of knowledge in order to attain the firm's objectives*".

There are different approaches of supporting knowledge management through IT systems within organisations and a business context. The scientific knowledge management literature distinguishes between different knowledge management approaches based on the characteristics of knowledge [Ackerman2003a, page 27-28]:

- stock approach; i.e. managing knowledge storage and retrieval based on knowledge which can be codified;
- flow approach; managing knowledge exchange for knowledge which cannot easily be codified (tacit knowledge); i.e. nontangible assets, such as know-how and tactical problem solving;
- knowledge management from an innovation perspective; managing knowledge creation, by unlocking tacit knowledge as well as combining different knowledge fragments;

In addition we can differentiate KM models based on the processes how knowledge is treated [Begona-Lloria2008, Prusak2006, Weber2002, Wiig1997]:

- Creating knowledge or knowledge development: This describes the processes for developing knowledge internal within organisations, by various processes such as re-interpretation,

shared processes to unlock tacit knowledge, but also buying knowledge, e.g. by business services such as consulting or even acquiring other organisations.

- Combination of knowledge: find synergies, re-use existing knowledge, innovation by re-combination of knowledge, etc.
- Knowledge retention: This encompasses the processes that knowledge becomes embedded in the routines, processes, human practices, or groups of people within organisations (i.e. how to perform tasks and fulfil roles), but also to consolidate knowledge and prevent it from disappearing.
- Knowledge transfer: distribution, dissemination, transfer, share, etc.; it is important to note, that unlike other objects, knowledge cannot simple be shifted around. The knowledge transfer processes are of a dedicated characteristic which will be discussed below.

Different concepts and models for knowledge management have been developed over the last years focusing on different subjects. We have to note that there was and is still a big gap between theoretical models and real use within an organisational context. Thus, the focus of KM models has changed over time.

3.6.1. 1st Generation Knowledge Management

Traditional approaches exploit the idea of "externalizing knowledge" and storing information into shared repositories for future use. This is essentially based on the assumption that knowledge is a "justified true belief" and exists independently of human action and perception (see Section 3.1.2 above). Such first generation of knowledge management (KM) focus on explicit knowledge and management of artefacts; i.e. processes and tools for collecting and sorting data are the main objectives. By doing so information databases are formed creating a kind of an organisational memory. Such approaches based on a repository view of knowledge with a focus on gathering, providing, and filtering available explicit knowledge are based on the hope of being able to manage easily reusable information in shared repositories. Although such approaches are very important functions within any organisation, there are limitations in principle to be considered [Ackerman2003a]:

- Decontextualized information is often not easy to be re-used. Decontextualized information has to be considered as pure data only (see Section 3.3 for a clarification of the differences between data, information, and knowledge).
- The re-usability of stored data has limitations. There is usually always the need of experts which explain the stored data.
- Tacit knowledge can anyhow not be stored in any repository and access to experts is indispensable (see Section 3.4 above for a discussion of explicit and tacit knowledge).

3.6.2. Limitation of Classical Knowledge Management Approaches

[Ackerman2003b] summarizes four technical approaches based on IT services for knowledge management:

- "Repository" which is usually a data store of fragments of knowledge; e.g. corporate databases.

- "Expertise locator" is a recommendation mechanism that helps employees to find other employees with the expertise that is required for answering a question or solving a specific problem or task.
- "Computer-mediated place" is a virtual online space, enabled by dedicated IT based communication tools, where people with questions can answer without knowing necessarily the people with the answers beforehand; i.e. a computer-mediated community building. Instead of identifying dedicated people when looking for dedicated knowledge, we arrange an IT system that people come to the problems. Ackerman calls this also "community of practice (COP)" where people with expertise come together and can help each other as well as newcomers.
- "Ad-hoc groups" are referring to flexible arrangements within an organisation to solve specific, time-limited problems.

In the following we discuss the essential knowledge problems or weaknesses with these approaches.

3.6.2.1 Repositories

Repositories are characterised by several assumptions [Ackerman2003b]:

- A single data base can be constructed for an entire organisation. Such an approach is clearly jeopardized by the organisational realities within a firm.
- All knowledge can be easily separated from individuals and stored in a data-base.
- People share their knowledge or offer their data and information spontaneously to others.
- People would easily understand what other experts had formulated and stored in databases.

Ackerman summarized, that these problems resulted mainly from "… *not understanding the social and organizational dimensions, both social-relational and structural, of repositories. In an organization, information is not value-free. Nor is sharing free – it carriers psychological costs, and the rewards may be unclear*." [Ackerman2003b].

3.6.2.2 Expertise Locators

The major problem with the expertise locator approach is to keep the finder engines up-to-date concerning the expertise of people. It is necessary to permanent update process of skills, experience, gained new knowledge, etc. In addition the information has to be provided correct, timely and filtered for the relevance of the organisation. It is obvious, that such an approach is not feasible in a real-world environment finally.

3.6.2.3 Computer-mediated Places

The essential problem with the concept of computer-mediated places is that it is assumed that others are easily willing to join such a group – joining an existing one or building a new one. Groups which are established based on strong ties; i.e. a group of people having a common history of social interactions can easily be performed - in fact this happens usually on their own motivation. However, with other experts with weak or no established ties in the reality in organisational life shows that experts in firms do not hang around and wait till they are asked for help or answering questions. Important functions for solving this problem are so called "gatekeepers"; i.e. people who knew other employees in a firm.

3.6.2.4 Ad-hoc Groups

Ad-hoc groups are often used in organisations to solve emergent problems such as emergency teams, crises management teams, dedicated project teams defined top-down according a defined strategy of the organisation. However, a bottom-up forming of project teams for developing new technologies or products within an innovation context is a different issue. Two issues are of concern with this approach:

- It is difficult to make up a team that can effectively work together in the offline world; trying the same in the virtual world is even much more difficult.
- There is the same problem as for the expertise locators approach: "… *the great difficulty in principle of finding the data to know who does what well*" [Ackerman2003b].

3.6.3. 2nd Generation Knowledge Management – The SECI Model

The second generation of knowledge management focused on tacit-explicit knowledge conversion and was considerably influenced by the SECI (Socialization, Externalization, Combination, Internalization) model of Nonaka and Takeuchi [Durant-Law2012, Mvungi2009, Alwis2008]. The SECI model was initially published in 1991, and was republished in 1998 [Durant-Law2012] to describe the ongoing process of continuous transformation between tacit to explicit to tacit knowledge again to transfer an individual´s knowledge to an organisation´s knowledge.

The SECI model describes four phases of knowledge generation, where one phase builds on the previous one [Nonaka1998, Durant-Law2012, Mvungi2009, Alwis2008] (see Figure 3.1 below):

i. Tacit-to-explicit knowledge transformation is the process of articulating an individual's or an organisation's experience – "*externalization process*"; i.e. the conversation of tacit knowledge to explicit knowledge. This codification of tacit knowledge results in artefacts that can be stored and communicated for further re-use; such as documents, book, drawings, videos, manuals, etc. This process is supported by dialogues, discussions, workshops, conferences, etc., to reflect the produced knowledge in the community. Appropriate skills for communication and especially knowledge representation play a key role for this process.

ii. Explicit-to-explicit knowledge transformation is the process of merging and "*combining knowledge*" to generate new knowledge. This process is often regarded as a form of innovation by combining existing building blocks to create something new or apply existing technologies in new markets (This mechanism was extensively discussed in Chapter 2 under "Innovation Management" [Arthur2009, Leopold2012c, Kelly2010]).

iii. Explicit-to-tacit knowledge is a process where explicit knowledge becomes part of individual knowledge by learning or doing - therefore new tacit knowledge is created, which is useable and actionable by individuals again. This process is referred to as an "*internalization process*".

iv. Tacit-to-tacit knowledge is transferred and shared through social interactions and shared experiences among individuals, such as discussions, meetings, cooperations, brainstorming, spending time together, etc. This process is called "socialization".

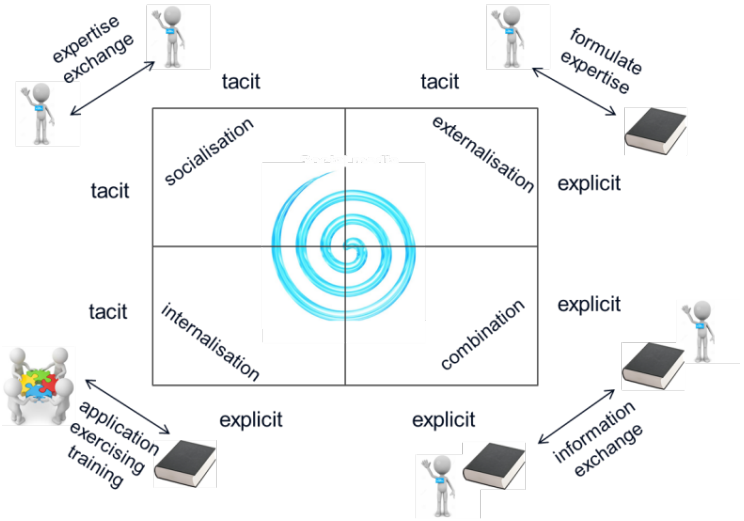

Figure 3.1: The SECI Model – four steps of knowledge development[107]

The processes of knowledge transformation are determined by different factors of the four quadrants of the SECI model [Mvungi2009]:

- Socialization quadrant – tacit-tacit: Interaction processes between individuals such as expert-to-expert, but also with customer, users and other personnel to transfer and shape tacit knowledge. This process requires usually a close physical proximity and joint activities. Examples of knowledge sharing approaches in this context are workshops, trainings, internships, apprenticeships, COP, expert interviews, lessons learned debriefings, and mentoring programmes.
- Externalization quadrant - tacit-explicit: These processes are determined by skills of individuals to formulate and represent information, knowledge, and expertise in an appropriate understandable way. Key capabilities are the target group oriented creation of representation of knowledge.
- Combination quadrant – explicit-explicit: Dedicated mechanisms for storing, identifying and re-working of existing knowledge building blocks are necessary to combine and re-use existing knowledge building blocks.
- Internalization quadrant – explicit-tacit: These processes are determined by filtering and selection mechanisms based on the need and added value for the application of knowledge or expertise. Knowledge to be applied needs to be absorbed by the individuals. Absorptive capacities of individuals are based on learning processes of individuals which are crucial issues in this context.

Based on this ongoing process, knowledge within an organisation is developed and organisationally implemented from individual knowledge to higher organisational levels, such as project teams, groups of persons and even the whole firm (see Section 3.5.1 above).

3.6.3.1 Knowledge Transformation is a Social domain: the limitation of the SECI Model

It is important to note that the different processes of knowledge transformation do not imply that knowledge transfer and development can easily be performed. By simply codifying knowledge (data

[107] Based on [Nonaka1998].

and information) in databases, the knowledge management problem is not solved. The classical SECI model is based on assumptions that are not reflecting the real world. These issues have been often ignored in practical knowledge management approaches:

- The SECI model is based on the assumption that tacit knowledge will always, at some stage in its life cycle, become explicit. This can´t be taken for granted in a daily business life. All four processes need an active involvement of the communicating partners and therefore personal commitment to support these processes. The SECI model is based on the assumption that people are altruistic and willing to codify what they know.
- Thus every transformation of knowledge in the SECI model - i.e. tacit-tacit, tacit-explicit, explicit-explicit, and explicit-tacit – needs considerable effort, for the sender as well as for the receiver, or in other words “energy” [Mvungi2009].
- Information consumption and the necessary selection process are always using the attention of the receiver of information (see Section 2.12 above). Thus, knowledge transfer and knowledge consumption puts some pressure on the “absorptive capacity” of an individual as well as on the whole organisation.
- In addition, know-why, know-who and know-when dimensions of knowledge management were not taken into due account [Snowden2002, Durant-Law2012] by typical KM models.

The necessary “energy” for the knowledge transformation process in all quadrants, especially when considering knowledge as flow, is determined fundamentally by the following factors:

- Understanding and skills of the individuals for absorption and communication of information, knowledge, and expertise.
- Motivation and willingness of individuals to spent their personal resources such as additional time (sometimes considered as their personal “free” time). Thus, personal motivation based on reciprocity and commitment is basically important. Need and value for both actors, sender and receiver of information or knowledge are the key driving factors for these processes.
- Finally, the availability and usability of resources are crucial. Resources for knowledge or expertise transformation are tangible such as funds, tools, infrastructures, defined processes and structures; or intangible such as time, quality of work, etc. For addressing required company resources, information and filter functions for an effective communication with the management are essential functions.

Thus, modern knowledge management has to consider also the social domain, i.e. the "ephemeral, active process of relating” [Snowden2002] and thus can be considered as 3rd generation knowledge management.

3.6.3.2 Revised SECI Model for Knowledge Management

To take the issues summarized above into account, the SECI model has to be extended by two crucial factors (see Figure 3.2 below):

- motivation based on reciprocity and commitment, and
- understanding for both, sender and receiver of information based on dedicated skills and personal resources to present and to absorb information and knowledge.

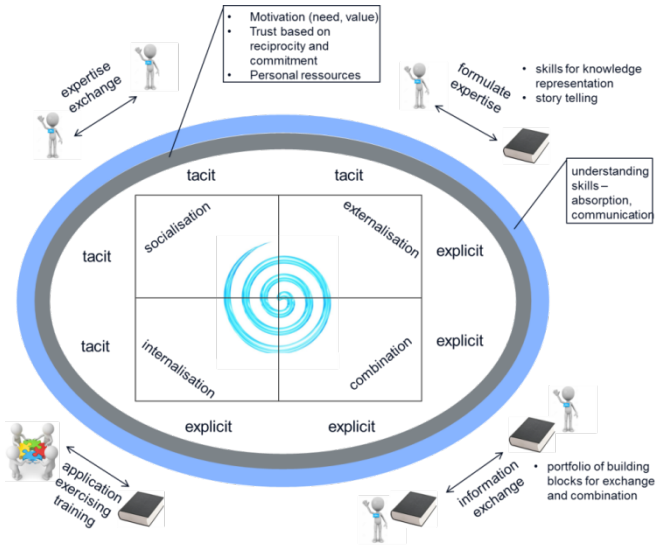

Figure 3.2: Revised SECI Model

3.6.3.3 Innovation need new Knowledge Management Mechanisms - The Cynefin Model

Snowden described a dedicated knowledge management model, the so called Cynefin model, which is based on the science of complex adaptive systems to describe the environment of organisations to derive the kind of knowledge necessary for managing problems and systems [Snowden2002]. Snowden argues that conventional analytic models, and hypothesis-based approach and the generalization of best-practice examples resulting from multi-client or multi-project studies are not appropriate to understand and describe the dynamics of the modern business world. Excessive focus on core competences, a single model for communities of practice or a common investment appraisal process are all examples of how organisations end up limiting their capabilities to adapt to business and market changes. Self-awareness concepts within organisations are necessary mechanisms to build upon both informal and formal groups as a basis for effective knowledge management in the organisation. The Cynefin model describes five spaces:

- known (simple): the relation between cause and effect is clearly understood;
- knowable (complicated): to understand the relationship between cause and effect is understandable by additional expert knowledge;
- complex: the relationship between cause and effect can be seen as a result of a process;
- chaotic: there is no relationship between cause and effect;
- disorder: this describes situations where there is no clarity about which of the other domains apply;

The model strongly rejects the usefulness of idealized models and highlights the importance of diversity as a key to develop adaptability capabilities. All four spaces require different tools, practices and conceptual understanding and involve different models of community description, decision-making and leadership principles. Thus, the Cynefin model highlights three key aspects:

- disruption of entrained thinking,
- creation and stimulation of informal communities, and
- just-in-time transfer of knowledge from informal to formal.

3.6.4. 3rd Generation Knowledge Management Systems – Expertise Sharing

By the use of IT-systems new forms of organisational functions are enabled, forming "virtual organisations" [Ackerman2003a]. In this context, it is important to point out that organisations that naturally perform their value generation processes via IT systems do not automatically have an information economy. Thus technology may play an enabling role but is not a critical factor either in the origination of the cognitive and motivational problems or in their solution [Ackerman2003a]. IT systems alone are not enough if an organisation has not learned how to properly gain, assess and make adequate use of information. The transformation of a company's core competence into "context-based" knowledge management cannot be guaranteed by IT systems alone. IT systems only bring about the desired benefits if collaboration among members of work-sharing teams is clearly defined through adequate processes, and all cultural prerequisites in terms of motivation and mutual appreciation are met.

Successful knowledge management must therefore define the framework conditions that enable higher productivity and effectiveness in decision making processes, as well as higher efficiency in information preparation and distribution. This can be achieved, firstly, through an informal bottom-up corporate communications culture, which enables the self-organisation of staff members beyond any hierarchical information sharing system and the exchange of information irrespective of time or place, and secondly by means of technical infrastructures and suitable IT applications (often referred to as "IT-driven knowledge management").

Information systems to support the sharing of expertise within organisations are useful but do not replace expertise or learning that takes place through interpersonal contact. IT systems usually capture data and information rather than knowledge or expertise [Ackerman2003a, page 21] and technology supports the codifying of knowledge [Ackerman2003a, page 43].

A promising technology development is in the area of expert-finding systems. These are systems that support the organisation of members in order to find experts on particular topics [Ackerman2003a, page 21]. These systems usually are not attempting to disseminate decontextualized knowledge but rather are trying to facilitate the development of interpersonal connections around topics of interest, thus building

- interpersonal ties, and
- communities of practice (COP) through which information and expertise can be shared effectively [Ackerman2003a, page 22].

Therefore, the organisation of knowledge management has to be further developed from the simple management of individual knowledge building blocks towards a more holistic knowledge management. Modern approaches are more focusing on information sharing concepts [Ackerman2003a] which focus on the human components; i.e. the cognitive, social, cultural, and organisational aspects of knowledge work within groups in addition to information storage and retrieval. Ackerman argued for the importance of so called expertise networks considering the active, constructive aspect of remembering in work activities as an invaluable resource in organisations.

Based on the assumption that a tayloristic reduction of information management through highly sophisticated IT tools will not at all solve the knowledge management challenge within organisations, and that management in organisations may be better able to facilitate than to prescribe or control information sharing activities we focus on knowledge development by self-organised knowledge workers.

[Ackerman2003a] provides a comprehensive review of the various aspects when implementing knowledge management mechanisms based on information sharing and discusses cognitive and motivational issues which effect information sharing as well as social psychology and behaviour of individuals within organisations. These factors are the basis for workplace learning factors and successful or failure of knowledge management within organisations. Ackerman introduces the term „expertise sharing“, in order to underline the difference to simple data sharing or sharing of explicit knowledge only and emphasizes the inherently collaborative and social nature of effective knowledge management [Ackerman2003a, Ackerman2003b].

Expertise sharing concepts enable organisational learning through better connected people and more effective as well as more efficient communication processes within organisations [Ackerman2003a]. Such concepts are the basis for easier forming ad hoc expert teams to solve time-critical or complex problems, providing better technical assistance and presales marketing, and maintaining customer relationship and.

An effective information sharing within organisations leads to the development of “social capital” including factors such as trust, reciprocity, and shared norms and values in knowledge-sharing processes [Ackerman2003a, Ackerman2003b].

3.6.5. Expertise Sharing Requires a Social Framework

These issues discussed above shows clearly that sharing expertise requires an understanding of the social and organisational framework within an organisational environment. Finally it is all about collaboration and we have to consider the “technical-social” gap; i.e. to understand the underlying social issue in IT based communication systems [Ackerman2003b].

The basis for achieving any effective communication processes by electronic communication systems; i.e. groupware or computer supported cooperative work (CSCW) is the necessary understanding of how groups or organisations use technology. Thus any kind of computer supported knowledge management has to be aligned with the interaction mechanisms between technology and social phenomena.

For this reason many knowledge management efforts within organisations have fallen below expectations. Thus Ackerman states: “*… we shall show why seriously including social-structural and social-relational considerations (i.e., social capital) into technology must be rewarding but inherently difficult*.” [Ackerman2003b].

When knowledge is considered as a public good of the community, where some members of the community collectively contribute to its provision and all members of the community may have access to this knowledge, motivation for knowledge transfer is not self-interest, but care for the community [Wasko2000].

Three basic social issues in any communication process among people are essentially important for any computer supported collaboration process [Ackerman2003b]:

- **Impression management**: It is important to understand that humans have a very basic attitude to present different information to different people. Everyone does impression management and wishes to maintain control. We usually tell our parents different stories and provide different information to them than for friends, colleagues in the firm and foreigners (this refers to dedicated research in the 60´s already).

Computer enabled communication systems, especially such as those for sharing expertise, are usually weak at supporting controlled impression management. Nobody would in a real-life face-to-face interaction tell all the private life situations to the business partner. Nowadays online social media tools are offering common undifferentiated information distribution to all kinds of relationships.

According to Ackerman, there is an inherent tension we have to understand – "… *either there is the nuance of control or the fluidity of interaction*." [Ackerman2003b].

- **Negotiating norms:** Norms have to be considered as formal rules as well as informal guidelines. People always create their norms which determine their way of acting and communicating within groups and especially the informal norms are very important, since formal rules can never be updated fast enough to changes and new situations evolving in a group. This happens in any social setting in general as well as for knowledge management processes in particular. Now it is important to understand, that any norms are also subject to permanent re-negotiation [Ackerman2003b]. The people within a system permanently interpret and discuss the established norms of behavior and shape them accordingly.
- **Incentive structures**: Ackerman refers to the so called Grudin paradox[108]: "… *What may be in the managers´ best interest may not be in the ordinary users´ interest.*" [Ackerman2003b]. For any collaborative activities there is the necessity of appropriate incentives which must be symmetrical; e.g. for managers as well as for employees, for experts as well as users. This is especially important when providing data or information without immediate additional value for the person who performs additional effort for a later advantage in the system.

Considering all those social issues as discussed above, Ackerman refers to a gap in principle between technically feasible systems and organisationally feasible systems. Thus, any technology platform has to be designed according to the social communication requirements. Ackerman formulates the following recommendations for designing the organisational-technical space [Ackerman2003b]:

- Tying together repositories with networks: this refers to the iterative construction of information over time; i.e. information is enhanced step by step by different people over time. This usually works very well in systems where nothing is to lose; Wikipedia is such an example.
- Self-feeding and thus self-organising expertise locators by supporting three basic phases: identification, i.e. "who might know", selection, i.e. "who was available", and finally escalation, i.e. the act of looking for additional people, even across organisational boundaries. Here social aspects such as trust are critical for any effective communication mechanisms.
- Lightweight social spaces: the technology platform should put rigid structures, processes or behavior on the employees concerned. Thus the community should maintain and promote themselves within virtual places.

[108] Jonathan Grudin Grudin is a pioneer of the field of CSCW and is well known for the Grudin Paradox, which states basically with respect to the design of collaborative software for organizational settings, "*What may be in the managers' best interests may not be in the interests of individual contributors, and therefore not used*." (https://en.wikipedia.org/wiki/Jonathan_Grudin, last access: 24.4.2017).

4. Utilising Social Media within Firms: from Online Collaboration to Next Generation Innovation Management

The success of a company is increasingly depending on its ability to capitalize on the talents and skills of its workforce in a productive manner regardless if the goal is to put in place sales-supporting measures, initiate customer retention programs or implement an in-house innovation process. Internal and external networking, cross-disciplinary teams and a corporate culture based on knowledge and information sharing have become the main drivers for corporate success as discussed in Chapters 1 and 2 above. The new breed of social media that are currently gathering momentum underlines this trend.

According to a survey carried out by Nielsen in 2009 [Nielsen2009], blogs and social networks are the fourth most used Internet application, accounting for 66.8% of total Internet usage and thus ranking even higher than e-mails, which account for 65.1%. Furthermore, the usage of social networking is growing twice as fast as all other applications on the Internet. In Austria there are 79% Internet users of the overall population 2012[109]. Out of these, 31% have been using online social media tools; i.e. active participation in at least one application – Facebook, Twitter, Google+, etc. – and contributions in blogs, fora, online discussions, etc. End of 2015, there are 40% active social media users in Austria[110]. In Germany, Bitkom summarizes 2012 [Arns2012], that 2/3 of the Internet users are active in social networks, where Facebook is the leading platform (56%), Stayfriend, Goggle+, XING, etc., are following with user numbers between 13% and 20%.

The AIT internal analyses through the employee questionnaire (see Section 8.4.6.9 below) showed the following situation at the end of 2015[111]: 30% Facebook users, 42% WhatsApp users, 28% Skype users, 6% Google+, 3% Xing, 12% LinkedIn. The usage is mainly private for Facebook (85%), WhatsApp (96%), Google+ (56%) and mainly for professional use for LinkedIn (77%), Xing (65%), and Research Gate (91%).

However, looking at SMEs, there is a slightly different situation. According to Bitkom, in the community of SMEs there are only 16% actively using online social media applications, basically this means that they have a Facebook page. We will discuss this difference between private and company use through the subsequent work of this PhD.

The wide range of application fields based on social media approaches impressively demonstrate the crucial role played by social media in many spheres of life, even if our understanding of the underlying functioning mechanisms and our ability to use them to our own advantage are still in their infancy. It is ultimately up to us to use and organise this new emerging technology culture in such a way as to improve the competitiveness of our economy and the coexistence within our society.

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[109] Social Media Statistik in Austria, https://de.statista.com/statistik/studie/id/34139/dokument/social-media-in-oesterreich-statista-dossier/ (last access: 24.4.2017).

[110] http://socialmediaradar.at/facebook, http://www.artworx.at/social-media-nutzung-in-oesterreich/ (2014), http://derstandard.at/2000006669467/Zahl-der-Social-Network-Nutzer-in-Oesterreich-fast-verdoppelt, (10.10.2014), (all 3 references last access: 24.4.2017).

[111] Daily usage or several times per week.

In this Chapter, we discuss the characteristics of social networks and highlight the essential concepts that differentiate Web 2.0 from Web 1.0. We clarify the meaning of "media" in this context, and elaborate why we could call media "social". Based on this understanding, the ways in which the core functions of social media platforms can enable change within knowledge management and innovation processes within firms are explored.

4.1. Social Media and Business Processes

"Social media" is a broad term used usually as a container concept for Websites such as Facebook, LinkedIn, etc. The conceptual change to earlier concepts is the move from groups, lists, forums, and communities to the emphasis on empowering loosely connected individuals in networks separated in space and in time.

This new communication paradigm in addition to relationship management, the formation of groups in the private sphere and a new communication mechanism for marketing and customer communication, refers to a wide range of approaches in numerous organisational areas. These include:

- social media as a communication medium for marketing and advertising;
- social media as a communication tool for customer relationship building and customer care - customer relationship management (CRM 2.0);
- social media for describing and identifying human profiles, skills and qualifications – human resource (HR 2.0);
- social media functions as integral part of new e-government services for citizens (open data) or as a new government philosophy based on transparency, participation and collaboration – e-government 2.0;
- social media functions to support learning processes and knowledge management tools (knowledge sharing);
- social media as collaboration and teamwork tool such as SW development teams (usually so called "wikis")

If a firm supports at least one of these business processes described above, it is usually called "enterprise 2.0". [McAfee2006a] coined this term to describe organisations that build and use social media or Web 2.0 technologies at their workplace [McKinsey2008, Fenwick2010].

Given the success of the e-mail as a basic electronic service used to support numerous business processes, the importance of "collaboration" will continue to increase significantly going forward due to the necessity of cooperation models in almost all spheres of life and economic fields moving forward. According to Gartner [Rozwell2011], the most economically successful companies will be based on social media mechanisms. Many firms are entering this market and developing dedicated platforms.

These different social media functions will be discussed in the following.

4.2. Social Media Applications

Since 2000, the world-wide ICT industry pushed for Internet access infrastructure roll-outs accompanied with liberalisation and regulation for public network operators in order to build a

powerful broadband communication infrastructure. Further on, easy to use and cheap end-user equipment (PCs, Laptops, digital cameras, etc.) became available for the mass market which enabled the long-tail business model and thus stimulated a vast amount of user generated content (UGC) and platforms such as Flickr and YouTube entered the market. Thus the play-ground for new software tools were enabled by the worldwide Internet resulting in the market success of the online social media platforms such as MySpace and Facebook. Microsoft launched Windows Live Spaces in 2004, but it was shut down in 2011 due to low viewership[112]. Different social media platforms focus on dedicated objectives such as Plaxo for the exchange of address data. Reunion.com should help to find and reconnect with old friends, lost loves, business colleagues, and family members. Different regions and user communities developed their own social media platforms like Cyworld in Korea, Friendster in Asia, Hi5 in Spanish-speaking countries, Orkut in Brazil and India, and QQ in China. An overview of the most important social media platforms is given in [Leopold2012c].

4.3. Social Media and Social Networks – New Communication Mechanisms

Even if the aforementioned application areas are very different, we assume that social media approaches are based on the same core elements. This raises a number of questions: Which basic characteristics constitute social media processes? Why should these new communication approaches generate an added value, and why should productivity increase in firms? In order to answer these questions we have to clarify the meaning of “media” in this context and why “media” could even be called “social”.

Thus, we discuss the characteristics of online social networks and their various functions, especially in the context of the ubiquitous connectivity of human beings by modern information and communication technology (ICT) and powerful broadband networks.

4.3.1. The “social” in Social Networks

The "social" in a societal meaning usually refers to the fundamental aspects of social life, such as solidarity with the poorer and weaker, reducing inequality, etc. The associated phenomena and behaviour patterns in human networks were already studied in the 1930s by the social network analysis and by field studies ("offline network science") [Chesher2015].

The shift to online social mechanisms was possible due to the networking via the Internet, broadband access, mobile access, and increased computing power at the customer´s equipment as well as cheap communication infrastructure services and customer equipment costs. Thus, “social” is no longer a reference to society and don’t no longer refer to a class, movement, etc. Nowadays the social manifests itself as a network, promising to enable new forms of “non-conformity and allowing new power structures between formalized power structures inside formal institutions and supports the essential importance of informal networks [Lovnik2012]. Granovetter developed already in 1973 a theory of the meaning and the strengths of weak links in societies (see a brief discussion in Section 4.3.4 below) and today this area is researched by nowadays techno-scientists in the "actor network theory (ANT)” research field. The ANT theory was mainly influenced by Bruno Latour[113].

[112] https://en.wikipedia.org/wiki/Windows_Live_Spaces (last access: 24.4.2017).

[113] Bruno Latour is a French philosopher, born 22 June 1947 (https://en.wikipedia.org/wiki/Bruno_Latour, last access: 24.4.2017).

An important contribution to the characteristics of social networks was made by Niklas Luhmann's social systems theory [Luhmann1971]. Luhmann was committed to finding explanatory models revealing how complex systems function. He differentiated between biological and social systems. In his work, he mainly focused on social systems and stressed the importance of communication in social systems and social organisations. In fact, Luhmann defined social systems as pure 'communication systems'; or in other words: an exchange of information is inherently connected to the relationship between human beings. This implies that a communication process is always based on a continuous exchange of opinions and is ultimately characterized by human discourse.

Thus, social networks are relationships of persons, which are connected by communication processes; we call this network of relationship "offline social networks", contrary to the ICT based social networks, which we call "online social networks (OSN)", which bring a new dynamic into the communication process.

An interesting issue is the establishment of a hierarchical ordering within groups of people within social networks. A user can receive a feedback on his/her contribution or action, thus triggering a group-dynamic classification, achieving a certain positioning or playing a certain role within the group. Through ICT platforms and new communication mechanisms, the leaders of conventional media such as TV and radio are replaced by the opinion leaders of virtual groups - in transient or permanent groups as they form social networks.

The meaning of "social" in the context of the networked media world was also discussed by Manuel Castells[114] by his thesis in "The Network Society" in 1996. He stated that the new paradigm, the global network of people, is a total social phenomenon and will change society fundamentally in its culture of coexistence.

Baudrillard[115] is referring to the important effect that by social media "the silence of the masses has been broken". Social media enable a new form of communication to give the mass of the people a possibility to articulate their wishes, thoughts and desires [Lovnik2012] referring to [Baudrillard1985]. [Lovnik2012] summarizes:

> *"The obscenity of common opinion and the everyday prostitution of private details are now firmly embedded in software and in billions of users. Continual voyeurism of the group in relation to itself: it must at all times know what it wants…..".*

4.3.2. Intimacy by Ambient Awareness

From the very beginning on, OSN communication platforms were very much driven by the youngest generation fulfilling an essential social requirement: "communication and staying in touch with friends". The OSN communication paradigm supports also communication without exchanging extensive content; i.e. the platforms allow easy ways to say "hello, I am just thinking of you" [Skeels2009]. For example the function "like" allows to stay in touch even with a large number of

[114] Manuel Castells (born February 1942) is a Spanish sociologist. In the 1970s Castells played a central role in the development of Marxist urban sociology. Castells most important contribution to sociology and media theory is the three-volume study of world society as a network society - " The Information Age", Economy, Society, and Culture - which was created between 1996 and 1998 and found wide appeal in relation with the Internet boom. The work was published in 2001 also in German.

[115] Jean Baudrillard (July 27th, 1929 – March 6th, 2007) was a French media theorist, philosopher and sociologist. He was a representative of the poststructuralist thought.

people, without exchanging complex content, in order to keep relationships warm. This exchange of short messages with friends, brief updates about activities, communication of feelings, experiences and so on generates an understanding of personal experience and emotion and thus contributes to the establishment of a tighter relationship with the people in connection. This is valid for weak as well as strong relationships. This permanent "keeping in touch" with friends generates an "ambient awareness" [Skeels2009] by referring to Clive Thompson [Thompson2008]. Skeels et al. summarizes [Skeels2009]:

> "*An extensive repetitious, brief status update can lead over time to greater understanding or intimacy. This enables the possibility to find common interests and experiences, sharing successes, frustrations, and moods to build a sense of closeness*".

4.3.3. From Social Networks to Social Media

Let us now discuss how we can describe "social media" in relation to "social networks." What is the meaning of "media" within the context of online social networks?

William H Wells, a business social media coach, argues according to the classical media view. According to him, social media refer to the tools which support the communication process (such as a communication medium), whereas social networks describe the way of using such tools by the user [Wells2011].

Kevin Kelly [Kelly2011] argues that a social network is the principle of connectivity (e.g. based on technical platforms), whereas social media refers to the content generated by social media applications. Following the same direction, Coursaris describes [Coursaris2007]: "*Media is characterized by storage and transmission of information, while social describes the distinct way these messages propagate in a many-to-many fashion among the communicating people as peers*".

Following this argumentation, Rozwell summarizes [Rozwell2011]: "*Social media users create and contribute to content being used and observed by other users and build on interaction and relationships through the act of content creation. Social media users are often found interacting with others via enabling technology: in the process of doing so, they are forming or further developing relationship with others*". Furthermore, Rozwell defines: "*Social Media is an online collaboration environment where content is created, posted, enhanced, discovered, consumed and shared, participant to participant, without a direct intermediary*".

"Without direct intermediary" means, in this context, that there is no need for an entity which organises and controls the information exchange, as opposed to classical industry processes with hierarchies, responsibilities and fixed processes.

Collective information processing by the users of a system also gives rise to a new set of information, which is usually defined as "user generated content (UGC)" [Anderson2004]. Therefore, social media have to be conceived as a communication concept, which is described as interaction and has a strong user generated content (UGC) component.

Chris Cree[116] defines social media as "*communication format publishing user generated content that allow some level of user interaction*". We have to note, as already discussed above, this is a problematic definition as it implies all early computer systems.

[116] https://successcreeations.com/438/definition-of-social-media/#ixzz1nJmIQl1c (last access: 24.4.2017).

A further important innovation brought about by the new interactivity is the ability to manage a larger number of relationships. Based on ICT tools, a wider range of relationships – strong ties as well as especially "weak ties" – can be simultaneously managed, more easily incorporated into the communication process and productively applied for specific tasks. This enables users to make decisions relying on a wider basis of information.

This vast amount of information exchange stimulated by online social media platforms, build an environment of “liquid networks”, where error and noise are added to the facts and other relevant information, and finally serendipity and can happen [Johnson2010]. This forms the basis for combination of information and the possibility to re-use available information. The permanent possibility of “re-use” and “re-purpose” of information (content) is an essential pillar for the creation of innovation or as Arthur puts it [Arthur2009]: "*The essential source of innovation is combination. The economy continually creates the new by combining the old and in doing so, it disrupts itself constantly from within.*" Similarly, Johnson [Johnson2010] summarizes that good ideas are not generated by a single event but in a network and in this sense they are generated when individuals and ideas are brought together or as Johnson also puts it: "*Chance favours the connected mind.*" It is not only the competition among individuals and companies that fuels innovation in product and service development, but rather an open system that is based on communication and interaction. This process leads to an ongoing progress of technological development based on adjustment, contingency and inevitability [Kelly2010]. These principles of “innovation” are discussed in Chapter 2 above and are summarized in [Leopold2012a].

4.3.4. Relationships among People: Social Networks and Strong & Weak Ties

The relationships among people within a social context are different in nature and in kind and have varying levels of intensity. The main characteristics of strong and weak ties are investigated by communication science. The essential issues which are relevant for our elaboration of ICT-based social networks are discussed in the following paragraphs.

In the area of sociology, the strength of interpersonal ties between individuals is depends on four main factors according to Mark Granovetter [Granovetter1973]. The first factor concerns the time spent together, the second factor, mentioned by the American forefather of the network theory and analysis, refers to emotional intensity, the third to intimacy, meaning mutual trust and understanding, and the last factor is reciprocity. Even if each of these characteristics is independent from one another, there is a correlation among them.

Strong ties such as the ones within a family, a friendship or a clique of friends are characterized by a high degree of similarity (common outlook on life, shared values, cultural homogeneity). Interaction in such relationships is learned intuitively and is based on the mutual understanding and familiarity among the individuals. Strong ties have the advantage that the persons concerned are responsible for each other and tend to have blind trust and understanding for the situation of their counterparts. However, they have the disadvantage that the information made available in these direct networks does not have a high novelty value due to the intensity of regular interaction. Strong networks have the tendency towards isolation and individuals with strong ties run the risk of becoming socially isolated.

Weak ties originate in most cases between friends of a friend or colleagues of a colleague within a given working environment. In the social realm, it could happen that partners with strong ties to a specific individual could have less strong relationships to others. These people in separated clusters

guarantee better access to new data, information and knowledge. Therefore, weak ties play an important bridging role for small-cell networks connecting them to other views, ways of life, mindsets and perspectives, while expanding the horizon of networks based on strong ties.

The dissemination of information with a higher novelty value compared to strong ties is the real strength of relationship patterns characterized by lower intensity. To support this statement, Mark Granovetter argues that close friends usually belong to the same circle and therefore they often receive information that tends to overlap. On the contrary, acquaintances, whom we know only superficially, probably know other people, who are totally stranger to us, and therefore receive more new information: "weak ties" connect us with a larger world, even if only partially, as they spend less time with us and have less in common.

Relationships can be described using two main properties – structure and flow – from the social network theory [Granovetter1973, Borgatti2003]. The structure of a user's relationship refers to how many connections they have and their position in their network of relationships. The denser and larger a user's portfolio of relationships is, the more central his or her position in the portfolio and the more likely that user is to be an influential member in their network.

In this context, a widely discussed theory proposed by the anthropologist Robin Dunbar [Dunbar1993, Hill2003] is particularly compelling. He theorized that people have a cognitive limit, which restricts the number of stable social relationships they can have with other people to about 150. Since social media platforms lead to the generation of communities that grow well beyond this number, they contribute to the establishment of a great number of weak ties.

The flow of a user's relationships refers to the types of resources involved in individual relationships and how these resources are used. It describes the strength of a relationship [Krackhardt1992]. Strong ties are long-lasting and intensive relationships, whereas weak ties are infrequent and distant [Hansen1999].

This effect also represents the added value of so-called 'weak ties'. The relationship is principally weak but it is still a relationship. The networking technology supports – as opposed to the off-line world - the creation of multiple weak ties since they are permanently available. On a case-by-case basis, single weak ties can turn into strong relationships.

As a result, the flow in weak ties can lead to new structures, with the structures and the flow having a stimulating effect on each other. It is therefore difficult to determine what is more important. In practice, there is a small number of contributors, who produce a lot of content (regardless of whether they are private persons or professional editors) and who are evaluated, forwarded, quoted or even commented upon by a huge multitude of readers. As opposed to the old media economics, the group guarantees the circulation of assessed information, whose flow is ultimately based on the sum of all relationships (strong and weak ties).

Finally, relationships can be analysed in a formal and structured manner, for example LinkedIn shows the list of people each user is connected to and also how many contacts are necessary to be able to get in touch with a desired person – see the "six degrees" networking phenomenon [Watts2003][117].

[117] Stanley Milgram coined, in 1967, the hypotheses that every human being on earth is connected to everybody else over a very short distance of relationships (this phenomenon was mentioned already 1929 in a story from Frigyes Karinthy (http://de.wikipedia.org/wiki/Kleine-Welt-Ph%C3%A4nomen, last access: 24.4.2017).

4.3.5. Communication is Interaction

Communication is based on the exchange of information (knowledge, experience, opinion, etc.). Interaction means that the communicating actors respond to comments of the communication partner by considering negotiation, interpretation and self-representation. Niklas Luhmann calls it "communication among participants“. With this understanding, we can clearly differentiate communication via online social media from other processes, such as classical written exchange by letters.

The technological development of modern information and communication technologies (ICT) reflects this natural behaviour of social interaction. In the beginning, there was plain old telephony (POTS), which supported interactive exchange of spoken information in real-time over distance. However, this real-time communication lacks essential functions when compared to face-to-face communication, since essential concepts are missing like non-verbal communication, or environmental issues in which the communication takes place. The next step of the development of ICT was the introduction of Web 1.0. This communication medium extended the information offering as well as information representation. The extensive roll-out of broadband networks, mainly driven by the development of broadband access technologies [Leopold1998], fibre optic communication technology [Leopold2008c], the widely acceptance of the Internet protocol (IP) as the basic protocol technology for any multimedia service [Leopold2006a, Banfield2006, Leopold2008d], and the availability of websites and connected PCs, built a new communication platform which enabled a new form of communication by supporting the exchange of multimedia information (data, text, images and videos). Peer-to-peer (P2P) communication enabled a new form of relationship building, and built the basis for the new Web 2.0 era. This paradigm change from peer-to-peer communication to Web 1.0 and Web 2.0 is discussed in more detail in the following.

4.3.6. Peer-to-Peer as New Communication Paradigm

Today’s peer-to-peer (P2P) production was traditionally associated with the development of open source software[118]. However, this self-organised form of project collaboration, where individuals join forces in egalitarian communities to accomplish their objectives, has now developed a host of different features. The operating system Linux, for instance, demonstrates how economically relevant such a modern economic type can be, since it is used today in nearly all application areas from the entertainment industry up to transport and even security industry [Tapscott2007].

In the following paragraph, the peer-to-peer proposition will be further explained on the basis of the findings and insights provided by the Belgian philosopher Michael Bauwens, who is the most active peer-to-peer theorist and researcher at the moment[119]. Bauwens provides a P2P definition in [Bauwens2005]:

> “*P2P describes the emergence, or expansion, of a specific type of relational dynamic, which I call peer to peer. It is a form of human network-based organisation which rests upon the free participation of equipotent partners, engaged in the production of common resources, without*

[118] Open source software is licensed under the “open source initiative (OSI)”, which makes the source text and the source code of software publicly available and is promoted through the further development of the material.

[119] Michael Bauwens, born March 21st, 1958, is a Belgian peer-to-peer theorist and researcher (http://p2pfoundation.net/Michel_Bauwens, last access: 24.4.2017).

recourse to monetary compensation as a key motivating factor, and not organized according to hierarchical methods of command and control".

This P2P format is emerging in different forms [Bauwens2005]:

- as a format of technology (the point-to-point Internet, file sharing, grid computing, blogs),
- as a third mode of production, which is also called "commons-based peer production" (neither centrally planned nor profit-driven production of hardware and software)[120], and
- intellectual and cultural resources that are of great value to humanity such as the GNU/Linux operating system, Wikipedia, etc., and
- as a general mode of knowledge exchange and collective learning, which is massively practiced on the Internet.

P2P also emerges as new organisational formats in politics [Bauwens2005][121] and spirituality, as a new 'culture of work' [Benkler2006]. In the end, Bauwens comes to the conclusion that P2P is simply a premise of a new type of communication mechanism that is still largely not understood.

In a second step, Bauwens further expands the definition of P2P [Bauwens2005]:

> "*It is a specific form of relational dynamic, is based on the assumed 'equipotency' of its participants, organized through the free cooperation of equals in view of the performance of a common task, for the creation of a common good. 'Equipotency' means that there is no prior formal filtering for participation, but rather that it is the immediate practice of cooperation, which determines the expertise and level of participation. It does not deny 'authority', but only fixed forced hierarchy, and therefore accepts authority based on expertise.*"

Bauwens defines this model as the "meritocratic" organisational principle, where either the project initiators or the most experienced members of the community take on the role of leaders.

File sharing systems were the first to be explicitly tagged with the P2P label. In such Internet sub-systems, all computers on the Internet are mobilized to share files amongst all participating systems, whether that be documents, audio files, or audio-visual materials[122].

4.3.7. From Broadcast TV over Web 1.0 to Web 2.0

What are the main differences between communication in the pre-internet era and today's Web 2.0 concepts? What is so special about Web 2.0 as opposed to Web 1.0?

Essentially, it is all about communication and forms of dialog, i.e. the exchange of messages and information, and about interaction among people. It is important to note, that "social" is more than just the digital awareness of the other on the Internet. There has to be an actual, real, existing

[120] Also called „Free/Libre Open Source Software (FLOSS)".

[121] [Bauwens2005] Chapter 4: P2P in the Political Sphere; The Afterglobalisation Movement, The 'Coordination' format, New conceptions of social and political struggle, New lines of contention, De-Monopolization of Power, Equality, Hierarchy, Freedom and Evolutionary Conceptions of Power; pp: 32-43.

[122] BitTorrent is an example of a free, open source file-sharing application effective for distributing very large software and media files.

interaction. This is the main difference between old broadcast media, Web 1.0 and the current social network paradigm “Web 2.0”.

Examples of such exchange of information (messages) are conventional letters of the off-line world or today’s widespread e-mails. Exchanging information via certain media is definitely nothing new and therefore it does not refer to a specific feature of the Internet or of Web 2.0, even if exchanging information via today’s electronic media is considerably easier, quicker and cheaper than ever before.

Already in the early days of our media world, i.e. of broadcast TV, viewers used to consume editorially processed content in a passive manner; however, by selecting a specific TV channel (commonly known as “channel zapping”) they did perform a certain interaction with the system. The selection of the content by users is subjected to thorough scrutiny by content providers to determine the advertising value of a certain TV programme; → 1st generation interactivity within the context of broadcast media.

The emergence of Web 1.0 functionalities offered the opportunity to make editorial content available to users in an easier and more varied manner. With Web 1.0, the number of "available channels" providing different content increased considerably. Suddenly there are no longer hundreds of TV channels available to distribute information, but millions of websites. A new, never before available, possibility for the presentation of available information (content) is the basis for our information society. In particular, the enormous interlinking of our available information is the basis for a new quality of information processing. Content creators and distributers have a new possibility for their content, and are able to offer it to many people and to initiate a communication with them[123]. However, it is important to note, that there is always a clear separation between the two different roles in a communication process: sender and receiver.

In the Web 1.0 area, the interaction between the user and the system was performed through the selection of a specific website or through selective content viewing. Also, the technically far easier method of exchanging messages with the content provider without media disruption (as opposed to the media discontinuity of TV channels and telephones) marked a further important milestone in the evolution of communication compared to broadcast media [Leopold2008a]. This technological advancement brought about by the Internet can be described as Web 1.0; → 2nd generation interactivity.

An essential communication system in the Web 1.0 context was established by the e-mail system. E-mail became one of the most important applications of the Internet (see Section 4.3.14 “Richness of e-mail” below). E-mail is basically easy to use, and perfectly designed for classical peer-to-peer communication. Thus e-mail experiences a remarkable acceptance by users.

In Web 2.0, a basically new principle comes into play: in addition to the actual communication process (exchange of messages), Web 2.0 also incorporates a strong social component, integrating socially relevant information as inherent part of the message: this includes data about who has

[123] Anderson [Anderson2004, Anderson2006] postulated three steps as basis for the new long-tail content market based on user generated content (UGC), opposed to the classical content production by the large film producers. i) First step: democratizing the tools of production; result: more products/stuff; i.e. the kind and amount of content which is produced – he calls this “lengthening of the tail”. ii) Second step: cutting the costs of consumption by democratizing the distribution; result: more access to niches, which fattens the tail. iii) Third step: connecting supply and demand; result: drive business from hits to niches.

access to the information or who has posted a comment ("like-it"), who is using or processing this information and in which way.

Therefore, Web 2.0 tools allow users to integrate social context information and make them available to the other users of the system. Thus, in addition to exchanging messages, a social interaction is performed. This leads to an ongoing change of roles that are potentially adopted in the communication process – that is to say that the receiver of the information will instantly become the sender and vice versa. The technical system now allows a dialog communication of the highest quality, which develops into a discourse and immediate exchange of viewpoints. Thus large numbers of people can engage in quality "face-to-face communication" over space and time, which previously was only possible in the context of "offline relationships." A discourse without hierarchical or organisational obstacles becomes possible, even over large distances; → 3rd generation interaction.

In the online context the social requires our permanent involvement, in the form of clicking, commenting, posting, etc. Here it is important to note, that we never can outsource such behaviour to machines – we as human being have to do that!

In addition we should not make the mistake to reduce social media only to a "media" issue; it is not only about searching for and producing information, it is the communication that is the basis for a collective intelligence [Lovnik2012].

Social media is also promising to algorithmically extend our network [Lovnik2012]. Social networking is enabling a potential use of the personal links; i.e. "I could contact this person", or "I will indicate my preferred views" – even without being asked. The aim within a "social network" is to find the other and not the information!

In addition to the interaction process described above, in order to make concrete an effective communication process[124] it is necessary to have a common understanding of people´s interaction behaviour. This point will become clearer through the "theory of communicative skills", developed by Habermas.

4.3.8. Theory of Communicative Skills by Habermas

According to Habermas, communicative skills are always taken for granted in every communication process, i.e., it is assumed that information exchange is understandable, true, correct and truthful. Habermas designates this as the "validity claim" [Haber2008] referring to [Habermas2008]. However, in reality – and above all in the enterprise reality – this ideal communication situation is impeded by organisational and hierarchical obstacles, whereby the validity claim of the persons involved in the communication process often cannot be determined.

[124] Especially knowledge workers in free markets are trying to draw upon principles based on system-theoretical models. In this context, effectiveness, which means according to Peter Drucker 'doing the right things', compared to efficiency 'doing things right' plays a crucial role [Drucker1963] (see also Section 5.1.2 below). If the end-result of an action is useless, i.e. "product with a failure", it makes absolutely no difference how efficiently this action has been performed. In this regard, a major dispute is still underway in the IT world, since the endeavours of IT organisations within firms are usually driven by efficiency parameters and effectiveness has usually a much lower importance. In this context, it should be borne in mind that the history of information technology (IT) within corporations began in the controlling department, and nowadays IT departments are often still integral part of the financial departments (personal experience of the study author during his management experience).

We can obtain and preserve an effective communication process when a discourse, led at a meta-level, develops arguments that try to reach the intelligibility, trueness, veracity and authenticity of the communication for all the dialogue participants. In hierarchical or rigid organised structures, establishing an argumentative equal opportunity between an employee and a leader is seldom possible. This is the case when, e.g., the veracity of an argument is suspected – that is to say when, for example, the act accompanying the leader's communication process do not correspond. It is also the case when the validity of an argument is suspicious, for example, in the way an employee, as a specialist involved in a topic area, is questioned by a leader who has not enough information to judge the information provided and has not enough trust. Consequently, the discourse within firms is very often denied.

However, only the problematization of the validity claim and its closer examination in an ideal and non-hierarchical communication situation offers the opportunity to accept the best argument among others. That is the actual problem. The validity claim will be cleared in the dialogue in an equal distribution of opportunity, in order to create a proper consensus, so that the dialogue participant can follow the unconstrained force of the best argument.

Social media communication platforms now offer inherent functions that allow the establishment of a dialogue process, which is independent from organisational competence and hierarchical accountability. Thus, other argumentation and information can be used to make up one´s mind – argumentation and information that can lead to a better decision being made.

4.3.9. Communities of Practice (COP)

When people are working and learning together, communication processes and relationships are performed within the group of people. The social psychologist Joseph McGrath noted that group activities serve three crucial functions [Skeels2009] referring to [McGrath1991]:

- production,
- member support, and
- group health.

