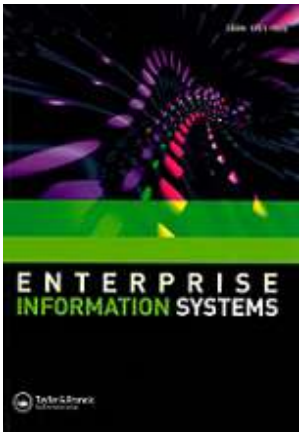

Bridging the Strategy Execution Gap of Designing Intelligent Talent Acquisition Systems Using Enterprise Modelling and Simulation

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Abstract

The development of modern intelligent systems poses numerous challenges in their strategic alignment and their effectiveness to a greater extent. Enterprise modelling has been emerging as a significant and effective paradigm for holistic and systematic enterprise analysis and design. We develop a multi-view approach based on enterprise modelling and simulation that bridges the strategy execution gap of talent acquisition processes and the underlying intelligent information systems (IS) design. The approach integrates a set of techniques and tools that are rooted in the conceptual modelling paradigm. We demonstrate the value of the proposed approach in a case study, and then we discuss its practical and theoretical implications.

Keywords: Enterprise Modelling and Simulation; Enterprise Models; Design Rationale; System Dynamics; Intelligent Talent Acquisition Systems.

1. Introduction

Small and medium enterprises (SMEs), are facing numerous challenges in decision-making relevant to strategic alignment, resources allocation, processes efficiency and competition from large corporations which have started to servitise their business models to deliver services that have been considered for a long time as out of scope services (El Kadiri et al., 2016). It has been argued that "over the next decade, artificial intelligence (AI) will not replace managers, but managers who use AI will replace managers who do not" (Brynjolfsson and Mcafee, 2017). It has been argued that "by 2020, 85% of customer-firm interactions will be conducted via computerised technologies" (Schneider, 2017). In attempts to automate enterprise business processes, SMEs have acquired varieties of information systems mostly purchased as COTS to increase process efficiency. Business processes, particularly in talent acquisition activities still might not be well integrated with an organisation internal processes and consequently might not serve the organisation in achieving the desired quality and quantity of knowledge they seek to absorb to support decision-making.

On the one hand, the talent acquisition process should be aligned with strategic objectives and respond to the demand for robustness in organisational capabilities; on the other hand, it should utilise the current intelligent capabilities of emergent technologies. Improving traditional business processes to incorporate emergent information systems (IS) comes with new challenges for enterprises to reach a sustainable equilibrium among business agility, control, and innovation. Therefore, some of the crucial issues are: how to determine the effect of key decisions, optimise enterprise resources, synchronise business-IS initiatives, and improve alignment to emergent intelligent IS. Yet, it is nearly impossible to achieve these objectives without a systematic strategy design that identifies the relationship between business needs and IS development.

Considerable efforts were made for holistic enterprise knowledge acquisition and development using enterprise architecture (EA) frameworks and enterprise modelling (EM) techniques. While these techniques and approaches focus on the conceptual properties of the modelling, most of these approaches neglect to offer business managers the tools to reason about their enterprise design alternatives. This paper presents a multi-view modelling approach with reasoning and simulation capabilities that are based on an integrated set of enterprise modelling, design rationale and system dynamics techniques to improve alignment between strategy, operation and IS design. In this situation, the enterprise deals with transformation initiatives using a set of tools to support the co-evolution of the enterprise and IS design where both services and their underlying capabilities are evolving within the enterprise ecosystem.

The approach is influenced by the paradigm shift towards continuous knowledge-intense activities (Yu, 2009), a paradigm that also utilises conceptual modelling (Guizzardi et al., 2013) as a way to deal with complex or problematic enterprise phenomena, and an attempt to design IS that support enterprise growth. In terms of the processes involved, there are essentially two activities: (a) model building and critiquing and (b) simulation and group deliberation. Models are mainly built by analysts with input from domain experts and are subsequently critiqued and revised by these experts. We use the design science research methodology to design a multi-view approach that is based upon enterprise modelling and simulation techniques. It can be used for aligning intelligent talent acquisition IS with both business objectives and operations. Furthermore, this approach consists of a set of distinct but interrelated

models that focus on (a) a definition of business strategy using the Business Motivation Model (BMM) (OMG, 2010), (b) analysis of the impact of talent acquisition using System Dynamics (SD) modelling (Sterman et al., 2015), (c) communication between stakeholders and business governance using the semantics of business vocabularies and business rules (SBVR) (OMG, 2006), (d) reasoning about potential designs using Design Rationale (DR) (Regli et al., 2000), (e) defining related business processes using Business Process Modelling Notation (BPMN) (OMG, 2013) and (f) implementing software services using SoaML (OMG, 2012). The paper offers a way to use current techniques and languages coherently and logically to address issues of strategy execution gap when designing modern intelligent information systems and not deliberate to develop a new modelling method framework.