It is obvious that "member support" and "group health" contribute to the level of productivity of the group. However the influences are difficult to measure.

This collective behaviour was researched by Etienne Wenger and Jean Lave who coined the concept of a Community of Practice (COP) [Brown1991, Wenger2004, Wenger2006, Brannigan2009, Ball2009, Durant-Law2012].

Andrew Cox [Cox2005] summarized the community of practice research activities. Lave and Wenger, 1991 [Lave1991] dealt with the subject how knowledge of a group can be passed through knowledge transfer to new people. It is about learning effects and training mechanisms (apprenticeship). They postulated that social interactions enable more effective knowledge transfer than mechanical dissemination of information. Brown and Duguid, 1991 [Brown1991], focused on the subject how knowledge in informal groups are created and how they find a common sense of understanding to solve problems better than in classic organisational structures. Wenger, 1998 [Wenger1998], focused on the theoretical aspects how informal relations in a group are developed and how a common understanding in a group is created to pursue a common goal. For a long time, the problem has been

that these theoretical concepts of the functions of a group were difficult to apply for everyday business processes.

Wenger, McDermott and Snyder 2002 [Wenger2002] discussed in their paper management and organisational aspects of group mechanisms and how the theoretical aspects described so far can be applied in the corporate context. They dealt with the advantages of group functions for companies, as they are formed across organisational boundaries and hierarchies. In their paper they discussed the different approaches to form a "community of practice" by following a management strategy by "empowerment". They describe 7 design principles to form productive informal groups in companies [Wenger2002]:

1. Design of evolution; i.e. to allow the community to develop as it grows (no fixed structure).
2. Enable an open dialogue between inside and outside perspectives.
3. Enable different levels of participation, that all members have a role to play according their interests and possibilities.
4. Develop both public and private community spaces; public: official events; private: one-to-one interaction among members.
5. Focus on added value, that the COP stays relevant for the organisation.
6. Combine familiarity and excitement; familiar events create comfort, while exciting events create novelty and spontaneity among members.
7. Create a rhythm for the community so that the pace of activities is suitable for the members.

A COP differ from other forms of organisations, e.g. project teams or formal working groups in terms of purpose, belonging, and bond among community members. A major function of a COP is the transfer of tacit to explicit knowledge [Ardichvili2008]. Wenger describes three elements that distinguish a community of practice (COP) from other groups [Wenger2004, Wenger2006]:

- A group of people is characterized by a common interest, passion, or need. Since the group members are committed to the group and are organising themselves around a particular area of interest, they develop a common sense of joint experience and thus a certain group identity (this is referred to as “domain”, i.e. area of interest).
- People in the group build a relationship in the group and are willing to share information, help each other and finally learn from each other (this is referred to as “community”).
- Finally, the people want to become more effective in fulfilling their common tasks. Thus, the group develops shared resources, experiences, tools, documents, and procedures to solve the common tasks; i.e. the group members develop a shared practice and the artefacts created by the community result from the accumulated knowledge of the community (this is referred to as “practice”).

Thus, a COP is characterized by concerted efforts to help each other, and communication is based on a common interest learning together and knowledge is accumulated and preserved within the group

and can be shared for subsequent use by others. This is one source of “tacit knowledge” embodied within a group as well as a basis for the effect of “emergence”. [Ball2009] summarizes a definition for a COP:

> *“A community of practice is a group of people with a common interest, passion, or need who commit to, with and from each other in order to become more effective in their practice”*.

Based on the permanent communication within the group, the community members develop a common understanding of their common tasks, practices, approaches as well as personal relationships and a shared way of interacting. They may even develop a common sense of identity [Wenger2002]. However, there is something more going on within a group. The expert role might change from time to time and from subject to subject thus, resulting in a dedicated dynamics of knowledge exchange and development. Randall et al. [Randall2007] describe the characteristics of a COP by referring to Lave and Wenger [Lave1991]:

> *“The learner learns by transforming the one into the other in and through the dialogue between learner and expert. Lave and Wenger describe this community of varying tyros and experts as a ´community of practice´”.*

4.3.10. When do Networks Operate

It is important to note that not all working groups automatically lead to closer cooperation with higher productivity. Often it is not possible to form a functioning group of networked people and the members of the group cannot deliver an expected group result. An ongoing balancing of all individual interests within a group is fundamentally necessary. Innovation management researchers describe success criteria for the operation of networks such as [Tidd2013]:

- High personal commitment and thus reduction of opportunistic behaviour of the individual member of a group,
- willingness to cooperate in spite of potential competition,
- reliance on long-term positive relationships, thus focusing less on short-term profit,
- lived partnerships based on equality, and finally
- high reliability of expectations of the joint outcome with simultaneous benefit for each network member.

However, there are further issues which have to be taken into account. First of all there are different aspects important for different phases such as for the formation of a network or the operational cooperation phase. In the initial phase, it is important to establish a pulse to bring the actors together and formulate a common objective.

Further on, it is important to note, that the advantages of networks are only achievable, as long as communication overhead costs required for networking activities do not exceed a certain level. We will learn that is one of the crucial aspects when discussing the cooperation attitude for innovation processes as a result of this PhD study. We will discuss this issue later on.

4.3.11. The Effective Network

Lazar and Friedmann studied social networks in order to understand their effectiveness concerning output generation end exploitation [Lazar2007]. Their research showed an inverted-U relationship

between connectedness and performance, in which both poorly and well-connected systems perform badly, and moderately connected systems perform best.

4.3.12. Free flow of Information versus Structure and Order

Networking which allows free-flow of information needs also structure, organisation and decision. As already highlighted in Section 2.10 above, it is important to note that organisations need to manage several factors independent of organisational structures such as human resources, legal frameworks, compliance issues, financial systems, stakeholder management, etc. All those factors are pre-requisites for implementing the creative ideas within organisations and within markets. A well-defined business strategy is the basis for clear and coherent communication to the market, as well as to the stakeholders. Furthermore, a well-defined strategy is a pre-requisite to manage personal resources and skill in order to achieve a critical mass of resources – budget, time, skills, human resources – within organisations and to provide employees with an orientation to focus their activities and is also a source of motivation, since common goals are communicated.

In order to gain advantage and to achieve this balance between organisational free-flow and structure, appropriate processes and tools have to be implemented within an organisation. This tension between organisational free-flow and structure is a key part that makes the topic of this PhD an interesting management topic.

4.3.13. Social Software and Difference to classical ERP Systems

Information Systems (IS) within organisations form the technological basis for supporting business processes in firms. According to [Kroenke2008]

> "*Information Systems (IS) include not only the Information and Communication Technology (ICT) an organisation uses, but also the way in which people interact with this technology in support of business processes. An Information System in a broad sense refers to the interaction between people, processes and technology."*

Based on this [Kroenke2008] distinguishes three core elements of information systems: actors (people), artefacts (information and communication technologies), and activities (processes). The actors, in organisational activities, are management, employees and external stakeholders.

Basically business processes are well-defined and software systems are designed accordingly. Within organisations these IT systems are usually called "enterprise resource planning (ERP)" tools, such as SAP, project and programme management, controlling and resource management tools. Of course social networks pre-exist Web 2.0 ("offline social networks"), and we could argue that traditional ERP systems do the same as Web 2.0 Applications. However, there is fundamentally a difference between usual data centric approaches - followed before Web 2.0 – and user centric cooperative approaches in the Web 2.0 area, as discussed above. The same applies to the "e-mail communication system" as a core business support system in our firms.

4.3.14. Richness of e-mail

It is important to note, that technical systems often can be used different than originally designed. Thus in most organisations, e-mail systems are used by far more than just to exchange messages. An e-mail system is often used as a process management tool, data archive, as content management

tool, as quality assurance tool, etc.[125]. Thus, an e-mail system is perceived as a very powerful system, covering several application areas, such as using it as an "audit trail", arranging staff meetings, using group messages, commitment processes [Brown2000, p. 267]. See also the discussion on the "richness of e-mail" [Snyder2011, Lee1994, Markus1994].

However, under closer inspection, there are important functions missing. There is a lack of certain collective aspects of the communication exchange from many not pre-defined users, and the systems do not offer the possibility to send messages integrating the social context related to them in a transparent manner.

According to this understanding, an e-mail system designed basically as a pure peer-to-peer application cannot therefore be considered as a Web 2.0 tool. Interestingly enough, young target groups rarely use conventional e-mail functions. At present, communication is increasingly taking place via Facebook and similar social networking websites by means of postings, messages, etc., such as WhatsApp for example[126]. The question is now, how this effect is changing the communication processes within the business world.

4.3.15. Wiki-based Community Collaboration

So called "Wikis", as one type of social media, became very popular for supporting collaborative working processes among professional communities of practice (COP) as a conversational knowledge management tool to address specific knowledge needs (see Section 4.3.9 for an in depth discussion of communities of practice)[127]. Mansour [Mansour2011] studied the potential dual role of Wikis within organisations: enabler as well as inhibitor for community and knowledge collaboration.

Wiki is usually used within expert groups as a web-based collaboration tool allowing multiple users to collaborate for the creation of specific content [Happel2008, Paff2007]. Wikis are often used by a working team to elaborate in a collaborative sense a common description, work plan, etc. Essentially, such a process of rewriting, reorganizing and adding and commenting content is a form of "shaping" content of several people into an useful knowledge [Mansour2011] referring to [Yates2010].

A well known "Wiki" is Wikipedia, a collaboration effort in an open environment. However, studies clearly show that education and the classical Wikipedia are fundamental different contexts than the workplace with dedicated knowledge-sharing and collaboration issues.

Wikis as any online social media tool can be used in different organisational settings, such as collaborations within communities of practice (CoP), user groups, e-learning, project management [Majchrzak2006], knowledge management [Hasan2006, Wagner2004, Wagner2006, Kosonen2009].

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[125] "E-mail ist das führende Systems", 10.3.2014, http://www.report.at/telekom/politik/item/85732-e-mail-ist-das-fuehrende-system (last access on 24.4.2017).

[126] „WhatsApp für Jugendliche wichtiger als Gespräche", 14.9.2014, http://www.golem.de/news/messaging-whatsapp-fuer-jugendliche-wichtiger-als-gespraeche-1409-109062.html (last access: 24.4.2017).

[127] "Wiki" is a Hawaiian word which means "quick", and refers to a simple dynamically updated web page that is open for anyone to edit, add, comment, and track content. This goes back to Ward Cunningham who developed an initial version for SW developers to collaborate within SW-development teams [Mansour2011]. Basically this function encompasses hyperlinked web pages that allow several users to add and edit information.

However, Stocker et al. [Stocker2009] identified clearly that organisations using Wikis struggle with the typical dilemma of a knowledge-sharing working environment. Usually the management level assumes benefits, where employees feel often uncomfortable when having personal content accessible by a large number of users [Stocker2009, p. 79]. Even more, other research identified that "*… the uncoordinated use of wikis by many users may result chaos such as distrusted content, difficult navigation, and inconsistency among wiki pages*." [Stocker2009] referring to [Danis2008]. Missing trust [Kittur2008] and malicious contributions [Happel2008] are further issues which jeopardize an effective use as a collaboration tools for innovation and knowledge management within organisations.

4.4. Social Media – Basic Functions and Principles

4.4.1. Core Functions of Social Media

To summarize the discussion above as well as referring to the literature [Smith2007, Kietzmann2011, Bradley2011], online social media approaches are based on some common core elements which address communication aspects that were not previously covered by traditional communication tools. We can identify the following twelve core principles of social media tools (see Figure 4.1 below):

1. **Identity:** A communication always happens between human beings, i.e., between identities. Latest studies show that the identity management became a very essential issue especially for the young generation [Cerra2012]. Identity is a core function of numerous social media applications. A person's identity implies disclosing factual information such as name, age, profession, location, the company one works for, hobbies, etc., but also consciously or unconsciously revealing subjective information such as thoughts, feelings, likes or dislikes, etc., and most importantly pictures of the person itself or pictures about his preferences (see for example the personal photos in Facebook or Instagram).

   Based on this identity representation function, self-promotion (Facebook) or self-branding (LinkedIn) using both, real or virtual identities (pseudonym), are important basic functions of social media applications.

2. **Relationships:** Relationships between human beings are a basic function for a social interaction. Certain social media applications have the objective to build up new relationships and expand the social network of a person (for instance LinkedIn), whereas other applications are aimed at simply cultivating and maintaining existing relations (e.g. Facebook).

   The "like" function to comment other users posts and content and the usage of "emojis" are essential features to keep contacts "alive" in this context.

   Social Network Analyses (SNA), a dedicated area of social software, is intended to identify these hidden structures[128].

   Other applications are centred upon less structured relationships. Applications such as Twitter and YouTube do not focus on direct interpersonal relationships; however, relationships among people do still play a crucial role. Blogs and Tweets can be used to

[128] This is the basis for identifying the "know-who" in a group of people (see Section 3.3).

cultivate contacts with other persons without having establishing formal relationships with them (see the social media principle “Reputation” below).

3. **Conversation:** Social media applications enable several new mechanisms for communicating, discussing or exchanging information, opinions and perspectives with others.

   In addition to conventional e-mail functions, conversation mechanisms include short messages, (tweets) as used by Twitter or more detailed explanations of certain topics used by so-called blogs. Tweets are of an ephemeral nature (real-time status up-dates or real-time observations) and do not imply the obligation to reply. Blogs support a more detailed, lengthy and asynchronous communication process.

4. **Reputation:** Reputation refers to the certain standing achieved by users in a social setting. Those, who earn a good reputation and act as a role model can play a leading role within a group. The mechanisms that contribute to raising the reputation of a person are often characterized by an increase in trust such as, for instance, the number of viewers of a YouTube video, the number of followers of a Twitter account or the reviews published by other people on a LinkedIn platform.

   It is important to notice, that in the case of applications such as Twitter and YouTube, relationships among people do play a crucial role. Twitter essentially revolves around the principle of followers. This means that Twitter users consciously and selectively choose to follow other people, who produce content and whose tweets appear on their Twitter page (flow). The quality of the relationship might be relatively superficial but nevertheless it plays a decisive role. Totally unknown persons can suddenly raise their level of popularity via their blog community. Based on the network effect, they can become celebrities over the course of time and be even more influential than established personalities. The same applies to YouTube.

5. **Groups:** Groups refer to the possibility of creating “communities of interest“. Two main types of groups exist: i) Self-created groups such as the list of friends (Facebook and LinkedIn) or followers (Research Gate); or ii) dedicated smaller groups that focus on certain topics. The latter ones can be open to anyone or closed (approval required) or secret (by invitation only). Even if this function already existed earlier in different tools (e.g. e-mail groups or file share), the simple way of using this function and inviting participants to a group in online social media tools brings about a new quality for the communication process.

6. **User Generated Content:** Social media have to be conceived as a communication format for publishing User Generated Content (UGC) that allows different levels of user interaction.

7. **Sharing:** Relationships refer to the motivation of users to establish a connection with one or more persons aimed at communicating, exchanging information and sharing “objects of sociality”. By supporting the personal relationship, social media is essentially based on the sociological phenomenon of sharing information and knowledge.

   Social media are based on information and knowledge sharing models that could create an added value and a win-win situation for single users. The term “social” means that this sharing function plays a crucial role, since the exchange of information objects provides

the basis for establishing relationships but also intensifying relationships with other people. Information objects are for instance pictures in Flickr or resumes in LinkedIn, but also messages, information, opinions, location, and even availability.

8. **Collective & Emergence:** By sharing information, another core principle of social media is emerging. Users no longer generate and then disseminate or exchange content in a conventional manner, but they create content in order to further elaborate it jointly with other users or they use existing content to further process it.

   Such collaboration processes, especially within large communities, cannot be simply predetermined and pre-designed. In a communication process, which sees the participation of many individuals, new content emerges over time through the interaction of the community members, through collaboration and the combination of single elements and single pieces of information. This is the way something new "emerges", or in other words, this is the way innovation happens [Arthur2009, Kelly2010, Johnson2010]. A discussion is provided in Chapter 2 above as well as in [Leopold2012a].

   What emerges will vary depending on the specific community and its purpose, and may include latent or hidden relationships, expertise, new processes and new ways to combine and organise information.

   Thus, content and not the user, as it was the case in conventional communication processes, is becoming the central element of the communication process. [Bradley2011] summarizes: "*People collect around the content to contribute, rather than individually create content and distribute*". The collective concept distinguishes social media approaches from distribution-based approaches such as e-mail and broadcast media in general. The involvement and participation of users in this "information exchange process" also gives social media a personal touch.

   In a nutshell, we can conclude that it is the enabling function which allows the combination of existing data, information and knowledge (over time and space) that crucially emerges as new.

9. **Presence:** To support personal relationships and communication processes, functions that indicate the presence and availability of a communication partner are crucial elements (presence). This includes knowing where others are in the real or virtual world and whether they are available or not. Given the increasing mobility of users and their always-on connectivity based on virtual Internet services, status information about their availability plays a crucial role**.**

10. **Persistence:** In conventional "real-time" conversations such as telephone calls or video conferencing, information is not stored during the communication process. With social media content can be generated and, regardless of time and space, reviewed, complemented or changed. Thus, a piece of information, an idea or a comment that would otherwise be lost, can be stored, processed and lead to a better end-result through online social media applications.

    The online social media tools do not only process factual knowledge but also hidden (tacit) knowledge, meaning the knowledge generated in processes that cannot be simply classified according to rigid structures. Examples of such a tacit knowledge are the hands-on experience of a company's sales force when talking to customers, the experience of a

project leader when managing a project or the different perspectives provided by a person, who is not directly involved in a project with regard to potential problem-solving scenarios.

In a growing community, the content and know-how of single individuals are bundled to enable subsequent usage.

11. **Independence:** In social media applications, communication is considerably more spontaneous and not fully organised. Independence means that any participant can make a contribution independently from the others. Participation is open to the community and no coordinated collaboration or pre-existing relationship is required (e.g. an e-mail-list, or defined participants of a meeting, etc.). Independence allows anyone to collaborate anytime and anywhere [Bradley2011].

    There is no workflow mechanism or document check-in/check-out process. It emerges informally and sometimes formally, through the community and technical design. The Wiki technology has taken off primarily because of its online editing capability that allows anytime, anyplace and anyone updates but also because it enables to track down the contributions of single individuals[129] (see Section 4.3.15).

    The principle of independence is required to enable real mass collaboration. It distinguishes online social media from traditional knowledge management systems, document management and content management systems, where a defined workflow is a key functionality. The principle of independence also distinguishes social media from synchronous interactions such as face-to-face communication, teleconferencing, video-conferencing and instant messaging.

12. **Transparency:** Social media applications are based on contributions made by single users (see also paragraphs on “sharing and participation“ and “collective“ above). Through the contributions made by a large number of users content is further complemented, commented upon, reviewed, validated and assessed.

    In this way, the community of users carries out a self-governing and self-correcting function. Since the contributions made by single individuals are transparent and clear for all other users, users are increasingly motivated and inspired to make their own contributions through online social media applications.

    This inherent transparency and clarity not only provides a basis of trust for all other users but also an incentive for each single individual [Bradley2011]. This offers the possibility for each user to make a contribution, and therefore achieve recognition and prestige within the community, or to position oneself as an opinion leader.

    The principle of transparency to all users distinguishes social media from other forms of content sharing, such as surveys, shared directories and traditional knowledge-management systems.

And finally we have to add the fact that we reached **technology literacy** in using online social media applications. There is a wide range of technical platforms that provide many of the social media

[129] Wiki technology created the unbounded, highly dynamic, multi-author document capability that is the basis of Wikipedia.

functionalities mentioned above. Users are increasingly becoming familiar with this new communication technology, leading to a new form of technology literacy. A large number of people are already making extensive use of these platforms in their private sphere – Facebook, for instance, is growing and reaches 1,4 billion users world-wide[130]. Therefore, the social media functionalities do not have to be created or learned by the users.

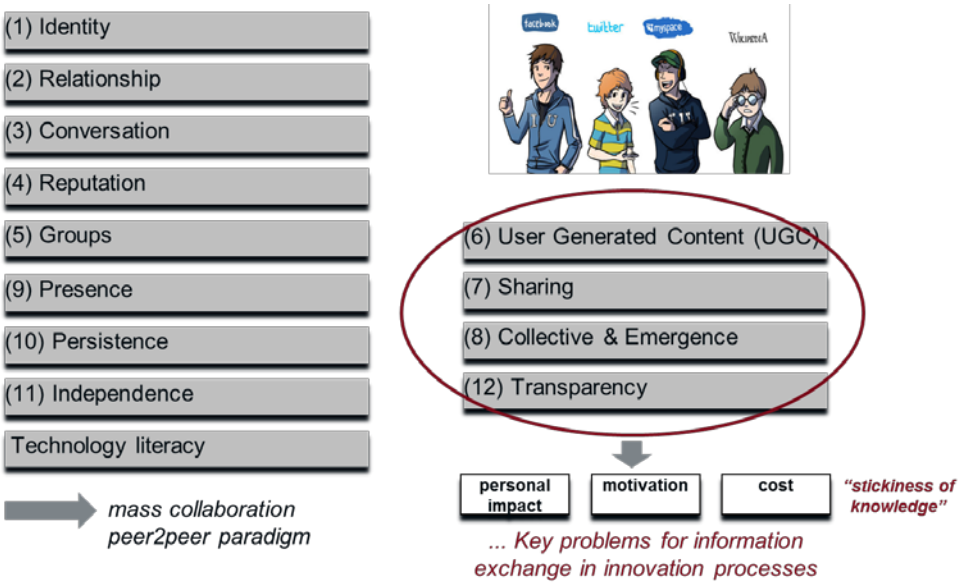

Figure 4.1: Twelve Core Functions of Online Social Media Tools

4.4.2. Key Functions for Information Exchange in Innovation Processes

Discussing the twelve social media functions above, there are four essential functions which stimulate potential problems for effective information exchange:

- user generated content (UGC)
- sharing
- collective & emergence
- transparency

The information exchange mechanisms in the context of these four social media functions have to be analysed in more detail.

4.4.3. Social Media is enabling Mass Collaboration and Wisdom of Crowds

The social media functionalities exemplified above play a crucial role for the establishment of mass collaboration and the usage of the wisdom of the crowds [Kittur2007, Lorenz2011], especially in the context of the new capabilities and skills of the wider population based on a new technology literacy.

[130] http://de.statista.com/statistik/daten/studie/37545/umfrage/anzahl-der-aktiven-nutzer-von-facebook/ (last access: 24.4.2017).

The value of an online social media application is rising with the number of users participating in the communication process, similar to the network effect described by "Metcalf's Law"[131]. With the network effect, online social media have the potential to amplify an individual's impact through the community as well as deliver a higher value to the individual from the community. This leads to the wisdom of the crowd effect which means, that a group of people achieves a better result in problem solving than an individual person.

Mass collaboration is the ability of large numbers of people, who may have no pre-existing relationships, to effectively collaborate around a shared purpose [Surowiecki2004, Noubel2007, Bradley2011].

Thus, it is essential to mobilize the community to contribute; or, in other words, to "participate" as summarised by [Bradley2011]: "*The wisdom of the crowd cannot be captured if the crowd doesn't participate*".

Mass collaboration is what is new and transformational and what differentiates social media from other collaboration technologies and practices. The act of going to the content to contribute is a fundamental shift in concept that enables the scale of mass collaboration.

How the mass collaboration effects are enabled by the aforementioned basic design principles of social media can be summarized as follows:

- Participation: Extensive user participation provides the basis for "mass collaboration" aimed at leveraging the value-added of so-called collective intelligence (wisdom of crowds).
- Collective: The act of collecting the content to contribute is a fundamental shift in behaviour that enables the scale of mass collaboration.
- Emergence: The behaviours in mass collaboration cannot be modelled, optimized or controlled like in conventional systems. They emerge over time through the interactions of community members. This is a basic principle that enables effective mass collaboration.
- Independence: In social media applications, communication is considerably more spontaneous and not completely organised. Independence means that any participant can contribute completely independent of any other[132]. Participation is open to the community and no coordination of collaboration or pre-existing relationship is required. Thus, the principle of independence is required to put the "mass" in mass collaboration.
- Persistence: As opposed to conventional real-time communication, such as telephone calls and video conferencing, social media applications can recover old information and process

[131] "*Metcalfe's law states that the value of a telecommunications network is proportional to the square of the number of connected users of the system (n^2).*" (http://en.wikipedia.org/wiki/Metcalfe%27s_law, last access: 24.4.2017).

[132] The attempt of the group to reach a viable solution to a problem can lead to potentially failures; i.e. the group behaviour is not smart. Groups of human beings can fail, if four basic conditions are not met: diversity of opinion, independence, decentralization, and aggregation. Potential negative effects on the collective intelligence of the group have also been unveiled by a study of the mathematician Jan Lorenz and the sociologist Heiko Rahut of the Swiss Federal Institute of Technology Zurich (ETH) [Lorenz2011], Holger Dambeck, "*Gemeinsam sind wir dümmer*", Spiegel Online, 17.5.2011, http://www.spiegel.de/wissenschaft/mensch/0,1518,762837,00.html (last access: 24.4.2017).

them regardless of time and space and independently from other defined processes. In this way, perspectives and information available within a group that had been previously ignored can now be taken into consideration and revalued.

- Transparency is an essential basis for creating motivation for participation and enabling opinion leaders in the group.

The French theorist Noubel defined four stages in the evolution of so-called “collective intelligence” [Noubel2007]: The first stage is the “original collective intelligence”. The second stage is the stage of “pyramidal intelligence”. The third stage of collective intelligence according to Noubel is “swarm intelligence”. The fourth stage is the “global collective intelligence”.

4.5. Social Media Platforms and Work Processes

Some research has investigated how social network sites could be used in the context of work, in particular the usage patterns when employees communicate among themselves when they have already a professional relationship have been studied. [Harvey2010] studied the added value of social media functions as knowledge and information sharing tool to support the technology implementation of larger IT-tools, i.e. so called business support systems (BSS), within firms. Rooksby et al. [Rooksby2009] analysed employee´s behaviour by using their home grown social media platform, as well as the usage of public social software tools such as Twitter, SlideShare, Dropbox, and Google Docs for their project management work. Skeels et al. [Skeels2009] studied the use of Facebook and LinkedIn for work related processes.

Mansour [Mansour2011] studied the potential dual role of Wikis within organisations: enabler as well as inhibitor for community and knowledge collaboration (see Section 4.3.15).

Complementary to those research objectives, this PhD focuses on the sociological aspects of information sharing and cooperation within a cooperative context. More specifically this PhD focuses on the motivation and attitude for information exchange between employees during creative and project generation phases within firms.

4.5.1. Different Social Media Applications are Focusing on Different Key Functions

Social Media applications are based on the functions described in Section 4.4.1 above. According to [Kietzmann2011] most popular social websites focus on three or four of these functions.

- YouTube: Sharing, conversations, groups, reputation: The motivation in YouTube is driven by the possibility to present creative movies to a wider community (sharing), and to be part of a competition that will attract more viewers.
- Foursquare: presence, identity, relationship: Foursquare is dedicated to exchanging information about the current location of a person (presence), and based upon the description of the Person (identity), relationships which are at the same location can be established.
- WhatsApp: conversation, groups, relationship; especially the communication within groups is an essential feature of WhatsApp.

Facebook and LinkedIn are described in the following in more detail.

4.5.1.1 Facebook

Facebook is based on the following main social media functions: relationships, conversations, identity, presence, reputation.

The personal profile (identity), hobbies and leisure activities (presence) are the basis for maintaining relationships with friends. Special events and personal experiences and views are shared with others, which could also lead to an increased reputation. The “like” and “emojis” are essential features in this context.

The IBM's Social Computing research group [DiMicco2009] analysed the Facebook users in the business context [Skeels2009]:

- Young professionals moving from college to workplace, offering personal information, informal status messages and non-professional images;
- users which present their image to their friends and even the public; i.e. they offer primarily job-related information with some personal information; “dressed to impress” is the term how Skeels et al. describe this group of people; and
- business users.

4.5.1.2 LinkedIn

LinkedIn is based on the following main social media functions: identity, relationships, reputation.

The central element of LinkedIn is the professional career of a person (CV) and the current affiliation and position of an organisation. Based on this and personal history, relationships to previous and current colleagues in firms are established and maintained. Remarkable career developments or important positions are increasing the reputation of a LinkedIn user. LinkedIn now enables the use of relationships of other persons (even if they are only weak ties) to create new relationships, which could bring an advantage for personal or professional objectives.

LinkedIn is useful for business people who are looking for new business contacts (consultants, vendors, etc.) but also for job-seekers as well as head-hunters. Thus different users such as students, young professionals and older professionals will use the platform differently. LinkedIn is built around the following basic concepts:

- LinkedIn is basically a professional CV which is permanently updated. This business profile is an inexpensive professional web page, which is accessible to friends as well as to the public via search queries.
- LinkedIn is a combination of a portal describing professional related personal information and a contact list. Thus, LinkedIn serves as web portal describing the personal professional experience and a self-updating address book which is owned by the user. However, it is important to note, that a LinkedIn page is relatively static apart from new connections. However, the postings of news around a person or his affiliations are becoming more and more relevant.
- Based on the business profile, “connections” are established with working colleagues. As soon as somebody is connected with someone the connection stays alive even when job or living location is changed. As strong ties may weaken, LinkedIn offers an easy tool to remain in touch. When the context is changed by changing the working group or even the firm, the

contacts are not lost and it is possible to keep easily track by notification of the career development of the connections.

- Further on, LinkedIn is an excellent tool which supports a basic general intention in business context: business networking. [Skeels2009] refers to the solution of a "*social dilemma*". With LinkedIn, we can support the making of connections during or after business networking events such as trade shows, workshops or conferences. Usually business cards are exchanged and then the connection is in addition established on LinkedIn. Such a connection is a very weak-tie, but a connection is made.

  Even if just weak ties, you can build on such connections, sometime in the future when there might be a need. Thus, "social capital" is formed. Skeels at al. summarize [Skeels2009]:

  > "*It can be considered as a promise to consider a future request*. *Even the simple act of accepting a connection implicitly legitimizes a future contact. No guarantee of success, but the possibility is there"*.

  This refers to the important effect discussed as "Chance favours the connected mind" as elaborated in Section 2.1 above.

- A further essential concept of LinkedIn is that members can use the connections of their connections; thus the "social capital concept" is even more underlined.
- According to the simple "hello message" principle, LinkedIn is offering the possibility to "*recommend*" specific skills of its connections, thus a profile is formed by all the connected friends.
- LinkedIn also supports person-to-person messages but does not reveal a member's direct e-mail address.
- LinkedIn supports the formation of groups through formal application and acceptance processes.
- LinkedIn supports postings of news and opinions.
- LinkedIn supports also "like" functions for work anniversaries in order to demonstrate a "stay in touch with you".

4.5.2. Online Social Media Tools Stimulate Additional Effort for an Organisation

Online social media tools do potentially also stimulate additional effort to use the tools and to create content for the platforms. In the same way, the added value of e-mail and systems was discussed after the introduction of these new technologies in firms[133]. There was even the situation, that the use of mobile phones was restricted by the organisation, since the added value for the company was not considered high enough compared to the cost[134]. Basically it was very difficult to prove that the new technologies are really increasing productivity in firms. [Skeels2009] and [Lovejoy2003]

[133] E-mail systems arrived in the 1990s; in IT centric firms in the late 1980s; e.g. one of the first duties of the study author was in 1989 in the course of a new European project to set up the e-mail communication service among the international partners.

[134] This was the personal experience during the affiliation of the author in the 1990s.

described the mis-judgement of the added value of e-mails and Instant Messaging (IM) for business processes when e-mail systems where introduced in the business world. Researchers argued that organisations would discover that e-mail reduce productivity and thus will not generate an added business value. Today e-mail has reached a mission-critical status for organisations since many business processes depend heavily on e-mail communication.

Thus, it is important to note that the impact and influence of a communications technology is often estimated to be false when it emerges.

The technologies are now widespread in the workplace and the tremendous impact on productivity increase by the e-mail system is more than evident (see Section on "Richness of e-mail" 4.3.14). Thus, it is important to note that the impact and influence of a communications technology is often estimated to be false when it emerges, even by experts out of the scene. Let us remember, Bill Gates once said, that the Internet will never gain importance and see what we have today.

4.5.3. Social Media Usage at the Work Place – Contrary Views

Opposite to the long list of potential positive aspects of OSN discussed so far, there are views which are contrary to it. Counter-arguments examples to the positive innovative supportive effect of the OSN LinkedIn are for example [Skeels2009]:

- The main added value is the possibility to find a new job, thus the only people active on LinkedIn are those looking for jobs, which definitely limits the potential positive aspect for innovation processes.
- No other usage then connecting to well-established professionals. It is only a pleasing effect, when somebody is asking for connection with only added value providing a positive emotional feeling. It is any easy and inexpensive way to please somebody which is asking for connection.
- More LinkedIn users report accepting invitations but then inviting people to connect.
- LinkedIn users do not frequently visit their own site.
- LinkedIn users do only seldom visit the sites of their friends.

To summarize, we can conclude that OSN such as Facebook and LinkedIn offer several functions to foster creative and emergence effects, as well as the establishment and maintenance of strong and weak ties. This is a basis for subsequent innovation processes which build on instrumentation capabilities and motivation on employees (we will discuss these effects extensively later on).

Concerning a more collaboration oriented social media platform, such as a Wiki, Stocker et al. [Stocker2009] identified clearly that organisations using Wikis struggle with the typical dilemma of a knowledge-sharing working environment. Usually the management level assumes benefits, where employees feel often uncomfortable when having personal content accessible by a large number of users [Stocker2009]. Even more, other research identified that "… *the uncoordinated use of wikis by many users may result chaos such as distrusted content, difficult navigation, and inconsistency among wiki pages*." [Stocker2009] referring to [Danis2008]. Missing trust [Kittur2008] and malicious contributions [Happel2008] are further issues which jeopardize an effective use as collaboration tools for innovation and knowledge management within organisations (see also Section 4.3.15 above).

4.5.4. Management Visions versus Actual Benefits

Discussions of social networking software often focus on identifying productivity benefits; i.e. to improve organisational process, locate expertise, and find answers to questions. [Skeels2009] identified only a weak evidence for such a productivity gain. In the survey done by Skeels et al. different usage patterns of OSN users have been identified, dependent on platform used as well as age and life situation of the users [Skeels2009]:

- fun,
- personal socializing/networking,
- networking within the company, and external professional networking.

According to Skeels et al., fun is the main motivation for employees under 26 years old and personal socializing and networking for other age groups [Skeels2009]. There is some evidence that OSN will be most useful for people actively forming social networks, such as young people but also new employees, employees joining a new group or taking on a new role, or those whose roles naturally involve networking such as those in recruiting or sales. However, according to [Skeels2009] all users of Facebook and LinkedIn rated the added value for firms internal networking lowest and the frequency of accepting new friends or connections declines with age.

To summarize, the usage of current OSN is only the first step. Finding an effective balance between professional and private usage of the new media will take time. It will require careful cultural development and behavioural adjustment.

4.5.5. The Tension by Mixing Professional and Private Social Media Use

Social media platforms like Facebook and LinkedIn are based on personal and professional social ties. The mix of these personal relationships in private and professional context tensions may potentially rise [Anderson2011]. [Skeels2009] identified four potential problem areas as a result of their interviews:

- Potential productivity decreasing effect through OSN use at the workplace: The use of OSN at the workplace is seen as a potential factor which decreases employee´s productivity. Sometimes firms forbid the usage of such tools through their company policy. [Skeels2009] refers to an example where the use of OSN was not allowed through the company policy. Four years later, a third of the company was using LinkedIn. A similar situation has been observed at AIT through 2 questionnaires (see Sections 8.1 and 8.4 below). OSN were not supported by the company, but many employees have been actively using Facebook, LinkedIn or ResearchGate in their “private” context.
- Mixing personal and professional identities and relationships. This refers to a new phenomenon brought by the new online networked society [Cerra2012]. In the off-line world we had complete control of our identity and usually we were even maintaining different identities in different life situations: a private identity at home or in a dedicated community and a professional identity at the workplace. In the new networked always-on society it becomes difficult to separate these different groups of relationships. Different audiences should not always see the same information.

The control of exchanging different information with different groups requires the maintenance of multiple separated accounts. However, this will not solve the problem in principle. The borders of different identities are more and more disappearing.

- Losing control of power boundaries, hierarchy and status. Hierarchic organisations often build their organisational structures and processes around power and status differences, implying social conventions for communication processes. When e-mail was introduced, it enabled new processes and capabilities for communication across management levels and organisational boundaries. It took some time that new conventions for formal and informal communication via the electronic medium have been developed and implemented. Such conventions are established formal in written compliance rules but also often unwritten established as a cultural element in the organisation.

  In a similar way OSN enable an equal opportunity to speak and challenge any argumentation easy and without any constraints, independent of status, hierarchy and organisational role in the company as one of the main advantages. On the other hand, this stimulates potential problems through mixing the boundaries of separated groups. Distributed information from our OSN friends could be impropriate to my boss or other relationships and could create a negative image on my personal identity. Furthermore, anybody can use the information of the OSN profile and misuse it in another context [Skeels2009] by referring to [Hewitt2006].

- Risk of violating the company communication strategy. Employees want to share work information with colleagues, of course assuming that it will not be communicated to the open public. Thus, confidential information or information which have not been authorised could easily be distributed through OSN profiles. Due to the free flow of information, quality assurance processes are much more difficult to be implemented and confidential information could be easy accidentally distributed.

It is important to note, that we are tackling the very basic question of work and private live separation. The increasing overlap of work and private lives in our businesses require new communication media for a convenient and cost-efficient way for both, the private as well as the professional live. New media will definitely bring personal activities into the workplace, but on the other side it could increase the motivation of the employees, although it brings also work to home, since they get more freedom and self-control resulting in higher effectiveness for the firm.

One of the main feedbacks and request during the introduction of the proprietary OSN "SoCol" at AIT, a huge complain of the employees was the missing interoperability to the firms external social media platforms like Facebook, Twitter (see initial Questionnaire Section 8.1). Also Skeels et al. reports the request of Beehive[135] users to connect their business OSN with public OSN networks [Skeels2009] referring to [DiMicco2009b].

4.5.6. Online Social Media is Disrupting Potentially Existing Cultures

There are also a number of experts seeing the extensive online social media use as a dangerous development for our society. Sherry Turkle is discussing the issue of "loneliness" [Turkle2011],

[135] "Beehive" (later called "SocialBlue") was an internal social networking platform of IBM research and was used inside of IBM from 2007 through 2011; http://researcher.watson.ibm.com/researcher/view_group.php?id=1231 (last access: 31.3.2016).

Nicholas Carr is warning on the loss of brain power and the ability to concentrate [Lovnik2012]. Keen is summarizing [Keen2012]:

> "T*he social is becoming a tidal wave that is flattening everything in its path. Keen warns that we will end up in an anti-social future, characterized by the "loneliness of the isolated man in the connected crowd.*"

This goes in line with the phenomenon that the attention span of human beings is dramatically shrinking in our always-on connected world as discussed in Section 2.12 above.

4.6. CSCW Changes Processes and Way of Interaction

Any technology introduction in our society in general and within organisations in particular has an impact on the environment and vice versa.

This intertwined relationship between technologies and adaptation of work processes within organisations was e.g. extensively studied for e-mail (see Section 4.3.14 "Richness of e-mail" above). However, e-mail was not introduced as a typical groupware system and the users had much time to adapt step-wise to this new technology supporting different communication processes and providing step-wise advantages during the system implementation within the organisations to each individual user. When introducing a much more powerful groupware system, the framework conditions are different. Orlikowski [Orlikowski1992] and Brown [Brown2000] studied already early the implied changes in work practices and social interaction facilitated by the introduction of groupware technology in organisations (they studied the introduction of Lotus Notes at that time as one of the early CSCW systems[136]). Orlikowski´s work suggested that "… *people´s mental models and organizations´ structure and culture significantly influence how groupware is implemented and used*", and concludes clearly that "… *groupware on its own was unlikely to engender collaboration. Recognizing the central influence of these cognitive and organizational elements is critical to developers, researchers, and practitioners of groupware*" [Orlikowski1992, p. 362].

The implication of groupware technology, such as additional effort and additional cooperation processes are usually counter-cultural to an organisation´s structural property, such as competitive and individualistic culture and rigid hierarchy. Thus, Orlikowski summarized: *"… technology will be unlikely to facilitate collective use and value, That is, where there are few incentives or norms for cooperating or sharing expertise, groupware technology alone cannot engender these."* [Orlikowski1992, p. 362].

[Brown2000] stressed that groupware is useful and accepted by users within the organisation, when it supports existing everyday organisational processes. When such a technology implies radical organisational changes, rigidity, i.e. the inability to change, of an organisational system is potentially jeopardizing a smoothly introduction of a new working technology within organisations. He was referring to difficulty to understand the added value of new functions of a groupware system and "… *personalized groupware is essential to accommodate individual differences*" [Brown2000, p. 271].

[136] Lotus Notes offered very basic groupware functions such as "public forums"; i.e. posting and reading of messages, workflow support, and "tracking"; i.e. data bases to keep a record of objects as well as activities [Brown2000, p. 266].

Parallel to this problem in principle when working with groupware within organisations, there is a general process of technology adaptation to be understood, which is discussed briefly in the following.

4.6.1. New CSCW Software Changes the Ways how People Work Together[137]

When a new technology is first introduced it begins to immediately interact with its operating environment. On the one hand, the new technology needs to be adapted to specific application scenarios and conditions (in the IT world this is often referred to as "customization"). On the other hand, it is the local context that needs to adjust to the new possibilities offered by the new technology.

In the context of SW technologies for enterprises to support the communication and working processes; i.e. computer supported cooperative work (CSCW), McAfee [McAfee2006b] outlines the different effects of this interplay between the new breed of SW technologies and the necessary adjustments that an organisation needs to carry out in order to adapt to these new technologies. He classifies SW technologies according to three distinct categories: Function IT (FIT), Enterprise IT (EIT), and Network IT (NIT).

This classification is important in order to ensure the most favourable effects from the adoption of new SW systems within an organisation. Now it is of crucial importance to point out that new technologies can only deliver greatly improved productivity levels when 4 organisational measures are implemented at the same time. McAfee refers to them as the "*complements" of* each new technology. The four factors are [McAfee2006b, page 143]

- better-skilled workers,
- better levels of teamwork,
- improved processes, and
- new decision rights.

A fundamental problem is that the management of an organisation often underestimates the need for mutual adaptation of the technology and the local context of use. This is mainly the case for NIT and EIT technologies according to the McAfee's classification.

FIT SW optimizes single work processes and enhances the productivity of stand-alone tasks. FIT SW does not generate complex interdependencies or interaction processes with the organisation or require changes of existing organisational processes.

EIT SW systems allow for the standardization of work flows, while contributing to the effective monitoring of activities and events. An example of such an „Enterprise IT" SW-application is SAP. Moreover, they bring about new interdependencies between different units within the organisation. They require new or modified processes and sequences and they also change existing decision-making procedures. In this context, it is important to highlight that the benefits of EIT SW for a company are not emerging over time. The introduction of EIT SW is usually top-down. Changes of

[137] The content of this section has been published as GIT Social Media Newsletter (in German), April 2014 under the title "*Management von Technologieeinführungen - eine soziale Herausforderung* (*Management of Technology Implementation - a social challenge)*" [Leopold2014a].

structures and processes become necessary within an organisation as soon as the new systems come into operation, which often stimulates considerable pressure onto the organisation and thus the employees.

McAfee categorises groupware IT systems which support the working and communication processes (CSCW) as "Network IT" (NIT). NIT SW systems increase collaboration within companies and are usually bottom-up driven: i.e. positive effects emerge over time based on the ongoing change of the application or the processes which use the application by the users.

Examples are the e-mail system [Lee1994] or the new online social networks. In these systems, the added value from the use of the technology developed over time that occurs due to the needs at different point in times. The SW-platforms offers the necessary flexibility in order to support emerging requirements. Thus, for example, the e-mail system experienced a development of an electronic mail function to a process and data management tool.

The introduction of such NIT systems brings a dedicated challenge to the organisation since several adaptations have to be managed at the same time [McAfee2006b]:

- First of all, the new technology has to be adjusted to the particular priorities and requirements of the organisation. The corporate strategy and the business priorities define the framework for these requirements.
- Then the existing in-house processes which are usually well accepted and trained by the employees have to be adapted according the new possibilities enabled by the new technology, such as new communication processes, information sharing and storage. Such new procedures enabled by an IT system may also stimulate new management processes such as approval procedures.

This is in line with the practical experience of the study author made during the implementation of large-scale OSS/BSS IT projects such as billing, inventory management, and performance management functions of the network infrastructure at Telekom Austria:

> *In the case of large-scale IT projects, numerous factors are mutually dependent: SW functionalities, interfaces to other IT systems, clarification as to whether other IT systems need to be changed following the introduction of new IT systems, necessary modifications to existing processes related to the usage of new IT technologies, user interfaces, necessary specifications of existing decision-making procedures, training of staff members about the usage of new technologies and gaining the experience to effectively reap the benefits associated with the newly available technologies.*
>
> *If all these aspects need to be clarified, specified and implemented "at the same time", this will result in a considerably longer implementation timeline and higher implementation costs than originally expected because planning assumptions are based on incomplete information in principle.*

Bansler explored this issue extensively, especially with regard to the introduction of CSCW SW systems, referring to the work of [Orlikowski1995] and others [Bansler2006, page 55].

4.6.2. CSCW Technology Acceptance Processes within Organisations

This aforementioned mediation process for new IT technology within an organisation is, according to [MacAfee2006], based on three phases: IT selection, IT adoption and IT exploitation. For the different SW technology categories - FIT, NIT, and EIT - these phases have to be performed differently as summarized in the following.

4.6.2.1 IT Selection

Basically we should first understand the company´s business goals and strategy and the requirements on business processes to be understood before a technology selection takes place (sometimes called "inside-out approach"). As experience shows, mangers often follow an opposite strategy and IT technology is purchased before having analysed the company objectives ("outside-in approach"). This goes in line with the discussion, whether buying a new IT-technology, e.g. commercial off-the-shelf (COTS) systems, or developing it from scratch in the company ("home-grown" IT systems). Home-grown IT systems allow more freedom of functions to be developed, whereas COTS systems require the organisation to adapt to the new system.

4.6.2.2 IT Adoption

FIT does not imply that processes have to be adapted within the organisation. Thus, this has just to be identified and taken into account.

The use of NIT is not mandatory from the very beginning for the employees. Thus, NIT technology can be introduced and then can be adopted by the users according their needs and their speed.

The introduction of EIT has different implications:

- Unlike NIT, EIT don't just offer new functionalities and thus enable new ways of working. EIT requires a mandatory use of the new tools. This implies a strong burden to the running organisation.
- Management is usually more supporting it then employees, because the benefits look great to the management but employees usually dislike EIT.
- EIT projects often are delayed since employees and management negotiate the necessary adaptations implied by the new technology in the organisation (structures and processes).

Thus it is crucial to build a common understanding and consensus within the organisation in order to achieve a successful EIT SW implementation. This is in line with the practical experience of the study author[138]:

> *A new product development process between the marketing and technology department was successfully introduced and implemented within a short time frame by focusing initially just on the objective to build a system for improving information exchange among the involved actors instead of building a new performance measurement tool for the management.*

[138] The author of this study was the main driving force and responsible managing director for implementing a gate based innovation management process at Telekom Austria, 2000-2002.

4.6.3. New CSCW Technologies Require Reorganisational Measures

The introduction of new CSCW technologies in enterprises is characterized by two main aspects:

- First, new CSCW tools, and any related new procedures within the organisation, have to compete with existing and already tried and tested tools and processes. "*No communication medium exists in the workplace in isolation and users are not passive consumers of media. They use the medium that suits their purpose at a particular point in time.*" [Bansler2006, page 56].

  Especially when users are stressed for success and pressed for time, they will tend to switch to old, well-known media even if the new technologies would lead to a potential improvement and simplification of processes [Bansler2006, page 56]. The risk of lacking the necessary know-how for a new application, or the potential malfunctioning of the new technology, is a strong deterrent for users who prefer to be on the safe side and therefore end up using conventional and more familiar tools.

- Secondly, the collaborative culture within an organisation and the correlated set of implicit rules that govern communication and cooperation among employees also play a crucial role in this context [Prusak2006]. Bansler talks about "*conventions*" [Bansler2006, page 56]: "*Users cannot just be given a new CSCW technology ... and be expected to optimally use it without some common agreements on the means of operation. Rather, conventions must be formed to regulate behaviour and provide a "modus vivendi" for making interactions proceed smoothly - and if such conventions fail to develop, the technology will fail too.*"

If such framework conditions are not developed within an organisation, a successful technology introduction is under threat. In a complex business context one cannot simply install a new software tool and expect that it will be optimally used.

When users tailor specific technologies to their real needs, especially in the case of CSCW technologies, they tend to use them in their daily work routine differently to what was originally intended or expected. As [McAfee2006b] used to point out: "*The biggest mistake business leaders make is to underestimate resistance when they impose changes in the ways people work.*" However, it is still quite unclear and there is still very little research on how the adaptation process of both the technology and its use in local context actually takes place within an organisation.

Thus, managers should not consider IT projects to be the simple implementation of technologies, but rather as a performance-related reorganisational measure; one that needs a cautious approach [McAfee2006b, p42]. This means that IT projects don't just pose a mere technical challenge, but represent a classic managerial challenge as well. In order to manage successfully this mutual dependency of technology and context of use, or technology mediation, as it will be discussed in the next section, the following guidelines are essential [Davidson2005]:

- Ensure an early employee involvement in organisational transformation processes.
- A positive emotional connection of employees to their company, especially in times of organisational transformation processes is crucial.
- Only a user-friendly design of the technique leads to a high acceptance by the users.

5. Driving Factors for Organisational Performance

"Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand"[139]

Albert Einstein, 1879 - 1955

5.1. Organisational Structures and Processes

Since Adam Smith, the organisational management community defined formal organisation structures for the division of labour. Further on, Ronald Coase´s fundamental 'theory of the firm' defined 1937 that firms emerge and exist as they benefit from transactions that are performed internally between independent parties on the basis of individual contracts instead of being mediated over the market [Coase1937, Kogut1992, Hart2008]. Thus, organisations are basically built to implement the most efficient form for performing specific transactions, defined by the business model of the firm, and the organisational structures are built for stability.

However, although organisational structures are built for stability, since firms are built around human beings, firms have to have visions as well as cultures and processes which don´t jeopardize the emergence of something new as well as the implementation of creative ideas in organisations. Organisations have to have the means to allow for and even enable creativity and support the permanent re-invention of the existing business model to adapt to fast market changes. However, these two approaches are not in contradiction; successful organisations are able to manage both conditions.

However, it is important to note that for a successful innovation management, all phases of the innovation process requires different competences within organisations and different processes to interact with the other stakeholders on the market and it involves also psychological considerations. Thus, the different phases of an innovation process, which will be described in Chapter 6.5 below, are shaped by factors such as [Sloane2006, Katzenbach2010, Baer2012, Brache2001 and Massar2008]:

- culture,
- leadership,
- strategy,
- organisational structures and processes.

All these factors influence employee´s motivation and thus are important driving forces for the organisations performance. [Baer2012] is further on referring in addition to these factors to the importance of climate, group characteristics, job requirements, and personal attributes that are basically determining the performance of an organisation.

[139] Albert Einstein quotes, http://www.goodreads.com/quotes/556030-imagination-is-more-important-than-knowledge-for-knowledge-is-limited (last access: 24.4.2017).

Based on the discussions so far, we further want to elaborate those factors in more detail that motivate employees within organisations to develop innovations or in contrary that prevent missing motivation which may jeopardize a successful innovation process.

5.1.1. Entrepreneurial Flexibility in Organisations

While for a long time innovation cycles used to embrace numerous generations, today, they follow short intervals to guarantee sustainable growth in line with social progress. Thus, one of the basic questions we are currently facing is how can we create a robust framework within our company to promote and drive innovations more easily, motivate and inspire employees to a more innovative attitude and mindset, while establishing a successful innovation management to adjust to ever-changing market conditions and support the management team to take viable future-proof decisions.

Many enterprises are still performing on the basis of long-established hierarchical forms of organisation, affected by labour sharing, specialisation and linear operations. Of course focussing expertise are important basics for economic success. But the formidable dynamic of the market and the pressure for innovation requires flexibility of an organisation, enabling an urgent and effective response to continuous market changes. In other words there is a necessity for complementary mechanisms in addition to traditionally structured forms of organisation, to support innovative processes: self-organising capabilities and supporting emergence effects.

As a result, economically successful enterprises have to develop considerable adaptation and resilience skills in order to be able to constantly adjust to ever-changing economic and technological conditions, while unleashing their innovative power to guarantee long-term corporate success against the backdrop of constantly evolving market dynamics. Homa Bahrami describes different senses of flexibility referring to effects in complex systems such as human psychology, biology or sociology by using terms such as: liquidity, plasticity, resilience[140][Bahrami2010]. Finally, Homa Bahrami defines flexibility by the ability to dynamically adapt to new reality by referring to two capabilities at the same time:

- on the one hand to withstand turbulence, and
- on the other hand to be able to transform and adapt.

She is calling “super flexibility organisations” those organisations, which have the capability to manage both successful; i.e. managing ongoing balancing act between the ability transform and to adapt. She describes Apple Inc. as a prime example of such a super flexible organisation. 1970 Apple started as a personal computer organisation and finally adapted to a consumer and even entertainment company with products such as iPod, Apple TV, Apple Watch, etc.

This entrepreneurial flexibility needs new principles for cooperation in innovation processes as well as supporting functionalities by tools and applications and backing from a new type of corporate culture.

[140] “Resilience” describes the ability of systems to cope with external disturbances respectively to have enough capacity in order not completely failing in case of failures.

5.1.2. Efficiency versus Effectiveness

Corporations have to a resolve a fundamental paradox: on the one hand, they have to function as efficiently as possible and, on the other, guarantee permanent innovation capability over the long term: thus, innovation processes have to be highly effective to allow an ongoing renewal of both business models and enterprises and, therefore, the sustainable economic development of a company [Paap2004]. Both aspects have to be successfully implemented by appropriate organisational structures at the same time.

To achieve a high level of efficiency, companies can now rely on a very high standard of knowledge in the area of management research, as well as on a good track record and proven hands-on experience within the industry. Most corporate consulting projects involving the restructuring of large corporations generally focus on ensuring the highest degree of efficiency. See for example the personal experience of the author of this study during the organisational restructuring processes at Telekom Austria between 1998 and 2008:

> *Organisational development projects usually focused on synergy effects among organisational units, efficiency in technical operations, customer service efficiency, efficiency of sales forces, efficiency of product management, etc. Reasonable investments were spent for consultancy services in this domain. Innovation improvement activities were on a much lower priority in the organisation.*

A particular difficulty is represented by the fact that efficiency improvements can be realized more easily and measured more directly and in a shorter timeframe than the benefits arising from innovation processes, which are based on intensive interaction and communication. Due to the greater difficulty in measuring short-term success and evaluating the effects of new innovation processes, managers tend to regard such innovation processes as a threat to existing priorities and procedures and, consequently, to the basis of business success.

This is due to the fact that it is relatively easy to communicate the need for improving efficiency within a company and, above all, its measurability is apparently something that can be understood by all those involved. However, such a unilateral approach inevitably leads to functional fragmentation and a suboptimal perception of subtasks. As a consequence, each organisational unit tends to focus on the optimization of its own performance indicators, which are narrowly defined and only valid at local level. This is exemplified by the following scenario of a typical telecom service operator[141]:

> *If a first-level customer call centre only focuses on optimizing the duration of each incoming customer call, since a short call duration for each customer query apparently shows that the company is highly efficient, this might have detrimental consequences for the company as a whole, as almost all customer calls will be forwarded to a second level support, without the problem having been solved. As a result, the company's highly specialized customer support will end up having to deal with all customer calls, making the introduction of a call centre obsolete. This is a very common and everyday occurrence in large corporations that have to deal with a large number of customer queries. Against the backdrop of an overwhelming volume of customer contacts, experts in technology organisations start to defend themselves by refusing to engage in a direct dialogue with customers, either by keeping their contact*

[141] This example is based on the personal experience of the author of this study during his duty as managing director for Platform and Technology Management (PTM) at Telekom Austria.

details secret or by communicating only via complicated management structures and strictly defined channels.

Thus, when management is asked to make improvements it means very often doing the same things more efficiently and at greater cost savings [Caglar2013, p.41]. However, efficiency is not enough to be successful in a dynamic and highly competitive market environment. It requires the capability to bring forward innovations within a company in a permanent and sustainable manner. Quantifiable impact, drivers of added value for customers and cost-effectiveness are important factors of a functional performance [Caglar2013].

Especially in today's highly dynamic market and technological environment, companies more than ever before are faced with the challenge of solving this apparently permanent conflict between organisational efficiency and innovation effectiveness; i.e. besides organisational efficiency, also the right decisions has to be made in time with the most appropriate and available information available. Not only must companies be able to successfully manage both aspects within their organisation, no matter how they are structured and in which industry they operate, but they must simultaneously implement internally contradictory processes and procedures and establish apparently inconsistent organisational structures, competences and cultures [Paap2004]. The successful implementation of these conflicting aspects poses unprecedented challenges to companies.

This interplay between the two conflicting tendencies, towards i) high-level efficiency, on the one hand, and ii) effective communication processes on the other, which represents a basic prerequisite for securing steady company success over the long term, is often not fully understood by large corporations [Paap2004]. In each industry, there are vivid examples of how leading companies often fail to adjust to disruptive technologies or market trends as discussed above (compare to the "tyranny of success" problem as described above).

5.2. Organisational Culture

It is not easy to define "organisational culture". Essentially it is a result of people working together. Harold Leavitt and Homa Bahrami describe in [Leavitt1988] very comprehensive the different factors to be considered when people are working together: psychological effects and behaviour of individuals, relationship issues among people, effects and mechanisms in small groups, as well as mechanisms between organisations and their environment.

An initial definition of organisational culture has been formulated by [Randall2007, page 128]: *". . . the solutions to external and internal problems that have worked consistently for a group and are, therefore, taught to new members as the correct way to perceive, think about, and feel in relation to those problems*".

Thus, a corporate culture is a pattern of collective beliefs, a set of shared values, behaviour guidelines and norms that provide people with rules of behaviour and common identity [Bessant2003, Prusak2006]. Culture affects inherently the motivation of employees and thus any communication process and finally the knowledge management processes within the firm. Culture is basically intangible and thus difficult to specify, difficult to manage, and not really possible to quantify. A corporate culture is very stable and does not change within a short time frame. A cultural change needs considerable time, consequent communication and intensive discussions before employees are able to accept new values, new rules and objectives [Bessant2003].

However, in order to understand the mechanisms within an organisation we had to understand the strong factor of the informal organisation which has a huge impact on the organisational culture.

5.2.1. Highest Productivity through Social Physics[142]

Also, the main difference between business efficiency and effective decision-making processes is clarified, concluding with the concept of "social physics" according to Pentland from MIT, where every communication at the working place is an ongoing clarification of the social roles within teams. Pentland elaborated, that in teams with highest productivity, team members are looking on purpose for new information and contacts outside of the group – he calls this behaviour "exploration" [Rothman2014, Pentland2014].

5.3. The Interplay between the Formal and the Informal Organisation

"The people who truly succeed in business are the ones who actually have figured out how to mobilize people who are not their direct reports." [143]

New York Times, April 16, 2011

"There are far too many informal and semi-informal communities within an organisation to be able to organise them." - [Snowden2002] refers to studies carried out within IBM, where they identified a ratio of informal versus formal groups of 1.000:1!

Organisations need to realize to what extent they depend on informal networks. A mature organisation will recognize that such informal networks represent a competitive advantage. Informal networks are often the only reason why organisations survive wild cycles of permanent reorganisation, lacking strategy and leadership.

However, especially large corporations need a robust and coordinated formal organisation. Clarity of structure and clarity of rules are necessary to provide the basis to collaborate and organise working processes. This is in line with the essential mechanism of strategic planning which is complemented by situated actions as described in Section 2.10 above.

Formal organisational structures provide the basis for the shareholder reporting process, the strategy process and enable the constant adjustment of working procedures aimed at enhancing performance and improving efficiency on an ongoing basis. In addition, a formal organisational structure is best suited to deal with predictable and repeatable work that needs to be done efficiently and with little variance. Thus, the formal organisation can be constantly improved in such a way as to enhance efficiency and remove variation. However, a formal organisation has some difficulties in adapting to changing and unpredictable situations: routine-based and stable formal processes therefore tend to jeopardize the dynamic behaviour and the ability of an organisation to adjust to uncertainties and unclear environments.

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[142] The content of this section has been published as OVE GIT Newsletter (in German), "*Social Physics as a basis for Social Media or efficiency does not always guarantee an increase in productivity (Social Physics" als Grundlage für „Social Media" oder „Effizienz garantiert nicht immer eine Produktivitätssteigerung*)", May 2015 [Leopold2015f].

[143] Quote published in the New York Times, April 16, 2011, Distilling the Wisdom of C.E.O.'s, by Adam Bryant; from the Times book "*The Corner Office: Indispensable and Unexpected Lessons From CEOs on How to Lead and Succeed*", by Adam Bryant.

Here is where the informal organisation comes into play. The informal organisation provides an added value when unexpected or new situations arise, when work needs to be done across boundaries, when specifications are unclear, or when changes must be made [Katzenbach2010]. While a well-defined process can make a task more efficient, underlying social networks among employees can help single individuals quickly team up and join forces to solve issues that arise unexpectedly and therefore cannot be managed based on a predetermined process.

In addition to the formal methods of compensation, the informal organisation enables employees to tap into emotional sources of motivation that commit them in ways that the formal mechanisms cannot achieve. The informal organisation enables motivation outside the conventional reward system, facilitates collaboration across organisational boundaries and supports the change of behaviour of a whole organisation even when there are conflicts with the defined formal structures and processes. The same applies to innovation processes that are built upon creativity, new perspectives and heterogeneity and that foster cooperation across organisational boundaries. Rigid formal processes could be potentially in contrast with this objective.

Thus we can conclude that there are basic organisational elements that determine a company's productivity:

- Clear structures, processes, responsibilities and procedures are indispensable to guarantee a sound business management over the long term (formal organisation).
- Companies need to create structures that promote creativity, innovation and, most of all, a positive emotional climate and a spirit for cooperation; i.e. the informal organisation [Katzenbach2010].

In order to combine these two, sometimes contradictive, worlds, the following objectives have to be taken into account:

- Harmonising employees' freedom with management guidelines, resulting in effective communication between management and employees. Setting priorities and ensure ongoing communication, is a crucial necessity (Always being aware, that too much freedom could lead to ineffectiveness).
- Striving to infringe bureaucratic rules by empowerment.
- Minimizing complexity and preserving freedom of action.
- Just-in-Time Transfer of Knowledge from Informal to Formal.

5.3.1. Harmonising Employees' Freedom with Management´s Duties

5.3.1.1 Limited Structure promotes innovation

Leitner [Leitner2009] points out, by referring to Brown and Eisenhardt [Brown1997] that the presence of a "*limited structure with regard to managerial responsibility*" contributes to the promotion of innovation and this is absolutely indispensable so that employees have the "*freedom to improvise within current projects*." Although, managerial responsibility cannot be explicitly and in principle limited, since performing managerial tasks in compliance with the "duty of care" provisions and fulfilling specific communications and reporting requirements are inherent required duties of every manager.

As to employees' freedom, excluding clearly defined production processes, we can assert that project managers, technical engineers, product managers, etc., have to have decision freedom for their activities. No company usually can put forward a detailed set of guidelines for each single corporate process obliging technical development, product and project managers to stick to them. Quite the reverse, companies have to implement structures and processes that grant experts the necessary leeway to make innovative decisions for the ultimate benefit of the company (Compare also with the strategic planning and situated action discussion in Section 2.10 above).

At the same time it is principally essential, that an extensive communication exchange between management and employees take place. Principally but especially for new product innovation projects, it is very often not obvious which priorities to be followed: "in time", in "budget", "scope of the functionality", "stability of the system", etc. Project manager and development engineers are always challenged with the resolution of these often mutually contradictory project objectives.

The successful implementation in the organisation is only possible when an appropriate priority setting has taken place and is accepted by everybody. Thus effective communication between management and with the project environment in the organisation and with project partners is fundamentally important for a successful innovation management.

5.3.1.2 Too much freedom could lead to inefficiency

When goal orientation and clear management directive is missing, potential fundamental problems may arise in the organisation[144]:

- Often the behaviour of technical developers is not conducive to innovation. They work too long on details. The objective is to look for an absolute solution than to put it in the context of the important market requirements. Since many aspects need to be considered at the same time, neither the right nor most comprehensive information is elaborated (see also the findings by the study of Proctor and Gamble as described in Section 5.4 below).
- Strongly diverging points of views between marketing, sales, product management, product development, and production, which are not sorted out through discussions among the groups pose considerable challenges to effective corporate management. At this point it is important to note, that just a formulation of a "strategic plan" in a document is not at all guaranteeing that the strategy is commonly understood and followed by the different groups of an organisation. A comprehensive discussion and reflection within the organisation is fundamentally important that a strategy is "accepted" by the employees.

5.3.2. Striving to Infringe Bureaucratic Rules by Empowerment

By referring to [McCarthy2006] Leitner [Leitner2009] stressed how "*a spontaneous self-organized group is successful because it's not restricted by bureaucratic constraints* ….". If we take this statement literally it would mean that companies are, per definition, against successful innovation and they introduce bureaucratic rules to hinder it. Since we can assume that each company strives to be innovative, we must also understand the necessity of bureaucratic regulations within companies.

Employees seek to interpret the corporate system in such a way that they are able to meet their personal targets, while at the same time complying with the system. Each player permanently weighs up what and how much information can be shared with others (see the effect of "outcome

[144] Experience made by the study author during his different affiliations.

expectation" described below). This principle applies at any hierarchical level, be it a manager reporting to the management board, an employee reporting to the head of the team or simply to a colleague. The reasons behind this permanent weighing-up of what, when and with whom information can be shared to achieve a personal objective range from simple survival strategies within a company to the realisation of personal ideals and visions despite the existing set of corporate regulations.

However, structures are needed to enable employees to enjoy their decision making freedom. In a managerial context, this is usually referred to as "empowerment". Only through empowerment can the necessary decision-making speed be achieved to react to dynamic changes within companies. Nevertheless, it is extremely important to harmonize corporate guidelines, corporate strategies and efforts to act in an economically responsible and diligent manner with the unpredictable dynamics of creative developments.

5.3.3. Minimizing Complexity and Preserving Freedom of Action

Too much control by rules and administrative overhead is increasing the complexity and the work load and limits the freedom of action. Sound programme management and reporting processes have to be implemented to minimize the complexity of the firm´s internal organisational management. Pro-active reporting, use of methodologies for information providing and effective IT-tools are key factors to deal with this issue.

5.3.4. Just-in-Time Transfer of Knowledge from Informal to Formal

It is important to note that contrary to other objects, knowledge cannot be simply shifted around and easily stored and retrieved (a more detailed discussion on data, information and knowledge is provided in Chapter 3).

Instead of collecting and hoarding information for just in case purposes[145], it is deemed more efficient to take into account "just in time KM" concepts [Snowden2002]. In this way, we build upon self-organisation and self-management models within complex environments to enable knowledge transfer to a formal knowable domain on a "just in time" basis.

Tools for just-in-time knowledge transfer include for example [Snowden2002]:

- Organisational story telling ("flagging by subject matter");
- Expertise location systems: as opposed to well-defined "expert lists", which are officially communicated within the organisation, a process is in place, where a knowledge seeker looking for expertise asks for support and a knowledge holder, properly informed about this request, decides to share his knowledge on a voluntary basis. This kind of knowledge transfer

[145] Knowledge Management (KM) is about making the right knowledge available (what) at the right time (when), at the right place (where) and, to the right person (to whom). Thus, successful KM within an organisation involves several processes [Begona-Lloria2008, Prusak2006]: i) identification of knowledge; ii) knowledge creation or knowledge development: this describes the processes of knowledge development within organisations and knowledge acquisition, e.g. by acquiring other organisations, and is also strongly based on the combination and re-use of existing knowledge; iii) knowledge retention, which encompasses those processes, in which knowledge becomes embedded in the routines, processes, human practices of certain groups of people within organisations (i.e., how to perform tasks and fulfil roles) with a view to consolidating knowledge and preventing it from disappearing; and last but not least iv) knowledge transfer (distribution, dissemination, transfer, sharing, etc.).

is based on mutual trust and motivation, which in turn will result in considerably higher efficiency (reduced costs and greater impact).

It goes without saying that the motivation factor is crucial for the success of such a process.

- Creation of 'ad-hoc' formal communities, marked by a common sense (similar expertise, similar problems to be solved, etc.). Swarming, i.e. the "wisdom of the crowd", can be used where no naturally occurring clusters can be identified.

To summarize, knowledge management is not just about managing employee knowledge, it also concerns their networking within a company. Even more, it is also about the consideration of the embodied actions around the processes of information exchange and communication within organisations. Therefore, the organisation of knowledge management has to be further developed from the simple management of individual knowledge building blocks towards a more holistic view of knowledge management, which in-turn will lay the foundation for the company's innovation, productivity and quality leadership.

5.4. Employees´ Motivation

The management at Procter and Gamble recognized early on that in most firms researchers investigate those problems that are most compelling for them and not those that might necessarily contribute to generating corporate growth[146]. As a result, a discussion process was started which sought to identify scientific and technological issues based on the most important questions raised by the market and customers, and, in a second step, to find solutions in other technology and specialist areas outside the company [Huston2006]. Thus, they followed an open innovation approach as well as an user driven approach to overcome the internal limitations of available skills and competences but also to align the strategy and focus of work in the organisation. However, this could lead to problems with the motivation of employees.

The question is now, how can we direct or channelize the motivation of knowledge-workers within an organisation to gain maximum gain from the organisation and still support the power of self-determination of highly skilled knowledge-workers?

Harold Leavitt and Homa Bahrami describe in [Leavitt1988] very comprehensively the different factors to be considered when people are working together. These factors are psychological effects and behaviour of individuals (such as motivation reinforcement, and cognition), relationship issues among people, effects and mechanisms in small groups, as well as mechanisms between organisations and their environment.

We will focus on the motivation and effects which determine employee´s behaviour for open communication within organisations in the following.

[146] This goes in line with the authors experience at AIT. Researchers are comparing themselves with other peers in the world; the cooperation with their own colleagues in the company is not necessarily seen as relevant for their career.

5.4.1. Intrinsic Motivation

According to Adam M. Grant[147] und James W. Berry[148], intrinsic motivation is mainly responsible for fuelling creativity [Grant2011]. Intrinsically motivated employees show enhanced learning skills and develop a cognitive flexibility that proves instrumental in supporting high-risk and more complex problem solving approaches.

Thus, granting a higher level of autonomy to staff members, using feedback and evaluation processes for employees' performance as well as integrating customer feedbacks in the development process at an early stage are elements which support intrinsic motivated employees. The sheer joy of experimenting of intrinsically motivated knowledge-workers and researchers become a central driving force in the early phases of the innovation process.

Intrinsic motivation is based on psychological behaviour patterns that are directed towards combining intuitive approaches with internalized value systems. Therefore, intrinsic motivation fulfils a filtering function when processing information. This filtering function is relevant for the creativity phase, but also for the cooperation processes within the organisation.

After a creativity phase when novel ideas have been generated in a first step, they have to be translated into something useful to fully leverage the economic potential of innovations. Especially when a wider cooperation is required within an organisation, which is very much relevant for the implementation of new ideas within the organisation, this filtering function by motivation is a very essential factor. When something new is implemented within an organisation we need an alignment of many people within an organisation. In this context, Grant und Berry ascribe "prosocial motivation" a decisive mediation role.

5.4.2. Prosocial Motivation - The Necessity of Others

In their 2011 published essay "*The Necessity of Others is the Mother of Invention …"* [Grant2011] Grant and Berry pose a central question:

> "*How can such a great variety of motivation patterns showed by knowledge-workers with regard to self-determination, the definition of targets and priority setting not only be supported and encouraged but also channelled in the right chronological order within the process?*"

According to Grant and Berry this alignment or mediation occurs via "perspective taking". "Perspective taking" refers to a cognitive process, where single individuals attempt to understand the preferences, values and needs of other people by adopting their perspectives.

This method adds new perspectives to previously generated ideas and innovations, which have hitherto proved unable to make an effective contribution to the decision-making process. More concretely: the integration, for instance, of customer perspectives in the product development process generates a certain added value, which ultimately demonstrates the real strengths of this psychological approach. For Grant and Berry "perspective taking" offers the possibility to break up rigid organisational structures that hinder successful innovation management.

[147] Adam M. Grant is associate professor at the Wharton School of Business of the University of Pennsylvania in Philadelphia.

[148] James W. Barry is assistant professor at the Department of Economics of the Cornell University in Ithaca, New York.

To summarize, successful innovation - creativity and implementation of an idea within the organisation - captures first of all a strong intrinsic motivation as well as extrinsic motivation, such as image gains and monetary rewards. However, this positive effect is always compared with the potential negative effects due to potential conflicts within the organisation.

5.4.3. Outcome Expectation and Willingness of Employees to Present Ideas in an Early Status

People have long been known to act upon the expected consequences of their actions [Doerner2012, Yuan2010], [Baer2012] referring to [Vroom1964], and [Lunenburg2011]. [Janssen2003] showed that innovative behaviour often created conflict with co-workers that, in turn, resulted in less satisfactory relationships with those individuals. In addition, ideas may fail to produce anticipated results; thus employees will lose reputation and may experience to lose the trust of friends and sponsors [Yuan2010]. This leads to an **outcome expectation** behaviour of employees. The outcome expectation captures the extent to which employees believe that their efforts will result in certain desirable outcomes. This outcome expectation was conceptualized by Yuan and Woodman and is referred to as **implementation instrumentality** [Baer2012].

The extent to which individuals expect a positive outcome, determines the willingness of open communication as well as the spend effort for implementing an innovative idea within the organisation; or as [Baer2012] summarizes it:

> *"Given these prospects, employees are unlikely to mobilize sponsorship and obtain advocacy in an effort to influence important resource allocation decisions, unless they believe that such efforts offer significant returns"*.

The potential negative impacts stimulated by new ideas and thus innovation within an organisation have an important power in determining success or failure at the end. Self-efficacy and outcome expectation are relevant factors which determine the creativity but also the implementation instrumentality.

5.4.4. Self-Efficacy and Outcome Expectation

Besides the effects of intrinsic motivation, prosocial motivation, and outcome expectation to understand and determine the behaviour of employees, there is a further important issue to be considered according to social cognitive theory: "self-efficacy".

Self-efficacy describes the personal judgement of one's own capabilities to perform successfully a dedicated task. Albert Bandura summarizes in [Bandura1977]:

> *"Expectations of personal efficacy determine whether coping behavior will be initiated, how much effort will be expended, and how long it will be sustained in the face of obstacles and aversive experiences."*

It is important to note that self-efficacy does not describe the personal skills, but the personal judgment of what can be achieved in the light of personal capabilities within the context of the environment. Thus, self-efficacy is a further essential factor which determines an employee´s choice of activities, especially when facing obstacles and barriers.

Employees who don´t believe that dedicated tasks can be accomplished by their personal capabilities tend to avoid these tasks (low self-efficacy), whereas people who judge their capabilities higher (high

self-efficacy) tend to spend the effort to accomplish a specific task, even when facing difficulties and barriers [Doerner2012].

Following this understanding, [Doerner2012, page 15] defines an "innovative self-efficacy" as a

> *"a person´s belief in their capabilities to produce innovative outcomes."*

Nadin Dörner identified in her study [Doerner2012] that outcome expectations and self-efficacy are not independent of each other. She states that outcome expectations do not independently contribute to innovative work behaviour. Self-efficacy is the important determining factor which influences also the outcome expectation.

Creativity and implementation are neither synonymous nor necessarily positively related. Even when creativity may be negatively received within an organisation, individuals can improve the probability that ideas are implemented. When employees are motivated and have self-confidence, and understand the disruptive innovation aspects better, several potentially innovation jeopardizing effects within the organisation can be balanced. In order to create a culture, which supports an innovative attitude based on the positive motivation of individuals, corporate values should support objectives such as [Gundling2000, Massar2008]:

- support individual capabilities,
- provide equal opportunity,
- encourage the initiatives of each and every employee, and
- respect the dignity and worth of individuals.

According to Nadin Dörner [Doerner2012], outcome expectations do not independently contribute to innovative work behaviour. In this context "*self-efficacy*" is a key characteristic for employees´ innovative work behaviour. Self-efficacy is the important determining factor which influences also the outcome expectation, and is the basic motivation factor to overcome stringent hurdles within organisations when acting innovatively.

An employee´s self-efficacy can be stimulated and increased by several organisational and management means such as self-evaluations, organisational support for innovation, and co-worker exchange [Doerner2012, page 89]. In more detail concrete measures are [Doerner2012]:

- communicate high performance expectations and express confidence in the employees capabilities;
- give positive feedback on innovative behaviour;
- managers should serve as a role model;
- the organisation should create an innovation-supportive environment;
- the organisation gives the employees the possibility for vocational training and experiencing communication and discussions to improve their interpersonal skills;
- the organisation should encourage employees to establish relationships with co-workers and create an environment that encourages social bonding through open ad understandable communication;

- provide employees with the possibility to observe various role models and sharing of experiences with co-workers;

5.5. Barriers to Successful Knowledge Sharing within Organisations

To summarize the discussion so far, effective and efficient communication and information exchange to let knowledge flow through the organisation are the fundamentals of any successful organisation. In this context it is important to note that, as elaborated above, in contrast to other objects, knowledge cannot simply be shifted around and easily stored and retrieved.

Expertise is largely tacit and embedded in the context of being used [Ackerman2003, page 21]. This difficulty arises from both cognitive and motivational issues. Motivation, self-confidence, and ability are essential factors for an innovative behaviour of employees [Ram1987, p. 208]; respectively the lower these factors are the higher is the "resistance to change" (see Section 6.4 below).

Referring to the literature discussed we can identify the following issues as essential barriers for a successful knowledge transfer. All those effects might potentially jeopardize effective communications process and thus the innovation management process within a firm:

1. Partial knowledge [Snowden2002];
2. Cost of codification and knowledge transfer [Snowden2002];
3. Group identity [Ackerman2003a, Ackerman2003b];
4. Outcome expectations and risk judgement for personal objectives [Baer2012];
5. Risk to jeopardize existing personal relationships;
6. Missing trust among the communicating partners;
7. Missing cultural norms and no culture of reciprocity [Prusak2006];
8. Personal factors for stickiness of knowledge [Szulanski2003, Durant-Law2012];
9. Too much rules prevent information sharing [Ackerman2003a, Ackerman2003b];

We will discuss these issues in more detail in the following.

5.5.1. Partial Knowledge

Experts often „know", but cannot explain why [Ackerman2003a, Ackerman2003b]. It is not always possible to fully understand an information domain exhaustively. Therefore, knowledge tends to be incomplete or partial. The great majority of real life problems have to be solved based on limited availability of information and a finite amount of time, which considerably affects any decision-making process. Therefore, "know-how-much" and "know-when" are important assets for any business decision-making process.

In addition to this basic "knowledge problem", there are additional factors that determine the information transfer process [Snowden2002]:

(1) Knowledge transfer depends on the willingness and motivation of the individual; i.e. it can only take place on a voluntary basis and it cannot be imposed for the very simple reason that we can never truly know if someone is passing on all of his/her knowledge. We can only verify whether it complied with a defined process or quality standard.

(2) We can always know more than we can say and we will always say more than we can write down. The nature of knowledge is such that we always know, or are capable of knowing more than we have the physical time or the conceptual ability to articulate. When speaking, producing a PowerPoint presentation, writing short notes or even a whole book, it will always just be a subset of the available knowledge of a person.

In addition, it is important to note that knowledge development takes place through the process of saying and writing something different. The process of writing something down is referred to as reflective knowledge; it involves both adding and taking away from the actual experience or original thought. Reflective knowledge has a high value but it is time-consuming and results in a loss of control over its subsequent use.

Improving the effectiveness of decision making in a business context is a crucial objective for a successful business operation. Thus, knowledge management approaches usually focus on managing knowledge with the ultimate goal to make sure that the right information (what), is available for the right person (who) at the right time (when) and to find out how much information is necessary to make the right decision. But this implies Taylor's view that we can know with certainty where all relevant what-who-when takes place – but this is the problem – we often don't or will ever know given the numerous specifics of any employee encounter with the world. This leads to the next essential issue of partial knowledge.

(3) We only know what we know when we need to know it. Human knowledge is deeply contextual: it is triggered by circumstances. To be able to understand what people know, we have to recreate the same context. Thus, we have to ask a sensible question within a context, to determine what someone knows. To summarize, even if we are willing to transfer our knowledge and we know what we know, we cannot specify in advance what we need to know as an organisation and when we need to know it! Therefore, we have to deal with a basic uncertainty. This stresses the importance of "know-when" and "know-how-much" knowledge.

Finally, it is important to note that, especially in the organisational and business context, the main limitation is represented by the amount of time available to collect, process, and interpret data and information. Thus, managers always have to judge how much knowledge is necessary to make business decisions, as "*know-how-much knowledge*" is of crucial importance in a corporate context.

5.5.2. Cost of Codification and Knowledge Transfer

It is crucial to understand that any knowledge transfer implies considerable efforts [Snowden2002]. Thus, a person must have a strong motivation to make such an effort: added value, prestige or even social objectives are driving forces in this context.

There are minor costs involved if a person does not extensively share his/her knowledge with someone else. However, a certain amount of effort might be still required to make knowledge simply available. On the contrary, substantial efforts are necessary to share knowledge with other people, as it is essential to create a common context and use a common language to achieve a level of common understanding. But such an attempt, to create a common language, implies a considerable effort on the part of the persons involved. Different group situations stimulate different levels of effort and attitudes [Snowden2002]:

(1) A colleague within a well-established team is looking for support and asks a question to another colleague within the same team. A brief exchange takes place in the context of common understanding and mutual trust and knowledge is transferred.

(2) A colleague, who is not part of the team, asks the same question. In order to establish a common understanding and a common context to receive a useful answer, additional efforts and time resources are needed.

(3) An expert is asked to codify his knowledge for potential future use, without a specific context. Even if this expert is willing to do so and writes a book, for instance, the codification of his complete knowledge is not feasible, as it is impossible to capture the full complexity of his know-how and to anticipate future needs. We discussed this effect already in Section 5.5.1 "*Partial Knowledge*" above.

5.5.3. Group Identity

A natural result of being organised in units or teams is the tendency of individuals to identify themselves emotionally with the team. The individuals desire for positive self-evaluation (social identity theory) leads to an in-group bias in which they attribute positive characteristics to their own group and negative characteristics to other groups. This attitude supports a reduced cooperation within companies [Ackerman2003a].

5.5.4. Outcome Expectations and Risk Judgement for Personal Objectives

Outcome expectations refer to the extent, to which employees believe that their efforts will result in a desirable outcome as discussed in Section 5.4.3 above. The extent to which individuals expect a positive outcome, determines the willingness to communicate openly and devote concerted efforts to implementing an innovative idea within the organisation [Baer2012].

Basically, every employee tends to achieve his/her own objectives, regardless whether such objectives are defined by the organisation through management, or whether his/her intrinsic motivation is the driving force. And Orlikowski´s groupware research 1993 showed that people do not share information, when they expect that this information will be used against them finally [Ackerman2003a].

Thus, every communication effort will be judged in advance, regardless whether it will contribute to achieving employees´ personal objectives or it will ultimately jeopardize their personal strategy. Only when this is answered positively by an employee an open communication takes place within the organisation.

5.5.5. Risk to Jeopardize Existing Personal Relationships

New ideas or approaches might jeopardize employees´ personal position or even disrupt existing processes and organisational structures (see Section 5.4.3 above). Thus employees usually tend to void any tension when it is not really necessary for their own objectives – see section above. However, there is an additional important issue to be considered: personal relationship. Employees will always judge whether their actions are jeopardizing existing personal relationships:

- New ideas or approaches my jeopardize the position of co-workers or are in contradiction to existing processes and organisational structures. This generates pressure on colleagues and co-workers and might endanger existing personal relationships.

- Ideas which may fail to produce originally planned results (independent if this happened because of partial available information, or because of having taken a considerable risk at the beginning), employees will lose potentially reputation and may lose the trust of friends and sponsors in the organisations.

5.5.6. Missing Trust among the Communicating Partners

Sharing of information as well as other personal entities requires trust. Organisational actions that destroy trust, such as downsizing or restructuring, induce fear, make the finally transfer of expertise less likely [Ackerman2003a, p. 15].

The factors mentioned above are strongly influenced by the fundamental issue of "missing trust" between communicating partners, i.e. when the knowledge source´s credibility is questioned and when there is a missing relationship between source and recipient. Missing trust is also closely related to the risk involved in sharing knowledge, when judging the potential outcome of transferring knowledge to co-workers, friends or the management.

Employees might be willing to exchange information with their network contacts, for example, with their cooperating partners within the company, only if the exchange is based on a number of tangible assets such as potential support in the future in exchange for the sponsorship [Prusak2006] referring to [Kanter1983]. When knowledge and information are passed on, there has to be an open-minded culture in place and everybody has to realise that information transfer will never have negative repercussions on the employees. Otherwise, no culture of "reciprocity" can be established within the organisation (see section below).

It goes without saying that this issue has to be viewed in the broader context of "outcome expectation and risk-judgment" as discussed above. However, missing trust represents a slightly different element. In addition to aspects such as the achievement of personal objectives, the potential risk of losing existing relationships, or endangering personal objectives, missing trust refers to a person's low level of motivation to make an effort for someone else, when trust is missing in the relationship.

5.5.7. Missing Cultural Norms and No Culture of Reciprocity

To summarize, knowledge is temporary and the timing depends on the organisational situation, but it is also tacit, thus depending on the motivation level and the type of relationship that exists between employees within a community. We can, therefore, conclude that knowledge is sticky and largely depends on cultural issues. Essentially, cultural factors influence the kind of information and knowledge management processes that are in place within organisations. Prusak summarizes this phenomenon with the phrase "*culture filters knowledge*" [Prusak2006][149].

It is important to note, that culture has to be seen as a soft factor. Firms and knowledge management discussions often tend to ignore the culture element, working under the assumption that knowledge is the same thing to all people, at all times, and in all places [Prusak2006].

[149] [Prusak2006] describes different cultural characteristics which influence the communication and knowledge management essentially: individualistic – holistic, short term - long term, high context - low context, public – private, shame – guilt, agency – destiny, direct – indirect, tangible – intangible, Low trust – high trust, local – cosmopolitan, universalist – particularist.

A corporate culture is a pattern of collective beliefs, a set of shared values, behavioural guidelines and norms that provide people with a code of conduct and a common identity [Bessant2003, Prusak2006]. It is an essential objective within an organisation to establish a positive corporate culture based on trust, which supports potentially risky knowledge transfer processes and raises employees´ motivation for open communication. Such a corporate culture has to be based on specific cultural norms and a culture of reciprocity among co-workers. This is in line with the so-called "gift economy"[150] as described by [Noubel2007].

Thus, a creative and innovative organisation which wants to build on cooperation and team working has to ensure interaction processes that contribute to the development of trust within the organisation [Durant-Law2012].

These factors, outcome expectation, risk-judgement, missing trust, and missing culture of reciprocity as discussed above, are a major concern of any company´s internal communication process which is very often under-estimated by the management in place.

Sharing expertise requires building a culture of trust and any organisation action or structure that destroys trust adversely affects the motivation of sharing information [Ackerman2003a]. Ackerman [Ackerman2003a] summarized that successful organisations with effective knowledge management processes have both formal and informal reward systems that provide

- status,
- recognition, as well as
- material rewards to those who helped others and shared knowledge and not to those who build knowledge silos.

5.5.8. Personal Factors for Stickiness of Knowledge

Szulanski [Szulanski2003] describes the problem that knowledge does not flow easily throughout an organisation even when knowledge is made available with a principle "stickiness" of knowledge. Knowledge is referred to as "sticky" when it requires significant efforts to be shared, or when the required actions or processes to identify and unlock knowledge are inherently complex.

This is because of tacit knowledge which is learned by experience and held by unconscious level or knowledge is embedded and difficult to extract from the particular situation or environment [Lave1991]), or because of the large number of stakeholders involved, or when knowledge is embodied in communal knowledge which is hard to pass on. Transfer of knowledge is often just possible through apprenticeship.

Knowledge sharing requires the transfer of knowledge across boundaries along with the development of a shared understanding [Ackerman2003, page 14]. [Durant-Law2012] lists nine reasons behind knowledge stickiness (referring to [Szulanski2003]), which we can categorize into four groups:

(1) Knowledge as such is challenged. Knowledge is not accepted as common knowledge; e.g. there is still a number of perspectives that have not been taken into due account yet or knowledge has a weak evidence base.

[150] "Gift economy" means, that there is a dynamic of giving in exchange for participating in the benefits of the community [Noubel2007].

(2) The knowledge source is the limiting factor. There are three potential reasons:

   a. When the potential success or failure of a knowledge transfer is still unknown there is a basic ambiguity and thus knowledge will not be transferred.

   b. The knowledge source's motivation to codify or transfer knowledge is weak. The process of transforming individual knowledge into a business asset requires usual substantial personal resources. In order that knowledge becomes institutionalized in the firm, the commitment of the concerned employees in an organisation, resulting in a positive motivation to accept this additional effort, is essential. In addition the organisation has to have supportive processes and tools in place that the efforts of individuals could be minimized.

      The source´s motivation to take additional effort for knowledge communication has been discussed above under “outcome expectation and risk judgement”, “trust”, as well as “cost of knowledge transfer”.

   c. The knowledge source's credibility or status might be questioned. When the source of the information is not credible, the receiver is raising potential doubts about the information received and thus ignoring the communication efforts made by the source.

   Further reasons are the low ability of experts to articulate knowledge to novices, as well as the low ability of experts to articulate their individual knowledge in such a way that it can be loaded into an information system for later retrieval [Ackerman2003a].

(3) The knowledge recipient is the limiting factor. There are three potential issues:

   a. The recipient has a low level of motivation to seek new knowledge.

   b. The recipient's absorptive capacity is weak due to missing skills.

   c. The recipient's absorptive capacity is weak, if the recipient has to deal with large workloads.

   These factors are in relation to issues of the “*attention economy*” as described in Section 2.12 above.

   In addition we have to add, that the recipient has to have the possibility to have access to new information. This requires additional means such as available time, possible access to other people, etc.

(4) Missing relationship between source and recipient, which has basically two reasons:

   a. The relationship between the knowledge source and knowledge recipient does not support an effective information exchange because of poor personal relationships.

   b. The organisational context is not based on an open-minded culture to take into account or accept new ideas or innovations from other sources; often referred to as “not invented here – sceptics”.

All the factors mentioned above play a crucial role for the type of cultural atmosphere established within an organisation, as analysed by Christensen´s “innovator´s dilemma” described in Section 2.7 above.

Based on all this aspects discussed so far we can derive a model of innovation resistance which will be discussed in the following.

5.5.9. Too much Rules Prevent Information Sharing

In systems constrained by rules, information sharing is not the obvious behaviour of the employees of organisations. Ideal information sharing processes allow relationships and shared interpretations with less rigid organisational control [Ackerman2003a]. According the so called “reactans theory” the attitude is even the opposite [Ackerman2003a, p. 14].

6. The Implementation of Creative Ideas in Organisations

Ideas are useless unless used[151]

Theodore Levitt

"*The features of successful ideas have more to do with the likelihood of gathering political support than with the likelihood of the idea to produce results*"[152]

R. M. Kanter, 1988

6.1. New Technologies affect the Environment and Vice Versa

6.1.1. "Internet" – a Technology for Simplification of Communication Shaped by the Users

Habermas criticizes the new media by stressing the fact that due to an information overflow, i.e. the overwhelming amount of superficial and irrelevant information available on the Internet, it has become increasingly difficult to filter and retrieve truly essential information from the huge amount of trivial communication currently underway on social media [Habermas2006].

In the publication "Critical Theory of Communication Technology", Andrew Feenberg[153] draws the opposite conclusion [Feenberg2009, page 4]:

> Critics of the Internet "… *overlook the human significance of the technology. They focus on the triviality of most of the communications but they fail to realize that without opening a channel for trivial speech, there can be no serious speech."*

Feenberg maintains that the critics of the Internet and the new media tend to oversee the important role played by the single individuals, i.e. the technology users, in the technology shaping process, when judging the new cyberspace applications. They mainly focus their criticism on the fact that most of the communication that takes place via these technologies is trivial, while failing to realize that if no communication channel for trivial communication is provided on the basis of modern IT technologies, no serious communication i.e. no serious expression of one's own opinion outside the institutionalized media can take place.

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[151] http://www.cyrielkortleven.com/69-amazing-creativity-quotes/ (last access: 24.4.2017). Theodore Levitt was born 1925 in Germany and was an American management theorist and economist. He was professor at Harvard Business School and was editor of the Harvard Business Review and died 2006 in Massachusetts. He is well known for popularizing the term "globalization"; http://www.nytimes.com/2006/07/06/business/06levitt.html?ex=1309838400&en=959815b0e89ed1c2&ei=5088&partner=rssnyt&emc=rss (last access: 24.4.2017); Barnaby J. Feder, „*Theodore Levitt, 81, der die Bezeichnung ´Globalisierung´ prägte, ist tot*", New York Times, July 6th, 2006.

In 1983, he proposed a definition for the real corporate purpose: "*Rather than merely making money, it is to create and keep a customer*." (https://de.wikipedia.org/wiki/Theodore_Levitt (last access: 24.4.2017).

[152] [Kanter1988]

[153] Andrew Feenberg is Canadian Philosopher, born 1943. He is focusing on philosophy of technology and critique of technology and science. He holds the Canada Research Chair in the Philosophy of Technology in the School of Communication at Simon Fraser University in Vancouver.

The latter had in fact a sort of monopoly on public opinion (one-to-many) up until the emergence of Web 2.0. The introduction of online social media has therefore broken this supremacy and the uncontested market power of traditional media (print, radio, TV, online media such as e-zines[154], etc.). Even if the 'anti-internet' stance adopted by technology critics can be viewed as plausible and it is, to some extent, true that communication on online social media consists for the most part of trivial interactions and self-portrayal, intellectual stimulating and well-founded opinions (blogs, discussion platforms, etc.) can offer valuable counterpoints to classical media especially in the political, cultural and scientific domain, leading to a multitude of perspectives and viewpoints on a number of issues. This applies, for instance, to "grassroots journalism" with the slogan "*We the media!*", as well as to the successful proof-of-concept user generated content (UGC) project "Colourful TV Engerwitzdorf"[155] as an interactive local community information channel and a predecessor of YouTube in Austria (see page 3).

Fact is that without Web 2.0 no trivial or serious communication would be possible beyond traditional media. But since Web 2.0 is a technology for all, it also finds universal application among users. And in principle, the relation between trivial and serious communication on the Internet reflects the real social relationships between the public at large and the marginalized group of the educated elite.

Thus, the question as to where the boundary between trivial and serious communication lies, cannot be really answered. A simple "like", for instance, can possibly represent a relevant and substantive piece of information, if it has been preceded by a substantial contribution to a debate. By subscribing to a blog, following a tweet or signing up to a RSS feed, we are expressing agreement with certain topics and authors.

To be able to find and retrieve serious content from the flood of trivial data currently available online, corresponding web-search skills and tools (semantics) are required, which effectively support the quest for relevant information. We need adequate attention tools, such as search engines and big data analytics, to easily filter and retrieve relevant content from the global flood of information; this relates to the discussion on the "attention economy" as discussed in Section 2.12 above.

Thus, Habermas is certainly right when he claims that it has become increasingly difficult to find substantially relevant information online. And Feenberg, on the other hand, is equally right when claiming that only a technology with human significance has succeeded in creating a new kind of freedom of expression. The imbalance between trivial and relevant content is the result of the humble contribution that our society is bound to make to reap the benefits of this outstanding achievement.

In the end, it is up to us to decide how we want to deal with the Internet. For instance, nowadays the great majority of "digital natives" are willing to disclose personal data to have the possibility of engaging in instant and personalized communications in return.

6.1.2. "Internet" – a Process of Ongoing Development

Andrew Feenberg puts further the hypothesis that the Internet is not a finished technology but is rather undergoing a constant process of evolution and transformation [Feenberg2009]. Besides, the

[154] Some electronic online magazines call themselves "e-zines" or "webzines". They distribute their content usually by e-mail; https://en.wikipedia.org/wiki/Online_magazine (last access: 24.4.2017).

[155] In German: "Buntes Fernsehen Engerwitzdorf".

Internet is characterized by a basic openness towards new and innovative developments that trigger enormous market dynamics. Thus, the Internet is not a "just a technology on its own" but rather a process of ongoing development shaped by the user. Technologies do not exist for their own sake; they fulfil a purpose only when they are applied by humans. This theoretical stance is reminiscent of the philosophical theories of Kevin Kelly "*What technology really wants*" [Kelly2010] as discussed in Section 2.1 above.

"*What technology really wants*" is illustrated in the most plastic of terms by today's forms of interconnected communication. At the beginning, the Internet was a mere network of hosts and servers for the steering of communication streams and the representative depiction of information and know-how. Now, a vast array of "apps" services every aspect of our lives, creating a networking infrastructure, in which information is exchanged by billions of connected individuals. In this way, the evolution of technology guarantees the continuing further development of society.

Andrew Feenberg [Feenberg2009], Kevin Kelly and Brian Arthur highlight the recognition that technologies always develop in parallel; i.e. in multiple locations simultaneously and sometimes even fully independently from one another. For instance, a bicycle with a big front wheel and a small back wheel allows for more speed, whereas a bicycle with equally sized wheels enables comfortable driving [Feenberg2009, Feenberg2010b]. But it is up to the end-users to ultimately decide (via certain market mechanisms) which one of the two alternatives is pursued and thus doomed to survive the next technology development stage and which one, on the contrary, is to be eliminated during the evolution process. In a further step, a solution is developed and brought to fruition along the product life-cycle to specifically meet certain challenges and is consequently applied for a certain lifespan. It then reaches its end of life, when a new disruptive technology emerges that can better fulfil the same requirements as the current technology.

This means that an incremental further development of a product is by no means less valuable than the search for disruptive technologies (see also Section 2.5 above), as postulated by certain companies and innovation theories. Quite the reverse, the continuous incremental further development of a technology is integral part of the technology shaping process as it makes sure that the technology really meets the requirements of both users and society.

The Internet has definitely not achieved this end-of-life stage yet and this won't happen any time soon. Against this backdrop, this comprehensive social transformation process, which began with the 'fifth Kondratjew wave'[156] and has now reached the next development stage in the new millennium, can be viewed as one of the most powerful and irreversible paradigm shifts in human history, whose magnitude cannot be fully grasped from today's perspective.

6.1.3. Every New Technology has its Advantage and its Price – a Permanent Adaptation[157]

In our post-industrial network and knowledge society, information technologies are omnipresent. They have gathered unparalleled momentum in the past decade, turning from mere data processing devices into social media. People all over the world, in particular the "digital natives" who have grown up with these technologies, use them as a matter of course in both their professional and

[156] https://de.wikipedia.org/wiki/Kondratjew-Zyklus (last access: 24.4.2017).

[157] The content of this section was published as OVE GIT Newsletter, October 2014, "*Technology – more a social than a physical phenomenon*" (last access: 24.4.2017) [Leopold2014b].

private lives. The interactive and peer-to-peer communication patterns, user generated content (UGC), the possibility of combining social context information and making them available to the other users lead to the new broadly accepted Web 2.0 communication paradigm (as discussed already in Section 4.3.7 above).

However, this broad usage with Web 2.0 technologies also has a downside. There are far-reaching implications for both society at large and individuals and no one seems to be currently really aware of them. Technologies do not simply exist as a natural or God-given phenomenon. Rather, they are an integral part of a highly inter-correlated network of framework conditions, to which their origin and further development are attributable. Thus, technologies always have a concrete "history" and are determined, at least to the same extent, by both nature and society. In addition to the physical laws that regulate their proper functioning, the new specifications and meanings attributed to them by users in the course of their application also play a vital role.

As the Canadian philosopher, Andrew Feenberg points out, when using technologies we are subject to the technical illusion that our technology usage will remain without consequences [Feenberg2009, Feenberg2010a, Feenberg2010b]. We have to recognise, that any single technology-based interference with our world affects us either in the form of a comprehensive social change or by impacting our nature.

Social networks and our current mobile and smart phone culture, unmistakably demonstrate the ethical consequences of this illusionary and all-pervasive use of technology. By turning to online social media, we seek to escape the hardship of reality by seeking refuge in the glamorous world of the virtual space. This virtual reality does not remain without consequences for our privacy, identity and social relations, but also for democracy, freedom and the entire public sphere [Feenberg2009, Feenberg2010a, Feenberg2010b].

Thus, on the one hand, we need to find ways to protect our privacy from public exposure and, on the other hand, we also need to prevent the public domain from being too saturated by the private information overflow. With our smart communication tools we enter a sort of "*present, absent mode*"; referring to the behaviour that we are mentally distracted from the reality of a face-to-face situation despite our physical presence[158]. This results in a disengagement from our real social

[158] "*Present, absent mode*" is a term, which goes back to the studies of Kenneth J. Gergen, from Swarthmore College. He published this term in "The Challenge of absent presence" in James E. Katz, Mark Aakhus (eds.) "Perpetual Contact - Mobile Communication, Private Talk, Public Performance," 2002 [Gergen2002].

Christine Rosen, senior editor of "The New Atlantis" in the essay "Our Cell Phones, Ourselves", number 6, 2004, pp. 26-45, was also referencing to Kenneth J. Gergen: "*Kenneth J. Gergen, for example, has argued that one reason cell phones allow a peculiar form of diversion in public spaces is that they encourage "absent presence," a state where "one is physically present but is absorbed by a technologically mediated world of elsewhere.*" Christine Rosen is further stating: "*Cell phones have led to a radical disengagement in the public sphere*". This is in line with comments of Habermas that our Web 2.0 communication behaviour on electronic devices leads to a mass distraction from the public sphere. Electronic communications shifts conversation to connection only. The belief an online identity can replace identity in real life is a big misunderstanding. We suffer from a diminished capability to pay attention to others in face-to-face situations. Technologies provide the illusion of companionship without the demands of relationship.

environment and public sphere and we tend to show increasingly higher tolerance for this state of "*being alone together*"[159].

According to [Feenberg2009] we must rethink this correlation between technologies and social behaviour; we need to underpin our technologies with concrete values. Only values can be a guarantee of factuality for technologies moving forward. However, ethics cannot be simply imported into technological solutions. They must first be translated into the relevant technological language [Feenberg2010a]. This can be accomplished at best, if we provide technology experts with concrete feedback from user experiences, thus offering them a first-hand insight into specific realty aspects when designing new technologies.

Consequently, sustainable technology design requires something such as "technical citizenship" [Feenberg2011] or as we stated it in Section 4.4.1 as "technology literacy". This describes the possibility of taking informed and responsible action, as well as judging upcoming technological developments concerning their impact on society and environment. As a forward-looking community, oriented toward democratic principles, we have to offer citizens the opportunity to co-shape the technological universe with their own interventions. This will help us strike a long overdue balance between technocratic claims and a bottom-up approach. All modern forms of cooperation and collaboration within companies are based on the principle of participation and on defending the interests of all those involved.

Against this backdrop, the meaning and purpose of technologies originate from non-technical factors, or in other words, social selection determines the technical specifications, with the social factor being translated into a technical solution. User-driven innovation is an example of how the public can be democratically involved in the controversial debate on technology design. Such processes can lead to modified applications that fulfil new requirements.

Thus technology always raises the philosophical question of responsibility to steer the technological development, which we are required to answer as a society if we are to fulfil our educational task. Already Friedrich Dürrenmatt raised this question of the responsibility of the technician in his permanent seeking process to developing technologies in his theatre play "Die Physiker", 1961[160].

This constant process of "technology mediation and sense-making" by the users of technology will be explained in greater detail in following section by referring to the work of Weick [Weick2001].

6.2. Technology Mediation and Sensemaking

A new technology stimulates the necessity to adapt the system in two areas in parallel. On the one hand the new technology has to be adapted to be used in the proper way to fulfil the requirements of the business objectives and the implemented business processes in the organisation (in the IT world this is often referred to as "customization"). On the other hand a new technology always needs to be adapted to the organisational processes in place and well accepted within the organisation [Bansler2006, Davidson2005].