The paper is organised as follows: Section 2 presents the research background on enterprise architecture and modelling, qualitative reasoning and continuous and discrete dynamic simulation. In Section 3 a motivational case study is presented, followed by the description of the research methodology in Section 4. The proposed approach specifications are developed in Section 5. The application of the developed approach is applied and validated in Section 6. In Section 7 we evaluate the usefulness of the approach and discusse the implication of modelling on talent acquisition processes for both practical and theoretical aspects. Finally, the conclusion of this paper focuses on challenges and opportunities for future research directions presented in Section 8.

2. Background

2.1 Talent Acquisition and Competency Management

Enterprises are currently facing challenges concerning the dynamics of acquiring skilled talents and identifying competencies, within their ongoing process of deploying human resources (Collings and Mellahi, 2009). Digital fusion and social media, workplace fragmentation and the multi-cultural workforce have all contributed to increasing complexity in acquiring talent efficiently and effectively (Mellahi and Collings, 2010). One study estimates that more than 1.5 billion people have entered the global labour market over between 2000 and 2015, and it is estimated that this number will rise by one billion by 2025 (Office, 2015). Enterprises need to adapt and respond promptly to all of these global challenges. Practices such as video interviews, mobile-based

solutions and the use of social media have become the new face of collaboration in talent acquisition, and became the normal during the Covid-19 pandemic. Talent acquisition systems have gained greater attention as they offer improved capabilities that help enterprises to enhance the strategic alignment between their human resource (HR) departments and organisational strategy, which in turn increases the efficiency of the talent acquisition processes (Marler and Fisher, 2013; Schuler et al., 2011). Phillips (2008) argues that current recruiting has become more collaborative, as more people are using web services and joining social networks, communities and sourcing sites, and many people are taking freelance or hourly-based jobs. It has also been reported that one of the challenges of talent management arises from the fact that while employees with the desired competencies and skills are available, they may be in another place or wrong position (Schuler et al., 2011). Attracting qualified and appropriate talent is the first element in the talent management process, according to (Parthasarathy and Pingle, 2014). who suggest that there are three stages in the talent acquisition process: (1) planning, including setting, verifying and communicating criteria, (2) sourcing both internally and externally, and (3) selection, including assessment and evaluation based on interviews and other tests. Some human resource (HR) electronic systems have extended features for talent acquisition, yet enterprises do not always see this as strategically important.

Several studies have explored companies' reasons for implementing electronic human resource management (e-HRM) systems, and these vary. For instance, in two studies (Panayotopoulou et al., 2007; Teo et al., 2007) it was found that companies desire to improve both the communication between HR and employees, and between managers and employees. Another study (Buckley et al., 2004) explored why companies implemented recruiting systems and found that the main aim was to make financial savings. Most of the other studies on the adoption of e-recruiting and e-HRM systems found that the reasons for this investment included cost reduction through streamlining HRM operations (Marler et al., 2009), improved effectiveness by providing a better delivery of HRM services (Ruël et al., 2004), while in a few cases the aim was the transformation of the HRM function to a strategic business partner (Lepak and Snell, 1998).

Post-implementation studies (Haines and Lafleur, 2008) also found that IT support of HR activities can positively influence the quality of HR's alignment with business

strategy, and that performance increased noticeably as the HR department worked as a service provider, partner and change agent to the whole organisation (Haines and Lafleur, 2008). It was also found to influence HR managers' perceptions of the effectiveness of HR strategy. Other studies have shown that implementing talent acquisition systems can increase the efficiency and the effectiveness of web-based recruiting, reducing the number of unqualified applicants and therefore speeding up the employment process (Dineen and Noe, 2009; Dineen et al., 2004).