[159] "*Alone together*" is a term manifested by Sherry Turkle in their book, "*ALONE TOGETHER - Why we Expect More from Technology and Less from Each Other*", Basic Books, New York City, 2011 [Turkle2011]. She is Professor of Social Studies of Science and Technology at MIT and the founder (2001) and current director of the "MIT initiative on Technology and Self", http://www.mit.edu/~sturkle/welcome.html (last access: 24.4.2017).

[160] https://de.wikipedia.org/wiki/Die_Physiker (last access: 24.4.2017).

This inherent flexible nature of technologies brings some ambiguity and thus enables different usage patterns in different applications. [Bansler2006, page 62] uses the term “equivoque”, referring to [Weick2001, page 148], to describe the freedom or flexibility for different interpretations of the usage of technology by different people.

A good example is our well established e-mail tool. Although an e-mail system has a very simple set of functionalities, it happened that e-mails are used for many different communication and cooperation applications not originally intended by the inventors of the system. See the comprehensive research on the “richness of e-mail” [Snyder2011, Lee1994, Markus1994] summarized in Section 4.3.14.

This ongoing adaptation process of both, the technology as such and its usage patterns in the dedicated organisational context on the one hand and at the same time changing the environmental framework condition such as organisational processes, approval and decision rules, etc., is referred to as technology-use mediation [Bansler2006, page 56] by referring to [Orlikowski1995]. Bansler refers in this context to “*second-order or ‘meta’ - structuring of technologies in use”* [Bansler2006, page 59].

This process of alignment of the technology usage patterns of employees with their organisational environment and working practices in such a way that they make sense in the execution of their work tasks is called “sensemaking” [Weick2005]. Weick states:

> “*Sensemaking is the process with which people, individually and collectively, produce meanings for the usage of a certain technology*” [Bansler2006, page 57] by referring to [Weick1995].

This, “making sense" is an attempt to convert a world of experience in an understandable and meaningful world. It's not just about the passive gain in knowledge of the environment, but to design the environment so that it gives a personal sense. This involves the assessment of a situation but at the same time also to the current situation to change and evolve. Thus it is in the process of searching for a meaning of a situation; i.e. “making sense”. Because technologies are always open to many different forms of using, a person who is looking for the sense of technology as an observer becomes implicitly to a designers of the technology.

> *“The basic idea of sensemaking is that reality is an ongoing accomplishment that emerges from efforts to create order and make retrospective sense of what occurs”* [Bansler2006, page 60] by referring to [Weick1993].

Since the local context in organisations is always very specific and also the behaviour of employees is always very different in different firms, such a process is principally unpredictable and open-ended. Sensemaking is therefore not only a passive process of interpretation, but more an active process interacting with the environment. The dedicated usage patterns of employees of a specific technology will most probably affect the existing environment in the organisations such as processes, decision rights, and behaviour in communication and cooperation which have to be changed [Weick1995, page 32]. Thus, employee´s actions by adopting the new technology affect the environment, which in turn may react to these actions by constraining or enabling them.

> *“Sensemaking is a process of “action” as well as interpretation and that people “receive stimuli as a result of their own activity ... They act and thus participate in the creation of the environment they face, and this environment in turn constraints (and enables) their future actions.”* [Bansler2006]

Weick calls this process of permanent interplay between adoption of the technology and changing of the environment as "*enactment*", to describe the fact that "people often produce part of the *environment they face"* [Bansler2006, page 84] referring to [Weick1995, page 30]. The process of how rumours are developing over time is an example of such a process [Bansler2006, page 61].

This mutual dependency of technology and usage of the technology by the society is also discussed by Feenberg´s philosophy that each new technology has its price as discussed in Section 6.1.3 above.

To summarize, the process of sensemaking is determined by different factors:

- Sensemaking is based on a person´s identity and influenced by personal background, perspectives and views and actual situation within the firm; e.g. an employee with a strong IT background will definitely react completely different as an employee without any technological understanding; or a CIO responsible for own IT infrastructure will prioritise in-house IT solutions opposed to cloud services which will transfer power to the end-user.
- Sensemaking is not limited to the individual context, but arises from the social sphere of an employee. It is a social process which is influenced by a number of social issues such as [Bansler2006, page 62]
    - discussions with colleagues and friends,
    - power relations,
    - public discourse and frame work conditions, and
    - institutionalized patterns of behaviour and thinking (i.e. culture).

Thus, the introduction of a new technology always happens in a social context. Technology users have to understand the usefulness and the added value and thus new technology have to make sense for the individual persons to fulfil their objectives (we discussed this in by the ongoing shaping of the Internet in Section 6.1.2 above). Thus, it is more about usefulness and plausibility rather than accuracy and objective truthfulness.

In such a process, individuals usually play dedicated roles, which are not necessarily always formalized within organisations, such as

- mediators,
- translators, or
- experienced users with particular technical skills (also called "local developers") [Bansler2006, page 59].

As mentioned already above, technologies always offer different possibilities to be used within specific environments. The process of identifying the most useful application for a technology in the specific organisational context is also called "*assessing the affordances of a technology"* [Bansler2006, page 63] referring to [Hutchby2001, page 444]. This process depends on the individual persons involved as well as the specific organisational context where the technology is used and thus is relational.

Mediators are assessing these affordances and thus are engaged to turn a generic technology into a "technology in practice" applied to a real organisational environment [Bansler2006, page 63]. Thus, mediators promote the use of a new technology by establishing guidelines for its use and support the

adaptation of the organisational environment that the technology can be deployed smoothly in the organisation [Bansler2006, page 59].

Since mediation is an ongoing discussion process within the whole organisation, mediation is also a collective process, involving people with different skills and backgrounds. Thus, mediators work on the boundary between technology development and the use of technology and thus between users of technology and usually IT experts. It is their "*proximity to the context of use that enables them to develop solutions that actually work* [Bansler2006, page 8].

According to Bansler more research is necessary to understand how power and politics influence the mediation process and vice versa [Bansler2006, page 88].

6.3. New Ideas and Innovation Stimulate Pressure on the Organisation

6.3.1. Implementation of New Ideas

It is important to point out that creativity and the implementation of new and novel ideas are neither synonymous nor necessarily positively related. Successful innovation is not just about generating new ideas, but even more the successful implementation within the company as well as the implementation in the market are essential activities to be managed.

An innovation process has several phases from creativity to development, implementation, industrialization and feedback (i.e. learning process). After the creative phase the idea has to be explained, developed, tried and tested, re-engineered and adjusted to give rise to a viable innovative solution. The idea implementation phase covers the selection, development and implementation of new ideas within the organisation. Finally the developed new product has to be successfully implemented in the market and can then be permanent improved through so called incremental innovations.

Thus we have to consider two essential business processes which complement each other, but which are also very much interlinked. On the one hand we have to foster creativity and bring new ideas into the game, and on the other hand we have to implement successfully new ideas and thus new products within our organisations and within the market.

The essential issues when implementing new ideas within organisations, taken into account what was discussed so far above, will be elaborated in more detail in the following sections.

6.3.2. Change Processes Imply Conflicts in the Organisation

As discussed extensively above, new technologies, new products, change of customer experience, or even more new business models (see Section 2.4 above) always stimulate disruptive effects within the organisation and the market which generate pressure onto the established organisational structures, existing procedures and processes, and available know-how. Of course, different stakeholders in the business value chain experience different change stimulated by innovation.

The management of an organisation that has to steer such an organisational change process is faced with the specific complexity that changes are required simultaneously at different levels which are interlinked and affect each other permanently [Blythin1997, page 45]:

- Changes on the technology made through the deployment phase of the technology.

- Changes to the organisational processes and structures. In this context [McAfee2006b] classifies three different categories of IT systems, depending on the necessary type of interactions that take place between the new IT systems and the organisation: FIT, NIT, EIT (as described in Section 4.6.1 above).
- Changes to the managerial philosophies, which tend to be modified during the development process of an organisation.

These changes are part of a "technology mediation" process as described above in Section 6.2 and imposes stringent challenges for the overall organisation and especially for the management. We can summarize the following key issues:

- *Conflicting objectives of individual organisation units*. Once an overall corporate strategy has been defined at a highly abstract level, the individual organisation units are required to develop and communicate a concrete strategy for their specific scope of activity. Product, sales, HR, IT or production strategy is the result of this process and provides the basis for the work that individual staff members in each department need to accomplish. Therefore, the changes that have to be carried out, both to the corporate culture and corporate structures, as well as the applied technologies, are not derived from one single overall strategy, but from a myriad of different strategies at department, group or even team level. This inevitably leads to conflicting objectives and contradictory processes within the organisation.
- *Local peculiarities demand local measures*. The implementation process within an individual operating unit can give rise to particular issues that depend on local conditions or circumstances and therefore require local measures. Since sometimes such local measures are in conflict with defined strategies, such conflicts can be settled using corresponding management procedures following the slogan "*Thinking through contradictions, while retaining the capacity to act*"[161].
- *Different prioritization of measures for individual departments*. The prioritization of the measures needed to fulfil the overall corporate strategy occurs at a local level and therefore varies from unit to unit. It also reflects different starting situations for the different organisational units.
- *Lack of clarity about the necessary indicators to manage the operating business*. It is not always immediately clear which operating measures need to be taken at the operative level in order to implement corporate strategy. Different potential technologies, processes and organisational structures lead to the adoption of a wide range of different measures that can affect the organisation in various ways[162].

6.3.3. Novel Ideas Bring Uncertainties to the Organisation

As creative ideas imply substantial changes to the existing and well-established structures, uncertainty is inherently stimulated in the concerned employees. Uncertainty is an essential reason for disputes caused by differences in viewpoints among those who are affected by an idea. Such

[161] Personal experience of the author of this study.

[162] Based on the personal experience of the author of this study management in large organisations very often do by far too late understand the missing synchronization between organizational strategy and department or working team level strategies.

discussions and potential conflicts may result in delays of implementations or even its ultimate failure to market launches [Baer2012]. This effect is also described by the so called „adaptive stretch of technologies" (see Section 2.3 above).

Ideas with limited novelty usually can be implemented within existing structures. More novel ideas challenge existing structures and require substantial changes in responsibilities, roles, power, and status. Potential changes in roles and processes, or redirection of resources will have an impact on individuals or even whole teams. Thus the concerned employees will usually disagree about the value of an idea, especially one that is novel and inherently ambiguous. Factors which explain these potential areas of conflict within organisations are [Baer2012]:

- New ideas will need existing resources for their implementation. Thus, budget, specific skill, human resources, etc., are usually in dispute among different concerned organisational units.
- New ideas resulting in new products, services, and processes imply usually substantial changes in responsibilities.
- The implementation of new ideas will usually stimulate conflicts with existing interests and jeopardize existing alliances within the organisation.
- Pressing for the implementation of new ideas usually challenges existing power structures in organisations which causes resistance.

Thus, novel ideas tend to challenge existing structures and require that substantial changes be made to formerly established responsibilities, roles, powers, and status. This process is subject to socio-political manoeuvers, sponsorship and advocacy as well as mechanisms aimed at influencing decisions within the organisation [Baer2012]. Thus, the opposition that creative ideas likely encounter may have less to do with their merit than with the organisational and personal consequences they imply, as described in [Baer2012] who refers to [Kanter1988]:

> "*The features of successful ideas have more to do with the likelihood of gathering political support than with the likelihood of the idea to produce results*".

This is the basis for the "Innovators Dilemma" of large successful companies according to Christensen [Christensen2011, Christensen2003], which usually have serious problems to adapt to disruptive business and market changes. This is in line with the practical experience of the study author during his affiliation with Telekom Austria.

> *This situation has been experienced by the network operators, when they had to implement new digital technologies such as broadband internet access, digital telephony or digital TV. Despite the fact, that this was the only possible strategy to redefine their business models, the organisations had strongly to fight with the internal resistance. For example at Telekom Austria, the customer service employees were concerned that their technical skills based on a very long experience on telephone technology are no longer adequate in the new digital TV world; even the union have been initially negative on this new change in the business portfolio*[163].

[163] In 2004 the official representative of Telekom Austria´s Works Council confronted the author of this study with his concerns, that the new broadband products cannot be handled by telephone technicians.

To summarize, the process of technology adoption of new technologies or new ideas within the organisation is mainly driven by social-political manoeuvres, looking for sponsorships, and mechanisms for influencing decisions within the organisation.

6.3.4. The Secret Phase in the Innovation Process

The provisioning and communication of information is an essential tool to steer the social-political manoeuvres within the organisation. Thus, information hiding is carried out in a wide range of manners throughout the different phases of the development process of an idea or of a project within a company. According to [Koch2008] the typical behaviour patterns in this regard are as follows:

1. "Secret phases" happen during the following processes:
    i. idea generation;
    ii. coalition building and networking;
    iii. prototyping;
    iv. persuasion of key actors;
2. Then the activity becomes official and the management will be informed.
3. Afterwards, when the management decides not to approve the project idea
    i. the project will be stopped, or
    ii. the project will be continued secretly.

This view is supported by the research done by Leitner et al. [Leitner2009]. They identified the success factors of successful innovative companies - see Section 2.9.1 above. They identified as one of the essential key success factors "*a minimal degree of interference on the part of management and staff members who intentionally work under cover*".

The interview with the middle management of AIT (see Section 8.3 below) will show that middle managers are aware of this situation. They know about the potential of this secret process. Since they have to represent the interests of the company as well as the interest of the employees they have to handle this contradiction.

6.4. A Model of Innovation Resistance

"*The biggest mistake business leaders make is to underestimate resistance when they impose changes in the ways people work*"[164]

Andrew McAfee, 2006

Although there may be forces in an organisation which promote the implementation of creative ideas, e.g. by an organisational mandate to be innovative, the very nature of creative and disruptive ideas generate reluctance about their implementation [Baer2012]. As discussed in detail above, innovation imposes change on a human being - as a consumer or as an employee within organisations. This is because skills, experiences, practice of use, a position within a group, or a relationship to colleagues is potentially jeopardized. Usually this results on a psychology of resistance

[164] [McAfee2006b]

to change by human individuals. Ram defined 1987 a model to describe "innovation resistance" based on cultural, situational and social factors and states clearly that innovation only happens if innovation resistance can be overcome [Ram1987]:

> *"Adoption* of an innovation *begins only after the initial resistance offered by the consumers is overcome. If the resistance is too high, the innovation dies and there is no adoption."*

Ram refers to theories in psychology concerning resistance to change and describes "innovation resistance" as a "normal response of consumers when confronted with innovations" [Ram1987]:

> *"… consumers have an intrinsic desire for psychological equilibrium. Any change imposed on their behaviour has the potential to disturb this equilibrium the consumers thus more often opts for resisting the change than going through a disturbing process of readjustment. … resistance would seem to be a normal response of consumers when confronted with innovations."*

Ram is considering the potential impact of the innovation on the individual and his position in the community. Ram builds on earlier research and describes a "resistance to change" behaviour in the following way [Ram1987, p. 208]:

> *"… any conduct that serves to maintain status quo in the face of pressure to alter the status quo" … and is associated with the degree of which individuals feel themselves threatened by change."*

Although Ram is focusing on consumer behaviour, we can adopt it to employees´ behaviour when introducing innovation within organisations.

6.4.1. Factors Which Influence the Innovation Resistance

Ideas of limited creativity tend to preserve the status quo rather than challenge it. When creativity and new ideas stimulate disruptive effects, innovation resistance is the consequence. Ram analysed the characteristics of innovation resistance and defined three classes of factors [Ram1987]:

- Perceived innovation characteristics,
- consumer characteristics, and
- characteristics of propagation mechanisms.

The **perceived innovation characteristics** are describing the nature of the innovation itself. Ram [Ram1987] is describing the "*realization effect"* of innovation by referring to [Zaltmann1973]. This effect is determined by the following factors:

- The *relative advantage* and the *compatibility* of an innovation for the human being; i.e.
    - the positive effect to an individual, and
    - how much of the existing environment or the usual behaviour of an individual has to be changed in order to get real benefits from the innovation.
- *Perceived risk* and *trialability* of an innovation. These factors describe the possibility to evaluate and decide on the adoption of an innovation for an individual as well as the possibility to modify the innovation to meet personal expectations. According to Ram, this is one of the most important factors.

- *Communicability* and *complexity* of an innovation. This factor describes the complexity of an innovation. The *divisibility* of innovation and the form of innovation (idea, product, process, etc.) are essential factors which determine the complexity of an innovation (Ram is referring to [Kelly1978]). If an innovation is too complex it is difficult to be communicated and thus not easy be understood by the recipient.

Consumer characteristics are described by the factors which are considering the psychological factors of the human being:

- *Personal attitude* of the consumer such as personality (variety seekers, self-confidence, etc.), value orientation and beliefs, self-prestige, believes, etc.
- *Consumer motivation*; i.e. the willingness to change established usage patterns;
- *Demographic* variables such as education, skill level, income, mobility, age;
- *Previous innovative experience;*

Thus it is about the basic mindset and the motivation of human beings. The classification of the factors as described by Ram are still valid, however, they have to be reconsidered with the new generation of digital natives. The new generation of digital natives has changed their principle personalities concerning technology acceptance as latest studies have shown [Cerra2012].

Characteristics of propagation mechanisms are described by the extent of the market control and by the type of communication of the new innovation. In this context the word-of-mouth effect is very essential [Ram1987].

6.4.2. Innovation Resistance Model

The innovation resistance is now higher or lower, depending on the different factors described above. Thus, Ram is describing an innovation resistance model, differentiating between perceived innovation characteristics (describing the nature of the innovation), and the consumer characteristics (describing the attitude and capabilities of the user of the technology).

To summarize Ram´s innovation resistance model, in the context of **perceived innovation characteristics,** the innovation resistance is

- **higher** the lower
    - the perceived *relative advantage* or the higher the perceived relative disadvantage;
    - the perceived *compatibility;*
    - the *trialability;*
    - the reversibility;
    - the *amenability of modifications* of an innovation;
    - the divisibility;
    - the *realization* of an innovation;
    - the *communicability* of an innovation;
- **higher** the higher
    - the levels of the *perceived risk*;

- the more discontinuous the innovation is;

- **lower** the higher
  - the *inhibitory effect* of an innovation on the adoption of other beneficial innovations;
  - the *complexity* of an innovation;

Concerning the **consumer characteristics**, the innovation resistance is

- **higher** the lower
  - the motivation for the consumer;
  - the consumer´s *self-confidence;*
  - *poorer the ability* of the consumers to innovate;
- **higher** the higher
  - the consumer´s perceived *lack of need* for the product;
  - the consumer´s *dogmatism;*
- **lower** the more positive a consumer´s
  - *beliefs* about innovations;
  - *attitude* towards adopting an innovation;
  - the more favourable a consumer´s *previous innovative experience;*

These characteristics are summarized in Figure 6.1 Innovation Resistance Model according to Ram, below. Both aspects are influencing the innovation resistance: the perceived innovation characteristics of the recipients as well as the recipient's characteristics as such.

Innovation resistance is	higher	lower
the higher • perceived innovation characteristics • consumer characteristics	• level of perceived risk • more discontinuous • perceived lack of need • dogmatism	• inhibitory effect to other innovations • complexity • beliefs • attitude • previous innovation experience
the lower • perceived innovation characteristics • consumer characteristics	• perceived relative advantage • perceived compatibility • trialability • reversibility • amenability of modifications • divisibility • realization • communicability • motivation • self-confidence • ability	

Figure 6.1 Innovation Resistance Model according to Ram

6.4.3. Innovative Work Behaviour of Employees

The innovation resistance model described above contains several factors which are in direct relation with the innovation characteristics as such (i.e. nature of the innovation) and has to be seen as a fixed framework condition which has to be considered as potential obstacles and barriers for

innovative work behaviour. On the other side people characteristics such as motivation, self-confidence and ability, dogmatism, and perceived lack are the essential factors which determine employees' attitude at the work place and thus the innovative work behaviour.

Looking at Ram´s model and considering the consumer characteristics only we can derive the following consumer related innovation model as shown in Figure 6.2.

Innovation resistance is	higher	lower
the higher	• perceived lack of need • dogmatism	• beliefs • attitude • previous innovation experience
the lower	• motivation • self-confidence • ability	

Figure 6.2 Consumer Characteristics Innovation Resistance Model according to Ram

Bear analysed in his research the dependencies among the different factors which play a role for implementing ideas within organisations [Baer2012]:

- In the absence of both *motivation* and *ability*, idea implementation should become less likely as *creativity* increases. Here he is referring to the issue, that a higher complexity of the innovation (perceived innovation characteristics) is requiring higher motivation and capabilities of the employees.
- Networking ability is defined as the extent to which employees are skilled in developing and using social networks, building effective coalitions to affect change at work[165] and thus navigate the social-political process for successful innovation [Kanter1983]. Networking ability increases with the established networks of strong as well as week ties by enabling a better implementation instrumentability which grows with the positive established relationships within the organisation.

In order to achieve substantial changes at work for successful implementations of innovations, it is essential to get supporters and coalitions with peers, co-workers but also top management. Employees need a developed implementation instrumentally by sponsorship and advocacy and support. Mobilizing sponsorship and advocacy requires that individuals have cultivated their social relationships - their connections to friends and trusted allies that provide access to company resources [Obstfeld2005]. Such implicit agreements for close cooperation and open information exchange are based on mutual trust and norms of reciprocity [Kanter1983] - compared to the "gift economy" as described in Section 5.5.7). This is forming a supportive culture that enables sound knowledge management based on information sharing. Such relationships are referred to as "buy-in relationships" (see Section 5.4.3 and 5.5.4).

When employees have a high number of strong buy-in ties, in order to mobilize the support of key allies to sway important decisions within the company, they are usually called "*skilled networkers*".

It is worth noting that different types of social relationships and network constellations, depending upon the needs of circumstances in which they operate, are established. If information is collected, a

[165] Networking ability can be measured by the six-item networking ability; i.e. the so called "PSI Political Skill Inventory" [Baer2012].

different kind of network (relationships) is cultivated than if employees are concerned with initiatives to be implemented within the organisation.

Nadin Dörner worked out in her study [Doerner2012] that self-confidence, i.e. *self-efficacy* (see Section 5.4.4) is the important determining factor contributing to innovative work behaviour. According to Nadin Dörner *outcome expectations* do not independently contribute to the innovative work behaviour but is mainly influenced by the self-efficacy factor.

6.5. Overcoming the Barriers for Effective Knowledge Transfer

Organisations have to implement structures and sets of management practices that overcome the barriers for effective knowledge transfer and sharing [Ackerman2003a].

6.5.1. Overcoming Cognitive Limitations

Potential approaches to overcome cognitive limitations are [Ackerman2003a]:

- Position of dedicated employees with an intermediate level of expertise to act as a kind of "translator" between expert end novices.
- Encourage 2-way interaction between expert and novice.
- Overcoming contextual differences through "boundary objects". Boundary objects are for example show cases, demonstrators, or prototypes. Such objects have extensive tacit knowledge embodied by the process of implementation. Thus they serve as a basis for forming mutual understanding as well as an effective communication between people with different backgrounds and knowledge base. Based on such tangible objects people can much more effective discuss and negotiate shared meanings.
- Cognitive limitations - One set of limitations is on sharing expertise is cognitive … the way experts store and transmit information … regardless whether they are motivated or not …. Skill level, education, basic knowledge, novice – expert
- Bridging the expertise gap:
    - Expertise is characterized by conceptual, abstract representations.
    - Developing abstract, simplified representations of the tasks allow experts to process information more rapidly. However, other persons with less experience or a lower knowledge base have potential problems.

6.5.2. Overcoming Motivational Limitations

Some organisations have much more success to transfer knowledge to other units than others. It is essential to "build a marketplace"; i.e. to give members of the organisation enough time present and offer their knowledge as well as to shop for knowledge. "A Catch-22 of the corporate worlds is that employees are too busy working to take time to learn things that will help them work more efficiently." [Ackerman2003a].

Specific changes in organisational practices can contribute to overcome motivational limitations to share knowledge within organisations. [Ackerman2003a] summarized the essential effects which are supporting or jeopardizing a cooperative culture:

- Competition does always play a dominant factor:

    - most organisations set teams to work against each other
    - people compete for promotions
    - people compete also for raises
    - individual incentives – one wins the other cannot
    - performance is often determined relative to other units
    - knowledge is power [Pettigrew 1972]; sharing expertise means sharing power … this is usually not useful in a competitive environment [Ackerman2003a, page 12];
- Reducing competition between groups can be achieved by
    - focusing on team level goals than on individual goals,
    - allowing communities of practice to evolve,
    - deemphasize status hierarchies,
    - appropriate incentives to balance the cost experts incur in the process of sharing their knowledge with others [Ackerman2003a, page 16)
- Few organisations provide the time required for knowledge transfer, believing that "conversations" are not real work [Ackerman2003a].

7. Innovation Management at AIT Department Digital Safety & Security

"*Innovation is always a conversation*"

Richard Miller, 2016[166]

AIT Austrian Institute of Technology is the largest national applied research centre of Austria. The key objectives of AIT are the achievement of international leading-edge scientific research results and, based on that, the generation of an added value for both industrial partners and the economy in general. By implementing this vision, AIT acts as a bridge between basic research, usually conducted at the academic level on universities, and product development at the corporate level. Thus, AIT has to combine both worlds in one organisation at the same time: to build upon its own creativity and innovation capabilities, while achieving high-quality technology results for the industries. Further on, the defined business model requires that 30% of the overall costs are financed by external funding on a project basis, such as European funded projects, and 30% are financed by dedicated industrial contracts. This results in a considerable challenge for the organisation to manage a huge number of projects. Some 300 running projects have to be managed yearly and about 120 new projects have to be started each year[167], even for a small department of 250 researchers only[168]. Each individual project requires several formal contracts, more than ½ a dozen formal approvals and conformation steps especially for funded projects, and in the same order the need of preparing reports.

In order to address these, sometimes conflicting, requirements within the AIT Austrian Institute of Technology, Digital Safety & Security Department, the author of this study has re-defined main business processes relevant for the organisational innovation management[169]: creativity phase, information exchange processes, formal approval processes, reporting processes, project and programme management processes and technology development processes. How these business processes are steered within the Department are described in the following Sections.

7.1. Stage Gate Process – Effective Information Exchange through Order and Structure

The generally accepted term "Stage Gate Process", to describe the process for a well-structured product development process within organisations, was introduced by Cooper and Edgett in the 90s. Robert Cooper and Scott Edgett defined the "Stage Gate" concept based on well-defined and generally linear structures [Cooper1993, Cooper2002]. They have conceptualized the essential business processes required for product development as seven phases: i) scoping, ii) building the business case, iii) product development, iv) testing and validation, v) product launch, vi) product

[166] Richard Miller, Interview of Deputy Director for Innovation, „Innovate UK" (UK's innovation agency, executive non-departmental public body sponsored by the Department for Business, Energy & Industrial Strategy); http://www.euractiv.com/section/innovation-industry/interview/innovate-uk-boss-innovation-is-always-a-conversation/ (last access on 24.4.2017).

[167] Considering a good success rate of European funding programs of 20%, for each starting project 5 project proposals have to be elaborated.

[168] Employees and contract researchers.

[169] The author of this study is the responsible Head of the Department Digital Safety & Security.

maintenance and adaptation and vii) product phase out. Since all phases of a product life-cycle are taken into due consideration, such a process is usually also called “Product Life-cycle Process (PLP)”.

A stage gate based process provides the basis for effective and transparent decision-making and is enabling ongoing efficiency improvements during the different phases of the product development process – especially for the formal organisation, but influences also the informal organisation[170]. This is an important pre-requisite for effective reporting processes and traceability of all decisions made as well as for the achievement of synergies among different organisational units.

According to Cooper [Cooper2002], a “gate process” supports the mutual coordination and clarification among the different organisational units and promote an inherent “commitment process”. For a product launch involving multiple corporate units especially within large-scale organisations, this provides a considerable added value in managing the high degree of organisational complexity. Such a well-defined communication process ensures a high level of transparency within the organisation, supports the objective to overcome knowledge silos, generates a culture of interactivity and supports a free flow of information and knowledge throughout the company. With regard to the relationship with external partners, such a process guarantees a high level of quality assurance and delivery capability, which is essential especially for industrial partners.

7.2. A Gate Process for the R&D Project Life-Cycle Management

At the AIT Digital Safety & Security Department, a “Gate Process” is deployed as a basis to be able to effectively manage all research projects within the Department: basic research projects based on AIT´s internal strategy plan; cooperative research projects which are based on funding programmes and external reviews, such as the EU research funding programmes; and finally contract research where dedicated results have to be delivered to industrial customers[171].

In order to change the organisations culture, the main goals were to overcome knowledge silos, generate a culture of interactivity, support the free flow of information and knowledge throughout the company and accelerate the learning process with regard to various formalities and requirements for project generation processes and application modalities for funding, etc. With regard to our relationship with external research partners, the main objective was to support a high level of quality assurance and delivery capability, which represent an essential requirement for industrial partners. In order to be able to face up to these challenges, the author of this study[172] has implemented a dedicated business process for innovation management within the organisation, which builds upon three main pillars:

- Enabling creativity and idea generation.
- Supporting conventional management duties within the company such as strictly linear resource planning, financial planning, reporting and management activities, while enabling the flexibility needed to constantly adjust to ever-changing market conditions and other environmental circumstances or constraints.

[170] Informal networks are often the only reason why organisations survive wild cycles of permanent reorganisation, lacking strategy and leadership (see Sections 2.10.1 and 5.3 above).

[171] AIT internal notation: “UF” for basic research projects; “KF” for cooperative research projects in funding programmes; and “AF” for contractual research with industry partners.

[172] In his role as Head of the Department.

- Ensure quality assurance for the delivery of results within cooperative research projects as well as for industrial results for contractual research projects with the industry.

To enable creativity and foster idea generation and ensure effective research activities, the following key strategic objectives have been addressed by the definition of the innovation management processes:

- Enabling transparent and efficient communication processes within the organisation among all employees,
- ensure pro-active communication with both in-house groups – including the management - and external research partners, and
- supporting effective decision-making processes within the organisation as well as by the management.

Such an innovation process landscape allows for a smooth transition between the most important stages of an innovation life-cycle, harmonizing technology push with market pull and enabling the organisation to put in place an effective strategic and operational asset management, while improving both, resource planning and deployment as well as the ongoing learning process.

Within AIT´s organisational context any output of a research activity is considered as a “product”. Every research activity is performed within a well-defined “project”. This is crucial, since all activities are funded by different sources – externally as well as internally. Thus, the relationship between resources spent and concerned output has always to be transparent.

A set of processes - Project Life-cycle Processes (PLP) - have been designed and implemented by the study author for the different phases of the innovation process, which focuses on a specific set of problems along the R&D workflow:

- Idea generation: “ideation” and “evaluation and selection”
- Project “development” and “implementation”
- Project Feedback Process: “feedback” and “ensuring the learning organisation”

In addition to this sound process landscape, dedicated tools have been designed to enable the management of the processes and the organisation. Further on, the implementation of well-defined roles such as innovation managers, programme and key account managers, and business developers, represents a basic prerequisite to meet the Department’s objective of guaranteeing an efficient innovation transfer from the research lab to the industry production line.

The defined processes as well as the used tools and the defined roles support the coordination of activities and the discussion among the different researchers, engineers, product managers, business developers and marketing&sales representatives engaged in the innovation life-cycle, from the early stage of idea generation up to the final deliverables, such as: reports, specifications and generation of prototypes, industry development support, etc. Thus, they allow the Department to enhance in-house work efficiency, management decision effectiveness, while ensuring a high-quality research output.

The specifications of these processes and the well-defined gates as well as the developed tools are described in the following.

7.2.1. DSS Project Life-Cycle (PLP) Gates

In order to address the objectives described above, the following seven main check-points – so called "Gates" - in the lifetime of a project have been defined. Each project has to pass these gates by explicit decisions as shown in Figure 7.1 below. The steps till the start of a project are also summarized as "project generation phase".

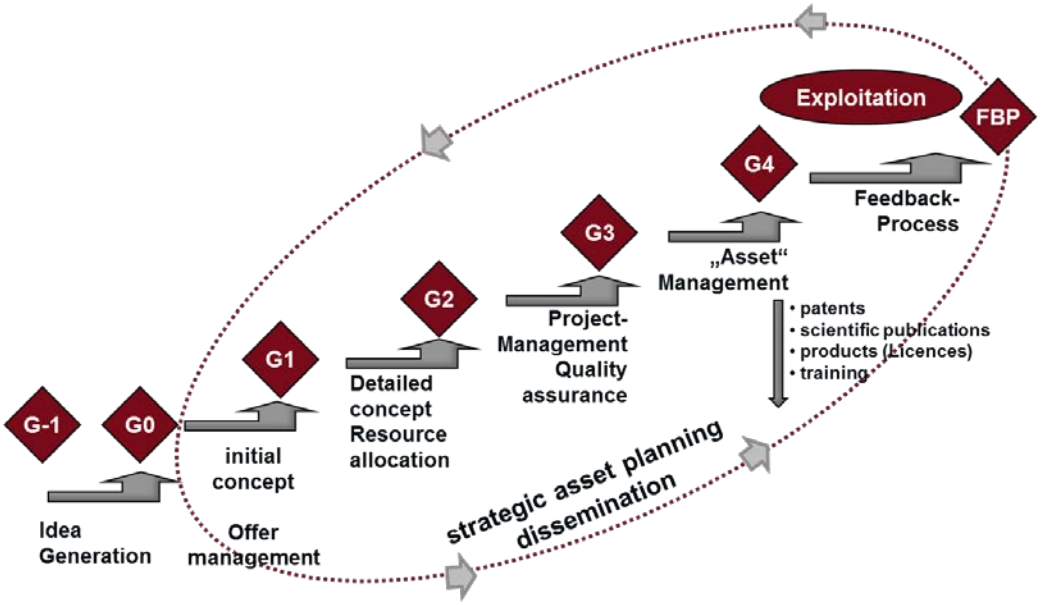


Figure 7.1: Gates of the AIT Project Life-cycle Process (PLP)

The process and the defined gates are described in the following.

Idea generation phase („Ideation" and "Evaluation and Selection"):

1. **Gate -1 (G-1): Communication of an initial idea or project proposal** to a wider audience within the organisation. At this stage, the use of the formal IT-tools within the company is not required. It is important to note, that this gate was the result of 4 years "Gate Process" experience and the lessons learned by analysing the result of interviews performed 2014 with the middle management and key personnel of the department. The results of the questionnaire see Sections 8.3 and 8.4 below.
2. **Gate 0 (G0): Idea check**. Initial evaluation of the idea and the intended project scope. An improved description of the initial concept and related objectives in the context of the Department's vision and strategy has to be provided. The financial figures have only to be provided by a very rough estimation.

Project development and implementation phase:

3. **Gate 1 (G1)**: **Check of the initial concept and related objectives**. Passing this gate is a pre-requisite for the submission of the project to a research funding body or submission of an offer to a client. The strategic orientation of the activity as well as the financial planning has to be in line with the organisation´s strategy and procedures.
4. **Pre-Gate 2 (PG2)**: **Financial approval to start the project implementation**. This gate is important for the financial system of the company such as budget planning, human resource planning, investment plans, etc. All the financial figures have to be clarified in detail. The customer has to have acknowledged the offer and funding organisations have to have approved terms & conditions for funding the project.

5. **Gate 2 (G2): Start of the project implementation**. This gate is the essential core of the "*commitment process*". At Gate 2 the detailed project plan has to be defined and thus all relevant resources are specified. For passing Gate 2, all concerned employees as well as managers commit their defined resources in the project plan.
6. **Gate 3 (G3)**: **Issue management to close the project** without any disruptions. Two main objectives are covered by this gate: i) financial management of the project; and ii) customer expectation management before finishing the project. This Gate is planned a few months before the planed end of the project to be able to take management actions before the project is finally finished.

Project Feedback Process (FBP): "Feedback" and "ensuring the learning organisation":

7. **Gate 4 (G4)**: **Lessons learned**. After the end of the project, start of the lesson-learned process. Assuring the documentation of project results for subsequent use, discussing major change management issues experienced during the project and elaborating next steps in order to build on the achievements of the projects. Preparation of guidelines of the lessons learned for subsequent use within the organisations.

Each project has to pass all these well-defined gates by an explicit decision making process which involves the management as well as key functions within the department (this happens within board meetings or by online tools – see below). It is important to note, that he real work to elaborate all the necessary issues to be able to have an effective decision at the defined "gates" happens between two gates.

The defined gates are described in more detail in the following.

7.2.1.1 Gate -1 (G-1): Communication of an initial idea or project proposal

Gate -1 (G-1) refers to the point in time, when a project idea is presented for the first time to a wider audience of colleagues within the Department and to the management.

The formulation of an idea or of a project proposal is the starting point of every single innovation process. An "idea" in this context means the definition of a rough project scope or of a question as a starting point for an R&D activity. "Project" in this context means an initial defined set of activities including all necessary resources: budget, time frame, personnel resources, dedicated skills, etc.

Basically every single researcher, programme manager or innovation manager within the Department, who is in constant contact with the corporate world, is requested to formulate ideas and potential research projects for the Department. Different methods such as brainstorming workshops, strategic discussion groups with customers or industry partners, internal creativity workshops are used to support this phase.

The presented ideas which are formulated the first time can now be evaluated in the context of a priority-setting process.

These "ideas" are further elaborated in a second step (both formally as well as from the content point of view), in accordance with the strategic objectives of the Department and on the basis of the skills and resources available. This represents the entry point to Gate 0.

Employees are requested to communicate project ideas as early as possible, even when technical feasibility and existing markets have not been fully clarified yet. The main objective of a (Gate-1)

presentation is to actively involve the management and other colleagues of the Department and request their support and allocation of resources for further elaboration steps.

However, it is important to point out that, at this stage, the use of formal IT-tools within the company for a (Gate-1) presentation is not requested in order to limit red tape. An important aspect of a (Gate-1) presentation is the minimization of formal and technical entry barriers in order to encourage idea generation and sharing in a simple, transparent and fast (efficient) matter.

7.2.1.2 Gate 0 (G0): Idea Check

Gate 0 (G0) is the "idea check"; i.e. the first formal evaluation of the idea and the intended project scope. This refers to the improved description of the initial concepts and related objectives in the context of the Department's vision and strategy. The financial figures have only to be provided by a very rough estimation.

A (Gate 0) decision is formally required for the first step (submission to a research funding body) of a two steps evaluation process.

7.2.1.3 Gate 1 (G1): Check of the initial concept and related objectives

Gate 1 (G1) is to check of the initial concept and related objectives - submission of the project to a research funding body or submission of an offer to a client. This refers to the concrete description of a project to enable its submission to a research funding body or the presentation of an offer to a customer. (Gate 1) refers to the point in time, when the project idea has been articulated in greater detail to allow for the formulation of concrete project proposals either for funding purposes or for the potential award of a contract. During the G0-G1 phase, technical feasibility is verified, potential target markets identified and a rough project plan with a first cost estimation made available. (Gate 1) descriptions encompass:

- a short project description and the identification of the main objectives;
- initial resource planning: skills, personnel resources, investments, project duration, etc.;
- initial project planning;
- a funding strategy of the planned activity;
- a dissemination strategy of project results and asset planning;

7.2.1.4 Pre-Gate 2: Financial approval to start the project implementation

A detailed financial planning is made available at this point. After collecting feedback from the market (either customers or public authorities in funding applications) as a response to the Gate1-based project proposals, the new framework conditions are subject to scrutiny. If the collected feedback and the concerned framework conditions are in line with plan assumptions and the overall strategy of the Department, the project can be formally given the go ahead. At this point in time, the financial systems of an organisation (SAP data input, etc.) come into play.

7.2.1.5 Gate 2 (G2): Check of the detailed concept and resource planning

This gate refers to the concrete implementation phase of a project, where all necessary details for the project implementation are better defined; i.e. project plan approved and thus start of the project implementation. These include the concrete planning of both resources and tasks. (Gate 2) refers to the point in time, when the project implementation is started. The necessary commitment to allocating corresponding funding resources or an order placed by the customer are present at this

stage and concrete terms are agreed with all project partners involved. (Gate 2) descriptions encompass:

- a detailed formulation of objectives and detailed project planning;
- detailed resource planning (time, personnel resources and investments);
- project financing details;
- the explicit commitment of all involved personnel resources – commitment process;
- risk planning;

The time interval between G2 and G1 includes contract negotiations with sponsors and project partners - although it should be noted that, for most EU-funded projects, the final contract (consortium agreement) is finalized after the project has already started (often up to a year after the start of the project).

7.2.1.6 Gate 3 (G3): Check of the project performance – preparation of project finalization

Gate 3 (G3) refers to the point in time, when the finalization of a project is prepared. Three months prior to the planned conclusion of a project, a review is performed to determine whether any additional management actions are requested to guarantee the finalization of the project according to the project plan. Thus, this gate covers the issue management to close the project without any disruptions. Two main objectives are covered by this gate: i) financial management of the project; and ii) customer expectation management before finishing the project.

7.2.1.7 Gate 4 (G4): Feedback Process (FBP) – start of the learning process

Gate 4 is the starting point of the Project Feedback Process (FBP) after the conclusion of the project. Once the project has been concluded, results and achievements are documented. Based on the information collected throughout the different Gates, a well-structured feedback process can be put in place, which provides the basis for an ongoing learning process, while ensuring effective knowledge management within the Department. Gate 4 activities include:

- monitoring the implementation of a project according to plan, the compliance with project deadlines and the achievement of planned objectives;
- finalization of the concept for dissemination purposes (start of an explicit dissemination project, patent processes, input for a subsequent research project, etc.);
- reporting to the top level management and for the shareholders;

7.2.2. DSS Project Life-Cycle (PLP) Tools

As described above, all R&D activities are performed in well-defined projects. Each project has to pass all defined decision points (Gates) from the initial idea till the finalization of the project. This decision making process is organised alongside well defined processes, structures and tools:

1. **Project Board (PB):** Any decision is done by the so called “Project Board (PB)”. This governing body is made up of all top-level managers of the Department as well as representatives of key functions of the organisation such as business development, marketing, controlling, and research funding. A Project Board (PB) meeting takes place on a

weekly basis[173] based on a well-defined agenda. This agenda is widely defined automatically based on the planned figures in the project planning and the concerned "Gate documentation". For each project the planned Gates - Gate -1, 0, 1, pre-Gate 2, Gate 2, 3 and Gate 4 - are always planned in advance and are defined in the documentations. The assumptions are permanently updated through improved knowledge on the project progress.

This board ensures also the minimum information exchange as well as transparency within the organisation.

2. **Project Life-cycle Process (PLP) owner**: A dedicated role is defined to design and develop the PLP process and the tools as well as to support planning, reporting and meeting activities.

3. **Electronic approval process**: For very urgent decisions or in the case that the added value provided by a presentation within a project board meeting does not justify the administrative burden involved, decisions are made using an electronic approval process called "*Rundlauffreigabe*". The necessary documentation (PPT, management summary, etc.) has still to be prepared but it is not presented and discussed within the framework of a Project Board meeting and the final go ahead is given via an electronic approval process. An electronic based approval process („Rundlauf") allows to minimize the formal restrictions to a minimum, but all formal processes and IT-tools are still supported. In order to limit the potential bureaucratic burden, there is even a further class of projects defined for very small projects. For small projects below 15 kEuro project budget only short project summaries with the minimum amount of required information have to be provided to document the project initiative.

4. **Gate presentations**: Information transfer, communication, and discussion are based on a well-defined structure. At each Gate specific well defined information has to be provided by the project manager. The main tool used for presenting information in an appropriate way is PPT with a well-defined structure. Those PPT-presentations are presented to the project board audience.

   For each specific Gate, a well-defined structure is used as a methodology to explicitly define the different types of information necessary to enable an effective information transfer. This allows the project leader to limit the amount of information presented and therefore to concentrate on the essentials and the presentation form offers the opportunity to discuss the project on a larger scale: live audience as well as virtually by electronic communication tools.

   Examples of information to be discussed with the project board are for instance: purpose of the project, problem definition, approach, rough evaluation of necessary resources, time frame, personnel resources, rough financial estimates, etc.

   For each subject, dedicated PPT-slides are defined in order to provide an easy access for the different viewpoints (the detailed defined PPT-Slides as forms are shown in Section 11.3 in the Appendix below): financial figures, administrative deliverables, marketing, human resource management, etc. The information to be described varies in detail among the different gates: Gate -1 request a very minimum amount of information, Gate 0 focuses on

[173] Project Board (PB) meetings are scheduled regularly every Wednesday.

basic strategies and scope, whereas Gate 1 has a focus on financial figures, partners and strategic fit with the organisation's strategy; Gate 2 focuses on project resources and project plans.

8. Empirical Analysis on Employees' In-House Communication Behaviour in the Context of Corporate Innovation

This empirical study on employees' in-house communication behaviour in the context of corporate innovation processes is based on a case study at the AIT Department Digital Safety & Security between the years 2010-2015. Data has been collected in four subsequent steps:

1. An initial questionnaire has been performed to study principle communication attitudes in the context of digital work processes within organisations.
2. A statistical analysis of the time duration used for the preparation phases of research projects within the AIT Department. This can be considered as a "project generation performance". What was measured in concrete terms was the time duration between the announcement made by the concerned employee about the first "project idea" (Gate 0) within the company and the formulation of a commercial offer for an industrial customer or the submission of an application for a funded research project (Gate 1). In this regard, a total of over 700 project preparation activities over a period of 6 years (2010- 2015) was subject to statistical scrutiny.
3. In the spring of 2014, an empirical survey was carried out based on oral interviews with the middle management of the Department Digital Safety & Security. The results of this survey form the second part of a comprehensive analysis of employees' communication behaviour, their information sharing practices and open communication habits within the company in the context of corporate innovation processes. Substantially, the interviewed employees were confronted with the facts resulting from the analysis of the Department's project generation performance over the past years.

   In fact 10 interviews have been performed with the management of the Department; i.e. employees which have the personnel responsibility of teams such as Department´s business unit managers (GFL) and Thematic Coordinators (ThC) as well as representatives of Departments support functions such Business Developer and Project Life-cycle Process (PLP) owner.
4. The fourth step was a survey which encompassed a broader analysis carried out among all employees of the AIT Department based on a written questionnaire, which could be filled out online. The drafted questions, which build upon a comprehensive literature research, has been fine-tuned and complemented with the results of the oral interviews with the middle management of the Department.

These research steps are discussed in more detail in the following sections.

8.1. Initial Questionnaire about Organisational Culture and Social Media Usage

This questionnaire was performed as a first trial to study the main communication attitudes and the organisational culture in the context of digital work processes within organisations. Initially, the questionnaire had a much wider scope as it also analyzed the work environment and basic cultural

attitude of the employees. For the purpose of this study, however, only online social media relevant questions were taken into account (for questions and answers see Section 11.1 in the annex).

The questionnaire's main details are as follows:

- Theme of the research study: digital work processes within organisations
- Method: online questionnaire
- Target group (sample): a total of 237 employees of the AIT Digital Safety & Security Department
- Response: 163, 69% (n = 163)
- Age groups:
    - 15-32 years: 29% (n=47)
    - 33-52 years: 62% (n=101)
    - > 52 years: 9% (n=15)
- Execution of the online questionnaire (to ensure full anonymity): theLivingCore
- Time-frame of the questionnaire: January 2012 – September 2012

This questionnaire highlighted that online social media tools are not considered very relevant for communication processes within the firm. One of the key learnings during the introduction of the proprietary social media platform "SoCol" at AIT was that employees complained about the missing interoperability between this internal platform and external social media such as Facebook, LinkedIn and Twitter as well as other business support tools within the organisation. The main findings of this questionnaire are summarized in the following section.

8.1.1. Main Findings of this Questionnaire

8.1.1.1 Communication Processes

- Informal communication groups are a crucial element for the employees:
    - Team communication with colleagues in the own working area is seen as the most relevant communication form (question 2.2). Communication with other colleagues in other working areas and departments was rated as the least relevant communication form (question 2.1).
    - This is also supported by question 4.3. Informal knowledge transfer has the highest rating (72%). Employees indicated that information is passed on only in a selective way and this transfer mainly takes place between people of the same working area. "Jour fix meetings" are seen as one of the most important instruments for knowledge transfer.
- Communication objectives:
    - The most important communication factors are "the exchange of opinions" and "to find out about different viewpoints" (question 2.3).

- Communication problems:
    - Concerns regarding theft of ideas as a result of the transparent exchange of ideas within the company are not considered very relevant (question 2.3).
- Communication mechanisms & tools:
    - E-mails are viewed as the most important tool for communication purposes followed by “face-to-face" interactions and the “telephone”. Social media tools are not considered very relevant for communication processes within the firm (question 2.4).
    - There are different tools for the different phases of a project – the creative phase, project implementation phase and marketing phase. The most frequently mentioned platforms for information exchange are “LinkedIn“ and “Xing“, followed by “Research Gate“ and “Doodle“ (question 2.3) as well as “Collwrite” (question 2.6). The most frequently mentioned tools for the project implementation phase are Foliocloud, Fabasoft and Github (question 2.7), and for marketing purposes Xing and LinkedIn (question 2.8). Besides, Wikis, Skype, and Blogs (question 5.5) are used occasionally.
    - Moreover, the employees pointed out that in addition to social tools, real-life events such as team events and “free-time activities” play an important role (question 2.3 and 2.6). Older persons do not see Twitter as relevant (question 2.3). Besides, the survey revealed that there is a significant need for real-life events and meetings, which should be fostered. This observation is supported by question 2.9, which highlights the importance of offline locations such as meeting rooms, discussions with clients, meetings at central coffee machine locations, cafeteria as well as sport events, lunch, etc. Such offline locations play an important role as they enable creative and quality communication and interactions. Virtual rooms are viewed as less important in general; however, they are more relevant for the youngest age group.
    - The attendance of “regular meetings” is the most important measure for creative and quality communication and interactions. However, it is particularly important for people over 52 years of age. “Team-building events” and “excursions” are rated as high as “regular meetings” (question 2.10). Employees want a more direct/informal form of communication than e-mails and other office tools. Employees often view communication with the formal organisation as “one way”; i.e. a dialog is missing (question 2.12).
- Working place:
    - Most of the time employees work at their desk (97%); followed by "in meeting rooms" (64%). Nearly 50% of the employees participating in the survey see “informal conversations” as an essential tool for productivity (question 2.11).
    - Distance (locations and floors) is viewed as a big obstacle to effective communication. Time constraints were also frequently mentioned as limiting factor for communication activities. Existing IT support tools within the organisation are seen as suboptimal (question 2.12).

It is remarkable that employees do not necessarily view electronic communication as part of their productivity. They consider personal communication crucially important.

8.1.1.2 Market Intelligence & Innovation / Working Culture

Cooperation within the organisation is viewed as good, based on respect, team spirit and openness. Some of the employees pointed out that the cooperation between business units could be improved (question 4.1). 59% of the survey participants rated the culture for innovation and change within the organisation as high. 92% see a positive culture for innovation and change (question 3.5). Asked about their intrinsic motivation, employees revealed that they like to deal with something fundamentally new (disruptive innovation) but also to improve what already exists (incremental innovation) (question 3.4).

According to the employees, innovation emerges randomly and is promoted by single individuals (66%) (question 3.7). Younger employees stated that innovation emerges through permanent experimentation and prototyping, including interaction with external partners in the context of an open innovation process (question 3.7).

The majority of survey participants rated market expertise as being relevant for their work (79%) (question 3.1). More than 50% of them ask at least once a week if the concerned project is relevant to the market (question 3.2). 75% of the survey participants (across all age groups) indicated research on the Internet as the most important source of information about the market, whereas online social media tools were only mentioned by 8% of the participants. We can assume that "Internet" is correlated with google and other search engines (question 3.3).

8.1.1.3 Online Social Media

49% of survey participants use social media tools, social networks, media portals, etc. also in a private context, and 27% use them seldom (question 5.1). The main motivation factors for the use of such tools in the private context are:

- staying in contact with others (networking)
- communication with friends
- being up to date, and
- organising spare time.

Data privacy is mentioned as an important issue to take into consideration.

When asked about the use of such tools for professional purposes, the usage rate is much lower (question 5.2): 34% use them often and 34% only from time to time. The main motivation factors for the use of social media in the professional context are (question 5.3):

- networking (66%),
- knowledge exchange (60%),
- collaboration (51%),
- studying (32%),
- innovation, creative process (30%).

When asked why social media platforms are not used, the main arguments were the following ones (question 5.2):

- only use Wiki,
- no time,
- no added value,
- prefer face-to-face communication,
- privacy concerns.

The networking function of online social media tools was recognized across all age groups. Besides, survey participants older than 52 do not use social media platforms for studying purposes and they use them only to a limited extent for the exchange of knowledge. Social media platforms are mainly used for collaboration purposes among people between 33-52 years of age, whereas they are not used for innovation and creative processes.

The majority of survey participants would use social media tools for communication within a project (60%) (question 5.4), whereas social media tools are not regarded as suitable for communication with the management - only 10% would use them (question 5.4).

When asked about the added value of dedicated online social media functions, information search functions, time scheduling, and document storage are considered the most important ones, whereas blogs and microblogging are not regarded as very helpful (question 5.6).

As far as potential obstacles are concerned, when using online social media tools (question 5.7), the most critical issue is represented by security concerns with regard to data used from the online platform, as the further use of data cannot be controlled.

With regard to the potential of online social media tools to support innovation processes (question 5.8), the most criticized issue is the usability of the tool. The currently existing online social media tool “SoCol” has an overwhelming number of functions. A reduction of functions would increase its usability.

8.2. Observation of the R&D Project Generation Performance

8.2.1. Measured Time Points

An evaluation has been started to understand better the performance of the project generation process. 700 research projects have been recorded statistically and analysed in the period from 2010 to 2015 at AIT Austrian Institute of Technology, Department Digital Safety & Security. Three point-in-times have been recorded according to the defined and implemented Project Life-cycle Process (PLP) within the AIT Department Digital Safety & Security. To each of these dates a plan value and then the actual value have been documented:

- Time “**Gate 0 (G0)**” at which a project idea was presented the first time to the colleagues in the Department as well as the management. The employees have been requested to communicate project ideas as early as possible, even when technical feasibility and existing markets are not yet clear. Objective of a G0 presentation was to actively involve the

management or colleagues in the Department in support of the project and to allocate resources for the further project elaboration.

- Time "**Gate 1 (G1**)" at which the project idea was elaborated in more detail to be able to formulate concrete project proposals either for funding bodies or for offers for contract projects. During the phase G0-G1, the technical feasibility was verified as well as the target market identified and thus a rough project plan with cost estimation has been prepared.
- Time "**Gate 2 (G2**)" at which the project implementation is started. A commitment for funding or an order by the customer is present at this time and also concrete terms for cooperation have been agreed with all involved project partners.

  The duration of time between G2 and G1 include therefore the contract negotiations with sponsors and project partners. It has to be noted that for the most EU funded projects the final contract (consortium agreement with all the external project partners within the project) is usually finalised even after the project start (often up to a year after the start of the project).

It is important to note, that in addition to the Gates described above, some more gates are used within the defined Project Life-cycle Process (PLP) within the Department. However, for the statistical analyses for this study, the following gates have not been considered:

- **Gate -1**: Communication of an initial idea. At this stage, the use of the formal IT-tools within the company is not required. This gate has been defined new and was the result of 4 years gate process experience and the lessons learned by analysing the result of questionnaire performed 2014 with the middle management.
- **Pre-Gate 2**: Financial approval to start the project. This Gate is important for the financial system of the company (budget planning, SAP, etc.). This Gate happens a short duration before the formal start of the project (Gate 2).
- **Gate 3 (G3**) which is preparing the end of the project. The project will be closed in a very short time frame. Important management decision will be discussed to ensure a project finalization according to plan or taking into account important changes of the project environment.
- **Gate 4 (G4**) which is the start of the lessons learned process after the end of the project. The project is closed and the results and achievements are documented. A discussion takes place how to learn from the experiences made during the project phase and how to treat with the project results.

An extensive description of the rationale of these gates as used within the AIT Austrian Institute of Technology, Digital Safety & Security Department is provided in Chapter 6.5 above.

8.2.2. Observed Behaviour of Project Generation Activities

The duration of the preparation time of 700 projects have been recorded and statistically analysed (see Figure 8.1 below). The measured time duration used for project generation (G1-G0) was:

- 67% of industrial projects (AF projects; i.e. industry contract projects) < 1 month;
- 65% of nationally funded projects (KF projects; i.e. national cooperative research projects) < 1 month;

- 58% of the EU funded projects (EU cooperative research projects) < 1 month;

It is interesting to note that roughly 2/3 of all projects (the national cooperative research projects as well as the industrial research contracts) have been prepared formally within less than 1 month. More than half of the EU projects have also been prepared in a duration of less than 1 month. Even more, in the case of numerous projects, the Gate 0 presentation was totally bypassed; this means that Gate 0 and Gate 1 decisions took place at the same time (G0=G1). This applied to:

- 52% of the industry contract research projects,
- 34% of nationally funded cooperative research projects, and
- 31% of the EU funded cooperative research projects.

The following findings of the analysis of the formal data are interesting. The duration between the presentation of the project idea and the formulation of a developed project concept was on average (median) only 1.5 months! 50% of the projects were designed in less than 2 months. Offers for a contract research to industrial customers were worked out even just within 2 weeks.

Since it is not possible to develop sound projects within such short periods of time, it is obvious that information has been shared as late as possible. Thus, practices such as “hiding information” or “a controlled information exchange” takes place instead. This demonstrates that employees are not willing to communicate ideas at a very early stage within the organisation. The statistical analysis of the project preparation phases made it obvious that there is a basic tendency among employees to communicate project ideas and project proposals within the company as late as possible. Employees usually wait until a high level of safety for the project implementation is guaranteed and potential ambiguities are totally eliminated.

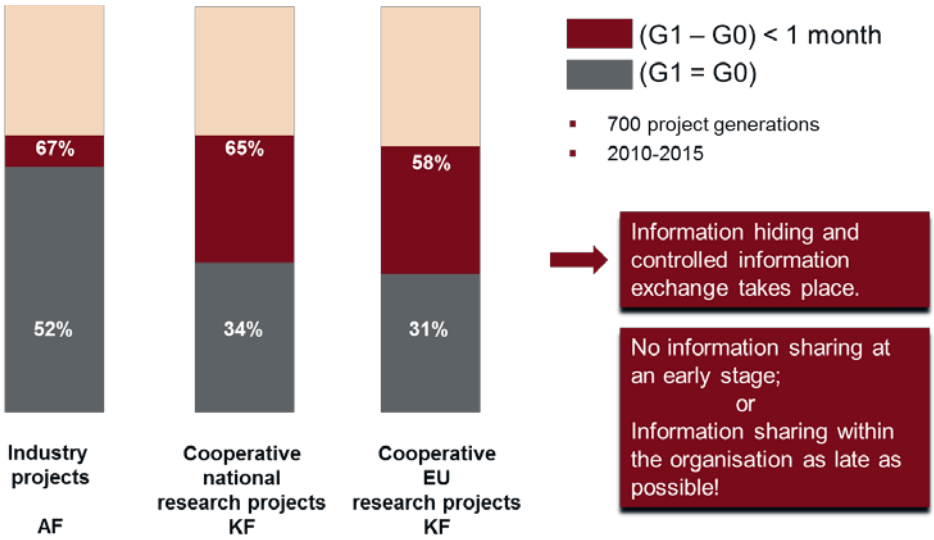


Figure 8.1: Employees´ Behaviour in Project Generation Phases

8.3. Interviews with the Middle Management

The results of the oral interviews conducted with the middle management of the AIT Department Digital Safety & Security are outlined in the following.

Starting point of the interviews were the results of the analysis of the Department’s project generation performance. According to the statistics of the time duration measured between Gate 0

and Gate 1 it becomes evident that employees tend to communicate their project idea in principle at a rather late stage.

The statistical analysis of the project preparation phases and the related explanations provided by the interviews with the middle management substantially corroborate the thesis put forward by Koch and Leitner [Koch2008]; i.e. that information hiding is carried out in a wide range of manners throughout the different phases of the development process of an idea or of a project within a company (see Section 6.3.4 above).

Based on the considerations made so far, one is bound to conclude that the 'lesson-learned effects', by the wider exchange of project experiences, fail to take place or it does only to a very limited extent.

This evident behavioural tendency can lead to a short-sighted attitude, which might turn out to be rather counter-productive, preventing the adoption of effective problem-solving approaches and thus hindering the successful preparation and planning of projects in the context of innovation processes.

In order to understand more about the motivation of the employees for this attitude, the middle management has been interviewed. In fact 13 semi-structured interviews have been performed with key personnel of the department; i.e. employees, who have the personnel responsibility of teams such as Department´s business unit managers (GFL) and Thematic Coordinators (ThC) as well as representatives of Departments support functions such Business Developer, Marketing and Project Life-cycle process (PLP) owner. The interviewed persons were confronted with the attitude of the employees to communicate their project ideas at a very late point in time and were asked to comment the reasons from their point of views.

In order to deal with the issue that the interviewer (the researcher) is part of the studied systems, i.e., there is a dedicated formal boss-employee relationship, some principles have been followed (an introduction into this issue was already discussed in Section 1.7.3 above):

- The interviewed persons have been informed that they should only express comments on those issues which they find important to mention.
- The interviewed persons were not asked about their individual behavior, but their observation or interpretation of the behavior of their employees.

It is important to note that the answers of this interview phase were only used to define the questions of the questionnaire for the employees. Thus, the potential issue that the interviewed persons provided biased answers, because of the boss-employee relationship with the researcher, is not relevant. This is because the answers were only used to shape the next step of the research process: the questionnaire with the employees.

The first question was formulated in the following way:

> *"By analyzing our project generation performance over the last years, we can see that 50% of project proposals were elaborated within one month only. A huge portion of the project preparation activities were formally carried out in no time, i.e. ´0 time duration´ (G0=G1). As this is totally impossible in reality due to the very complex nature of project preparation activities, what do you think is the reason behind this?*

From your point of view, what lies behind this attitude of the employees? Please tell us what you think." (First question used for the interview).

Thus, only the issues that were considered important by the interviewees were mentioned and thus collected as data.

For the second part of the interview, the following question with a more detailed focus was asked:

"Why is the Gate 0 mechanism not used to stimulate a discussion within the organisation? Why are employees not asking ´can anybody help me´? Why does an employee not follow the objective ´I organise company resources to implement my project ideas´? (Second question used for the interview).

8.3.1. Results of the Interviews

The interviews have been performed personally by the author of this study and the interviews have been recorded and then transcribed. No specific questions have been formulated. Only the results of the statistical analysis have been presented to the managers. The answers of the interviews have then been summarized to 14 key factors which have to be taken into account for subsequent innovation process designs. These factors are:

1. Added value in principle of a stage gate process and Gate 0 within an organisation
2. Added value of creative processes based on open information sharing crossing organisational boundaries
3. Short-term invitation to participating in funded projects
4. Red Tape effort without generating added value for the project leader through the exchange of information
5. Fear of criticism
6. Fear to lose control over "one's baby"
7. Sharing ideas
8. Competitive situation of the different organisational units
9. External perspectives and feedbacks about an in-house project
10. Holding a presentation to the project board as an exercise
11. Gate 0 happens – but without noticing
12. Available resources for project generation activities within the organisation
13. IT-Tools in general and public online social media tools in particular
14. Different functions within the organisation have different advantages

These factors and the expressed views articulated during the interviews are described in the following. After the discussion of each factor, the learnings have been summarized and highlighted explicitly.

Added value in principle of a stage gate process and Gate 0 within an organisation: With regard to the stage gate process, the interviewed participants expressed their principle appreciation but also a certain criticism. All interviewed employees agreed on the basic functionality of this innovation mechanism. The middle management justified the deployment of this tool by stating that, with this

method, ideas can be generated irrespective of any hierarchical structures and innovation can be managed based a holistic perspective. There was also general consensus in acknowledging that information sharing at an early stage might prove particularly instrumental when liaising with important support functions such as sales, business development, marketing, funding management, resource planning, etc. The middle management lamented, however, that numerous project managers fail to perceive Gate 0 as a 'sparring arena', where ideas and project concepts can be discussed and fine-tuned at an early stage of interaction. Consequently, the AIT DSS Project Board (PB) is mainly regarded as a decision-making body, where one can receive the final go ahead for the realization of a project, rather than an open discussion forum.

Summary – Learnings:

- The PLP is seen positive in principle:
    - for information sharing among researchers as well as with support functions;
    - ideas can be generated irrespective of any hierarchical structures and innovation can be managed based a holistic perspective;
- The working level prioritize the decision making process with the management more than the open information sharing process.

Added value of creative processes based on open information sharing crossing organisational boundaries: The potentially early start of a real idea-finding process and the acceptance of divergent knowledge and lateral thinking as effective creativity techniques have not yet reached the heads of all of the employees. The value of information sharing in the preliminary stages, i.e. the disclosure of complementing sources of information in addition to the official communicated contents, has not been recognized as an added value yet by many employees. However, practical experience and an established routine and a proven track record in successfully developing research projects can contribute to softening this rigid attitude of withholding information.

Numerous scientists of the department continue to believe that sharing information in the preliminary stages of an innovation process only make sense in the context of a coalition-building strategy - or a persuasion strategy to win support in closely related networks - and only within the same organisational unit. They do not recognize added value in communicating their innovative ideas to other business unit managers in the Project Board. They also argue that communication with their own business unit manager can be more open than a presentation to the Project Board. A more intense interaction with other business unit managers and with the head of the department only takes place when innovative ideas lie beyond the core strategic scope of both the company and the management. Interestingly, some have expressed the opinion, that an intensive communication with industrial partners is not helpful to improve the concrete focus of a project.

Summary – Learnings:

- The added value of real open communication beyond the own organisational unit is not yet completely understood by the concerned working level of employees.
    - Prevalent opinion: sharing information in the preliminary stages of an innovation process only make sense in the context of a coalition-building strategy - or a persuasion strategy to win support in closely related networks - and only within the same organisational unit.

- Positive practical experience and an established routine and a proven track record in successfully developing research projects can contribute to softening this rigid attitude of withholding information.

Short-term invitation to participating in EU funded projects: With regard to this problem area, survey participants pointed out that short-term invitations by external organisations to join prepared projects, dot not allow the active organisation and driving forward specific project objectives. However, this potentially leads to weak project conceptions as demonstrated by corresponding negative assessments in the review process (see EU project success rate measured by the department[174]).

Very often project presentations were done in a combined Gate 0/Gate 1 presentation and decision in the Project Board. As a result, the intended approach, according to which a project idea has first to go through Gate 0, gets comments and recommendations to refine the project proposal and then Gate 1 to further develop and reach a higher level of maturity, is undermined by this approach. Even more, also quality improvement measures such as quality control of the drafted project proposals by external experts is not possible finally.

Summary – Learnings:

- For the potential possibility to get some funding, not well-conceived joining to existing project consortia takes place (although we have to note, that limited effort is usually necessary as well)[175].

Having to deal with a considerable amount of red tape without however generating added value for the project leader through the exchange of information: In this thematic area, answers mainly focused on the additional administrative burdens, which is usually required for the formal description of a project proposal. Entering an idea into an IT tool in the form of a system entry is not perceived as advantageous from a project manager perspective.

The workload required for the recording of data, the collection of information and the preparation of a Gate 0 presentation (i.e. a well-defined PPT-presentation) as well as for the ongoing up-date of these data is viewed as an effort without a real added value. Especially the ongoing up-dating of both planned and actual data in an IT-system, such as data referring to Gate 0 and Gate 1, is viewed as useless workload for the project manager. This shows how top-down management approach, which is characterized by the search for constantly up-dated and transparent information in the organisations IT-based business support systems, is in contrast with project managers´ objective of limiting workload to a minimum extent.

Due to these diverging perspectives with regard to the understood requirements of a project manager that a Gate 0-suitable project description should fulfil, communication often takes place

[174] The experience within AIT´s Department DSS shows clearly that the success rate of EU project submission is significantly higher when more effort has been spent in establishing sound project proposals than just to react on late invitations to join existing project consortia.

[175] However, an important indicator is jeopardized by such an approach: ratio of submitted and gained EU project proposals. Usually, successful EU project performance for the proposal process is an indicator which is used to compare competence among organizational units.

only after the project idea has been finalized jointly with the external project partners[176]. In many cases, this delayed communication and project preparation is attributable to the waiting time incurred for a call text of a targeted funding programme. According to the experience of the department's project administration, information needed for a Project Board presentation prior to the submission of a project is provided as late as possible to guarantee the highest degree of correctness. It is, however, worth noticing that a more frequent participation in Project Board discussions is changing the attitude of employees as they recognize the potential added value of early information exchange in the group.

Summary – Learnings:

- Entering an idea and thus some information and data into an IT tool in the form of a system entry is not perceived as advantageous from a project manager perspective; resulting in a limited motivation for the employees to use extensively IT-tools to document project information.
- A top-down management approach, which is characterized by the search for constantly up-dated and transparent information in the organisations IT-based business support systems, is in contrast with project managers´ objective of limiting workload to a minimum extent.
- A Project Board presentation prior to the submission of a project is provided as late as possible to guarantee the highest degree of correctness.
- A more frequent participation in Project Board discussions is changing the attitude of employees as they recognize the potential added value of early information exchange in the group.

Fear of criticism: "*Starting an idea in a Stage Gate Process is like opening a Pandora's Box*", said a business unit manager. His quote demonstrates how fear of criticism can have a considerable deterrent effect on employees' willingness to openly communicate within the organisation in general and in the context of the Project Board specifically. In this case, a potential flop in the form of a rejection of a project is weighed against the potential benefits arising from open communication[177].

Before an employee dares to present an innovative idea to the Project Board, informal approval is sought beforehand, facts and evidences are collected in the background and efforts devoted behind the scenes to clarifying the real scope of the project. In this context, a basic problem was identified, revealing how employees struggle to convey the essence of an idea and get their point across. All interviewees agreed, however, on the fact that bad ideas should never be negatively judged.

Summary – Learnings:

- Fear of criticism is dominating any kind of information exchange process.
    - Before an employee dares to present an innovative idea to the Project Board, informal approval is sought beforehand, facts and evidences are collected in the

[176] It has to be noted that often by far too much information has been prepared for Gate 0 presentations by the employees, although it was not necessary in such a detail by the defined process (such as partners, cost and effort estimations, etc.).

[177] However it is interesting to note, that the rejection of a project essentially has never happened in the past 6 years in a Project Board meeting.

background and efforts devoted behind the scenes to clarifying the real scope of the project.

Fear to lose control over "one's baby": With regard to the practice of withholding information in the early stages of the innovation process, the fear of losing control over one's own idea mainly concerns the way employees tend to perceive themselves in their role as scientists. Researchers are often driven by the fear that their ideas might not fit into the overall corporate strategy and therefore be rejected. They might also refuse third-party support in answering open questions about a project out of misinterpreted vanity, as they are afraid that accepting support in clarifying certain open issues might be misunderstood as a lack of expertise on their part.

The ability to ask the management for assistance in dealing with certain issues is part of a corporate culture that is still alien to the scientific and research community, where the pride of each single individual still prevails. Even if it is obvious that no researcher can know everything, employees cannot afford to expose themselves to the risk of being unable to answer potential questions that might arise in an open discussion. Therefore, there is a clear tendency towards postponing large-scale communication and project discussions to a later point in time, when project leaders can feel sufficiently familiar with a certain topic and are well prepared for holding a presentation to the Project Board. In this context, it is worth pointing out that brainstorming about potential improvements to a project in a broad discussion is not deemed as an overriding objective for most project managers.

Summary – Learnings:

- Experts potentially refuse third-party support in answering open questions about a project out of misinterpreted vanity, as they are afraid that accepting support in clarifying certain open issues might be misunderstood as a lack of expertise on their part.
- To ask a wider audience or even the top management for assistance in dealing with certain issues is part of a corporate culture that is still alien to the scientific and research community.

Sharing ideas: The opinion of the interviewed participants was quite divided on this aspect. While exchanging ideas in strategy meetings is considered rather unproblematic, there is a general reluctance in sharing project ideas due to the fear that these might be "stolen".

Summary – Learnings:

- There is a general reluctance in sharing project ideas due to the fear that these might be "stolen" by others.

Competitive situation of the different organisational units: With regard to this aspect, the interviews revealed that there are self-serving interests and internal rivalries between the different organisational units (i.e. business units in the AIT structure). Examples of these are the submission of multiple project applications for one single funding programme or the development of special competences within one small group independent whether such skills are available within other groups. The fear that someone might succeed in making a deal with "stolen" ideas is real according to survey participants. Therefore, a certain level of mistrust may be considered legitimate.

Summary – Learnings:

- A certain level of mistrust within an organisation due to competitive forces has always to be taken into account. The fear that someone might succeed in making a deal with stolen ideas is real.

External perspectives and feedbacks about an in-house project: Dealing with external perspectives is a very delicate affair. The process of improving an idea, a concept or an argument through external feedbacks not always takes place. This is due to a number of reasons. External remarks might not match the project sponsor's vision or might be interpreted as unwelcome interference. In many cases, the notion stubbornly persists that it is unacceptable that an outsider can make a contribution to a well-defined project. Based on this basic attitude, external feedback (for instance with regard to special services for improving the project application quality, for project proposals to be funded, such as dedicated national services[178]) is simply ignored.

The frequently expressed opinion by some researchers "*we know everything already and a discussion in a larger group does not offer any added value*" could not be confuted completely.

Summary – Learnings:

- The process of improving an idea, a concept or an argument through external feedbacks not always takes place.

Holding a presentation to the project board as an exercise: By holding a presentation to the Project Board, one can improve the ability to better articulate the idea he/she has in his/her own head. Although there have been some positive examples reported during the interviews, there is some potential to realize by the employees that an ongoing written exchange about newly conceived ideas will contribute to further improving and fine-tuning the project and the overall argumentative basis.

Summary – Learnings:

- It is not yet fully accepted, that a written exchange (including holding presentations in front of the management) about newly conceived ideas will contribute to further improving and fine-tuning the project and the overall argumentative basis.

Gate 0 happens – but without noticing: Numerous ideas originate in previous projects, in e-mail communication and in the heads of the most dedicated employees. What is missing, however, is the formal presentation of these ideas in line with the defined procedure of an innovation process. When Gate 0 project ideas pop up, a corresponding funding programme or a potential industrial customer must be searched for. This can take place within the project group, in the process of budget planning or in the team responsible for strategy discussions. At latest, when it comes to finance and strategy planning, a "Gate 0" process has to be implicitly initiated by the business unit manager although it is not communicated explicitly.

Even if project ideas do not go through a Gate 0 or Project Board presentation, the corresponding activity implicitly happens within the protected inner circle of fellow colleagues.

The great majority of project ideas originate in strategy workshops, where the further orientation and course of action is discussed and further elaborated. Once this has been clarified, the project team waits for a corresponding call for funding projects or for an invitation from industry partners to prepare an offer. If the team wants to follow an active role, it has to be clarified to which companies

[178] For example, there are dedicated funding support organisations to help organisations to increase their performance in funded projects.

or whole markets the idea should be addressed. In an R&D context, innovative ideas are usually generated 2 to 3 years before they ultimately reach the status to be offered to an industry actor (Gate 1). Thus, many of those who have a new idea ask themselves if it really makes sense to endure the considerable red tape involved in the articulation and communication of their newly conceived idea, as it is impossible to know beforehand whether a project will be ultimately submitted.

Most of the interviewed experts are summarizing the Gate 0 very specifically: Gate 0 is exclusively project-oriented. Its main objective is to receive the go ahead by the management in the form of a signature, which confirms that the project basically fits into the overall corporate strategy. According to survey participants, the open discussion of project ideas in strategy workshops makes sense. There is also a general consensus among them that idea generation within personal networks often takes place in a random way and Gate 0 discussions occur without anyone really noticing. Out of the large number of Gate 0 project drafts of single teams only a few ones make it all the way to the Project Board. This is therefore undeniable evidence that a "Gate 0" also takes place outside the project boardroom – even not formalized but in principle.

Summary – Learnings:

- Many of those who have a new idea ask themselves if it really makes sense to endure the considerable red tape involved in the articulation and communication of their newly conceived idea.
- There is a clear evidence that a "Gate 0" also takes place outside the project boardroom – even not formalized but in principle and not always visible.
- Gate 0 is exclusively project-oriented. Its main objective is to receive the go ahead by the management in the form of a signature, which confirms that the project basically fits into the overall corporate strategy.

Available resources for project generation activities within the organisation: Idea development and project generation for Gate 0 and Gate 1 presentations only can take place, if there are considerable resources available for the employees to do so; i.e. expert knowledge, personnel resources, budget, etc. The question arises, whether the behaviour of the employees changes if the organisation will be much more restrictive and rigid concerning the available resources in the organisation. The interviewed employees argued that this will not really change the attitude of the employees concerning communication processes. If there were no resources for the preparation of projects and each single activity (even a minor one) were subject to prior approval via an application system, this would definitely lead to an increase in presentations following the maxim "everything is new and great", in order to get approval for the resources from the management, but, there are considerable doubts whether this would generate a real added value.

As a result, even if the implementation of an idea would be more challenging within the organisation in a changed framework, the organisation would always find a way to put together the necessary resources. Moreover, everybody agreed that a system can never be so rigid as to prevent staff members to find ways "behind the scenes" to start a project.

Summary – Learnings:

- It will not really change the attitude of the employees concerning communication processes, when the organisation will be much more restrictive and rigid concerning the available resources in the organisation.

IT-Tools in general and public social media tools in particular: Specific processes, such as the exchange of scientific information, are not supported by typical Social Media platforms. Public social media, such as Facebook, are mainly aimed at self-promotion, but are hardly used for scientific discussions. Scientific information exchange mainly takes place in corresponding forums.

Summary – Learnings:

- Public social media such as Facebook are not really supportive for creative and scientific discussions.

Different functions within the organisation have different advantages: The head of a department, the business unit manager and the project leader have different views regarding the potential advantages arising from the early disclosure of information about a project idea. When information is shared early on, the department head gains a good overall picture of the processes currently underway within the department and therefore enjoys the added value of knowing what's going on. The business unit managers get a good overview of the activities in other units and thus are able to identify synergies and cooperation potentials.

However, a project leader does not enjoy any immediately recognizable added value and this is exactly what undermines the system.

Summary – Learnings:

- Different functions within the organisation have different advantages from the various business processes (top management, middle management, project manager, business support functions, etc.). This has always kept in mind when discussing the acceptance of new tools and processes.

8.3.2. Conclusion: Suggestions for Improving the Innovation Process

The answers of the interviews revealed the motivational reasons behind employees' reluctance to share information during project generation phases. Based on the interviews we can summarize the following motivations of employees which guide their behaviour during secret phases within creative phases of innovation processes:

- **perceived "red tape effort": Missing motivation to take an effort for presentation and discussion without any evidence that this is helpful for the concerned person.** First and foremost, employees tend to perceive the organisational requirements for the preparation of new ideas and consequently the preparation of concerned project descriptions (e.g. PPT presentations, data entries in IT tools, G0 presentations, etc.) as excessive and therefore as a major hurdle. As a result, they fail to recognize the potential added value resulting from information exchange in discussion processes for further improving the project ideas and approaches.
- The middle management of the department formulated unanimously that the **Gate 0 process needs to be considerably simplified**. A reduction of the administrative burden related to Gate 0 would be more than welcome. One potential option could be a Gate 0 process without the necessity of using IT tools. The survey participants would also appreciate if the Gate 0 process would be designed in a more abstract manner, meaning without the necessity to describe pre-defined issues. According to the survey participants, it is not so much the preparation of a presentation for Gate 0 to be viewed as a problem but rather the hassle of

having to enter all data into a data and process management tool and to keep this data up-to date[179].

- "**Ideas have to be new**": Another reason for the poor communication of project ideas beyond one's closer team, i.e. beyond the project team, lies in the special attitudes and sensibilities of members of the scientific community which is always driven by the objective to identify something new and not known so far.
- "**Competition on ownership**": The fear of competition among scientists, who are afraid that a project might be awarded by management decisions to one of their colleagues conducting research in similar topical areas, can stimulate or even exacerbate their natural tendency towards over-caution and therefore their innate reluctance to communicate the research objectives and approaches they use in a project. This factor becomes worse the more indicator-driven a performance evaluation of units or employees take place.
- "**Experts have to know everything**": Further on, the fact that researchers tend to self-label themselves as experts is in direct opposition to an open communication culture, as scientists do not want and cannot afford to be looked upon as 'unknowledgeable' by other fellow researchers in a large panel of experts such as the Project Board (PB)[180]. Scientists often tend to use arrogance as a sort of defence mechanism and they do so to such an extent that they like to carry out their projects on their own in self-inflicted isolation. The expression, "*I don't need any internal correctors or any external contacts*", exemplifies in a nutshell this 'ivory tower mentality', which is still a relevant factor among scientists.

In order to validate these findings a wider questionnaire with all employees of the Department was conducted.

8.4. Questionnaire on Information Hiding Attitude

8.4.1. Development of the Questions

To better understand the behaviour and motivation of the staff members of the AIT Digital Safety & Security Department were subject to thorough scrutiny. First of all, observations regarding the project generation phases within the Department over the past years were analysed; including the duration spent for the idea generation and the project preparatory steps (see Section 8.1 above). These data were measured via the implemented project life-cycle process.

The results of the gate process analysis were discussed in semi-structured interviews (see Section 8.3 above) by oral interviews with the middle management and key personnel within the Department (business unit manager, thematic coordinator, business developer, etc.)

In a further step, 12 concrete theses were formulated building upon Koch´s "information hiding theses" [Koch2008], with a view to better understanding the motivation behind innovation activities

[179] Initially "@Enterprise", a dedicated IT tool, has been used within the department to ensure a process oriented work style to support the innovation process and programme management.

[180] The Project Board (PB) is the regularly meeting event at the Department level, where project proposals are discussed among the key personnel of the department; i.e. all business unit leaders, Thematic Coordinators (ThC), marketing & sales representatives, controlling, etc. A description is provided in Section 7.2.2 above.

in general and more specifically the motivation behind phases of secrecy and related communications practices within a company for creative phases of idea and project generation.

For the elaboration of the theses mentioned above, both knowledge gained from the interviews carried out with the management and with key players within the AIT Digital Safety & Security Department and personal professional experiences were included into the analysis. For each formulated thesis, a corresponding anti-thesis was put forward, which negates the original thesis. For all theses, corresponding questions were formulated in the form of a statement and the staff members of the department were asked to contribute their evaluation via an online questionnaire.

As explained in Section 1.8, the data collection via a questionnaire within the organisation was done by following all necessary ethical standards. The Works Council and the Data Privacy Advisory Board of the organisation was part of the preparation. Since the target group for the questionnaire are employees of the organisation, the final collection of the data from the employees was done via an online questionnaire by an external marketing research firm in order to ensure highest privacy within the organisation[181].

8.4.2. Style and Basic Data of the Questionnaire

In the case of a larger number of interviewed persons and who have not necessarily a context to innovation management processes, other methods of organising the questionnaire would have been possible. It could have been possible to ask one group about the thesis and another control-group about the anti-thesis or to mix all questions up and are then presented in a way that the correlation of theses and anti-thesis are not seen. But, since in our case, a total of 250 people addressed for the questionnaire as one comprehensive group, both thesis and anti-thesis were asked at the same time. In addition the interviewed persons are well educated people who understand the context of innovation management; i.e. all employees are academics and are involved in some way or another in R&D projects with a high level of external connections (to R&D partners, customers, etc.).

The questionnaire has been designed in the following form. Two corresponding opinions, thesis and anti-thesis, are asked in a way that these, to some extent contradictory, views are transparently shown to the interviewed person. Each question is formulated as a statement and has to be answered by choosing in a scale of 6 points whether they agree or disagree to the formulated statement.

The basic data of the questionnaire are:

- Method: online questionnaire
- Basic population, i.e. group of invited people to participate in the questionnaire: 205 staff members of the AIT Digital Safety & Security Department as well as 45 freelancers. We can assume that freelancers, i.e. PhD and master students, will be much less motivated to participate in such a questionnaire. This has to be taken into account when calculating the response ratio.

[181] The questions have been elaborated by the author of this study as well as related issues such as the invitation of the employees, etc. The market research firm IFES (http://www.ifes.at/ last access: 24.4.2017) used their online system to collect the answers anonymously.

- Response: 104 persons; 50,7% of the employees and 36,49% of freelancers are taken into account. In the questionnaire, no differentiation was made to keep it simple concerning the data privacy and work council considerations.
- Period of the questionnaire: 5.11.2015 – 27.11.2015

8.4.3. Areas of Investigations of the Questionnaire

In order to better understand the motivation of the employees concerning their behaviour in innovation activities in general and more specifically the motivation behind phases of secrecy and related communications practices within a company, 11 concrete theses were formulated building upon Koch´s "*Information hiding theses*" [Koch2008] as well as the results of the interviews with the middle management and the observation of the project generation performance as the basis for concrete questions.

In particular for this investigation, the difference between communication within the inner circle of the colleagues and communication with the management was taken into due account in the questionnaire. In addition the personal willingness to take effort and to interact with the organisation was part of the evaluation. Finally 32 questions have been designed based on a theses and anti-theses concept. In addition to that, 7 further questions have been drafted to elaborate the context of their social media usage in general. To summarize, the questions are covering the following fields:

- communication and presentation of ideas
    - communication and presentation of ideas in front of colleagues
    - communication and presentation of ideas in front of the management
- preparation of ideas in documents and in IT-tools
- holding presentations
    - holding presentations in front of colleagues
    - holding presentations in front of the management
- introducing ideas into the organisation
- position as an expert within a group
    - dealing with errors
    - dealing with ambiguity
- cooperation within the organisation
    - cooperation with other organisational units within the organisation
- management of intellectual property of ideas
- relationship between employees and management in the company
- general usage of social media tools

These issues have been considered by 37 elaborated questions within 11 theses, which are described in the following.

8.4.4. Motivation Behind the Phase of Secrecy – 11 Theses

In the following, the theses which are the background for the formulated questions are explained and the derived questions for the questionnaire are formulated as statements. Possible behaviour of the employees is formulated as thesis and anti-thesis.

All questions have to be answered in a scale of 6: applies fully = 1, does not apply at all = 6, and it is also possible "not to answer".

Thesis 1: There is a risk that half-baked concepts and ideas might be negatively judged by others since in the early stage of the concept development process not all aspects are given due consideration. As a result, the management or certain colleagues within an organisation might take a negative stance, which in the course of a decision-making meeting might stop the idea or steer it to an undesired direction.

- Question 1a: *I present my idea or my project conception to my inner circle of colleagues, only when I'm sure I can answer all related questions.*

Anti-thesis: Instead of viewing the raised points as a positive contribution to further brainstorming or as an improvement of the original idea or approach, only the potential risk of a negative judgment by other people is taken into consideration. However, the presentation of half-baked concepts offers the opportunity to address new perspectives and include aspects that had not been previously considered into the final concept generation.

By discussing half-baked ideas at a very early stage, work can be accomplished in a more time-effective manner and potential miss developments can be prevented more effectively.

- Question 1b: *I present my idea or my project conception to my inner circle of colleagues, at a very early and raw stage so that open aspects can still be discussed among colleagues and consequently included in the final concept.*

Further on, a difference can be made between communication within the inner circle of a group of colleagues, or communication in a broader context within the organisation or communication with the management, resulting in two more questions:

- Question 2a: *I present my idea or my project conception to the management, only when I'm sure I can answer all related questions.*

- Question 2b: *I present my idea or my project conception to the management, at a very early and raw stage so that open aspects can still be discussed among colleagues and consequently included in the final concept.*

Thesis 2: Innovators try to avoid red tape as they are convinced that red tape does not provide any added value for the development of innovations. Formalities such as filling in forms, preparing presentation materials or other documents, engaging in discussions etc. are deemed as too effort intensive and as an unnecessary hassle for the development of innovations.

- Question 3a: *Ideas and project proposals are prepared and presented via databases, presentation materials and workshops. Such extensive preparation activities are too effort intensive for me and do not deliver a corresponding added value.*

Anti-thesis: The activities involved in the preparation of a presentation or an argument are productivity-enhancing activities, where different lines of thoughts and chains of reasoning are developed and strengthened. By developing easily comprehensible presentations, aspects that had not been previously considered can be identified. As a result, such topics can be subsequently addressed and further developed.

- Question 3b: *The creation of a presentation or the formulation of an argument enhances productivity: different lines of thoughts and chains of reasoning are developed and strengthened, as the presentation should withstand the judgment of an audience. By developing easily comprehensible presentations, aspects that had not been previously considered can be identified.*

Thesis 3: Holding a presentation and engaging in a discussion with a larger group of people is felt as unpleasant. This question does not refer to the aspect of a calculated avoidance of efforts as in question 2 but it rather focuses on the explicit sensation of uneasiness it generates. The question would be as follows: "Holding a presentation and engaging in a discussion with a larger group of people is a very unpleasant experience for me and therefore I try to avoid it." However, since it is very difficult to admit it, we will opt for a different formulation, which does not directly address this emotional aspect.

- Question 4a*: Holding a presentation and engaging in a discussion with my inner circle of colleagues is very time-consuming and requires a great deal of efforts so I try to avoid it.*

Anti-thesis: The conscious act of holding a presentation obliges me to elaborate clear messages. In this way, I'm bound to question the concept behind my project idea and, as a result, this helps to identify perspectives that have not been previously considered.

- Question 4b*: I'm happy to hold a presentation in front of a larger group of my colleagues in order to have a feedback that I can use for my project idea.*

Again, a difference can be made between communication within the inner circle of a group of colleagues, or communication in a broader context within the organisation or communication with the management, resulting in two more questions:

- Question 5a*: Holding a presentation and engaging in a discussion with the management is very time-consuming and requires a great deal of efforts so I try to avoid it.*

- Question 5b*: I'm happy to hold a presentation in front of the management in order to have a feedback that I can use for my project idea.*

Thesis 4: An innovation probably lies outside the scope of a defined corporate strategy and therefore of a company's roadmap. Innovators fear that new approaches are not in line with the corporate strategy and are therefore not supported by the management.

- Question 6a: *When I think that new ideas are not in line with the corporate strategy, I do not engage in a large debate within the company but I try to set up the project in secrecy and establish it within the organisation.*

- Question 6b*: When I think that new ideas are not in line with the corporate strategy, I do discuss them within the inner circle of my colleagues but not with the company management.*

Anti-thesis: It requires both time and financial resources to process a new idea, which can be given the final go ahead by asking the explicit approval of the management. This necessitates, however, a convincing line of reasoning, which should demonstrate that the invested company resources are in the best interest of the company. The line of argument pursued should work for both incremental and disruptive innovations. In the case of disruptive innovations, this will require considerable efforts and will prove more risky in the sense that the line of argument chosen might be more vulnerable to objections.

However, the question arises as to how this process can take place in an effective and sound manner with the few company resources available, if the development of an idea happens in the background. This aspect also depends on the budget situation of the company and of the team. If it concerns the optimization of the existing team capacities without however requiring any cost-cutting measures, the available resources can be managed by the team without engaging in an explicit discussion with the management or the organisation.

If, however, the company is pursuing a growth strategy or additional resources are needed, which are not currently available within the company and which would lead to an implicit delay of the project (new resources such as personnel, skills, budget, etc.), an interaction with the top management is inevitably necessary.

In the case of innovative approaches that are not the central focus of a corporate strategy, innovators profit a great deal from the critical evaluation of the feasibility of an idea based on the available resources within the company and the consequent realization whether additional resources might be required with a view to ensuring new growth opportunities and developing new markets. Thanks to this reflection process, innovators are able to further strengthen their line of argument, providing the basis for a convincing presentation of their idea to the top management, while having a bottom-up impact on the corporate strategy.

- Question 6c: *Also in the case of innovative approaches and project ideas that are not the central focus of the corporate strategy, I explicitly present and discuss them within the organisation to contribute to further expanding the strategic focus of the company.*

Thesis 5: New ideas can question or even jeopardize existing or tried and tested in-house technologies and corporate processes. This is mainly the case when disruptive innovations are involved. This might lead to a situation, where certain colleagues or the management do not support or even jeopardize the original idea – see the "Innovators Dilemma Paradox", [Christensen2011], [Paap2004]. Thus, innovators prefer to bring an idea to a greater level of maturity to be able to show concrete results and provide a solid factual base.

- Question 7a*: it is a good strategy for certain projects to collect facts in the first place. This can be a customer order, an explicit declaration of intent of a customer or of a project partner, with whom we have already entered into an informal commitment.*

Anti-thesis: Disruptive innovations are seldom fully new developments. Allowing new ideas to expand and improve existing technologies can lead to a process of repurposing and to a future-oriented transformation of the company, enabling it to develop a unique selling proposition on the market. Disruptive ideas tend to put the existing organisation under pressure. The resulting debate brings about value added and a positive change for the company.

- Question 7b: *I like to bring up new ideas that exert pressure on established structures and engage in a large discussion within the company because in this way I help the company move forward.*

Thesis 6: Employees are afraid that too many colleagues might find out about a misjudgement they made with regard to an idea they had previously conceived. The innovator tries to keep communication on a small scale and within the inner circle of his/her acquaintances in order to prevent reputational damage in the case of other potential failures (this corresponds to an attitude, where failing as a company is considered a major flop).

- Question 8a: *I'm afraid that too many colleagues might find out about a misjudgement I made with regard to an idea I had conceived that turned out not to be well thought out.*

Anti-thesis: Against such an argument one could object that in other markets, such as for instance, the USA there is a well-established culture of failure. In order to promote this very promising 'trial and error' approach also in Europe, a major paradigm shift has to take place at the cultural level not only within companies but also within society at large so that decision made at a very early stage are deemed as brave and not as a failure. Success also originates from making mistakes, correcting errors and making corresponding adjustments. In other words, successful innovation requires free scope to experiment beyond the rigid borders of a corporate strategy (this corresponds to an attitude, where making mistakes is considered to give rise to new insights).

- Question 8b*: One can only learn from mistakes. Therefore, even if a conceived idea turns out to be not feasible, I have certainly learned a great deal, while contributing to the further development of the company. Thus, my reputation as an expert is not at stake.*

Thesis 7: The representation of a problem situation, where it is evident that not all aspects have been addressed and explained in an exhaustive manner, is inconsistent with the basic image of an expert/engineer. Therefore, a technology-oriented innovator or a key-player, who thinks mainly structurally, tends to first clarify all aspects before presenting them.

- Question 9a*: I'm afraid that an open representation of certain aspects that are still unclear and have not been dealt with in an exhaustive manner could be viewed as inconsistent with my expert position.*

Anti-thesis: No topic can be dealt with 100% with the available know-how; this means that any attempt in this direction is bound to fail.

- Question 9b*: New projects bring about a level of complexity that cannot be totally understood. An open communication about those aspects that have not been addressed yet stresses my expert position and therefore my integrity.*

Thesis 8: Employees are often not allowed to address topics that lie outside their area of competence or do not correspond to their job description. As a result, they carry out their innovation activities in secrecy.

- Question 10a*: I think that the company does not welcome the fact that I might enter into cooperation with other parts of the organisation (such as other business units or departments), even if this could give rise to innovations.*

Anti-thesis: No organisation can define a clear area of competence with a top-down approach. However, numerous companies still try to establish such rigid organisational structures in a quest for enhanced efficiency. The more this approach is pursued, the more the company's innovation power is limited, since innovation originates from the unknown, re-use and from diversity.

- Question 10b: *The interaction with other colleagues from other organisational units often leads to creativity and value added.*

Thesis 9: Innovators fear that they must hand over their best ideas and approaches to other colleagues. Therefore, they carry out their research activities as a personal initiative in great secrecy.

- Question 11a*: When I present my ideas, it can happen that someone else is appointed project leader and becomes responsible for the further development of the project. I therefore lose control over the success of the project (and I lose control over 'my baby').*

- Question 11b*: I'm afraid that my ideas might be 'adopted and further developed' by someone else and, as a result, my authorship of these ideas for potential future publications and/or patents might be affected or lost.*

- Question 11c*: If I'm the expert with regard to a specific topic, then I'm the only one who can act as the project leader, nobody else can deal with this topic as effectively as I do.*

Anti-thesis: Successful innovations require openness, interdisciplinary and an inter-cultural approach to problem-solving. Numerous revolutionary developments are to be attributed to new innovation models such as open innovation, user-driven innovation and crowd sourcing methods among scientists. With open data based on a new breed of information sharing tools such as social networks, new way of collaboration and hierarchy-free discussion platforms can be developed. It therefore lies within the responsibility of the top management to establish a climate of openness, where the aforementioned fears and the company's silo mentality can be overcome.

- Question 11d*: It is in my own interest that other people are entrusted with the task of executing the project on an operative basis.*

- Question 11e*: I'm well aware of the fact that a good idea can turn into a successful innovation only when a critical mass of players has been reached. That's why I'm trying to find lots of supporters and collaborators within the company.*

Thesis 10: Resource conflicts within an organisation - when an idea or a project concept is conceived, a resource conflict can take place within the organisation. The decision of the top management, which is based on a priority list, might jeopardize the initiatives of single individuals. As a result, one might try to prepare and conduct a project in secrecy to such an extent that external contingencies such as customer relations, etc., might make it difficult to stop the project.

- Question 12a: *Competition for in-house budget resources is very strong and therefore I try to execute project ideas also without the involvement of the management since I can organise the necessary resources within my own area of responsibility.*

- Question 12b: *Competition for personal skills within the company is very strong and therefore I try to execute project ideas also without the involvement of the management since I can organise the necessary resources within my own area of responsibility.*

Anti-thesis: Based on a good line of argument, the necessary resources can be approved by the company (commitment). For a project that is carried out in the background only limited resources for its development can be made available and this increases the probability that the project might ultimately fail.

- Question 12c: *It is of decisive importance for a project idea to be able to establish itself by overcoming internal competition and be executed with the support of the management, since only in this way all necessary resources can be made available.*

Thesis 11: Lacking interaction culture between management and the workforce. This can be attributed to a specific objective of the management, which is determined to implement a change process within the company. In this case, in-house feedback is not given much consideration. Or there is a cultural problem and the management is unable to communicate its confidence in the ability of the workforce to perform and innovate. In both scenarios, the workforce tends to show very limited willingness to openly communicate potential new and disruptive approaches to the company. Employees tend to act passively and operate secretly.

- Question 13a: *I believe that the company does not welcome it if I contribute new ideas.*
- Question 13b: *I only disclose those types of information that are not essentially important for my professional position and do not jeopardize my professional standing.*

Anti-thesis: I do not let myself be misled; I'm guided by my team. I'm trying to make a difference through my active contribution in the organisation and thereby develop the organisation further.

- Question 13c: *I communicate my new ideas to my circle of colleagues, to my team and to the management.*

8.4.5. General Questions about the Usage of Online Social Media Tools also Outside the Company

The following questions are intended to analyse the context of social media tool usage in general; i.e. even outside of the organisation. The objective of these questions is to understand the relationship between professional and private usage of online social media tool.

- Question 14: *Which online social media tools do I use and how often?*

  For each tool, please describe the usage by the following options: daily, several times per week, approximately once a week, several times per month, even more seldom, never, no answer:
  - *LinkedIn*
  - *Xing*
  - *Facebook*
  - *ResearchGate*
  - *Twitter*
  - *Skype*
  - *Google+*

- *WhatsApp*
- *AIT internal Tools (SoCol, Sales Force, etc.)*
- *Others*

- Question 15*: If you have chosen "others" in the question above: Which other Online Social Media Tools do you use? (Please note)*
- Question 16: *(IF USED) Which of the used social media tools that you use do you use mainly in a private context, in a professional context, or both?*

  For each tool, please describe the usage by the following: used mainly privately, used privately and professionally in equal measure, used mainly professionally, no answer.

- Question 17: *Which added value do you expect from using these tools?*

  Please specify for each point in a scale of 1-5: totally agree=1, don't agree at all=5, no answer:

  - Networking - keeping in contact ("update address lists")
  - Networking - potential future specialist communication about technical/scientific contents
  - Networking to be informed about marginal topics (of my area of specialization)
  - Networking to keep abreast of core topics in my area of responsibility
  - Networking – potential future industry contacts
  - Communication - marketing for my projects
  - Communication – self-marketing
  - Networking for future job opportunities
  - Communication – marketing for AIT

- Question 18: *Do you have concerns when using AIT internal tools like SoCol, Salesforce, etc.?*

  Please specify: applies fully, partially applies, does rather not apply, does not apply at all, no answer.
- Question 19: *I do not like to use online social media tools within the company, because …*

  Please specify:

  - *I'm afraid that the information I disclose might be misused*
  - *I'm afraid that my contacts might be misused*
  - *I'm afraid that the information I disclose might be misinterpreted*

- Question 20: *Do you have any comments, anything you want to tell us with regard to this survey? (Please note)*
- Final comment: *Thank you very much for your kind participation!*

8.4.6. Results of the Questionnaire

The following findings can be summarized from the questionnaire.

8.4.6.1 Communication and Presentation of Ideas in Front of Colleagues and Management

- Question 1a: *I present my idea or my project conception to my inner circle of colleagues, only when I'm sure I can answer all related questions.*

- Question 1b: *I present my idea or my project conception to my inner circle of colleagues, at a very early and raw stage so that open aspects can still be discussed among colleagues and consequently included in the final concept.*

51% are definitely not waiting to discuss issues with their colleagues (question 1a); and from the other point of view 80% indicate, that they are presenting their idea even in a very early stage (question 1b).

- Question 2a: *I present my idea or my project conception to the management, only when I'm sure I can answer all related questions.*

- Question 2b: *I present my idea or my project conception to the management, at a very early and raw stage so that open aspects can still be discussed among colleagues and consequently included in the final concept.*

Concerning the discussion with the management, it is slightly different. 52% are waiting till they feel that they have enough material to be able to discuss it with the management (question 2a). Although we have to recognise, that already 24% are claiming that they are definitely willing to discuss even half-baked ideas with the management (question 2b).

8.4.6.2 Preparation of Ideas

- Question 3a: *Ideas and project proposals are prepared and presented via databases, presentation materials and workshops. Such extensive preparation activities are too effort intensive for me and do not deliver a corresponding added value.*

- Question 3b: *The creation of a presentation or the formulation of an argument enhances productivity: different lines of thoughts and chains of reasoning are developed and strengthened, as the presentation should withstand the judgment of an audience. By developing easily comprehensible presentations, aspects that had not been previously considered can be identified.*

29% are stating that preparation activities are too effort extensive and they don't see an appropriate added value (question 3a). Although we can see, that 61% see an added value in preparing an idea by structured means (presentations, documentation, etc.) (question 3b).

However, based on these questions it is not clear whether the additional burden of using IT-tools and following strict business processes is the matter of issues or no added value is seen in principle.

8.4.6.3 Holding presentations in front of the colleagues and management

- Question 4a*: Holding a presentation and engaging in a discussion with my inner circle of colleagues is very time-consuming and requires a great deal of efforts so I try to avoid it.*

- Question 4b*: I'm happy to hold a presentation in front of a larger group of my colleagues in order to have a feedback that I can use for my project idea.*

60% are rejecting the view that they want to prevent the holding of presentations in front of colleagues (question 4a). This is confirmed by question 4b, that 67% indicate that they are using a presentation in front of colleagues on purpose.

- Question 5a*: Holding a presentation and engaging in a discussion with the management is very time-consuming and requires a great deal of efforts so I try to avoid it.*

- Question 5b*: I'm happy to hold a presentation in front of the management in order to have a feedback that I can use for my project idea.*

Here we can see a tension between effort to prepare and holding a presentation and expected added value from a discussion with the management. 1/3 (30%) see the effort as too much compared to the added value; 1/3 (37%) see an added value which pays off the effort for the presentation; and 1/3 (32%) are unsure (question 5a).

Question 5b is confirming this view: 1/3 (31%) is willing to hold presentations; 1/3 (31%) is not willing; and 1/3 (38%) is unsure.

8.4.6.4 Introducing ideas into the organisation

- Question 6a: *When I think that new ideas are not in line with the corporate strategy, I do not engage in a large debate within the company but I try to set up the project in secrecy and establish it within the organisation.*
- Question 6b*: When I think that new ideas are not in line with the corporate strategy, I do discuss them within the inner circle of my colleagues but not with the company management.*
- Question 6c: *Also in the case of innovative approaches and project ideas that are not the central focus of the corporate strategy, I explicitly present and discuss them within the organisation to contribute to further expanding the strategic focus of the company.*

Only 9% are following the concept to keep a new idea secret when they assume that new ideas do not fit to the company´s strategy. 1/3 is definitely willing to present such ideas. According to question 6a, 68% don´t agree that they don´t engage in communication when considering new ideas. Looking at question 6b, 1/3 acknowledges that they definitely will present new ideas and an additional 1/3 is more positive than negative.

When asking about the strategy to influence even the whole organisation even to adapt the defined strategy, 1/3 is very open and interested to change the company (34%). 1/3 (22%) is not interested and 44% is unsure (question 6c).