We argue that existing practice does not meet the needs of managing the complex alignment of talent acquisition in terms of efficiency and effectiveness. To ensure that the enterprise has the required skills and the way to develop them for future needs, competency management systems are enterprise systems that are typically integrated with ERP packages e.g. payroll. Competency management literature suggests that enterprises should define the competencies that are needed to participate in executing business strategy. Though, the literature did not specify how the enterprise can systematically and effectively do this exercise. Eliminating a large part of the repetitive work is one of the promises that intelligent systems offer. Designing such systems should also correspond to the enterprise needs and their strategic goals.

2.2 Modelling and Simulation Methods

To address the previously mentioned gaps, a set of modelling and simulation techniques will be used to bridge the strategy execution gap of the required competencies by designing intelligent systems. The following sub-sections offer a background of enterprise modelling and simulation tools that offers a foundation to our suggested approach.

2.2.1 Enterprise Architecture and Modelling

Enterprise architecture (EA) frameworks such as TOGAF, Zachman or DoDAF/MoDAF, EA Cube, NATO, CIMOSA (Vernadat, 2020; Fayoumi and Williams 2021) (Bernaert et al., 2015) aim to offer a blueprint for a holistic and systematic enterprise knowledge codifying, typically using conceptual modelling techniques. Waves of modelling languages still emerging, while there are several mature languages, particularly the effort of the Object Management Group (OMG) open consortium

developed a set of languages specifications concerned with business modelling, namely, BMM, SBVR, BPMN, and decision modelling and notation (DMN). Despite the lack of semantic interoperability between the specifications, the specifications offer opportunities for capturing wide elements of business objects with a suitable separation of modelling concerns. BMM provides a metamodel for business-IT alignment and a framework for requirements elicitation, while BPMN is a widely used activity-based technique with sophisticated tools that enable generating BPEL and XPDL for workflow engines. while SBVR is mapped through different tools to OCL, RuleML and several other execution languages of rule engines. On the system modelling side, SoaML is a service-oriented modelling technique that can be easily mapped aligned to BPMN from the business layer and generate code (e.g. WSDL web services, and Java classes) in the software systems layer.

Moreover, there are several enterprise modelling frameworks proposed in the literature e.g. ArchiMate MIMO, NIMO, 4EM, DEMO (Dietz and Mulder, 2020) and 4EM (Sandkuhl et al.), these frameworks are hybrid between frameworks and languages as they offer semantics and notations. Several frameworks were developed as domain-specific modelling languages (DSML), the underlying foundation of DSML takes into consideration the objectives and guidelines presented in (Österle et al., 2011) for design-centric IS research, and in particular, draws on (Karagiannis and Kühn, 2002) and their experience in the development of a meta-modelling framework manifested in ADOxx platform, as a core of the enterprise modelling languages.

Two relevant DSML frameworks were presented by Frank (2014a), and Buchmann and Karagiannis (2017). Frank (2014a) discussed a set of requirements for enterprise models approach and materialised these in multi-perspective modelling that was later implemented as DSML using model-driven development principles. The approach presented by Buchmann and Karagiannis (2017) focuses on Semantic traceability for modelling requirements of a mobile app through a process-orientated approach. The paper offers guidelines to designers through each step and evaluate the approach in terms of semantics and understandability. Karagiannis et al. (2016) presented guidelines for multi-view modelling focusing on two facets 1) behavioural, which contains procedural and collaborative views 2) structural, which entails motivator and participants views. Later the paper discusses the semantic consistency and further develop an approach based on RDFs and SPARQL queries.

Several researchers presented comparisons among modelling tools highlighting their strengths and weaknesses (Bork et al., 2020, Yustianto and Doss, 2019). Overall, some of the limitations of model-based techniques require other types of modelling to allow a) social argumentation on design choices b) data-driven insight with quantitative prediction. To address these gaps, a set of modelling techniques must be used to bridge the strategy execution gap with the required competencies. We aim to develop a multi-view approach using several facets of enterprise modelling, with goals modelling being used as the main starting point in the enterprise design process. A further elaboration on enterprise models of business processes, rules, decisions and intelligent IS services are to be considered for holistic alignment. Then, we aim to use the design rationale modelling technique for design exploration and to facilitate design choices among stakeholders (Regli et al., 2000), describing the argumentation that supports the competencies required for enterprise and the ways it can be operationalised. Also, we suggest using the SD method to enable quantitative simulation and prediction for enterprise (Sterman et al., 2015), both are discussed briefly in the subsequent sections.