- Question 7a*: It is a good strategy for certain projects to collect facts in the first place. This can be a customer order, an explicit declaration of intent of a customer or of a project partner, with whom we have already entered into an informal commitment.*

- Question 7b: *I like to bring up new ideas that exert pressure on established structures and engage in a large discussion within the company because in this way I help the company move forward.*

60% intend to organise facts in order to increase the probability that their new idea will be accepted by the company (question 7a).

And again we see 1/3 (28%) which is definitely interested and willing to change the company´s strategy; 1/3 isn´t (25%); and 1/3 is unsure (question 7b).

8.4.6.5 Position as an expert within a group

Dealing with errors:

- Question 8a: *I'm afraid that too many colleagues might find out about a misjudgement I made with regard to an idea I had conceived that turned out not to be well thought out.*

- Question 8b*: One can only learn from mistakes. Therefore, even if a conceived idea turns out to be not feasible, I have certainly learned a great deal, while contributing to the further development of the company. Thus, my reputation as an expert is not at stake.*

1/6 (17%) is afraid to be judged as a non-expert due to misjudgement; however 55% are not (question 8a). This is confirmed by the fact that 63% indicate that they are willing to learn from mistakes (question 8b).

Dealing with ambiguity:

- Question 9a*: I'm afraid that an open representation of certain aspects that are still unclear and have not been dealt with in an exhaustive manner could be viewed as inconsistent with my expert position.*

- Question 9b*: New projects bring about a level of complexity that cannot be totally understood. An open communication about those aspects that have not been addressed yet stresses my expert position and therefore my integrity.*

Demonstrated ambiguities by presentations of projects in a very early status are not really a problem for 60% (question 9a). This is confirmed by the view, that 79% even see that their expert view is even underlined when they present open issues for discussion, even when those issues are not clear ("Mut zur Lücke") (question 9b).

8.4.6.6 Cooperation within the organisation

- Question 10a*: I think that the company does not welcome the fact that I might enter into cooperation with other parts of the organisation (such as other business units or departments), even if this could give rise to innovations.*

- Question 10b: *The interaction with other colleagues from other organisational units often leads to creativity and value added.*

Only 8% believe that they should not cooperate with other organisational units within the organisation; whereas 66% are definitely interested to cooperate with other organisational units (question 10a). This is confirmed by the fact, that 80% see an added value and increased creativity when they cooperate with other units and even nobody answered that this does not bring any creativity at all (question 10b).

8.4.6.7 Management of intellectual property of ideas

- Question 11a*: When I present my ideas, it can happen that someone else is appointed project leader and becomes responsible for the further development of the project. I therefore lose control over the success of the project (and I lose control over 'my baby').*

- Question 11b*: I'm afraid that my ideas might be 'adopted and further developed' by someone else and, as a result, my authorship of these ideas for potential future publications and/or patents might be affected or lost.*

- Question 11c*: If I'm the expert with regard to a specific topic, then I'm the only one who can act as the project leader, nobody else can deal with this topic as effectively as I do.*

- Question 11d*: It is in my own interest that other people are entrusted with the task of executing the project on an operative basis.*

- Question 11e*: I'm well aware of the fact that a good idea can turn into a successful innovation only when a critical mass of players has been reached. That's why I'm trying to find lots of supporters and collaborators within the company.*

Only 15% are afraid that somebody else can take over their project idea as a project leader for further elaboration; 48% are not (question 11a). Only 17% are afraid that authorship or patents will be lost by to open communication; 52% are not (question 11b). Only 4% believe that only they as expert should work on their topics; 69% are not (question 11c). 60% are interested to find more people to support their projects and ideas; 10% said no interest (question 11d). Even 65% see that only when they achieve a critical mass, their project idea will be successful finally; only 2% have an opposite view (question 11e).

8.4.6.8 Relationship between employees and management in the company

- Question 12a: *Competition for in-house budget resources is very strong and therefore I try to execute project ideas also without the involvement of the management since I can organise the necessary resources within my own area of responsibility.*

- Question 12b: *Competition for personal skills within the company is very strong and therefore I try to execute project ideas also without the involvement of the management since I can organise the necessary resources within my own area of responsibility.*

- Question 12c: *It is of decisive importance for a project idea to be able to establish itself by overcoming internal competition and be executed with the support of the management, since only in this way all necessary resources can be made available.*

Only very few are following the strategy to work on new ideas without management negotiation; 12% to fight for budget and 9% to fight for dedicated skills in the company. The majority is willing to discuss their ideas with the management; 67% for budget and 65% for skills (questions 12a and 12b). This is confirmed by the clear view that 68% are aware that only management support can guarantee a project success for new ideas; only 5% don´t have this view (question 12c).

- Question 13a: *I believe that the company does not welcome it if I contribute new ideas.*

- Question 13b: *I only disclose those types of information that are not essentially important for my professional position and do not jeopardize my professional standing.*

- Question 13c: *I communicate my new ideas to my circle of colleagues, to my team and to the management.*

10% believe that it is not welcomed, when they bring new ideas into the organisation; whereas 75% see the interest of a company to bring new ideas into the organisation (question 13a). 6% keep essential information to protect their career; 65% are very open (question 13b). This is confirmed by 70% which are very open to share any information (question 13c).

8.4.6.9 General usage of social media tools

- Question 14: *Which online social media tools do I use and how often?*

Nearly half of the employees are not using Social Media Tools at all; LinkedIn 44%, Xing 46% and Facebook 39%, Research Gate 43%, Twitter even 72%. LinkedIn is used daily only by 4%; Xing even only by 1%. Only Facebook is used on a daily basis by 26% and WhatsApp by 28% (question 14).

- Question 15*: If you have chosen "others" in the question above: Which other Online Social Media Tools do you use? (Please note)*
- Question 16: *(IF USED) Which of the used social media tools that you use do you use mainly in a private context, in a professional context, or both?*

When asked about private or professional use, Facebook (85%) and WhatsApp (96%) are mainly used for private means; whereas LinkedIn (77%), Xing (65%), Research Gate (95%) is used for professional use (question 16).

- Question 17: *Which added value do you expect from using these tools?*
    1. Networking - keeping in contact ("update address lists") – 65%
    2. Networking - potential future specialist communication about technical/scientific contents – 50%
    3. Networking to be informed about marginal topics (of my area of specialization) - 46%
    4. Networking to keep abreast of core topics in my area of responsibility – 46%
    5. Networking – potential future industry contacts – 43%
    6. Communication – self-marketing – 39%
    7. Networking for future job opportunities – 31%
    8. Communication - marketing for my projects – 30%
    9. Communication – marketing for AIT – 19%
- Question 18: *Do you have concerns when using AIT internal tools like SoCol, Salesforce, etc.?*

29% have concerns when using AIT internal tools (question 18)! When asked about the motivation of their concerns:

- Question 19: *I do not like to use online social media tools within the company, because …*
    - I'm afraid that the information I disclose might be misused – 36%
    - I'm afraid that my contacts might be misused – 33%
    - I'm afraid that the information I disclose might be misinterpreted – 34%

- Question 20: *Do you have any comments, anything you want to tell us with regard to this survey? (Please note)*

The general comments made by the interviewed employees by this question, can be summarized by the following statements:

- E-mail is seen still as a very essential tool for communication and cooperation.
- It is important how employees have been treated within the organisation when they raise new ideas.
- The complexity or the missing effectiveness of IT-tools as well as defined processes such as forms, etc., are essential factors determining the acceptance of new tools and organisational processes.
- The administrative overhead stimulated by new tools or organisational processes should be kept on a minimum level.

One single statement is worthwhile to mention, since it summarises the whole discussion very clearly:

> *"Tools are ONLY a tool and do not replace the trustful (direct) interaction between the actors. Dissemination of information is also an expense and is only made happy if it's worth in the long term and when the concerned information (= capital) is handled fairly in the organisation."*[182]

These issues have to be taken into account by defining subsequent organisational processes and forming corporate culture.

8.4.7. Summary of the Empirical Analysis

The results of the empirical analysis can be summarized by the following ten categories:

1. Communication with the management – information hiding
2. Interaction with the management
3. Influencing the organisation
4. Effort to prepare information for an effective communication process
5. Perception as expert
6. Cooperation with other units
7. Fear to lose ownership of ideas or patents
8. Looking for support of their ideas and projects
9. Innovation is part of the organisation´s culture
10. Use of public online social media platforms for professional use

These ten issues are explained in more detail in the following.

1. **Communication with the management – information hiding:** 80% of the employees indicate that they are presenting their idea even in a very early stage to their colleagues (question 1b).

   Employees are a little bit more cautious when communicating with the management. 24% of the employees are indicating that they are willing to discuss half-baked ideas even with the management, however 52% are waiting till they feel that they have enough material to be able to discuss it with the management (question 2a).

   60% are rejecting the view that they want to prevent the holding of presentations in front of colleagues (question 4a). This is confirmed by question 4b, that 67% indicate that they are using a presentation in front of colleagues on purpose.

   Only 9% are following the concept to keep a new idea secret when they assume that new ideas do not fit to the company´s strategy. 1/3 is definitely willing to present such ideas.

[182] Original phrase from an anonymously interviewed employee: *„Tools sind NUR Werkzeug und ersetzen nicht den vertrauensvollen (direkten) Umgang zwischen den Akteuren. Weitergabe von Information ist auch ein Aufwand und wird nur dann gerne gemacht, wenn sich das auch langfristig lohnt und mit dieser Information (=Kapital) fair umgegangen wird.*"

According to question 6a, 68% don´t agree that they don´t engage in communication when considering new ideas. Looking at question 6c, 1/3 acknowledges that they definitely will present new ideas and an additional 1/3 is more positive than negative.

Question 5b is supporting this attitude: 31% is willing to hold presentations; and 31% is not willing. Since 38% are unsure, it shows the huge potential to influence pro-actively this group of employees through appropriate organisational measures.

Considering the management, the reluctance becomes clearer. 39% are willing to present the ideas to the colleagues but not to the management; although 17% are willing to present such ideas even to the management (question 6b).

Only 6% keep essential information to protect their career; 65% are very open (question 13b). This is confirmed by 70% which are very open to share any information (question 13c).

60% intend to create facts in order to increase the probability that their new idea will be accepted by the company (question 7a).

When using AIT internal tools (question 18), 29% have concerns, because they are afraid that the information disclosed might be misused (36%); contacts might be misused (33%); and 34% of these are afraid that potentially provided information might be misinterpreted.

Learnings:

- ⇨ the employees are in principle open to communicate with their peers;
- ⇨ Employees are more cautious when communicating with the management.
- ⇨ Information hiding is not the main driving force for employees. However, the strategy to create facts in order to increase the probability that new ideas will be accepted by the company is a potential source for information hiding.

2. **Interaction with the management:** Only very few are following the strategy to work on new ideas without management negotiation. The majority is willing to discuss their ideas with the management: (questions 12a and 12b). This is confirmed by the clear view that 68% are aware that only management support can guarantee a project success for new ideas; only 5% don´t have this view (question 12c).

   Learnings:

   - ⇨ The majority is aware or even more is actively looking for sponsorship and support for their ideas in the organisation and with the management.

3. **Influencing the organisation:** When asking about the strategy to influence even the whole organisation in order to adapt the defined strategy of the organisation, 34% is very open and interested to change the company. 22% is not interested and 44% is unsure (question 6c).

   And again we see nearly 1/3 (28%) which is definitely interested and willing to change the company´s strategy; 1/4 isn´t (25%); and 47% is unsure (question 7b). This shows again the huge potential to gain this group of employees for an innovative supportive attitude through appropriate organisational measures.

   60% intend to create facts in order to increase the probability that their new idea will be accepted by the company (question 7a).

   Learnings:

- ⇨ The employees are even willing to influence the defined strategy of the organisation; a huge portion is unsure (44%) and thus is a potential to be addressed.
- ⇨ The strategy to organise facts in order to increase the probability that new ideas will be accepted by the company is a potential source for information hiding.

4. **Effort to prepare information and use of IT-Tools for an effective communication process:** There is a tension between effort to prepare information for effective communication process and expected added value. Basically we identified that 1/3 behave very openly and see an added value which pays off the effort for the presentation, 1/3 see the effort as too much compared to the added value, and 1/3 are unsure. This is one of the reasons, why the Gate 0/1 presentations are organised very often within a very short time frame; i.e. there is a basic tendency not to present premature ideas or project proposals in a wider context within the organisation.

   29% are stating that preparation activities are too effort intensive and they don't see an appropriate added value (question 3a). Although we can see, that 61% see an added value in preparing an idea by structured means (presentations, documentation, etc.) (question 3b).

   It is important to note that based on these answers, it is not clear whether the additional burden of using tools and following strict business processes is the problem for the employees, or they do not see any added value of using the tool in principle.

   Learnings:

   - ⇨ The biggest concern of the employees was driven by the seen unnecessary red-tape effort for preparing information and using too complex IT-tools. Concerning the "complex IT-tools", it is the combination of not enough thought through processes in combination with complex IT-Functions with low usability.

     The additional effort stimulated by knowledge management and reporting tools and processes is a very serious issue, which has to be taken into account in any organisational set-up.

5. **Perception as expert:** 17% is afraid to be judged as a non-expert due to misjudgement; however 55% are not (question 8a). This is confirmed by the fact that 63% indicate that they are willing to learn from mistakes (question 8b).

   Demonstrated ambiguities by presentations of projects in a very early status are not really a problem for 60% (question 9a). This is confirmed by the view, that 79% even see that their expert view is even underlined when they present open issues for discussion, even when those issues are not clear ("*daring the gap"*[183]) (question 9b).

   Learnings:

   - ⇨ We can conclude that the expert level is not really endangered by discussions and the experts are supporting open communication within the organisation.

6. **Cooperation with other units:** Only 8% believe that they should not cooperate with other organisational units within the organisation; whereas 66% are definitely interested to cooperate with other organisational units (question 10a). This is confirmed by the fact, that

[183] Phrase in German: „*Mut zur Lücke*".

80% see an added value and increased creativity when they cooperate with other units and even nobody answered that this does not bring any creativity at all (question 10b).

Learnings:

- ⇨ The majority sees and added value by communication and information exchange.

7. **Fear to lose ownership of ideas or patents:** Only 15% are afraid that somebody else can take over their project idea as a project leader for further elaboration; 48% are not (question 11a). Only 18% are afraid that authorship or patents will be lost by to open communication; 52% are not (question 11b).

   Only 4% believe that only they as expert should work on their topics; 69% are not (question 11c).

   Learnings:

   - ⇨ There is no real fear of the employees to lose ownership of ideas or patents

8. **Looking for support of their ideas and projects:** 60% are interested to find more people to support their projects and ideas; only 10% had no interest (question 11d). Even 65% see that only when they achieve a critical mass, their project idea will be successful finally; only 2% have an opposite view (question 11e).

   Learnings:

   - ⇨ Employees are looking for sponsorship.

9. **Innovation is part of the organisation´s culture:** Only 10% believe that it is not welcomed, when they bring new ideas into the organisation; whereas 75% see the interest of a company to bring new ideas into the organisation (question 13a).

   Learnings:

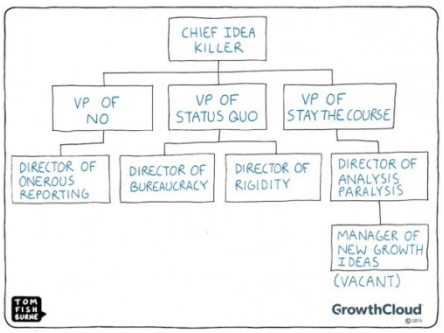
   - ⇨ The majority sees their innovation as highly welcomed by the organisation.

10. **Use of public online social media platforms for professional use:**

    Facebook (85%) and WhatsApp (96%) are mainly used for private means; whereas LinkedIn (77%), Xing (65%), Research Gate (95%) is used for professional use (question 16).

    - ⇨ The social media platforms for professional use, such as LinkedIn and Xing are dedicated to publish the personal CV, and Research Gate is dedicated to publish the own publications and not really to use it as an idea exchange platform.

9. Conclusion



Innovation Killer Org Chart[184]

9.1. Innovation and Knowledge Management within Firms

At the beginning of this study we stated the research question how modern ICT-based communication tools can positively contribute to the innovation management challenge within organisations. In order to answer the research question:

> *"Whether and how the new online social media tools can increase the innovation competence of firms, by using these tools as an internal information and communication platform?",*

or in more detail:

> *"Which issues enable, and which prevent an effective information exchange within working teams in organisations, thus helping or jeopardizing the potential positive aspects of online social media?"*

we discussed comprehensively the essence of innovation and knowledge management (Chapter 2 and 3) as well as the basic functional building blocks of online social media tools (Chapter 4). By this study, it became evident that re-use and combination of information, expertise, technology and products are the real driving forces of innovation. Further on, error and noise and serendipity are fundamental elements to foster creativity and innovative solution development. These issues are the factors on which open innovation and online social media networks are based – we need to know what is out there to recombine it.

Based on this view knowledge management theorists and related concepts over the last decades followed approaches for storing information into shared repositories for future use. Such first generation of knowledge management concepts focus on explicit knowledge and management of artefacts; i.e. processes and tools for collecting and sorting data are the main objectives (see Section 3.6.1). These approaches based on a repository view of knowledge with a focus on gathering, providing, and filtering available explicit knowledge are based on the hope of being able to manage easily reusable information in shared repositories.

However, it is important to note that although such approaches are very important functions within an organisation, there are limitations in principle to be considered as extensively discussed during this study. As summarized in Section 3.6.2 there are clear limitations of the added value of repository approaches, as well as expertise locator recommendation systems and computer-mediated places to find dedicated prepared information. All these concepts need a reasonable effort to be kept updated

[184] https://marketoonist.com/campaigns/all/growthcloud (last access: 24.4.2017)

permanently and a personal commitment of individuals to spend personal effort which is usually not feasible in a real-life environment.

During this study it became evident, that the re-usability of stored data has clear limitations. Decontextualized information and knowledge is not easy to be re-used. There is usually always the need of experts to explain the stored data and add context as well as tacit information. In addition, tacit knowledge has dedicated characteristics in principle:

- Tacit knowledge cannot be stored in any repository and thus access to experts is required anyhow.
- Tacit knowledge is not easily separable from the human being and is only useful and actionable by those who are already knowledgeable.
- Knowledge of individuals is not always immediately visible, i.e. tacit, and usually "sticky" with the individual (see Section 5.5.8). This means that there is always some burden to unlock tacit knowledge and thus always some effort needed to transfer knowledge within an organisation.

This essential characteristics of knowledge or "expertise", as Ackerman is calling it, defines a dedicated framework for information exchange within organisations as summarized in Chapter 5. On the one hand it is always reasonable effort required to prepare tacit knowledge and communicate it accordingly. This implies always the necessity of some motivation for the sender of information as well as the recipient of information as summarized in Section 5.4.

On the other hand there is a further essential factor to be recognised when discussing information exchange within firms. There is a natural innovation resistance within firms based on potential drawbacks on individuals when change happens within organisations as discussed in Section 6.4. It becomes evident that information exchange takes place where personnel core interests are not endangered. Idea collection processes by a mass of people where no drawbacks can occur for the person as such - even the other way round, often there is a possibility to get a payment, for example, or a certain level of prestige - do work effectively. Also, when information is exchanged which supports collaborative working, where the information exchange is mainly based on facts, exchange of information works well. However, for the internal innovation processes within firms (research question) the situation is slightly different. For a company's internal innovation process, which is more an issue of power; i.e. it has "… *more to do with the likelihood of gathering political support than with the likelihood of the idea to produce results*." [Kanter1988] as discussed in Section 6.3, there is a fundamental different situation.

Novel ideas tend to challenge existing structures and require that substantial changes be made to formerly established responsibilities, roles, power, and status. This process is always subject to socio-political manoeuvers, sponsorship and advocacy as discussed in Chapter 6. Whether the culture in the organisation is more oriented on cooperation or on competition is now heavily influencing the behaviour of individuals in this game of power-relations.

The second generation of knowledge management focused on tacit-explicit knowledge conversion (cf. the well-known SECI model) (see Section 3.6.3). However, there are severe limitations of this model as well. Such models are based on assumptions that are not reflecting the real world; i.e. that tacit knowledge will always, at some stage in its life cycle, become explicit. This can´t be taken for granted in a daily business life. Each process of transferring knowledge needs an active involvement of the communicating partners and therefore need personal effort and commitment. Usually firms

have severe problems to understand this social dimension in their organisation. We cannot assume that employees are altruistic and willing to codify what they know especially when additional personal effort is necessary and potentially without any added value for them personally. And there is always the potential change in established responsibilities, roles, power, and status. Thus, it is important to note that within an organisation information sharing is not for free. Information transfer implies psychological costs as well as personal resources such as time and emotion which will not be spent when the reward or the potential drawback for this effort is not clear.

Thus it is of utmost importance to understand on the one side the potential barriers for knowledge transfer among employees, working groups and organisational units, and on the other side to find the right motivational factors to enable or even foster pro-active knowledge transfer within the organisation. Pay, promotions and bonuses might be an essential driving factor for employees. However, dedicated social means are required to get access to hidden knowledge and to enable appropriate motivation that personal effort is spent for communicating, transferring and absorption of knowledge.

When a culture is established where knowledge is considered as a public common good there are other relevant drivers for knowledge transfer and communication compared to privately owned knowledge where self-interest is the main driver. Generalized reciprocity and prosocial behavior is one of the key effects to enable effective knowledge transfer.

According to the objective of this PhD, focusing on innovation management, it is essential to consider both phases the creative phase as well as the innovation implementation phase. Both phases have to be considered in a comprehensive way in order to ensure an innovation-prone company and an effective online social media support. Motivation, self-confidence, and ability are essential factors for an innovative behaviour of employees within firms. Respectively the lower these factors are the higher is the “resistance to change” (see Section 6.4) with strong impacts on the motivation to communicate pro-actively and open within the organisation.

Thus, modern innovation management has to consider also the social domain, i.e. the ephemeral process of relating. This is usually covered by so called third generation knowledge management concepts (see Section 3.6.4). Online social media functions address exactly this interpersonal networks relation management. We have no longer to organise information but to organise relationships and easy to use information exchange possibilities.

9.2. The Added Value of Online Social Media Platforms

Online social media, which build on networking functions, allow passive information, i.e. tacit knowledge, and thus expertise to be accessed by the active involvement of individuals. The online social media approach uses ICT tools to connect people and develop interpersonal and intergroup networks, even based just on weak ties, in which employees can share tacit knowledge that cannot be codified, and that cannot be easily captured by a simple database. In addition online social media supports emotional, as well as social communication issues among human beings thus contributing to emotional aspects.

Thus, we can conclude that online social media is not about the handling of documents within an organisation, but about social collaboration and the sharing of information within projects, working groups or even entire organisations. Online social media has the potential to considerably enhance the quality of the information exchange with the help of easy-to-use IT tools, as well as through the use of dedicated communication concepts, which are strongly oriented towards sharing and social

collaboration. The use of online social media technologies is offering, for the first time, the opportunity to put knowledge management in a new context by using a new form of the easy and flexible P2P communication paradigm, in order to support a “personalization strategy” which has a huge impact on employees´ motivation which is an essential driving factor for innovation management and communication mechanisms.

A personalization strategy is supported by the dedicated online social media functions (as discussed in Section 4.4.1) such as identity, relationship, and reputation, whereas other functions are more supporting easy to use and spontaneous communication mechanisms such as conversation, groups, presence, persistence, and independence which contribute to creativity processes as well as to the motivation of the individual experts by offering easy to use tools and lowering the bureaucracy for communication processes.

9.3. The Limitation of Online Social Media Platforms

Effective and efficient communication and information exchange to let knowledge flow throughout the organisation are the fundamentals of any successful organisation (as discussed in chapters 2 and 3). However, as discussed in detail during this study knowledge cannot simply be shifted around and easily stored and retrieved. Expertise is largely tacit and embedded in the context of being used and “energy” of individuals is necessary to transfer tacit knowledge into the explicit domain as well as to communicate and transfer tacit as well as explicit knowledge. Social media tools lower the effort to communicate tacit knowledge by several functions and enable especially expertise finding processes as summarized above.

However, it is important to note when innovation comes into the game, novel ideas tend to challenge existing structures and require often that substantial changes be made to formerly established responsibilities, roles, power, and status. This process is always subject to socio-political manoeuvers, sponsorship and advocacy. Whether the culture in the organisation is more oriented on cooperation or on competition is now heavily influencing the behaviour of individuals in this game of power-relations. Organisations should understand the factors that affect employees' willingness to share information.

Online social media platforms, as any kind of IT tool, can only deliver a real added value when essential organisational and cultural concepts are ensured within the organisation beforehand. In this context of outcome expectations of communication processes and power play within organisations, there are four essential online social media functions to be considered (out of the twelve online social media functions as summarised in Section 4.4):

- user generated content (UGC),
- sharing,
- collective and emergence, and
- transparency.

These functions are strongly related with personal factors of individuals and thus critical factors for firm´s internal communication processes which we discussed in Chapter 6 and summarize in the following.

9.4. Innovation Building Blocks for an Innovative Supportive Organisation

The effectiveness of information exchange for innovation management objectives in general and online social media tools in particular depend on environmental, cognitive, motivational, and social issues which we elaborated throughout this study. To summarize, the following seven issues have to be understood and considered when designing effective innovation management concepts within an organisation in general but especially when using social media tools within firms:

1. employees´ motivation and willingness to share information, knowledge and expertise;
2. power relations within the organisation;
3. employees´ understanding in communication processes and capabilities for communication and absorption;
4. employees´ capabilities for implementing new ideas within organisation;
5. the availability of a market place to find easily explicit knowledge but also links to experts and thus tacit knowledge;
6. establishing an organisational culture that knowledge is treated as public good and not as individually owned;
7. balance privacy and flexibility;

These factors are the reasons for the required "energy" as well as target oriented communication behaviour of individuals for an effective information and knowledge transformation process. These factors are summarised in the following.

9.4.1. Employees´ Motivation for Innovative Behaviour

Usually personal motivation and willingness of employees to spent "energy"; i.e. their personal resources such as additional time or emotional effort is based on cultural norms of reciprocity and commitment (see Section 5.5.7). Missing cultural norms and no culture of reciprocity are usually jeopardizing a high motivation to spend personal energy for knowledge sharing. Furthermore interpersonal factors such as missing trust (see Section 5.5.6) or low capabilities of sender and receivers results in a stickiness of knowledge (see Section 5.5.8).

In addition, recognised need and value for both, sender and receiver of expertise are key driving factors. This is especially relevant when considering the cost of codification of tacit knowledge and preparation of useful and easy understandable information for knowledge transfer (see section 5.5.2). Due to the cost required for codification and knowledge transfer, too much rules within an organisation are barriers and potentially prevent information sharing (see Section 5.5.9). And finally, if the attitude of a group identity (see Section 5.5.3) is not supporting a larger organisational spirit a reduced cooperation within the company is the consequence.

When knowledge is considered as a public common good there are other relevant drivers for knowledge transfer and communication compared to privately owned knowledge where self-interest is the main driver (see Section 3.5). Empirical research shows that employees are highly motivated when a community interest is established based on generalized reciprocity and prosocial behavior.

9.4.2. Power Relations within Companies

A company's internal innovation process is always an issue of power; i.e. it is usually more about socio-political manoeuvers, sponsorship and advocacy in the context of power-relations. Any knowledge transfer within companies depends essentially on the outcome expectations and risk judgement for personal objectives of an information exchange (see Section 5.5.4); risk to jeopardize existing personal relationships (see Section 5.5.5), and finally also missing trust among the communicating partners (see Section 5.5.6) is an important filter function for open communication.

Outcome expectation captures the extent to which employees believe that their efforts will result in certain desirable outcomes. Since employees do not want to lose reputation and may experience not to lose the trust of friends and sponsors, they develop dedicated behaviour patterns (see Section 5.4.3 above). Self-confidence is an important factor which influences the outcome expectations (see Section 5.4.4).

9.4.3. Understanding and Capabilities in Communication Processes

Both, sender and receiver of information need dedicated skills for communication and absorption of expertise. Processes for better understanding and finding of information can be improved by paying attention on preparing information that it is easier to understand and that it can be used as an object in a marketplace. This is especially relevant when considering that knowledge is often very comprehensive and is not always easy to understand but also that knowledge is always partial and never complete in principle (see Section 5.5.1).

9.4.4. Employees´ Capabilities for Implementing new Ideas

Implementing innovations within a firm need two essential capabilities and structures:

- The availability and usability of resources. Resources for expertise transformation are tangible such as funds, tools, infrastructures, defined processes and structures; or intangible such as time, quality of work, etc. For addressing required company resources, information and filter functions for an effective communication with the management are essential functions.
- Networking ability. In order to achieve substantial changes at work for successful implementations of innovations, it is essential to get supporters and coalitions with peers, co-workers but also top management. Employees need a developed implementation instrumentality by sponsorship and advocacy and support. Mobilizing sponsorship and advocacy requires that individuals have cultivated their social relationships - their connections to friends and trusted allies that provide access to company resources [Obstfeld2005]. Such implicit agreements for close cooperation and open information exchange are based on mutual trust and norms of reciprocity - compared to the “gift economy” as described in Section 5.5.7). This is forming a supportive culture that enables sound knowledge management based on information sharing. Such relationships are referred to as “buy-in relationships” (see Sections 5.4.3 and 5.5.4).

  It is worth noting that different types of social relationships and network constellations, depending upon the needs of circumstances in which they operate, are established. If information is collected, a different kind of network (relationships) is cultivated than if employees are concerned with initiatives to be implemented within the organisation.

Self-confidence (see Section 5.4.4) is an essential factor for a strong implementation instrumentality.

All these issues are addressed by online social media. Thus OSN is an effective tool to support networking ability and implementation instrumentality.

Finally the availability of a “market place” is essential in order to enable sharing and combining effectively information as well as people with expertise. It is necessary to find information, experts but also to build networks for support, sponsorship and advocacy based on purpose but also enabled by serendipity.

9.4.5. Market Place as an Eco-System based on a “Gift-Economy”

While still in the age of industrial mass production, long product lifecycles were the norm. Today, the speed of digital markets stimulates new prerequisites for innovative entrepreneurial activities. Analytical technical expertise, efficient manufacturing processes, and cost control alone no longer guarantee sustainable competitiveness.

Creativity, implementation capability, and a culture of cooperation are increasingly the focus of successful and sustainable business models. This view is even more relevant for R&D institutions which, by definition, have to find new technologies but also new approaches, methodologies, tools, and solutions. This trend is thereby significantly exacerbated by the rules of the now prevailing knowledge economy. Innovation is about exploration in a multifaceted business and market environment. Valuable innovation impulses are emerging from comprehensive observations, not only from the technological developments in the industry, but massively determined by the overall social dynamics.

Innovation has its starting point in a (brilliant) idea. For that idea to mature we need an environment with a positive climate and a framework in which innovations can happen. Such environments are based on cultural techniques that enable and foster innovative skills, such as spontaneity, intuition, vision and aesthetics.

To promote a culture-based creativity it is necessary to give a space outside any regulation, allow human expressions based on a playground, as well as (channelled) dissent. Such a foundation for creativity is based on interdisciplinary, pluralistic approaches, and crosslinked lateral thinking, supporting personal development. If we are guided in the innovation process by these personal management practices, we can ensure the prerequisite for successful innovations.

But most importantly an environment as a market place has to be established which foster a positive culture of cooperation based on mutual trust and reciprocity to ensue effective expertise sharing mechanisms within the organisation as summarized in Figure 9.1.

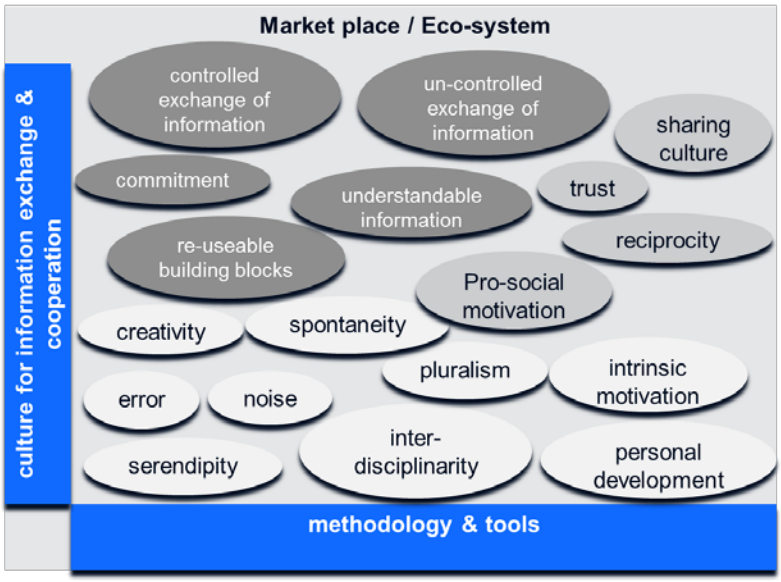


Figure 9.1: Market place / Eco-system for Innovation

In order to support the free flow of information to enable emergence effects within “liquid networks” according to Steve Johnson (see chapter 2), market places for information and expertise exchange and have to be established within organisations. A market place has to support a "gift economy" as described by Noubel in Section 5.5.7, since it is not guaranteed that for each employee a benefit is immediately implied by the information distribution. On the contrary, there is a drawback in principle associated, since there is always an effort implied for information preparation and transfer for which there is often no immediate added value for the information source.

Information must be prepared in order that it is "understandable” and “tradable" as already stated above in Section 9.4.3. Employees have to describe and document their experience and knowledge in a proper way, such that the expertise can be found when needed. This should, of course, not imply too much bureaucracy and work load for the employees.

In this spirit, a minimum set of information has to be proactively made available and communicated in the working group but as well as within the organisation, even without any clear target at the beginning. This will build the basis for even unintended combination of thoughts, information, projects, etc., to form the basis for effective creative and innovation processes.

However, a fearless and creativity-creating corporate culture is only one aspect of a successful innovation process. In order that creativity can find its way into the real world economy, it also needs other mechanisms. These mechanisms should provide the necessary economic resources throughout the company, ensure the alignment of innovation activities with the business objectives, and create marketplaces for innovative developments.

9.4.6. Knowledge as a Public Good

When knowledge is considered as a public common good there are other relevant drivers for knowledge transfer and communication compared to privately owned knowledge where self-interest is the main driver. Employees participate primarily out of community interest based on generalized reciprocity and prosocial behaviour. This is the basis for free flowing knowledge throughout the organisation.

9.4.7. Balance Privacy and Flexibility

We need mechanisms to protect information access, but it has to be ensured that the usability and motivation for employees is not jeopardized and the innovation process of information exchange is still supported. The way how information is provided for further access becomes key in this regard. Employees have to be supported and ongoing trained to describe and communicate information in a way that innovation and expertise sharing is feasible, but data security is still followed. Thus a permanent communication between management and working level has to be ensured.

9.5. Organisational Culture Enabling Innovation

9.5.1. Innovative Thinking as part of the Organisational Culture

In the performed questionnaire within AIT, only 10% believe that it is not welcomed when they bring new ideas into the organisation. 75% of the AIT employees believe that it is appreciated by the organisation to bring new ideas into the organisation (question 13a of the questionnaire). However, despite of this basic understanding, there is a strong evidence of reasonable reluctance that information is openly communicated during creative phases of idea and project development, as experienced during this PhD study.

Several framework conditions have to be implemented beforehand within an organisation. Involving a larger part of the organisation and thus, involving many employees in the innovation process, requires a broad acceptance for the constant need of corporate change, which is built upon the understanding that innovation is an integral part of a firm's cultural value. It has to be ensured that a company´s vision is not in contradiction with individual's views and expectations of the employees. It is important to develop frameworks to enhance cultural understanding and improve how employees work together, communicate effectively and engage in decision making and benefiting from a rich diversity of perspectives and behaviours.

Whether innovative thinking is an integral part of a corporate culture depends on several factors (see Sections 5.2 and 5.4.4) [Bessant2003, Katz2004, Doerner2012]:

- whether the management is clearly committed to an innovative culture and builds its activities on trust towards employees´ capabilities;
- managers should foster an entrepreneurial spirit at all levels, should serve as a role model, and give positive feedback on innovative behaviour;
- there is a challenging authority, questioning conventional wisdom and communicate high performance expectations;
- employees should understand and learn that innovation is part of the organisation´s culture; i.e. the organisation is open to new ideas and contribution from employees;
- employees should have the possibility to discuss openly their ideas with colleagues and if they wish with the management; thus they can look for sponsorship and support;
- the willingness and ability of the organisation to react quickly;
- an established goal-oriented culture;
- a willingness to take risks, allow a certain margin of error and learn from failures;

- the organisation gives the employees the possibility for vocational training and experiencing communication and discussions to improve their interpersonal skills;
- provide employees with the possibility to observe various role models and sharing of experiences with co-workers; the organisation should encourage employees to establish relationships with co-workers and create an environment that encourages social bonding through open and understandable communication; (employees should understand that they can and should cooperate with other units);
- employees should find defined processes and easy ways to interact with the management to stimulate sponsorship and support, but also having the possibility to potentially being able to influence the strategy of the organisation;
- It is essential to keep the effort and thus burden for preparing information as low as possible (lower the red tape as much as possible). Well defined processes which are well understood by the employees and optimized tool support is of top importance.

An innovative supportive company has to create a working environment that promotes a free and creative mindset and is encouraging and rewarding active and committed employees, while preventing aloof passivity. Such an open minded cooperation has to support creative processes as well as implementation processes within organisations to achieve impact in real-life environments. A working environment characterized by a climate of fear, where a career-focused mentality, silo thinking and information hiding prevail, will in the long term lead to a low level of innovation capabilities.

This is one of the principle problems of universities. Universities usually do not spend management attention and resources for improving communication processes among different organisational units, nor are there usually any incentives for such behaviour. Even more, university researchers are basically career-focused as this is their mission in principle – to finalize their research work, and not focus on open communication to enable innovation. These factors lead to a silo thinking attitude. In the same way, not carefully thought through management by objectives (MBO) systems, implemented incorrectly within organisations very often jeopardize corporate culture objectives, such as cooperation and an open mindset.

If an organisation does not support innovation processes, it is also very difficult for external organisations to interfere with those organisations in order to transfer technology or know-how. In a worst case, know-how transfer from universities and research centres to organisations only takes place with the mobility of people, based on their education and work experience – which is a very indirect effect, of course.

9.5.2. Innovation needs Chaos as well as Controlled Environments

Beside the internal communication issue within the organisation, it is also the external world which has to be considered for effective communication mechanisms. It is the "apparent" contradiction of an open innovation culture to generate ideas and the necessary transformation of innovation into a business context which makes the entanglement of two complementary approaches essential for the desired success.

The "factory" of technology development within an organisation has to be strongly linked with market measures, such as the dissemination of project progress and technology development (e.g. by science PR), development agreements with industry (from letter of intents till to contracts),

technology and product marketing (such as prototype presentation at fairs and presentations at conferences) and finally concrete business development as well as sales activities.

Figure 9.2 below sketches the necessary combination of bottom-up non-linear creativity processes based on transparency, cooperation and trust as comprehensively discussed during this study with top-down steering processes within an organisation. In a sound innovation process landscape, a combination of permanent concept discussions and development/prototyping cycles has to be ensured. Potentially valuable market results are available permanently through-out the innovation process. It is about the effective identification and then transformation of the even intermediate results into concrete product developments, deviations of other development directions and concrete go-to-market activities as well as the ongoing effort for building networks and alliances as a basis for sponsorship and support for dedicated projects.

To summarize, the following factors have to be ensured by the design of appropriate environments as shown in Figure 9.2.

(1) **Creativity**: It is fundamentally important that idea generation, the indispensable starting point for innovation, is separated from the strict corset of predictability. Only when we build on the intrinsic and social motivation of our employees, which provides the room for new routes, sometimes even uncomfortable but ultimately based on indispensable dissent of thinking, we will enable real innovative behaviour in our organisations. By this, we get volatile playgrounds where "error and noise" as well as “serendipity” play a fundamental role for real innovations.

(2) **Culture of information exchange & cooperation based on openness, cooperation, and trust:** We have extensively discussed during this PhD that information sharing is more than just the opening of individual islands of knowledge, which favours the establishment of a company-wide knowledge database that can be queried on an ad-hoc basis. Information sharing is a highly cultural process, which takes place on an interpersonal level and with the continuation of an actual practice of mutually appreciative relationships. Innovation management will thus become an act of solidarity and information is treated as a public good of the community, where some members of the community collectively contribute to its provision and all members of the community may have access to this knowledge, motivation for knowledge transfer is not self-interest, but care for the community.

(3) Employees need effective **methodologies** and communication **tools** for collaboration and the exchange of data, information, and knowledge, even across organisational boundaries based on maximum usability and lowest bureaucracy.

    An innovation process, which is based on a stage gate model, ensures that essential framework conditions are created in such a way that innovation benefits from free, highly motivated researchers, but can be harmonized with the requirements of the commercial organisation. It is the basis for continuous efficient as well as effective evaluation mechanisms that validate the feasibility and marketability of the creative ideas based on a maximum of information.

    A gate based innovation process also provides the basis for an organisational knowledge management system, as ideas and project proposals as well as project results that are not directly pursued, are prepared and stored for the future when time has come for the technology. For all projects, there is a short, understandable, and uniform format that

describes technological USPs and marketing opportunities as well as other relevant information. This enables and improves the level of an effective interaction among the employees and within the organisation.

A further essential building block of such an innovation process lies in the regularly defined meetings and personal knowledge exchange processes based on effective information exchange processes but also based on openness in which decision making, network building and expertise sharing takes place.

In addition based on such a process, new internal as well as external expertise can be easily combined with in-house competence, supporting an open innovation approach.

(4) **Exchangeable and communicable building blocks**: In order that a market place can work we need units to be exchanged. This could be information, knowledge, experience, complementary thoughts, expertise, but also technological entities such as SW or HW but also the establishment of relationships with others for potential future sponsorship, advocacy and support. Usually building blocks prepared for exchange with others are publications in the scientific world, or project reports in the world of projects or products in the business world. Now it is important to note, that it is not possible in advance to determine the matureness level of such an entity for exchange. This can finally only be answered in the context of a specific application area at a dedicated point of time and concrete planning procedures. Thus, such entities are not enough to foster effective innovation management processes. In order to support innovation mechanisms the easy understandability of the units to be exchanged is of crucial importance.

(5) **Well defined go-to market strategies and methodologies**. In order to collect information and knowledge for market strategies an information exchange with the "external world" has to be initiated as early as possible by various means. Each gate in the innovation process offers the basis to evaluate potential go-to-market strategies or to collect additional information for strategy development.

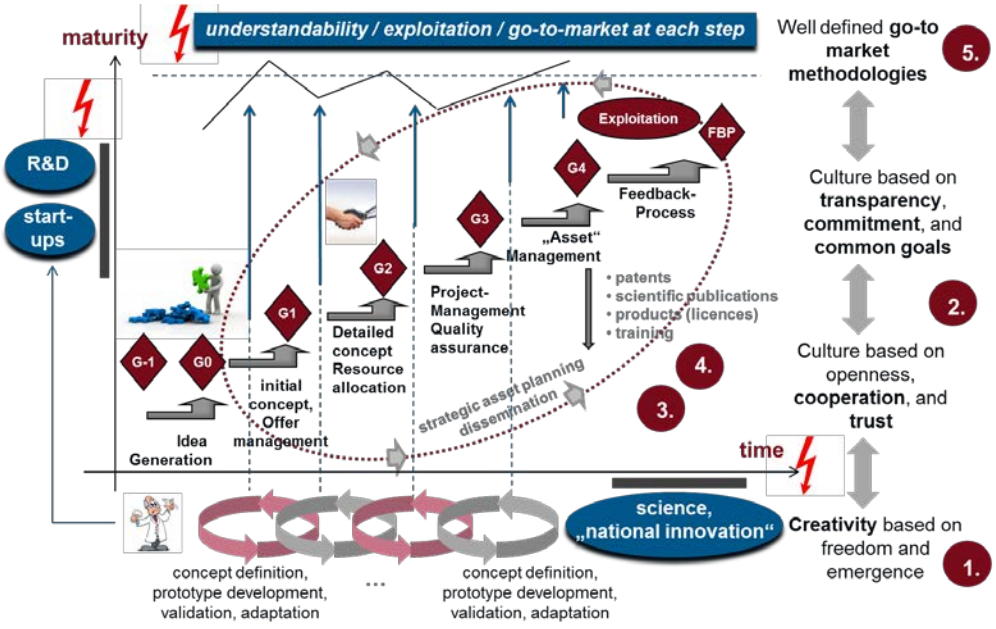


Figure 9.2: Chaos and Organised Serendipity meets Linear Processes

Beside these design criteria, three problem areas are shown in Figure 9.2 to highlight usual communication problems which have to be addressed by dedicated processes and methodologies and tools[185]:

- the classical problem area of bringing R&D results into the market; usually this means considerable effort for prototyping, business development, marketing and proof of concept projects;
- the principle problem area of the gap between science and national or EU funded research projects and real-life products; i.e. it´s about the basic question how to transfer science and research results into real world products;
- the basic issue of bringing views and requirements from the market into the firms innovation process as well as trying to influence the market and potential users as early as possible with new approaches and technologies (user driven innovation and technology mediation as discussed above in this PhD);

9.6. A revised Knowledge Management Model for Innovation Implementation

The findings of this dissertation demonstrate that employees´ innovative work behaviour is determined by several factors that are concerned with the attitude and motivation of employees, as well as their positioning within the organisation. Both phases, the creative phase as well as the innovation implementation phase, have to be considered in a comprehensive way in order to ensure an innovation-prone company and an effective online social media support. Motivation, self-confidence, and ability are essential factors for an innovative behaviour of employees within firms. Respectively the lower these factors are the higher is the "resistance to change" (see Section 6.4) with strong impacts on the motivation to communicate pro-actively and open within the organisation. Even more knowledge has to be considered as a public common good within a company compared to privately owned knowledge where self-interest is the main driver. Then employees participate primarily out of community interest based on generalized reciprocity and prosocial behaviour. This is then the basis for pro-active contribution and information sharing.

As a result of the discussion during this research study, we can summarize a revised knowledge management model for innovation management based on the SECI model (see Section 3.6.3).

First of all it has to be noted, that an organised communication and decision process as the designed gate based project life-cycle process has to fulfil different functions according to the different phases of a project in its life-cycle. Different phases of the knowledge management process have to be supported as sketched in Figure 9.3. The different phases of the gate process (Gate -1 till Gate 4) are addressed differently to enable the tacit-explicit knowledge transfer as well as establishing relationships and trust based on open communication. These phases are supported by an appropriate culture (motivation for information sharing) as well as enabling support functions fostering creativity.

[185] Marked with a red flash.

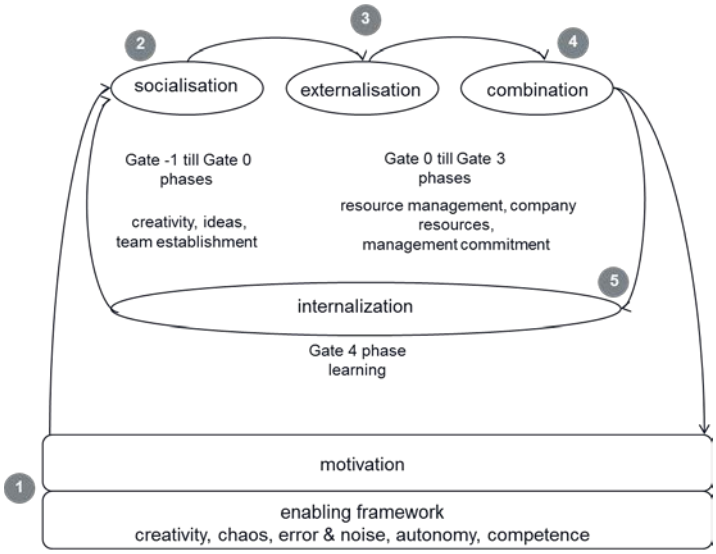


Figure 9.3: Knowledge Management has to address Different Phases

More specifically Figure 9.4 shows the additional dimension which has to be addressed by a modern knowledge management, specifically for the different phases of the SECI KM model, by appropriate processes as well as tool support:

- motivation based on reciprocity and commitment; personal resources;
- understanding for both, sender and receiver of information, has to be supported; i.e. through dedicated skills but also through methodologies and tools to present and to absorb information and knowledge;
- company resources (tangible and intangible); it is of utmost importance to focus beside employees´ creativity on capabilities for implementing new ideas within the organisation;

These factors have to be addressed differently for the different phases of the SECI KM model for the gate based innovation process (e.g. AIT´s PLP process) as well as for the online social media functions.

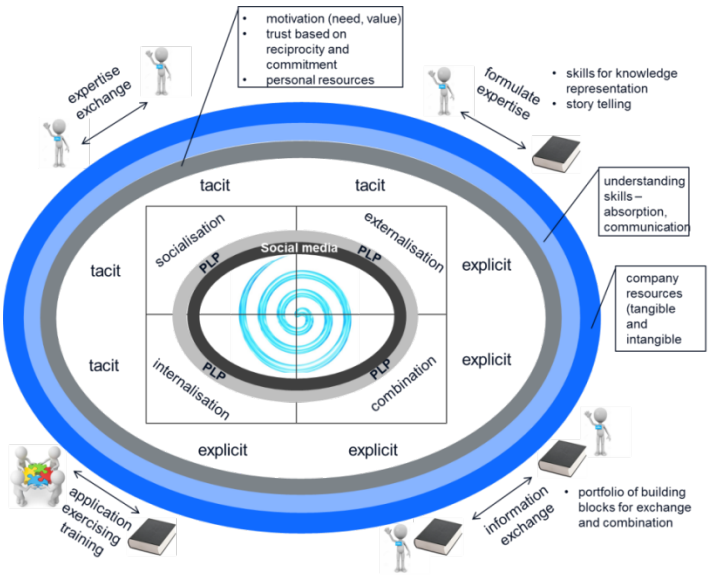


Figure 9.4: Knowledge Management Model for Innovation Creation

9.7. Recommendations for Building an Innovative Organisation

Throughout this PhD work it became very evident that, beside the usability and technical features of knowledge exchange platforms, it is essential to understand the social and cultural mechanisms which not only support but ultimately steer any knowledge exchange among human beings. Organisational culture, not technology, has a much more important impact on whether people exchange knowledge. In addition it is important to note, that the availability of knowledge may not translate into new knowledge creation automatically nor is the knowledge transfer process effective. Usually employees look for information that is most easily accessible, such as asking co-workers. Thus finding the right experts becomes a crucial function. Further on, as extensively discussed throughout this PhD study, knowledge is never complete for working purposes.

The motivations for why employees exchange knowledge are fundamentally different for specific types of knowledge but as well whether economic motivation and self-interest, or non-economic and motivated by community interest and moral obligations. Company norms drive people´s motivation for knowledge transfer based on economic as well as non-economic means.

> *"… whether knowledge exchange is viewed as an economic or non-economic exchange is socially constructed and depends upon individual perception and contextual factors such as organisational structures and incentives…."* [Wasko2000].

Thus, an innovative company needs creativity based on independence, chaos, and serendipity based on a culture enabling open communication and information sharing, but needs also a controlled environment to steer and manage the company resources. For this objective, eight recommendations are summarized below (see Figure 9.5).

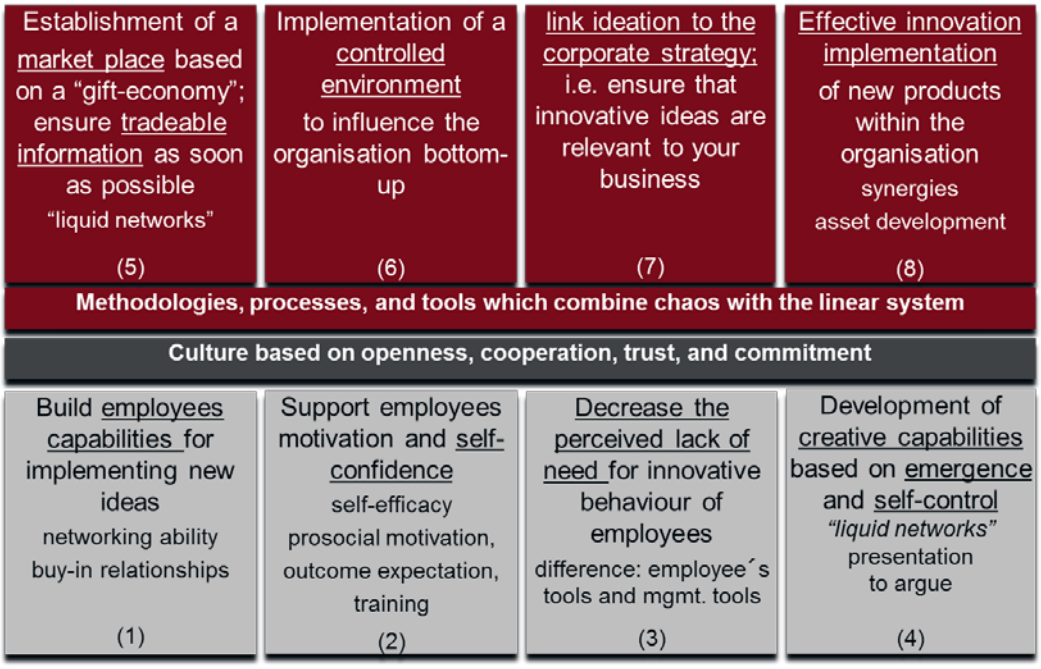


Figure 9.5: Eight Recommendations for Building an Innovative Organisation

9.7.1. Eight Rules to Form an Innovative Organisation

We take the intellectual skills to perform a firm´s business model as granted and do not discuss them within the scope of this study. We focused on those issues which determine the information sharing and cooperation culture within companies. It is important to note, that the issues discussed will also

massively contribute to the competence development in the context of a learning company. To summarize the discussion throughout this PhD work, we can derive the following recommendations to form an innovation-supportive organisation clustered in two domains – organisational culture and methodologies and tools (see Figure 9.5):

Develop the organisational culture based on openness, cooperation, trust, and commitment:

1. **Build employees capabilities for implementing new ideas.** Implement implementation instrumentality by sponsorship, advocacy and motivation for creating and implementing new ideas:

    a. Develop a **networking ability** of the employees; i.e. the extent to which employees are skilled in developing and using social networks, building effective coalitions to affect change at work.

    b. Employees should develop their **buy-in relationships**. The organisation should encourage employees to establish relationships with co-workers and create an environment that encourages social bonding through open and understandable communication. When employees have a high number of strong buy-in ties, in order to mobilize the support of key allies to sway important decisions within the company, they are usually called "skilled networkers".

    c. A **personalization strategy** aims to develop networks of people, in order to enable subsequent sharing of tacit knowledge and establish an attitude to treat knowledge as a public good of the group and not as a privately owned good.

    Approach:

    - Implementation of the possibility and framework that employees meet each other besides direct work cooperation to develop relationship and trust.
    - Organise exchange of knowledge and information besides direct work cooperation; e.g. so called innovation days, in-house trade fairs, etc.
    - Enforce employees, that they support each other even when no immediate direct "payment" is made.
    - Ensure that trust is the most important driving factor in the group.

2. **Support employees motivation and self-confidence (self-efficacy):**

    a. **Prosocial motivation** encourages employees to explain and communicate also background information for their activities, that colleagues can take the perspective of the project intention. "Perspective taking" according Grant and Berry, offers the basis to break up rigid organisational structures that hinder successful innovation management.

    b. **Outcome expectation** captures the extent to which employees believe that their efforts will result in certain desirable outcomes. Since employees do not want to lose reputation and may not want to lose the trust of friends and sponsors, they develop dedicated behaviour patterns. Self-efficacy is an important factor which influences the outcome expectations.

c. **Implement a permanent training possibility** for arguing and presentation of issues, ideas and projects; i.e. by permanent presentation of the project in all different phases in front of wider audiences (e.g. Gate -1, 0, 1, 2, 3 and 4 presentations in well defined project boards).

Approach:

- Give more responsibility to project leaders based on the trust, that they will also shape the framework conditions for a successful project implementation
- communicate high performance expectations and express confidence in the employees capabilities;
- give positive feedback on innovative behaviour;
- managers should serve as a role model;
- give the employees the possibility for vocational training and experiencing communication and discussions to improve their interpersonal skills (e.g. by permanent "project boards", where presentation and discussion is done in a wider audience within the firm).
- provide employees with the possibility to observe various role models and sharing of experiences with co-workers (i.e. by the observation within the regular project boards);
- encourage employees that they should ask for support and help even in wider audiences than closer working teams.

3. Decrease the perceived lack of need for innovative behaviour of employees:

a. Employees should understand and learn that innovation is part of the organisation´s culture.

b. Employees should understand that they can and should cooperate with other units.

c. Employees should have the possibility to discuss openly their ideas with colleagues and if they wish with the management. Thus they can look for sponsorship and support.

d. Employees should find defined processes and easy ways to interact with the management to i) stimulate sponsorship and support, but ii) also having the possibility to potentially being able to influence the strategy of the organisation.

e. It is essential to keep the effort and thus burden for preparing information as low as possible (lower the red tape as much as possible). Well defined processes which are not in contradiction and well understood by the employees and optimized tool support is of top importance.

Approach:

- Define a gate based process with a focus on personal face-to-face information exchange with Gate-presentations in front of a wider audience within the organisation and transparent decision making processes.

- Define very carefully MBO measures which are not jeopardizing cooperation behaviour among working groups (e.g. very single minded strict MBO objectives could hinder or even prevent cooperation among teams).
- Implement an IT-tool landscape which supports the defined business processes in a seamless manner[186].

4. **Development of creative capabilities based on emergence and self-control.** Enable the potential for new ideas, problem solving capabilities and new approaches by different means. It is essential to draw upon phenomena such as "*emergence*" and "*self-control*" or self-organisation. Self-control is achieved through fundamental principles, such as *transparency*, *independence* and *participation*. Emergence describes the way something new arises through a communication process over time as a result of the exchange of information among the numerous parties involved. The following issues are fundamental to enable and even ensure the creative potential within firms (this relates to the establishment of a market place – see below):
    a. enable creativity by identification of new unexpected connections, ways and approaches;
    b. processes which enable and support emerging effects and self-organisation;
    c. transparency to enable emerging effects;
    d. provisioning of information and knowledge in a workable and understandable way;
    e. enable real-time, dynamic collaboration among employees;
    f. the possibility to integrate unexpected available knowledge and information; e.g. by cross functional teams;
    g. bring in other views from the market, from customers, etc.;
    h. ensure that potentially inspiring information is added to the factual information; i.e. "*error*" and "*noise*" (referring to see Steve Johnson). This can be achieved by disclosure to unknown participants and the use of weak ties;
    i. support the effect of "*randomness*" that information is found by chance; e.g. through the support of open conversation that people can join into, even uninvited; e.g. by the use of the added value of "weak ties" (see Granovetter);

    The mechanisms summarized above enable and foster open communication without organisational borders and hierarchies forming "*liquid networks,*" where ideas and even half-baked technologies can flow, can be re-used and recycled in varying use cases without any hierarchical control (Steve Johnson) and is also the basis for the transfer of tacit knowledge to explicit knowledge.

    Approach:

    - Prepare defined project descriptions in a well-defined manner (gate documents), presented and discussed within a wider audience (project board presentation);
    - Provide access to this information by electronics means.

[186] This is often not the case in organisations (experience made by the study author during his affiliations).

- Attach information to programs and individuals and offer the information by social media means.
- Ensure that complementary experts and stakeholders take part in the project presentations in the context of project boards.

Methodologies, processes, and tools:

5. **Build the basis for information sharing by the establishment of a "market place" based on a "gift-economy":**
    a. Establish a culture of a "gift economy"; a sharing culture by mutual trust and norms of reciprocity and highest possible transparency to all involved stakeholders.
    b. Ensure the preparation of understandable and tradable information to be shared.
    c. Ensure the preparation of a minimum set of information, which can be easily communicated.

    Approach:

    - Implement a process for permanent exchanging information (e.g. weekly project boards, with cross-group project and idea presentation) with a well-defined group of participants (different roles and responsibilities).
    - Define well defined documents with clear structures for each step of the innovation process (Gate -1, 0, 1 und 2) as a guidance for the employees; different key information to be provided for each phase.

6. **Implementation of a controlled environment to be able to consider and even influence the firm´s business environment;** i.e. ensure effective exchange of information and foster effective decision making processes within the organisation:
    a. effective communication processes to harmonize technology push and market pull;
    b. information has to be prepared and offered, that minimal cost is implied to consume or use specific information;
    c. safeguarding the flow of information between employees and management; management alignment - in both ways - employees to the management and the other way round;
    d. taking into due account that different product development phases require different company's resources;
    e. making sure that management is granted sufficient budget and financial backing, new skills, resources and sales support for project initiatives;

    Approach:

    - Gate process and Gate documentation (see below);

7. **Ensure that innovative ideas are relevant to your business;** i.e. link ideation to the corporate strategy:
    f. ensure competencies and assets very early to be able to deliver new products;

g. ensure appropriate resources spent for an innovation activity by a close information exchange between management and employees;

h. get rid of potential hurdles of the organisational administrative overhead (reporting and filling in of data bases stimulate considerable effort with a strong influence of the motivation and the productivity within firms);

i. ensure appropriate governance structure very early;

j. ensure that changing market drivers are understood (standards, regulation, etc.);

k. start sales and marketing very early;

l. networking capabilities and mobilizing sponsorship for implementing new ideas;

Approach:

- Gate process and Gate documentation (see below)

8. **Ensure innovation implementation capabilities** to implement new products within the organisation:

   a. foster synergy effects among different organisational units;

   b. develop sustainable assets as a result of creative work;

   c. ensure an ongoing skill development of the employees;

   Approach:

   - Gate process and Gate documentation (see below)

9.7.2. A Gate Process to Enable Transparency as well as Effective Management

It is essentially to design a PLP process not as a selection process. An effective PLP process is a commitment and information sharing concept where the representation of easy understandable knowledge and information is the key focus for

- providing understanding, for specific target groups for just in case for the future (e.g. business development, market, etc., and
- to ensure that the management is clearly committed to an innovative culture and builds its activities on trust towards employees´ capabilities, and
- establish a commitment of all involved stakeholders.

Thus, a project generation process with well-defined process steps and clearly traceable decision-making steps (so called Gates) should provide the necessary basis for the properly functioning of the linear system, as it is represented by a company, and is the basis for essential business process objectives:

- **Implements a "commitment process"** as a basis for an effective collaboration among the different organisational units. Such a commitment process ensures
  - goal orientation of the whole team;
  - provisioning of necessary resources;
  - is the basis for taking ownership and thus increased motivation;

- **Ensure effective management processes.** A sound gate process for innovation management has the following positive functions:
    - support the generally linear business processes of a company, such as reporting to the management and shareholders, financial planning processes, etc.;
    - ensure an effective exchange of information with the management to achieve efficient decision-making within the company;
    - ensure the top-down implementation of the corporate strategy;
    - allow priority setting by the management;
    - support asset roadmap planning;
    - enable effective resource and skill management throughout the whole organisation;
    - enable strategic resource planning at an early stage of the process;
- **Supports compliance with rules and guidelines within the company and quality assurance processes:**
    - guarantee transparent and traceable decision-making processes;
    - a well-defined and documented linear product development process fulfils the requirements of typical quality management systems, such as ISO 9000, which are designed to help organisations to ensure that they meet the needs of customers and other stakeholders while meeting statutory and regulatory requirements;
    - support the necessary commercial duty of care when making decisions;
- **Is the basis for an effective information security management**. The generation phase of each project is the starting point for an effective information security management, such as ISO 27000. For each project a classification of the output (deleiverables) has to take place as a basis for subsequent measures for information security.
- **Provides the basis for a simple, effective, and sustainable information sharing system** among the different organisational units to allow for a higher degree of information transparency within the organisation, while at the same time leveraging potential synergies early on. The gate process supports to identify synergy potentials among different organisational units which are identified on an emergent basis.
- **Supports an open-minded culture based on transparency and open information exchange:**
    - achieve an equal degree of transparency for both employees, within the teams but also among different organisational units and the management;
    - structured way of providing information (i.e. complex project scopes have to be prepared in a well-defined structured and easy to understand way);
- **Provides the basis for effective feedback and thus learning processes.** Such a process provides a fundamental basis for
    - feedback/learning processes and later on evaluations;
    - knowledge and asset management;
- **Safeguards high-quality standards for cooperation with industrial partners.**

- enable quality control for deadlines and deliverables;
- enable monitoring procedures and guarantee sustainability of work progress, taking into account the different phases of a PLP:
- the project preparation phase; e.g. for funded projects there are sometimes many formal steps to be considered;
    - the project management phase;
    - the project feedback phase;

- **Act as a starting point and pulse generator for attendant business processes** such as communication, marketing, key-account, sales or partner management. A sales and marketing process should not only start after the project has been finalized (Gate 4) but as soon as the project idea has been generated (Gate 0) or perhaps even (Gate -1);
- **Is the basis for providing positive feedback for successful and innovative behaviour.** This is essential for supporting the self-efficacy of the employees.
- **Is the basis for subsequent performance evaluation of the innovation process.** Without such a methodology no organisational and process improvement can be implemented effectively.

9.8. Thesis Contribution

This PhD described, first, the background and rationale for implementing a leading edge innovation process within a real working environment at AIT Austrian Institute of Technology. To the knowledge of the author of this PhD study, no other Research & Technology Organisation (RTO) has implemented such a gate based innovation process up till now. The thesis goes on to describe and assess a framework that was defined and built in to the operative innovation processes within AIT to foster bottom-up creativity and innovation. This framework is intended to complement the regular, linear management tasks of an organisation. Any social media platform within an organisation has to be supported by a cultural development process as well as with a well-defined steering process such as the described Gate process.

An observational study of the communication attitudes of employees in internal communication processes within organisations was conducted. This study contributes to our understanding of the complex issues of communication behaviour in the context of innovation processes within organisations in general, as well as in the particular case of using online social media functions. This PhD study demonstrates the importance of considering and understanding the social and cultural issues as a top priority in order to ensure a successful communication and information exchange tool implementation within organisations in general and on online social media platforms in particular. Especially important is the alignment of cooperation processes as well as tailoring technology platforms in order to take into account company strategy and cultural status.

The study shows how important and beneficial observational studies can be for research in relevant aspects of computer science, since usage of technology is shaping the technology as such as well as the usage patterns of that technology. Practical observation of the real-world behaviour of employees within an organisational context can provide an extended understanding of the relevant factors for potential success when implementing online social media tools for innovation processes within organisations. It identifies the issues that arise when introducing a new technology platform

and the considerations that need to be made by the organisation. The findings of this study form a basis for the understanding of when and how to use online social media tools within organisations. The results make clear that it is not at all just a technology issue when implementing new IT systems within organisations.

The findings of this PhD and the elaborated methodologies, processes, tools and guidelines can be used as a guideline to implement an effective innovation process within an industry oriented R&D organisation, even working within complex industry and market environments.

9.9. Future Work

The PhD thesis shows that there are three complementary worlds which have to be considered separately, but have always to be combined and harmonized since they are closely intertwined: the creative phase of flexible and uncontrolled information exchange, the implementation capabilities of new ideas within organisations, and finally the very linear process world that is needed to live within the business context of organisation as well as to steer the financial and business management issues.

9.9.1. Process Landscape and Employees Attitude

The research results show very clearly that there is still a strong attitude in the context of creative phases not to communicate with the “formal organisation”, although there is strong evidence of a willingness to exchange information with colleagues and experts. Based on this it is worthwhile to consider in the process landscape the difference of communication processes with the management and communication within and among the teams.

The research results lay down the fundament for further work in the following areas. First, based on the summarized theoretical models and defined methodology of different phases of an innovation processes within an organisation, the attitude and motivations for information exchange among employees for the different phases have to be analysed in more detail. While during this PhD study mainly the phase of idea creation, i.e. Gate 0 till Gate 1 in the innovation process methodology, was analysed, research focus has also to be spent on the other phases of the innovation process: the very early phases of idea creation (Gate -1 till Gate 0), the phase after project start (Gate 2 till Gate 3), the project management and implementation phase, and the dissemination and sales process, i.e. the business development and sales process, which accompanies the whole development phase of the innovation process. All these different phases have different requirements for problem solving and need for communication and information exchange, and all these phases have different framework conditions to be considered.

To understand the behaviour of employees better, it would be essential to investigate in more detail the difference of the attitude of younger employees, which can be considered as digital natives, compared to older personnel; such a differentiation was not made during this study.

9.9.2. IT-Tools and Online Social Media Platforms within Firms

Based on the findings of this PhD thesis, it is essential to develop a set of dedicated functions for an online social media platform to support the effective information and knowledge exchange within companies for innovation processes. It should be clear now, that there will be no suitable commercial-off the shelf (COTS) tool which will support all the different phases of an innovation process. Very early creative phases, in which unstructured and easy to handle information exchange is supported, or dedicated information exchange for specific tasks within or among teams or

structured information gathering for addressing specific problem statements, require different processes and different functions of a social media platform. Blog-functions, twitter-like functions, document shares, etc., have to be combined very carefully according to the defined objectives and selected processes to be supported.

By using such social media functions for the different phases of a project life-cycle data will be generated which could be used for further analyses of processes and communication behaviour.

Finally, based on the experiences made during this PhD study, a closer focus is necessary to harmonize features and processes of the different business support systems (BSS), which are always in operation within organisations in order to ensure a seamless integration of online social media tools within the firm´s IT landscape.

9.9.3. Different Framework Conditions for Product Management Process

Since this PhD study was performed within the context of an applied research centre, in which the background of all the employees is mainly technical, it would be interesting to extend the empirical research with additional fieldwork to explore the dedicated situation in larger organisations around a classical product management process. In such environments, a different attitude of the involved actors will be observed. This is because of the varied cultural backgrounds of the employees. Employees with marketing, sales, customer service, or a controlling background, and larger companies with a larger functional split within the organisation, will impose a different culture with different employee attitudes in the information exchange processes.

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11. Appendix

11.1. Questionnaire “Future at Work”

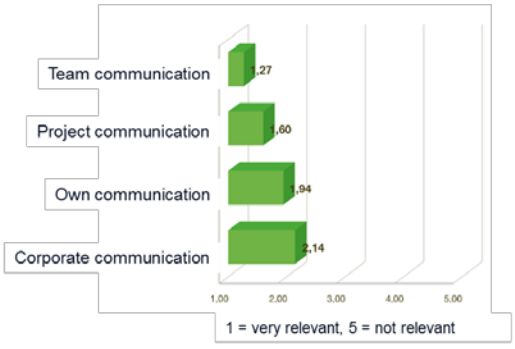
Basic Data for the Questionnaire I “Innovation at work”

Sponsor:	DI Helmut Leopold
Design of the questions:	DI Helmut Leopold and Thomas Fundneider, the LivingCore
Interpretation and commenting on the data:	DI Helmut Leopold
Theme of the study:	digital work processes within organisations
Target Group:	AIT employees of the Department Digital Safety & Security
Sample/response:	237/163 (69%) (age split: 15-32 years (n=47, 29%), 33-52 years (n=101, 62%), > 52 years (n=15, 9%)
Method:	Online-Questionnaire
Date of the Questionnaire:	January 2012 – September 2012
Execution of the study:	theLivingCore
Project team at theLivingCore	Thomas Fundneider, Markus F. Peschl, Martina Hartner,
Basis of data for all subsequent slides:	n=163 (100%)

Question 2.1: How do I evaluate the relevance of communication in the working process on the following groups?

Team communication with colleagues in the own working area is seen as the most relevant communication form. Project communication with external partners (research community as well as industry) is seen as the second most important.

Corporate communication with other colleagues in other DSS working areas/ departments /AIT subsidiary companies has been rated as least relevant.



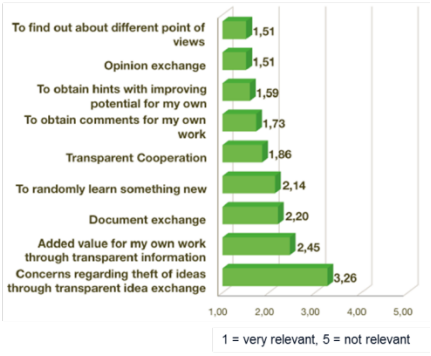
Question 2.2: Which groups/departments/institutions/interest groups/ etc. belong to my “informal communication group”? - open response format

- The most frequent statements were “team-colleagues”, “colleagues within the same research area“, “colleagues from other departments within AIT“ but also “alumni“ (former colleagues, universities, etc.).
- Social networks like LinkedIn and Xing are often mentioned too.

Question 2.3: How important are the following factors to me when it comes to communication?

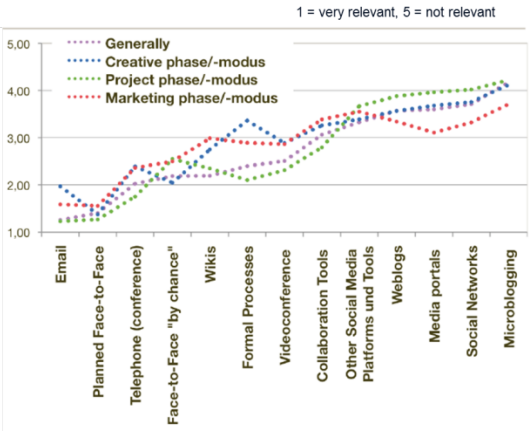
The most important factors for communication are "opinion exchange" and “to find out about different point of views“.

Concerns regarding theft of ideas through transparent idea exchange in the company is considered as not very relevant.



Question 2.4: How important do I consider the following means of communication generally?

- eMail is seen as the most important tool for communication followed by “face to face" and “telephone”.
- Social media tools are seen as not very relevant for communication processes within the firm.



Question 2.5: Other social media platforms and tools for means of communication generally. Which ones?

- Most mentioned platforms are "LinkedIn" and "Xing", followed by "Research Gate" and "Doodle".
- However, the employees emphasize that next to social tools real-life events such as team events and "free-time activities" are very important.
- Older persons do not see Twitter as relevant.

Question 2.6: Other social media platforms and tools for the creative phase. Which ones?

- Most mentioned platforms are LinkedIn, Collwrite, Doodle and Xing.
- Again there´s an indication for the relevance of real-life events.

Question 2.7: Other social media platforms and tools for project phase. Which ones?

- No real strong usage of social media tools of the employees for communication in the project implementation phase. Platforms like LinkedIn or Doodle are mentioned.
- Tools only mentioned in this phase are Foliocloud, Fabasoft and Github.

Question 2.8: Other social media platforms and tools for marketing phase. Which ones?

- Young employees mentioned much more social media instruments as important than older people.

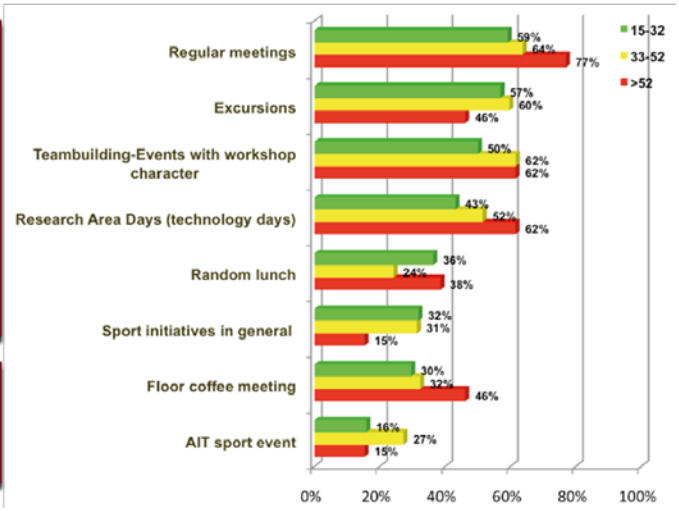
Question 2.9: Which locations enable creative and quality communication & interaction?

- Classical offline locations like meeting rooms, clients premises, coffee machine, cafeteria as well as sport events, lunch, etc. are seen as the most important locations.
- Virtual rooms are seen as least important in general but it offers most value for youngest age group.

Question 2.10: Which measures enable creative and quality communication & interaction?

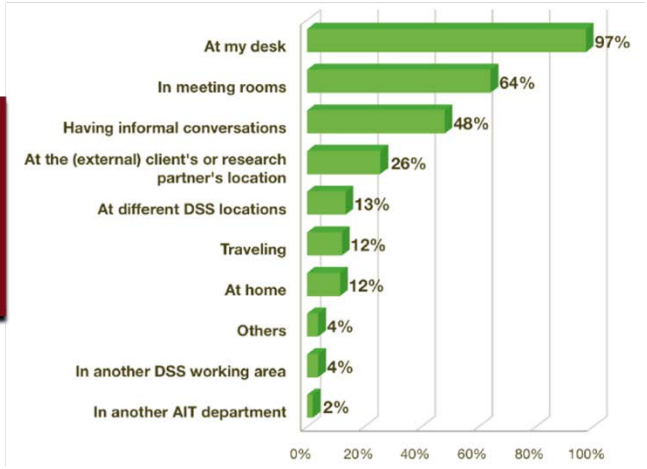
- "Regular meetings" is the most important measure for creative and quality communication & interaction, however, it seems most important for people over 52 years.
- Further, "teambuilding events" and "excursions" are almost rated as high as "regular meetings".

Strengthening the organisation´s culture is more important than vast corporate events.



Question 2.11: I spend my working hours prevailingly…?

Almost all of the time employees are working at their desk (97%); followed by "in meeting rooms" (64%). Nearly 50% see "informal conversations" as essential.

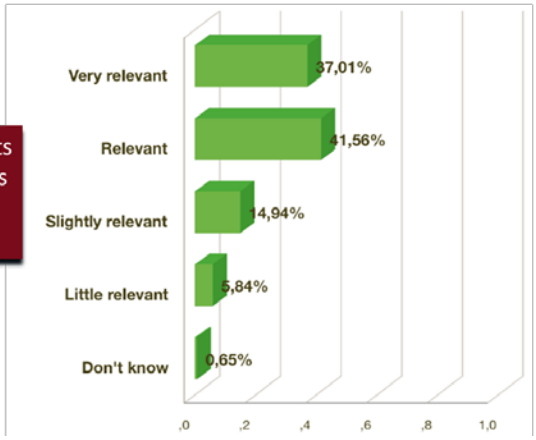


Question 2.12: What are the major obstacles/barriers for my communication activities within the project, team & department?

- Distance (locations and floors) is seen as a big obstacle for communication.
- Time constraints have been stated most frequently as limiting factor for communication activities.
- Existing IT support tools are seen as suboptimal.
- Employees want more direct/informal communication than by emails and tools.
- Employees see communication often as "one way" – there´s a dialog missing.

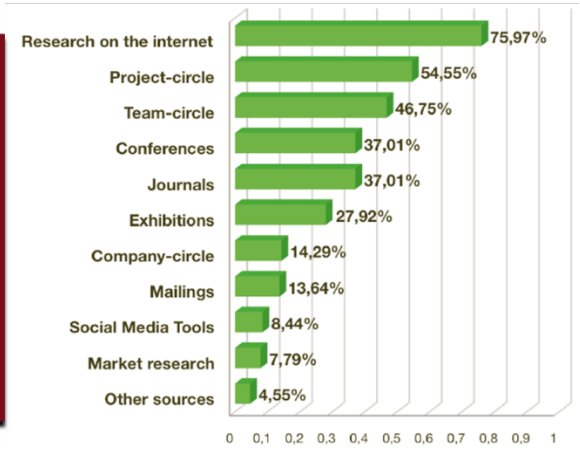
Question 3.1: To what extent market expertise is relevant for my work?

- The biggest share of respondents evaluate the market expertise as being relevant for their work (79%).



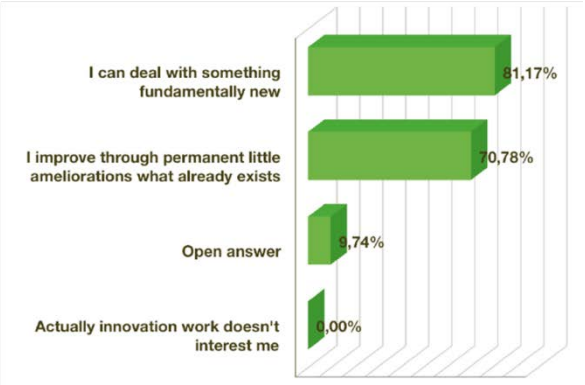
Question 3.3: What sources do I use to obtain knowledge about the market?

- Top source is research on the internet, project and team circles.
- 75% (across age groups) mentioned research on the Internet as a source to obtain knowledge about the market, but online social media tools are mentioned only with 8% relevance (we can assume, that "Internet" is correlated to google and other search engines).

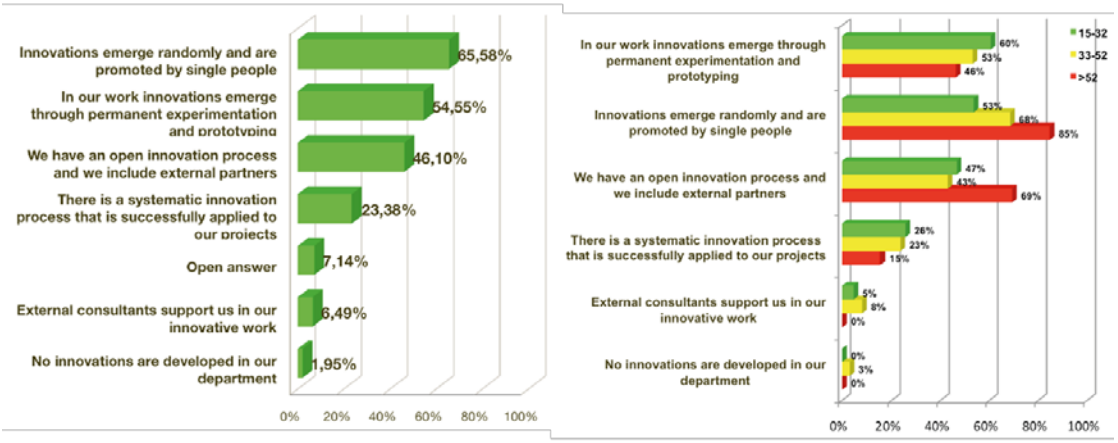


Question 3.4: Concerning my interest for innovative work at DSS: I´m exalted when…

- Most indicate that they like to deal with both: something fundamentally new as well as to improve what already exists.



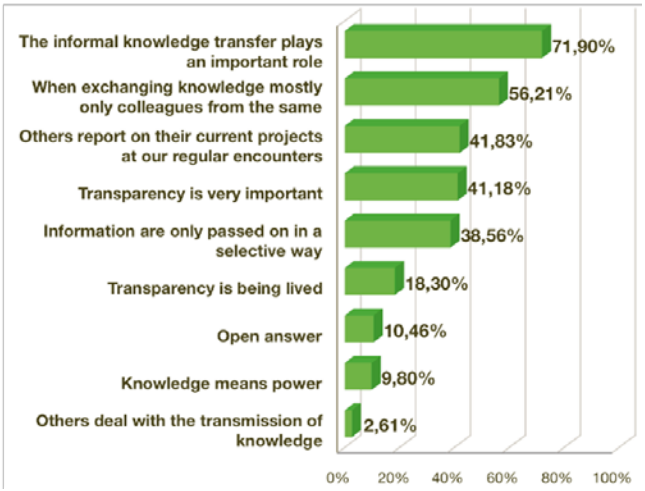
Question: 3.7 How do innovations emerge in DSS?



According to the employees, innovations emerge randomly and are promoted by single people (66%).
Younger employees state that innovations emerge through permanent experimentation and prototyping, and including external partners in the context of an open innovation process.

Question 4.3: How is knowledge transferred in our department?

- Informal knowledge transfer is highest rated (71,9%)
- Mostly knowledge-transfer takes place between people of the same area
- Employees indicate that information is only passed on in a selective way
- "Jour fix meetings" are seen as one of the most important instruments for knowledge transfer.



Question 5.1: Do I use social media tools, social networks, media portals, etc. outside of the professional context?

- 49% State yes and 27% rarely.
- Main motivation factors for usage of online social media tools are:
  - staying in contact with others (networking)
  - communication with friends
  - being up to date, and
  - organizing spare time.
- Reasons for not using it (open answers):
  - Data privacy issues
  - Too time consuming
  - No perceived added value

Question 5.2: Do I use social media tools, social networks, media portals, etc. for my professional activities?

- 34% yes and 34% rarely. Main motivation factors are:
  - staying in contact with others (networking),
  - Wiki as structured Information source/documentation,
  - idea exchange / inspiration
  - fast access to news, and
  - easy networking across distances and thematic fields.
- Reasons for not using online social media tools:
  - Data privacy issues
  - Too time consuming
  - No perceived added value for the work

Question 5.3: For what purposes in the professional context would I use social media ?

- networking (66%)
- knowledge exchange (60%)
- collaboration (51%)
- studying (32%)
- Innovation, creative process (30%)

- Respondents >52 don´t use social media for studying (0%) and only limited for knowledge exchange. The networking purpose of social media tools has been agreed upon across all age groups. Collaboration purposes, but not innovation and creative processes are more prevalent among people being 33-52 years old.

Question 5.4: For what other purposes in the professional context would I use social media ?

- The majority would use it for communication within a project (60%).
- Communication with colleagues in the team (53%).
- Communication in the organization (38%)
- With external stakeholders (28%)
- For communication with the management, social media is not regarded as suitable - only 10% would use it.

Question 5.5: Which Social Media tools do I use for my professional innovation activities?

- 45% state that they ar not using any social media tool
- 35% are using tools such as SoCol, Wikis, Skype, Youtube, and Blogs.
- Other usage: Xing (27%), LinkedIn (18%), Facebook (9%), Twitter (7%), Google+ (7%)

Question 5.6: How do I evaluate the (possible) advantage of the following Social Media functions for my own work?

- Most important functions are: full text search, time scheduling, permalinks, document storage, email alerting
- blogs and microblogging is not seen as helpful.

Question 5.7: Do I see obstacles or do I have concerns when using Social Media Tools?

- The most critical issue is security in terms of confidentiality concerns, but also in terms of **privacy concerns** about data used from the platforms (the further use of data can not be controlled).
- Too **time consuming** and distraction from work are also mentioned.
- Face to Face is seen as more important especially for innovation

Question 5.8: Where do I see the biggest potential concerning the support of innovation processes through the SoCol tool?

- The most criticised issue is the usability of the SoCol tool.
- It is not seen, that SoCol is an entry tool for all further online applications.
- SoCol has too many functions which are overwhelming. A reduction to a few functions only would increase the usability.

11.2. Questionnaire on Information Hiding

11.2.1. Announcement Letter for the Employees from the Management

Dear Colleagues!

I hereby invite you to support a research project through your participation in a survey. As part of the KIRAS project "Inno4Sec" we are trying to elaborate new approaches to innovation processes within and between companies. In this context, the use of social media platforms plays an important role. Since we already have some experience in this field in our Department, I would like to consider your views and experiences.

Innovation processes and the exchange of information are always a tension between free and open exchange of information and tactical use of a knowledge advantage. This is the primary objective of a business-oriented company to gain a competitive advantage.

To gain more understanding of the background and motivation for information exchange processes in companies, I have created a list of questions. The answers should serve as a basis for the definition of a dedicated communication process with our business partners, and to improve cooperation within the Department.

Participation in the survey is voluntary and completely anonymous! Anonymity is also preserved in that the poll is conducted via an online questionnaire by the polling institute IFES. Only statistical results will be passed from IFES to AIT. The company IFES will contact you in the next few days by e-mail and request to answer the questionnaire electronically.

Please respond from your point of view as an expert, drawing on your experience.

Your point of view can be considered as a "blueprint" for all Austrian innovation organisations and marks an important basis for the further development of the innovation market in the area of security research in Austria.

The survey results will also be communicated to all of you in a suitable form.

I thank you in advance for your time and support!

Kind regards

Project Manager "Inno4sec"

11.2.2. Invitation letter for the Questionnaire from the Market Research Firm

The following invitation letter to participate in the questionnaire was used.

Subject: Survey on innovation processes within organisations

Dear Ladies and Gentlemen,

As you have already been notified in advance, the IFES Vienna (Institute for Empirical Social Research) will perform an online survey concerning "Innovation processes within companies".

We cordially invite you to participate in this survey and ask for a few minutes of your time to answer the online questionnaire. With your help you will make it possible to find new approaches for innovation processes.

The following link takes you directly to your questionnaire:

[individualized access]

Alternatively, you can also click on https://www.ifes-umfrage.at, in order to enter your personal access data to get to the questionnaire.

Your username is: xxxxxx

Your password is: xxxxx

In the evaluation, absolute anonymity is guaranteed. All data collected will only be evaluated in an anonymous form, i.e., without using a name and address.

We ask you to answer the questionnaire within the coming days, but no later than XX. [Month] XXXX.

If you have technical or other questions, you can contact us at IFES by using the following e-mail address: befragung@ifes.at.

Thank you very much for your participation in the survey!

Best regards

XXXXX

Project Manager

IFES – Institut für empirische Sozialforschung GmbH

Adress: xxxx

Tel.: xxxx

This invitation letter was followed by a remdinder leter after 10 days; i.e. the same letter as above whith a slightly different formulation of the invitation letter:

….

If you have already participated in the survey, we thank you very much!

If you have not yet participated in this questionnaire, we ask you kindly to support us and answer the online questionnaire. The following link takes you directly to your questionnaire:
…..

11.2.3. Results of the Questionnaire 2 “Innovation hiding”

In the following the questions and the answers of the questionnaire are provided. In the for each of the questions a brief interpretation is provided (red boxes).

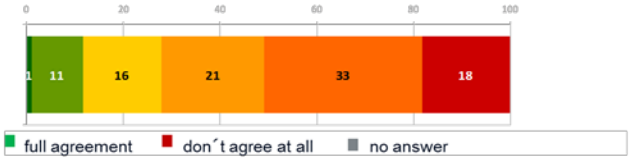
Basic Data for the Questionnaire

Sponsor:	DI Helmut Leopold
Design of the questions:	DI Helmut Leopold
Interpretation and commenting on the data:	DI Helmut Leopold
Theme of the study:	Innovation processes within organisations
Target Group:	AIT employees of the Department Digital Safety & Security
Sample/response:	285 persons/ 104 persons (36,49%)
Method:	Online-Questionnaire
Date of the Questionnaire:	5.11.2015 – 27.11.2015
Execution of the study:	IFES
Project manager at IFES:	Mag. Christine Schuster, IFES
Project assistant:	Christoph Hochwarter, BA BA MA, IFES
Statistics:	Mag. Claudia Pflügl, IFES
Basis of data for all subsequent slides:	n=104 (100%)

Communication and presentation of ideas in front of colleagues

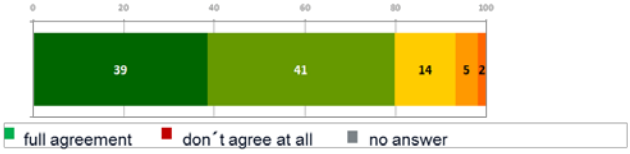
Thesis – Question (Q1a):

I present my idea or my project conception to my inner circle of colleagues, only when I'm sure I can answer all related questions. [in percent]



Anti-thesis - Question (Q1b):

I present my idea or my project conception to my inner circle of colleagues, at a very early and raw stage so that open aspects can still be discussed among colleagues and consequently included in the final concept. [in percent]

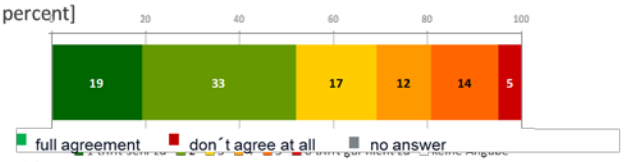


51% are definitely not waiting to discuss issues with their colleagues (question 1a); and from the other point of view 80% indicate, that they are presenting their idea even in a very early stage (question 1b).

Communication and presentation of ideas in front of management

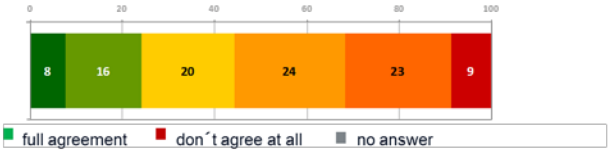
Thesis - Question (Q2a):

I present my idea or my project conception to the management, only when I'm sure I can answer all related questions. [in percent]



Anti-thesis – Question (Q2b):

I present my idea or my project conception to the management, at a very early and raw stage so that open aspects can still be discussed among colleagues and consequently included in the final concept. [in percent]

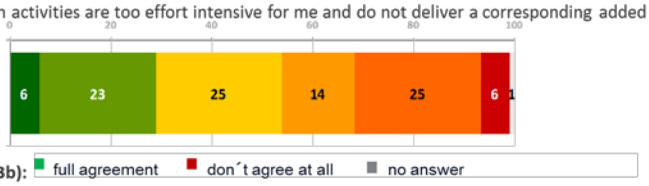


52% are waiting till they feel that they have enough material to be able to discuss it with the management (question 2a). Although, already 24% are claiming that they are definitely willing to discuss even half-baked ideas with the management (question 2b).

Preparation of ideas in documents and in IT-tools

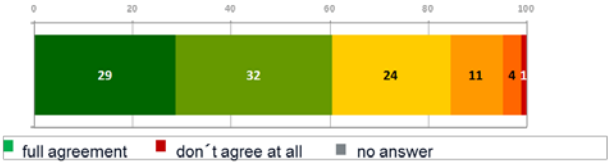
Thesis – Question (Q3a):

Ideas and project proposals are prepared and presented via databases, presentation materials and workshops. Such extensive preparation activities are too effort intensive for me and do not deliver a corresponding added value. [in percent]



Anti-thesis – Question (Q3b):

The creation of a presentation or the formulation of an argument enhances productivity: different lines of thoughts and chains of reasoning are developed and strengthened, as the presentation should withstand the judgment of an audience. By developing easily comprehensible presentations, aspects that had not been previously considered can be identified. [in percent]

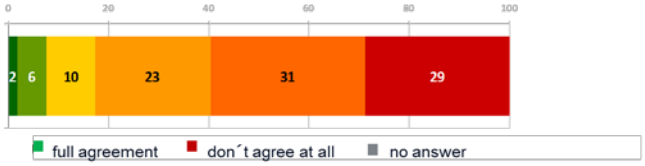


29% are stating that preparation activities are too effort extensive and they don't see an appropriate added value (question 3a). 61% see an added value in preparing an idea by structured means (presentations, documentation, etc.) (question 3b).

Holding presentations in front of colleagues

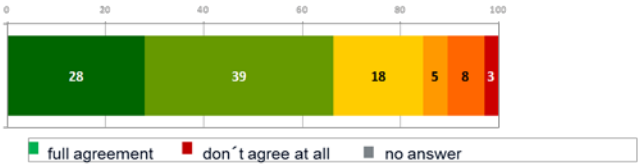
Thesis – Question (Q4a):

Holding a presentation and engaging in a discussion with my inner circle of colleagues is very time-consuming and requires a great deal of efforts so I try to avoid it. [in percent]



Anti-thesis – Question (Q4b):

I'm happy to hold a presentation in front of a larger group of my colleagues in order to have a feedback that I can use for my project idea. [in percent]

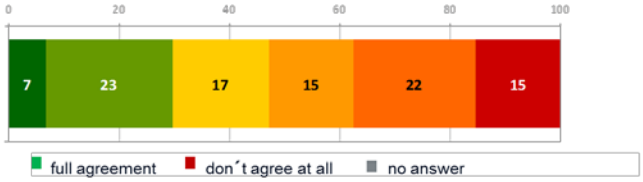


60% are rejecting the view that they want to prevent the holding presentations in front of colleagues (question 4a). This is confirmed by question 4b, that 67% indicate that they are using a presentation in front of colleagues on purpose

Holding presentations in front of the management 1/2

Thesis – Question (Q5a):

Holding a presentation and engaging in a discussion with the management is very time-consuming and requires a great deal of efforts so I try to avoid it. [in percent]

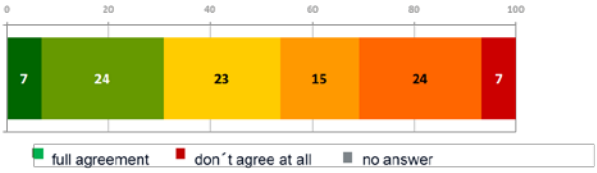


Here we can see a tension between effort to prepare and holding a presentation and expected added value from a discussion with the management.
1/3 (30%) see the effort as too much compared to the added value; 1/3 (37%) see an added value which pays off the effort for the presentation; and 1/3 (32%) are unsure (question 5a).

Holding presentations in front of the management 2/2

Anti-thesis - Question (Q5b):

I'm happy to hold a presentation in front of the management in order to have a feedback that I can use for my project idea. [in percent]

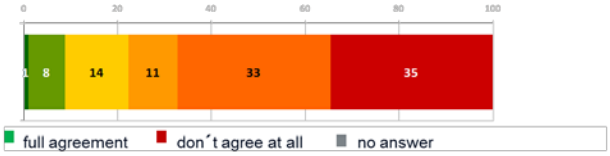


Question 5b is confirming this view: 1/3 (31%) is willing to hold presentations; 1/3 (31%) is not willing; and 1/3 (38%) is unsure.

Introducing ideas into the organisation (1/2)

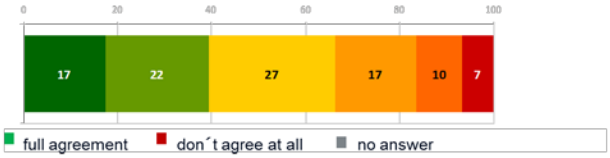
Thesis (Q6a):

When I think that new ideas are not in line with the corporate strategy, I do not engage in a large debate within the company but I try to set up the project in secrecy and establish it within the organisation. [in percent]



Thesis – Question (Q6b):

When I think that new ideas are not in line with the corporate strategy, I do discuss them within the inner circle of my colleagues but not with the company management. [in percent]

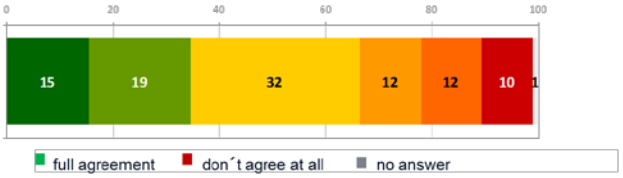


Only 9% are following the concept to keep a new idea secret when they assume that new ideas do not fit to the company´s strategy. 1/3 is definitely willing to present such ideas, 68% don´t agree that they don´t engage in communication when considering new ideas (question 6a). Looking at question 6b, 1/3 acknowledges that they definitely will present new ideas and an additional 1/3 is more positive than negative.

Introducing ideas into the organisation 1/2

Thesis – Question (Q6c):

Also in the case of innovative approaches and project ideas that are not the central focus of the corporate strategy, I explicitly present and discuss them within the organisation to contribute to further expanding the strategic focus of the company. [in percent]



When asking about the strategy to influence even the whole organisation even to adapt the defined strategy, 1/3 is very open and interested to change the company (34%). 1/3 (22%) is not interested and 44% is unsure (question 6c).

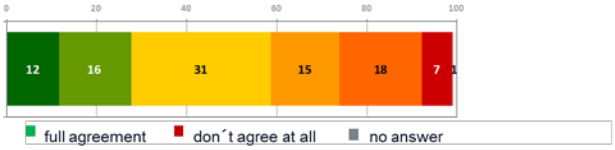
Introducing ideas into the organisation 2/2

Thesis - Question (Q7a):

It is a good strategy for certain projects to collect facts in the first place. This can be a customer order, an explicit declaration of intent of a customer or of a project partner, with whom we have already entered into an informal commitment. [in percent]

Anti-thesis - Question (Q7b):

I like to bring up new ideas that exert pressure on established structures and engage in a large discussion within the company because in this way I help the company move forward. [in percent]

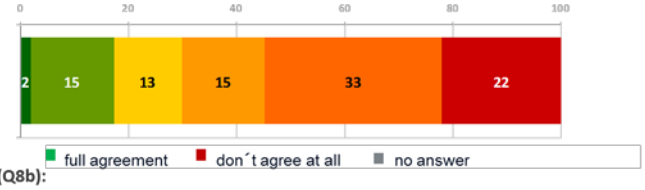


60% intend to organise facts in order to increase the probability that their new idea will be accepted by the company (question 7a). And again we see 1/3 (28%) which is definitely interested and willing to change the company´s strategy; 1/3 isn´t (25%); and 1/3 is unsure (question 7b).

Dealing with errors

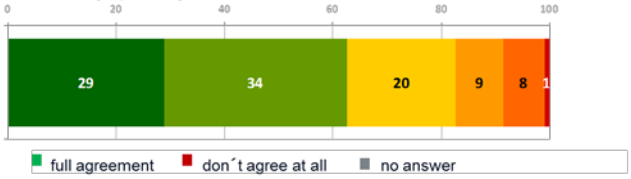
Thesis – Question (Q8a):

I'm afraid that too many colleagues might find out about a misjudgement I made with regard to an idea I had conceived that turned out not to be well thought out. [in percent]



Anti-Thesis – Question (Q8b):

One can only learn from mistakes. Therefore, even if a conceived idea turns out to be not feasible, I have certainly learned a great deal, while contributing to the further development of the company. Thus, my reputation as an expert is not at stake. [in percent]

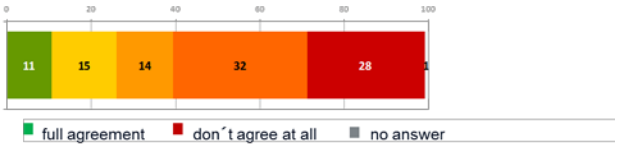


1/6 (17%) is afraid to be judged as a non-expert due to misjudgement; however 55% are not (question 8a). This is confirmed by the fact that 63% indicate that they are willing to learn from mistakes (question 8b).

Dealing with ambiguity

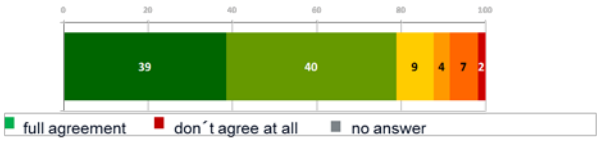
Thesis – Question (Q9a):

I'm afraid that an open representation of certain aspects that are still unclear and have not been dealt with in an exhaustive manner could be viewed as inconsistent with my expert position. [in percent]



Anti-thesis – Question (Q9b):

New projects bring about a level of complexity that cannot be totally understood. An open communication about those aspects that have not been addressed yet stresses my expert position and therefore my integrity. [in percent]

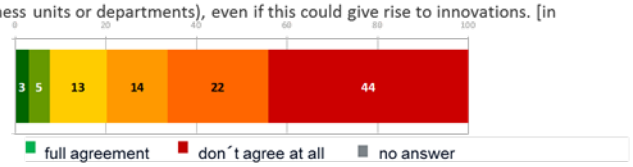


Demonstrated ambiguities by presentations of projects in a very early status are not really a problem for 60% (question 9a). This is confirmed by the view, that 79% even see that their expert view is even underlined when they present open issues for discussion, even when those issues are not clear ("Mut zur Lücke") (question 9b).

Cooperation with other organisational units within the organisation

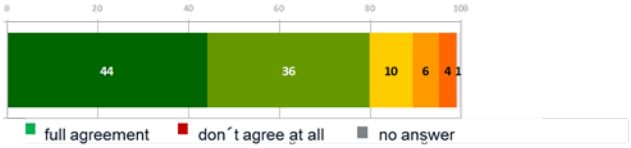
Thesis - Question(Q10a):

I think that the company does not welcome the fact that I might enter into cooperation with other parts of the organisation (such as other business units or departments), even if this could give rise to innovations. [in Prozent]



Anti-thesis- Question (Q10b):

The interaction with other colleagues from other organisational units often leads to creativity and value added. [in percent]

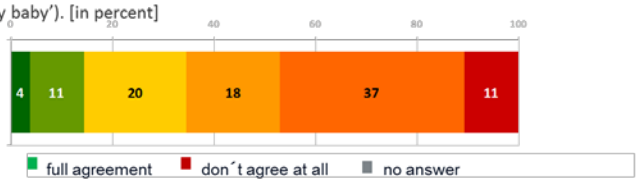


Only 8% believe that they should not cooperate with other organisational units within the organisation; whereas 66% are definitely interested to cooperate with other organisational units (question 10a). This is confirmed by the fact, that 80% see an added value and increased creativity when they cooperate with other units and even nobody answered that this does not bring any creativity at all (question 10b)

Management of intellectual property of ideas (1/3)

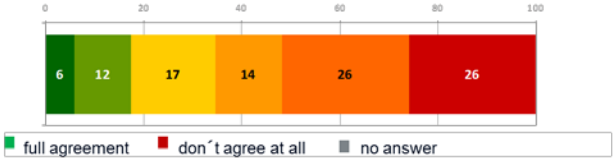
Thesis – Question (Q11a):

When I present my ideas, it can happen that someone else is appointed project leader and becomes responsible for the further development of the project. I therefore lose control over the success of the project (and I lose control over 'my baby'). [in percent]



Thesis – Question (Q11b):

I'm afraid that my ideas might be 'adopted and further developed' by someone else and, as a result, my authorship of these ideas for potential future publications and/or patents might be affected or lost. [in percent]

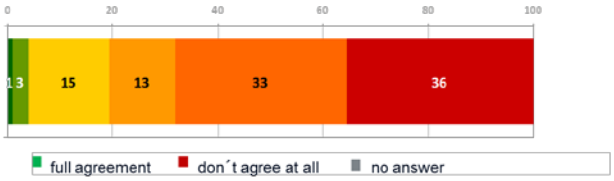


Only 15% are afraid that somebody else can take over their project idea as a project leader for further elaboration; 48% are not (question 11a). Only 17% are afraid that authorship or patents will be lost by to open communication; 52% are not (question 11b).

Management of intellectual property of ideas (2/3)

Thesis – Question (F11c):

If I'm the expert with regard to a specific topic, then I'm the only one who can act as the project leader, nobody else can deal with this topic as effectively as I do. [in percent]



Only 4% believe that only they as expert should work on their topics; 69% are not (question 11c).

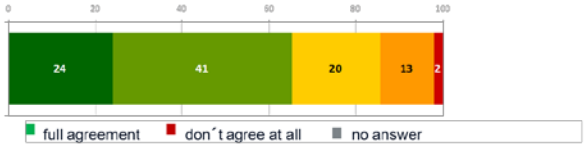
Management of intellectual property of ideas (3/3)

Anti-thesis – Question (Q11d):

It is in my own interest that other people are entrusted with the task of executing the project on an operative basis. [in percent]

Anti-thesis – Question (Q11e):

I'm well aware of the fact that a good idea can turn into a successful innovation only when a critical mass of players has been reached. That's why I'm trying to find lots of supporters and collaborators within the company. [in percent]

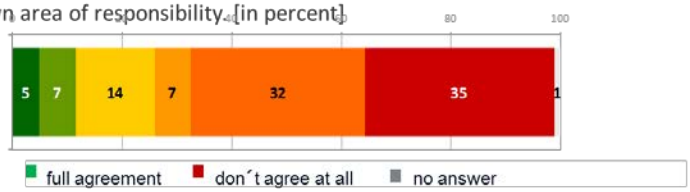


60% are interested to find more people to support their projects and ideas; 10% said no interest (question 11d). Even 65% see that only when they achieve a critical mass, their project idea will be successful finally; only 2% have an opposite view (question 11e).

Relationship between employees and management in the company (1/4)

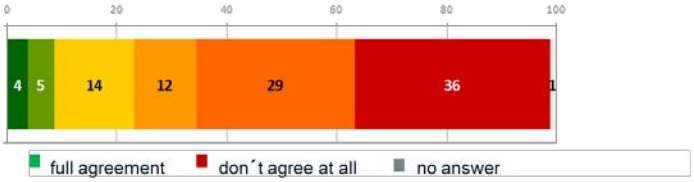
Thesis – Question (Q12a):

Competition for in-house budget resources is very strong and therefore I try to execute project ideas also without the involvement of the management since I can organize the necessary resources within my own area of responsibility. [in percent]



Thesis – Question (Q12b):

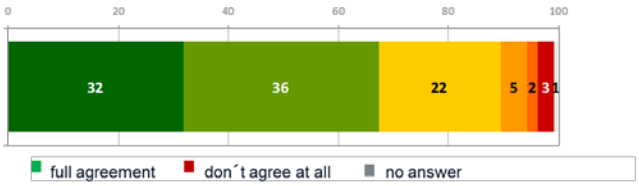
Competition for personal skills within the company is very strong and therefore I try to execute project ideas also without the involvement of the management since I can organize the necessary resources within my own area of responsibility. [in percent]



Relationship between employees and management in the company 2/4

Thesis - Question (Q12c):

It is of decisive importance for a project idea to be able to establish itself by overcoming internal competition and be executed with the support of the management, since only in this way all necessary resources can be made available. [in percent]

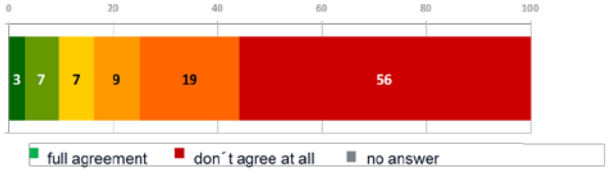


Only very few are following the strategy to work on new ideas without management negotiation; 12% to fight for budget and 9% to fight for dedicated skills in the company. The majority is willing to discuss their ideas with the management; 67% for budget and 65% for skills (questions 12a and 12b). This is confirmed by the clear view that 68% are aware that only management support can guarantee a project success for new ideas; only 5% don´t have this view (question 12c).

Relationship between employees and management in the company 3/4

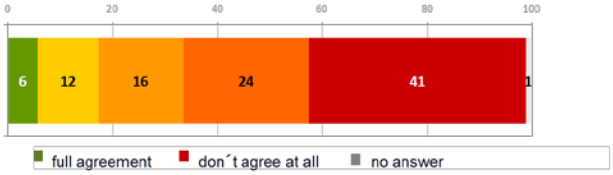
Thesis - Question (Q13a):

I believe that the company does not welcome it if I contribute new ideas. [in percent]



Thesis - Question (Q13b):

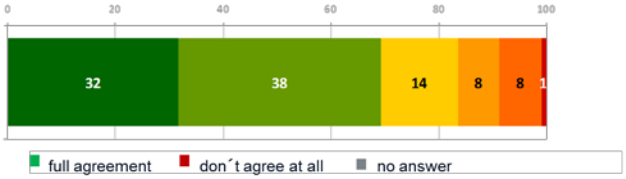
I only disclose those types of information that are not essentially important for my professional position and do not jeopardize my professional standing. [in percent]



Relationship between employees and management in the company 4/4

Anti-thesis - Question (Q13c):

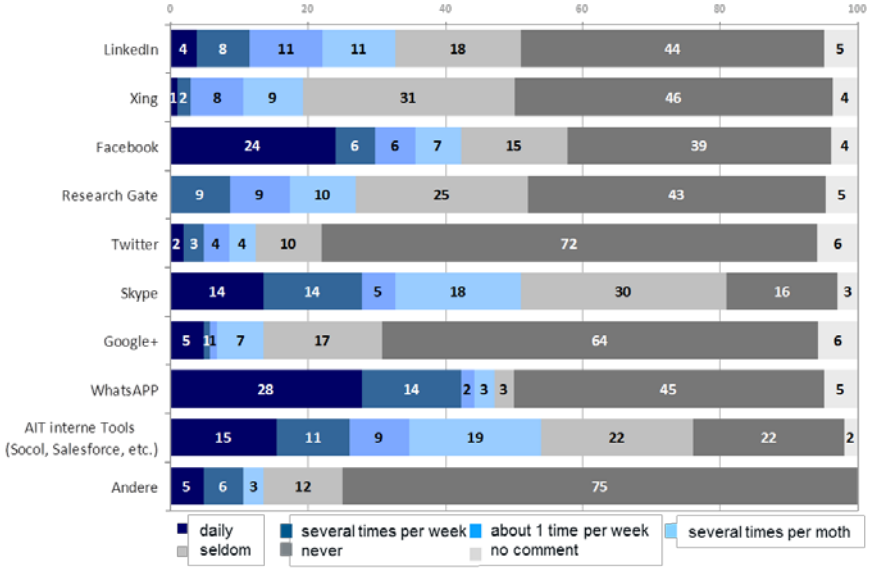
I communicate my new ideas to my circle of colleagues, to my team and to the management. [in percent]



10% believe that it is not welcomed, when they bring new ideas into the organisation; whereas 75% see the interest of a company to bring new ideas into the organisation (question 13a). 6% keep essential information to protect their career; 65% are very open (question 13b). This is confirmed by 70% which are very open to share any information (question 13c).

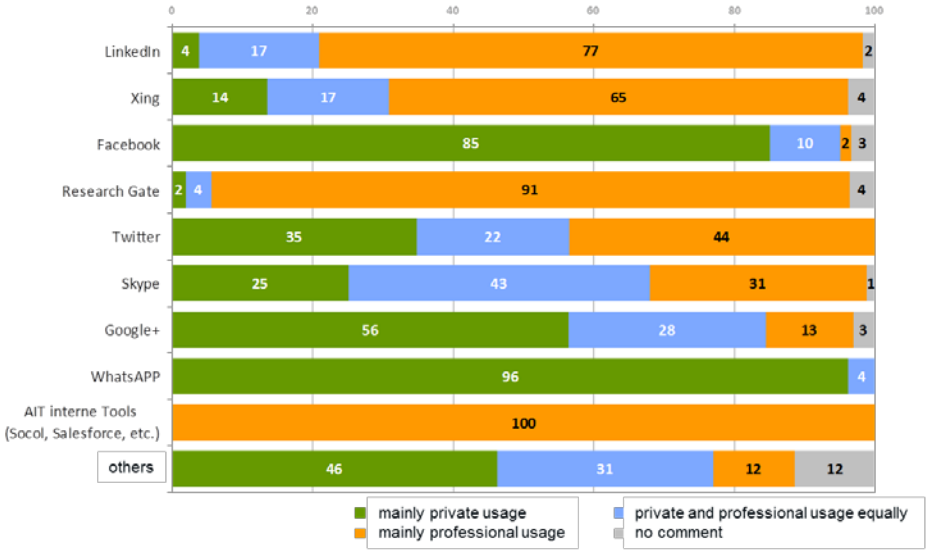
General usage of social media tools

Question Q14: Which online social media tools do I use and how often? [in percent]



General usage of social media tools

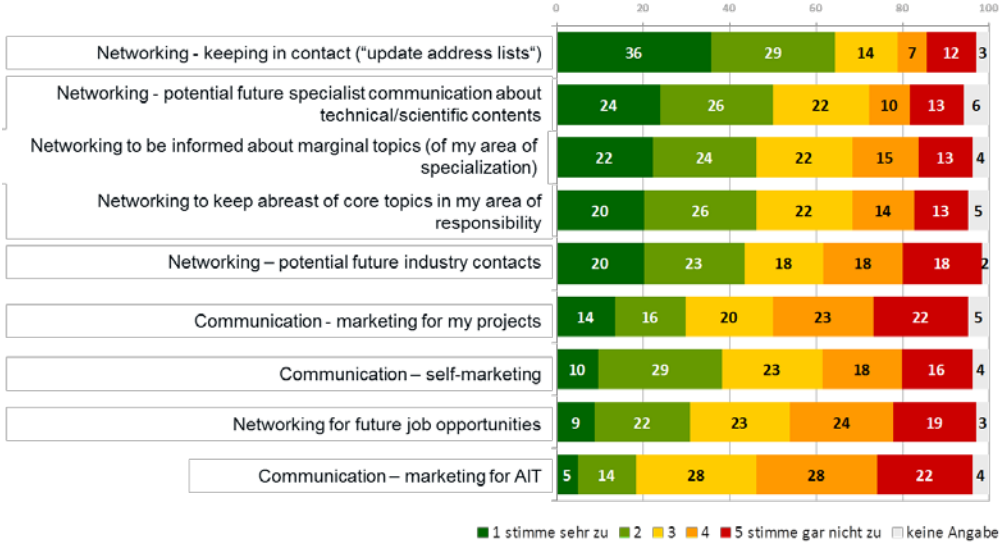
Question Q16: Which of the tools you use is used primarily in a private context, professionally, or both? [in percent]



Added Value of Online Social Media Tools

Question Q17: Which added value do you expect from using these tools? [in Prozent]

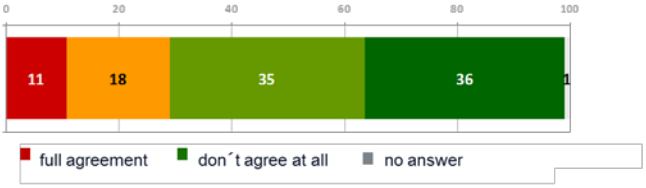
Please specify for each point in a scale of 1-5: totally agree=1, don't agree at all=5, no answer.



Fear when using AIT internal tools

Question Q18: Do you have concerns when using AIT internal tools like SoCol, Salesforce etc.? [in percent]

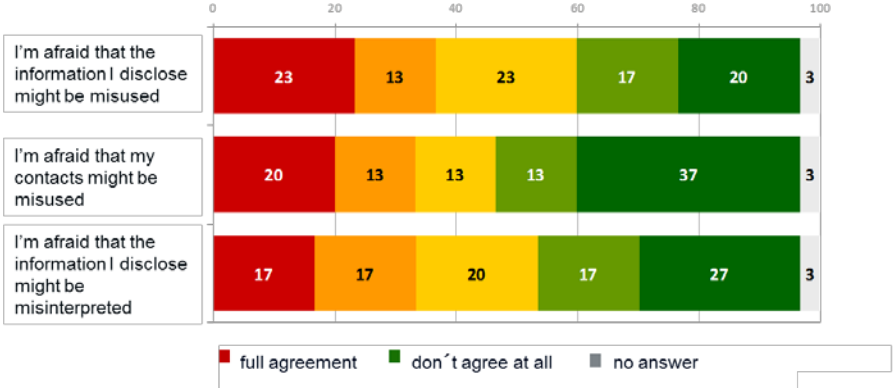
Please specify: applies fully, partially applies, does rather not apply, does not apply at all, no answer.



Fear when using AIT internal Tools

Question Q19: I do not like to use online social media tools within the company, because …

Please specify:



11.3. Defined Structured Forms for the Innovation Process

Dedicated ppt-forms have been defined to provide the guidelines for the employees in order to describe the project proposals in a well defined and structured form. The forms shown in the figures below are used for all defined Gates in the context of the innovation management process: G0, Gate 1, Pre-Gate 2, Gate 3, and Gate 4. These presentations have to be considered as the most important "meta-information" to synchronise all other business processes throughout the company. The structure and the very specific details of these forms have been elaborated by the author of this PhD study.

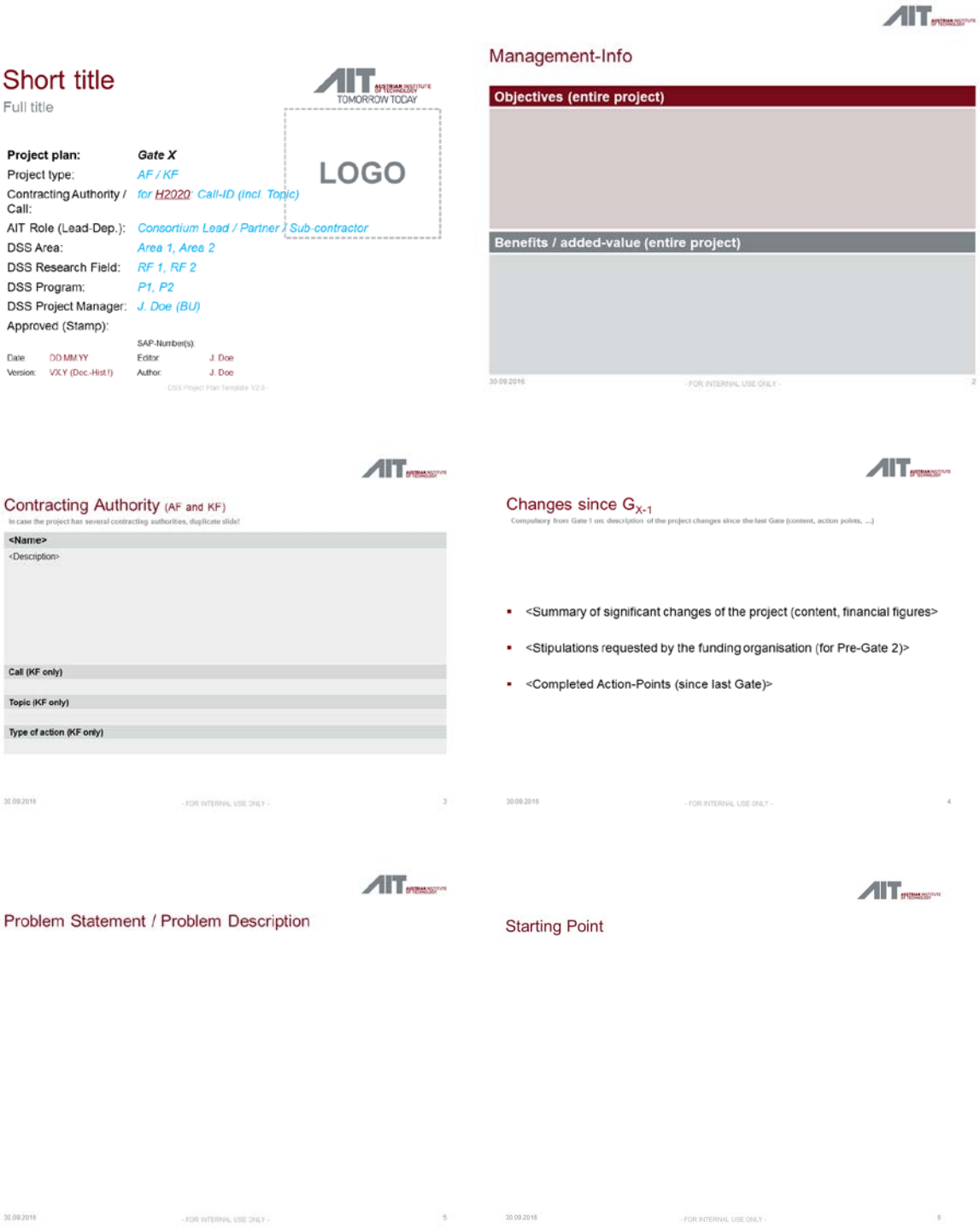
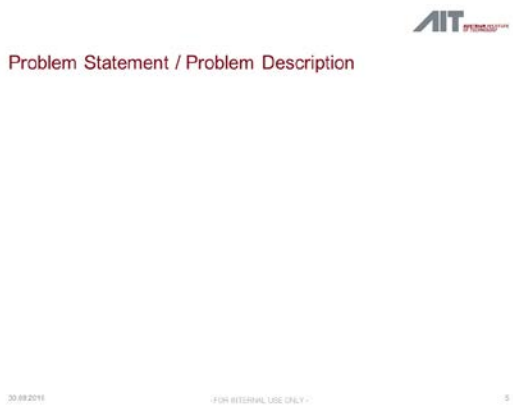


Figure 11.3.1: Gate forms: Overview and Management Information



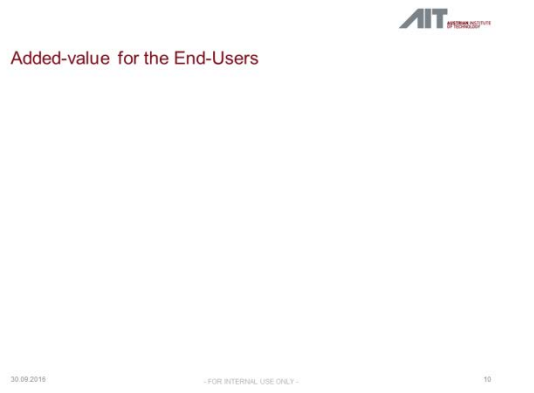
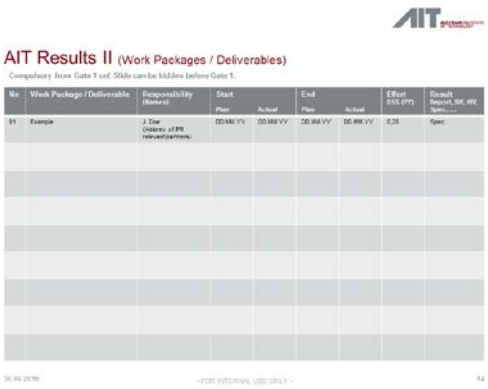


Figure 11.3.2: Gate forms: Approach and Project Scope

AIT Results I (Work Packages / Deliverables)

Compulsory from Gate 1 on! Slide can be hidden before Gate 1.

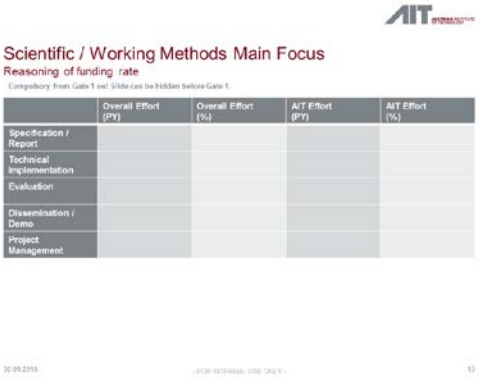
No	Work Package / Deliverable	Responsibility (Names)	Start		End		Effort DSS (PY)	Result Report, Str, HW, Spec, ...
			Plan	Actual	Plan	Actual		
01	Example	J. Doe (Abbrev. of PR relevant partners)	DD.MM.YY	DD.MM.YY	DD.MM.YY	DD.MM.YY	0,25	Spec



AIT Results II (Work Packages / Deliverables)

Compulsory from Gate 1 on! Slide can be hidden before Gate 1.

No	Work Package / Deliverable	Responsibility (Names)	Start		End		Effort DSS (PY)	Result Report, Str, HW, Spec, ...
			Plan	Actual	Plan	Actual		
01	Example	J. Doe (Abbrev. of PR relevant partners)	DD.MM.YY	DD.MM.YY	DD.MM.YY	DD.MM.YY	0,25	Spec

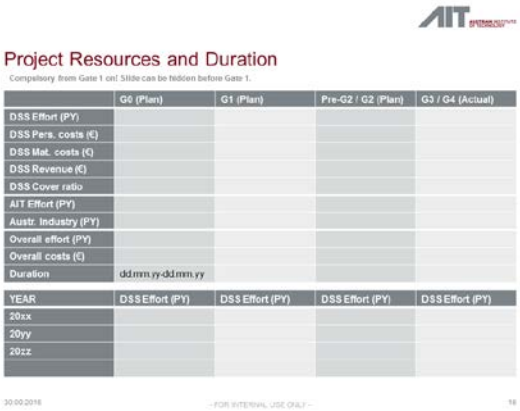


Scientific / Working Methods Main Focus

Reasoning of funding rate

Compulsory from Gate 1 on! Slide can be hidden before Gate 1.

	Overall Effort (PY)	Overall Effort (%)	AIT Effort (PY)	AIT Effort (%)
Specification / Report				
Technical Implementation				
Evaluation				
Dissemination / Demo				
Project Management				



Project Resources and Duration

Compulsory from Gate 1 on! Slide can be hidden before Gate 1.

	G0 (Plan)	G1 (Plan)	Pre-G2 / G2 (Plan)	G3 / G4 (Actual)
DSS Effort (PY)				
DSS Pers. costs (€)				
DSS Mat. costs (€)				
DSS Revenue (€)				
DSS Cover ratio				
AIT Effort (PY)				
Austr. Industry (PY)				
Overall effort (PY)				
Overall costs (€)				
Duration	dd.mm.yy-dd.mm.yy			

YEAR	DSS Effort (PY)	DSS Effort (PY)	DSS Effort (PY)	DSS Effort (PY)
20xx				
20yy				
20zz				

Timeline KF (chronological)

G0	G1	Pre-G2 / G2	G3 / G4
Gate 0: DD.MM.YY	Gate 0: DD.MM.YY		
A0 Pre-proposal: DD.MM.YY	A0 Pre-proposal: DD.MM.YY		
Gate 1: DD.MM.YY	Gate 1: DD.MM.YY		
A1 Project proposal: DD.MM.YY	A1 Project proposal: DD.MM.YY		
Gate 2: DD.MM.YY	B Grant offer: DD.MM.YY		
Gate 3: DD.MM.YY	Pre-Gate 2: DD.MM.YY		
Gate 4: DD.MM.YY	B Grant acceptance: DD.MM.YY		
	Gate 2: DD.MM.YY		
	C Grant agreement: DD.MM.YY		
	Project start: DD.MM.YY	← KF-Example	
	D Cons. Agreement: DD.MM.YY	(adapt to your needs!)	
	E1 Mid-term report: DD.MM.YY		
	E2 Mid-term report: DD.MM.YY		
	E3 Mid-term report: DD.MM.YY		
	Gate 3: DD.MM.YY		
	Project end: DD.MM.YY		
	F Final report: DD.MM.YY		
	Gate 4: DD.MM.YY		

Timeline AF (chronological)

G0	G1	Pre-G2 / G2	G3 / G4
Gate 0: DD.MM.YY	Gate 0: DD.MM.YY		
Gate 1: DD.MM.YY	Gate 1: DD.MM.YY		
A Offer: DD.MM.YY	A Offer: DD.MM.YY		
Gate 2: DD.MM.YY	B Order: DD.MM.YY		
Gate 3: DD.MM.YY	Gate 2: DD.MM.YY		
Gate 4: DD.MM.YY	B Confirm. of order: DD.MM.YY		
	Project start: DD.MM.YY		
	Gate 3: DD.MM.YY		
	Project end: DD.MM.YY		
	C Final receipt: DD.MM.YY	← AF Example	
	Gate 4: DD.MM.YY	(Adapt to your needs!)	

Figure 11.3.3: Gate forms: Results, Cost Figures and Important Dates

Project Team (Status: DD.MM.YY)

Compulsory from Gate 1 on! If changes in the team arise -> Project Plan Update (duplicate this slide!)

Name	BU	Role / activities

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Dissemination (Publications)

Compulsory from Gate 1 on! Slide can be hidden before Gate 1. Results: see the corresponding section.

- <Dissemination strategy>
- <Planned publications>
- <Other measures>

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IPR / Exploitation

Compulsory from Gate 1 on! Slide can be hidden before Gate 1. Results: see the corresponding section.

- <Legal framework from discussion / contracts → opportunities and constraints for exploitation for AIT>
- <Exploitation strategy>
- <Market description>
- <Competitors>
- <Product description>

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Proposal Check (Status: DD.MM.YY)

Compulsory from Gate 1 on! Slide can be hidden before Gate 1.

	Technical / scientific quality of the planning	Pertinence of the proposal towards the call	Eligibility of the applicant	Economic potential and exploitation
Overall Evaluation				

- <Summary>
- <External (e.g. FFG) or internal proposal check shall be done BEFORE G1>
- <The results of the proposal check (internal or external) shall be included by the PM in the „DSS Checkliste für Projektanträge">

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Confidentiality Measures

Current and planned confidentiality measures

- EXTERNAL measures
  - <Description>
- INTERNAL measures
  - Salesforce (sensitive): <yes/no>
  - <Comment>

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Communication Plan (DSS Marketing & Communication)

- <Is the topic critical (e.g.: UAV)? Why?>
- <Special needs wrt. communication (e.g. acknowledgement)>
- <What is the position of the partners regarding PR concerning the topic? (commitment)>
- <External contact persons for PR? (PM / PR Department; Objective: most efficient communication)>
- <Planned PR activities>

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Figure 11.3.4: Gate forms: IPR Exploitation and Communication Steering

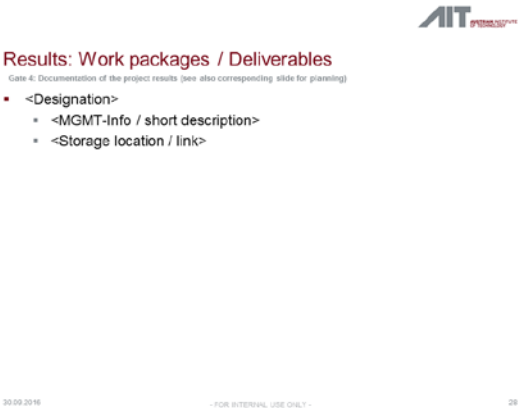
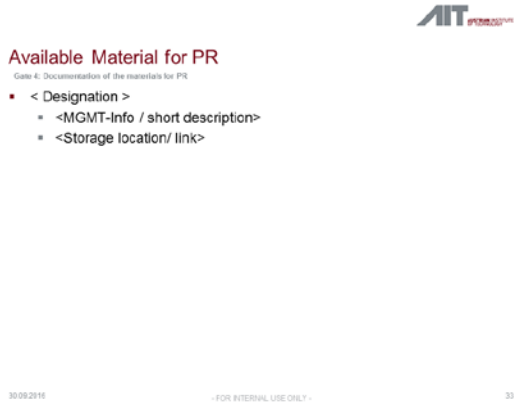


Figure 11.3.5: Gate forms: Risk Management and Dissemination



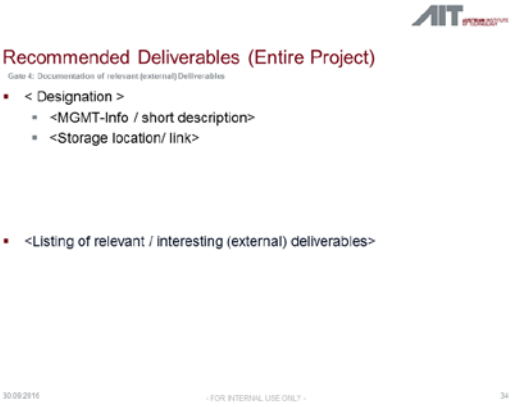


Figure 11.3.6: Gate forms: Lessons Learned and Outlook

11.4. Social Collaboration (SoCol) Platform

With the social collaborator (Socol) online social media IT platform, four essential areas are addressed in the context of the AIT innovation process in the department Digital Safety & Security:

- improved knowledge management by increasing the effectiveness of the exchange of information and expertise;
- increase the productivity of teams through more effective communication processes within teams, but also outside defined organizational structures;
- improve the creative phase by enabling unplanned and unstructured information exchange between the department's employees;
- increase the motivation of the employees by enabling contribution and cooperation, even outside the core tasks of an employee;

In particular, the Socol online social media platform has been designed as a "Gate 0 Tool". Thus the functions of the platform are primarily intended to support more effective communication mechanisms for creative processes; i.e. the collaborative elaboration of project proposals are supported. Thus the communication processes during the Gate -1 till Gate 1 phase in the context of the AIT / DSS innovation process are supported by this platform. The following concrete organizational and management objectives are pursued with the Socol online social media platform:

- to build on the individually unique abilities of employees for wider areas of application, even outside their core tasks;
- Ensure a more effective project proposal elaboration through comprehensive exchange of expertise;
- increase the productivity by improving access to project documents by linking documents with people, projects and groups
- improve the network relationships between different teams and different organizational areas;
- Efficient information exchange beyond knowledge silos of different teams;
- increase employee motivation through contribution and "commitment" beyond one's own competence and defined core tasks;
- effective exchange of experience across team boundaries;

SoCol is a social media application implemented on the basis of Web 2.0 open source technologies and is usable via a web browser. The following basic functions have been implemented:

- searchable profiles - persons, groups, and ideas
- possibilities for the networking of people and the development of thematic clusters (relations as a member of a group, friend, favourite)
- Blogging and microblogging possibilities
- Document storage and easy linking of profiles with documents to establish the enable the development of community knowledge;

- Scheduling. To each profile (person, group or organization) deadlines and dates can be anoatated. Through the friendship network and as well as the active memberships, these dates are then also displayed in the own profile.
- Journal

The implemented functions of the SoCol platform are described below.

11.4.1. SoCol Implementation

The various functions of the SoCol online social media platform have been implemented as a web browser function. The implementation was based on the Open Source JAVA Framework "Spring[187]" and was implemented by Johannes Zeitelberger with his startup *u.enterprise*.

11.4.2. SoCol Functions

11.4.2.1 Microblogging – YELL!

YELL! Is a microblogging service that allows the user to send short messages to other platform users. In YELL! a survey function is also integrated. With this function tool, the users have the possibility to follow other YELL! entries; i.e. those to which the user subscribed. The user receives the YELL! messages from all those he has subscribed in chronological order and can answer these with a short comment.

11.4.2.2 Blog

A blog is a service with which the profile owner can write scientific-technical articles which are then published by SoCol. Other users can comment on this article. This creates a discourse on relevant topics, which then results in a multi-faceted spectrum of opinion and knowledge that is documented and which can then be retrieved in the long term.

A blog contribution can only be created by the owner of the profile. There is also the function "guestbook" in which also other users can create entries.

11.4.2.3 Storage

In the storage ("Ablage") the profile owner can create any document folder structure. The folders can be moved by drag & drop. In addition to documents, notes and web-links can be stored. Permalinks can be used to create links to document. The document itself is stored in SoCol physically only once.

11.4.2.4 Profiles

The basic objects that are treated as "profiles" are in SoCol "person", "group" and "idea".

People are the users of the application that can sign in to SoCol, which are then created by an administrator. Groups can be created by each person and managed by the same as "owner".

- To these profiles certain attributes are assigned: guestbook, blog and documents (description of the attributes see below). The user can switch between different profiles.

[187] The "Spring Framework" is an Open Source Java Framework, https://de.wikipedia.org/wiki/Spring_(Framework), https://www.frank-rahn.de/einfuehrung-spring-framework/ (last access: 24.4.2017).

- Relationships can be created between the profiles, e.g. "Friend" or "member".
- For each profile it can be defined whether the profile is public or not. Public profiles are visible to all users; non-public profiles are visible only to users who are related to the profile; i.e. friends, members, and owners. This concept is consistently followed in SoCol, i.e. also by search for profiles or in the display of events in the journal (explanations see below).

11.4.3. Navigation

Basically, the SoCol web browser always displays a profile with the corresponding attributes.

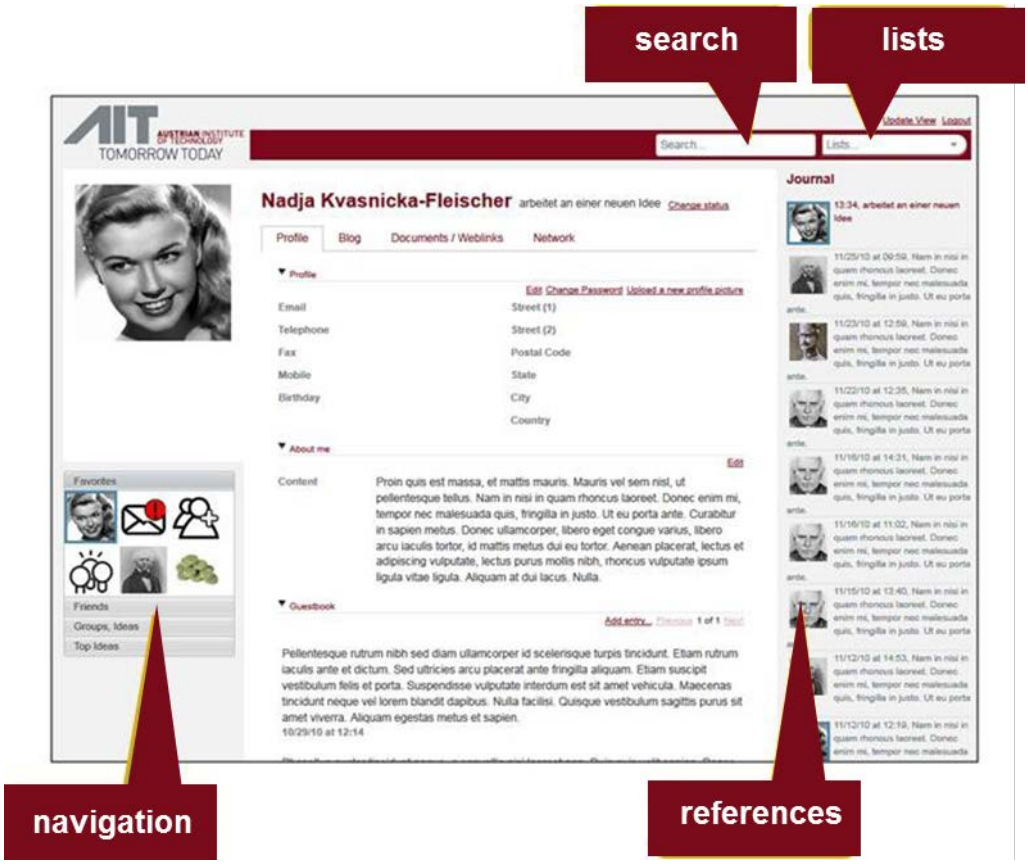


Figure 11.4.1: SoCol: User Profile

Switching between different profiles is possible by several functions:

- through the navigation area (bottom left); Here you can switch to other profiles: favourites, friends, groups, ideas, and top ideas;
- by different lists of profiles (top right); There is a list of all users, all groups and all ideas;
- by searching for profiles (top right); Here one or more search terms can be entered;
- by references to other profiles (bottom right); These profiles are contained in the displayed attributes such as navigation bar, guestbook, and journal;

The navigation is always at the bottom left and contains different sub-areas (which can be extended by clicking on each) which are summarized in the following.

11.4.3.1 Actions by other Profiles

For each other profile, the following actions can be executed under the profile:

- Send Message
- Add as a Friend" or "Remove Friend"
- "Add to Favourites" or "Remove from Favourites"
- "Invite to group"

Figure 11.4.2: SoCol: Actions

11.4.3.2 Favourites

Under „favourits“, references to frequently used profiles can be inserted. These can be any profiles, i.e. there is no need to be a friend or a member of a particular group.

Favourites	Description
	The own profile is always the first entry in the favourites. This it is possible to switch to the own profile at any time (home function).
	Switches to display the SoCol messages – from and to other profiles. This icon is always included under “favourites”.
	Create new profiles (group or idea, or new persons by the administrator); This icon is always included under “favourites”.
	View list of all ideas; This icon is always included under “favourites”; The list shows the current status for each idea (see the chapter on ideas below).
	Further self added profiles, for quick change to important other profiles Weitere.

Figure 11.4.3: SoCol: Favourits

11.4.3.3 Friend

This area shows all friends. In order to become a friend of an existing profile, a "friend request" must be submitted (action field below the profile image). A personal message can be formulated which is then transmitted with the friend request.

If the request is accepted the relationship "friend" is noted.

For “friends” also the action "remove as a friend" is possible to terminate a “friendship”.

11.4.3.4 Member

To become member of a group, a message with the request is sent to all owners of the group, which has to be confirmed by all other members.

The membership can be terminated through the “remove from the group" function.

11.4.3.5 Groups and Ideas

In this area all groups as well as ideas are summarized which are owned or which are related by a membership.

11.4.3.6 Top Ideas

The ideas that most users like are displayed here in a ranking. The evaluation of an idea is done by using the action "like" or "I do not like it anymore".

11.4.4. Socol Functions

11.4.4.1 Journal

The journal shows the ongoing activities in the SoCol platform. This area is located on the right side of the browser window and provides a chronological overview of the last 25 actions of all SoCol users (the Jornal is constantly updated).

In the own profile, all the journal entries available for the current profile are displayed. These entries are

- public profiles
- profiles of the friends, and
- profiles of the groups and ideas to which a profile is registered.

When switched to a different profile, only entries in relation to this profile are displayed.

Figure 11.4.4: SoCol: Journal

An event that took place within the last 10 minutes is highlighted in red.

The profile of the actor is displayed in the journal. When the cursor is moved over the profile image, the name of the actor is displayed. When the cursor is moved over the text of an event, further details about the event are displayed.

11.4.4.2 Creation of a new Profiles

A creation of a new profile is done through the function „creation of a new profile". A selection of the available profiles is displayed for a profile to be selected:

- group or idea
- person (a person´s profile can only be created by the administrator). Any interested user can register at www.socol.at.

The selected profile is displayed immediately and can be edited. The creation of a new profile can be canceled by clicking the cross at the selection window in the upper right corner of the window.

11.4.5. Profiles

11.4.5.1 Profile – Person

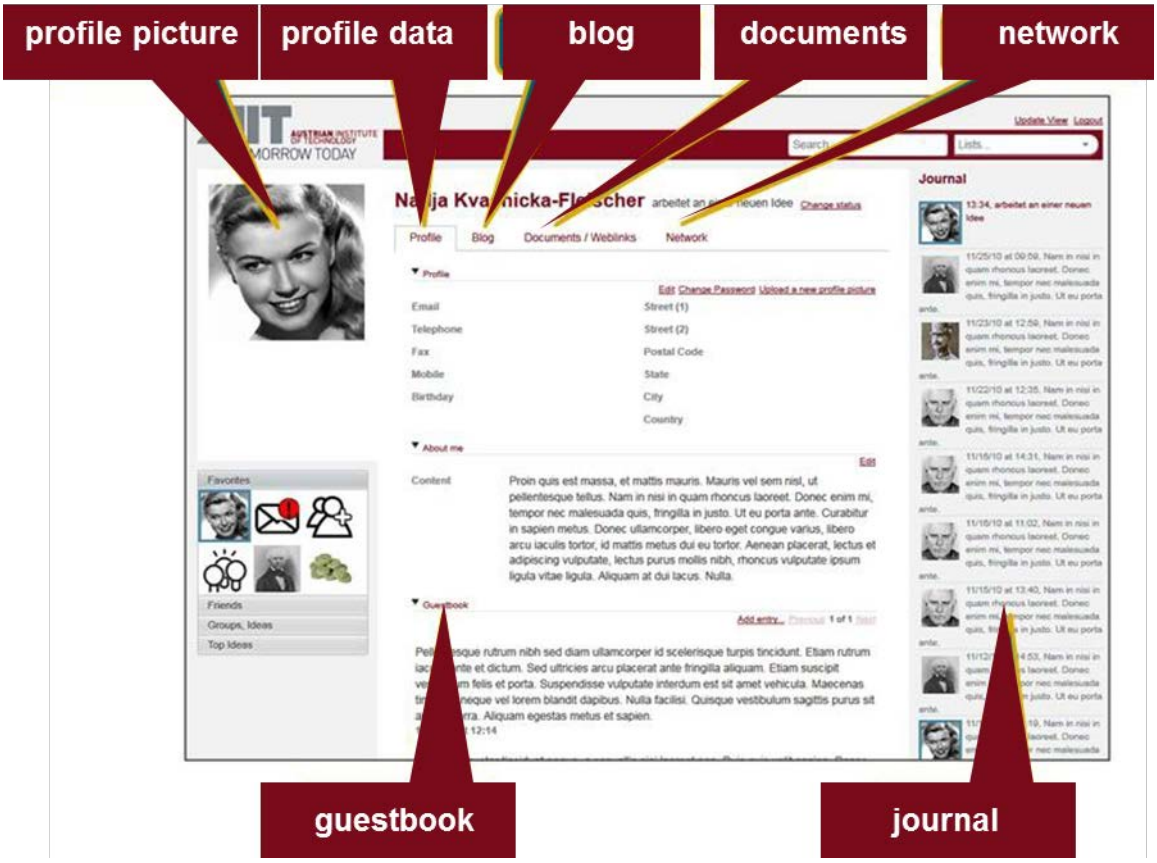


Figure 11.4.5: SoCol: Profile - Person

The profiles are located on the "Profile" tab and consist of several sections. The individual sections can be opened / closed. Actions on a section are located at the right edge of the section heading.

- A guestbook is a blog function. In the guestbook of a user, entries and comments on entries can be written by other users (as opposed to the blog in which only the owner can create new entries).

  The most recent entry is displayed first, with the actions "previous" and "next" can be scrolled within the guestbook. The author of an entry (or comment) may delete or edit this entry. The owner of the guestbook may delete or delete entries or comments from the guestbook.

- Corporate Directory: Attributes of a user who are automatically taken over from the company's corporate directory. They can not be changed by the user.

- About me: This section can be customized

- Personal data of a user. Possible actions are:

  - Edit, Change password, Upload new profile image
  - Language: English or German can be selected. The selected language is only used for e-mail notifications. The language specified in the browser settings is used in the Web browser.

- Public: a public profile can be found other users in SoCol; otherwise the profile will be invisible except for your friends.

11.4.5.2 Documents – Web-Links

Documents (any files) or weblinks can be stored in folders. Any number of folders and subfolders can be created. When a folder is selected, a new folder is created as a subfolder.

A file can be uploaded, or a URL can be added to create a weblink. If the file name (in the first column of the table) of an entry is selected, the document is opened or the corresponding page for a web link.

11.4.5.3 Network

All profiles associated with the user are displayed here: friends, groups, or ideas owned by the user, and groups or ideas in which the user is a member.

11.4.5.4 Profile - Group

A new group can be created by each user. The owner of the group and can add more users as members to the group by the "invite to Group" action (below a user's profile image). A SoCol message will then be sent to the affected parties. When they accept the invitation, they are members of the group.

Users can request membership in a group through the action "become a member" below the profile of a group; then a SoCol message is sent to the group owner. The owner has to agree to become member of the group.

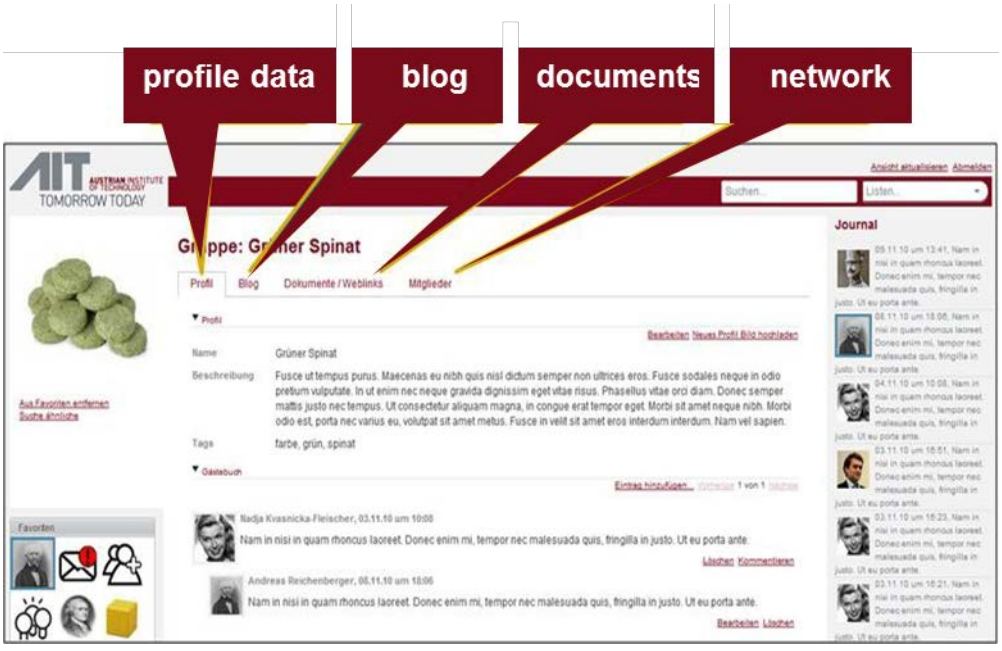


Figure 11.4.6: SoCol: Profile - Group

Similar to the "Person" profile, the owner can edit the profiles and upload a profile picture.

11.4.5.5 Tags

A special attribute of group are “tags”, in which keywords can be entered for the group. The corresponding action "search similar", which is available under a group profile, provides a list of additional groups for which similar keywords has been assigned.

11.4.5.6 Guest book

The guestbook has the same functionality as in the the person “person”.

11.4.5.7 Blog

The blog has the same functionality as for the profile "Person". In addition all group members may create entries, not only the owner.

11.4.5.8 Dokumente / Weblinks

Documents and Weblinks have the same functionality as for the "Person" profile. In addition all group members can create entries, not only the owner.

11.4.5.9 Members

The owner of the group and the members are displayed here. If a profileblid is selected, a menu opens, in which various actions are available. Actions for group members and owners are:

- View Profile: Switch to the selected profile
- Register as a member
- Register as owner
- Remove from the group

11.4.5.10 Profile - Idea

An idea is a group that has been provided with additional attributes and a "life cycle". The idea has an additional section "extended description", with the following fields:

- Short presentation
- Initial situation and problem statement
- Solution approach
- Technology
- Added value for users
- Remarks

These fields can be edit by the owner of the idea.

11.4.6. Life Cycle of an Idea

An idea is to be processed or rejected after creation within 60 days in the form of a project. There are for potential states:

- Work: The idea is developed by the owners and members. Once fully developed, it can be passed on to an "idea manager" for approval. Idea Managers are users who have a dedicated role assigned by the administrator. The remaining time is displayed. If the time is expired, the system automatically changes the status of the idea to "CHECK". The owner of an idea can also manually change the status to "CHECK" at any time (action "Change status").
- Check: The idea should be approved by the Idea Manager. It can only be edited by the Idea Manager.

- Perform: The idea was approved by the idea manager and can then be further processed in the context of the StageGate based innovation process.
- Closed: The idea is inactive. It can be reactivated by an idea manager.
- Top ideas: Every user can comment a "like me" for each idea. How many users like a particular idea is displayed below the profile of the idea. In the navigation area there is a tab named "Top Ideas", in which the ideas, which are most liked, are displayed.

11.5. Abbreviations

app Application Software

ADSL Asymmetric Digital Subscriber Line

AF Auftragsforschung (industry contract research)

AIT Austrian Institute of Technology

ANT Actor Network Theory

API Application Programming Interface

ASA American Sociological Association

BDS Berufsverbandes Deutscher Soziologen (professional association of German sociologists)

BPR Business Process Reengineering

BSS Business Support System

CAS Complex Adaptive System

CATV Cable TV

CD Compact Disk

CEO Chief Executive Officer

CIO Chief Information Officer

COP Community of Practice

COTS Commercial Of The Shelf

CPU Central Processing Unit

CRM Customer Relationship Management

CRP Complex Responsive Process

CSCW Computer Supported Cooperative Work

CV Curiculum Vitae

DARPA Defense Advanced Research Projects Agency

DGS Deutsche Gesellschaft für Soziologie (German society for sociology)

DSL Digital Subscriber Line

DSS Digital Safety & Security

EIT Enterprise IT

e-mail electronic mail

ERP Enterprise Resource Planning

ETH Swiss Federal Institute of Technology Zurich

EU European Union

FAQ Frequently Asked Question

FIT	Function IT
FLOSS	Free Libre Open Sources Software
FTE	Full Time Equivalent
FTTx	Fibre To The x - FTTH Home, FTTB Building, FTTC Cabinet
Gx	Gate x
GFL	Geschäftsfeldleiter (Business Unit Leader)
GIT	Gesellschaft für Informations- und Telekommunikationstechnik (society for information and communication technology)
GNU	Project for the development of an open source operating system
GPL	General Public License
GPT	General Purpose Technology
HR	Human Resource
HW	Hardware
ICT	Information and Communication Technology
IP	Internet Protocol
IP	Intellectual Property
IPR	Intellectual Property Right
IPTV	Internet Protocol TV
IPv6	Internet Protocol Version 6
IS	Information System
ISDN	Integrated Services Digital Network
IT	Information Technology
KIRAS	Austrian security research programme
KF	Kooperative Forschung (cooperative funded research)
KM	Knowledge Management
MBO	Management By Objectives
NIT	Network IT
OI	Open Innovation
OSI	Open Source Initiative
OSN	Online Social Network
OSNS	Online Social Network Service
OSS	Operation Support System
OVE	Österreichischer Verband für Elektrotechnik (Austrian Electrotechnical Association)

P2P	Peer-to-Peer
PB	Project Board
PC	Personal Computer
PLP	Project Life-cycle Process
POTS	Plain Old Telephony Service
PPT	Power Point
PR	Public Relation
PSI	Political Skill Inventory
PTM	Platform and Technology Management
R&D	Research and Development
RSS	Really Simple Syndication
RTO	Research and Technology Organisation
SAN	Storage Area Networks
SAP	German software manufacturer, Bussiness Processs Support SW tool portfolio
SDSL	Symetric DSL
SECI	Socialization, Externalization, Combination, Internalization
SIM	Subscriber Identity Module
SME	Small and Medium-sized Enterprise
SN	Social Network
SNA	Social Network Analyses
SNS	Social Network Service
SoCol	Social Collaboration
STB	Set Top Box
SW	Software
ThC	Thematic Coordinator
TV	Television
UF	Unabhängige Forschung (independent research)
UGC	User Generated Content
US	United States
USP	Unique Selling Preposition
VDSL	Very High Speed DSL
Vlog	Video blog
VoIP	Voice over IP

xDSL different versions of the Digital Subscriber Line (DSL) technology (broadband transmission technology over copper pairs of telephone access lines): ADSL, VDSL, SDSL

11.6. Key Words

"Chance favours only the prepared mind"[188]

[188] Luis Pasteur, lecture at the University of Lille, 7.12.1854, https://de.wikipedia.org/wiki/Louis_Pasteur (last access: 24.4.2017.