2.2.2 Qualitative Reasoning

This is a cognitive approach describing how humans make sense of, and make decisions about, some aspects of the world. There are different approaches to reasoning, and one of the most well-known is the 'design rationale' (Regli et al., 2000). Design rationale techniques are used in this paper as a method for qualitatively justifying and reasoning about every design step, in order to be sure that the decision made is the most suitable one. Well-known design rationale styles include:

- Issue-Based Information System (IBIS), based on Issue, Position and Argument
- Procedural Hierarchy of Issues (PHI), based on issues at different levels and the links between them
- Questions, Options and Criteria (QOC), based on Question, Option and Criteria
- Design Rationale Language (DRL), based on Goal, Alternative, Claim, Question, Group, Viewpoint, Procedure and Status.

2.2.3 System Dynamics Simulation

System Dynamics (SD) is a method supported by computer-based simulation tools as an element of our suggested modelling approach. SD supports quantitative analysis using

continuous dynamic simulation to understand nonlinearity in complex systems behaviour. It allows developing the models conceptually using causal loop diagram and stock and flow diagram which enable the modeller to add formulas and algorithms, execute the model and visualise the results. A System Dynamics approach provides "essential insight into situations of dynamic complexity" (Sterman, 2000), particularly when testing whether real systems are viable. A simulation may rely on assumptions or historical data to predict and imitate system and process behaviour, ideally using a mixture of both. It is useful tool to implement varieties of assumptions and constraints to test 'what-if' scenarios.

3. Motivating Scenario: InfoCall Case Study

InfoCall is a leading mobile value-added services (VAS) provider serving countries worldwide. The number of new mobile subscribers increases exponentially while the data usage is becoming cheaper, which has been reflected in increasing the market size for mobile value-added services. This market is also shared among various players in the value chain – mobile operators, content providers, and application developers. The VAS market is expected to grow at a strong compound annual growth rate of around 22%, and to generate revenues of over US$18.5 billion by 2019. The most popular VAS services delivered by InfoCall are mobile apps, entertainment, financial, learning, and social services through mobile phones. The content is either developed by InfoCall or by 3rd party who owns the Copywrite. Customers billing is conducted by mobile operators and revenue is shared according to pre-specified contracts. Figure 1 illustrates InfoCall's business model.

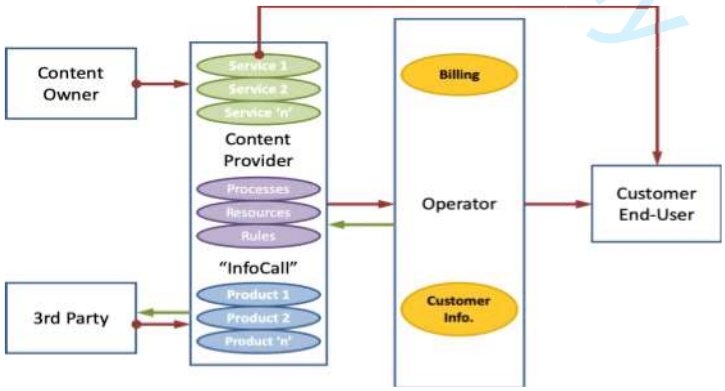


Figure 1: The InfoCall illustration of business model

Mixed methods are used by InfoCall, which combine interviews with the key stakeholders and the analysis of documents as a form of qualitative inquiry (Johannesson and Perjons, 2014; Yin, 2009; Patton, 1990) to gain the level of detail required for the modelling and design. A summary of the interviews is presented in Appendix A. InfoCall continuously improves the quality of its services by improving strategic alignment and optimising the business process. It has lately started to adopt several industry standards to improve its development and delivery processes, such as the PMP approach for project management (Phillips, 2013), adopting ITIL (Steinberg et al., 2011) for IT support and service delivery, and implementing a ticketing system to handle internal and external technical issues. At the same time, InfoCall is looking to hire more talent to support its goal of maintaining high quality and market-leading services. The case was chosen based on the professional connections of the principal researcher where the CEO was also interested in knowing how modelling and simulation might bring useful insights to tackle business challenges. The CEO has explained how the company is challenged to reach and acquire the right talents who are creative and innovative to expand the boundaries of their services portfolio. Therefore, an analysis of the talent acquisition process and its relationship with the organisation's strategic objectives is crucial for building the underlying intelligent IS. This discussion also draws on the strategic human resource management perspective (Wright and McMahan, 1992) on how talent acquisition should be aligned with, or be responsive to, enterprise strategy. Oesterreich et al. (2019) highlight that, there is a gap in the talent market, and the required skills do not necessarily follow the market trends as they first appear, which requires significant planning and alignment with the company's requirements. Organisations have difficulties in building strategically aligned and designed talent acquisition systems that exploit current advances in internet technology and overcome the challenges of globalisation and talent pool fragmentation. In the context of the work reported here, the intelligent talent acquisition system should contain a talent manager avatar that will search, allocate, coordinate and support the selection of suitable talents for the organisation. Furthermore, the approach based on enterprise modelling and simulation should help to:

- make strategic decisions on how enterprises will promote themselves and on which platform, in order to ensure their credibility and find the right talent for open positions, within appropriate working modes;

- choose a design that takes into consideration the contemporary environment of talent acquisition and relevant emergent and intelligent IS by using a wide range of professional social networks with enablers of different working mode preferences. Mobile apps will enhance accessibility so that these systems are utilised for maximum benefits;
- decide where to advertise jobs, how to reach talents, which media platforms to use and the type of contract to offer;
- offer embedded analytics capabilities for the enterprise to help it make better and more informed decisions. Such capabilities can be either acquired from off-the-shelf (COTS) or developed in-house by the enterprise.

4. Research Methodology

The research presented in this paper uses the methodology of design science research (DSRM) for information system research (Peffers et al., 2007). As a first step, we identified the problem and motivation using an exploratory investigation into InfoCall company, in addition to the review of the relevant literature on talent acquisition systems the problem was lack of alignment between strategic objectives and talents acquisition and the correspondent business benefits. The solution we propose is to design a multi-view enterprise modelling approach as an artefact that aid organisations in aligning talent acquisition systems to their strategic goal and design better operation systems that can materialise the desired benefits. This aim can be achieved by fulfilling the following objectives: (a) to improve the alignment between talent acquisition practices and strategic objectives, (b) to offer companies insights on how possible to design talent acquisition systems by using enterprise models and (c) to define system requirements by developing software services using alternative enterprise capabilities which can meet minimum requirements. The development of the approach will rely on an orchestration of enterprise modelling and simulation techniques and the process of using them in a rational top-down approach to address InfoCall's needs. The approach is based on a set of EM techniques that represent different views in addition to design rationale and system dynamics simulation techniques. The approach corresponds to Karagiannis and Kuhn (2002) recommendation on designing modelling approaches in a flexible manner. It has two main elements, the first is a modelling technique, which consists of a modelling procedure, i.e., the logical steps that need to be followed for

modelling, and modelling languages, these are the languages used to model enterprise and IS views (e.g. UML, BPMN, SBVR, SoaML). The second element comprises modelling mechanisms, which describe the underlying ways in which the model will be executed logically and mathematically which will be described in detail in the next section (Section 5). We evaluate the approach from a theoretical and practical lens and we conclude with a reflection on the approach and its application in the case study (Peffers et al., 2012), we highlight its contribution to intelligent talent acquisition systems and its contribution to EM practices (Patton, 1990; Peffers et al., 2007; Venable et al., 2012).

5. A Multi-view Approach for Bridging the Gap in Designing Talent Acquisition Systems

As a starting point of developing the multi-view approach, we develop what is called domain ontology, which represents the abstract knowledge of the intelligent talent acquisition system's context. The multi-view approach will help organizations to align their talent acquisition goals to their strategic goals, as well as to the operational activities that enable the achievement of talent acquisition goals, and finally to design the intelligent IS services that are required to run autonomously part of the talent acquisition activities. Modelling of different enterprise levels is crucial for alignment success, the enterprise is considered as an autonomous system, i.e. one that has the motivation and goal of existing and functioning within its context. Changing in one motivational element or external influences might cause a triple effect propagated across enterprise levels and facets. The development of a system should start with understanding and designing the motivation and goals, the strategic plan will correspond to these goals. Strategic planning will thus enable the design of business processes at the operational level, and the design of the intelligent IS that supports business strategical and operational needs. In the context of this research, the intelligent system entails what we call a talent manager avatar. The avatar will be responsible for locating, selecting and coordinating for talent recruitment. Figure 2 presents the main components of the proposed approach, grouped into problem and solution domains.

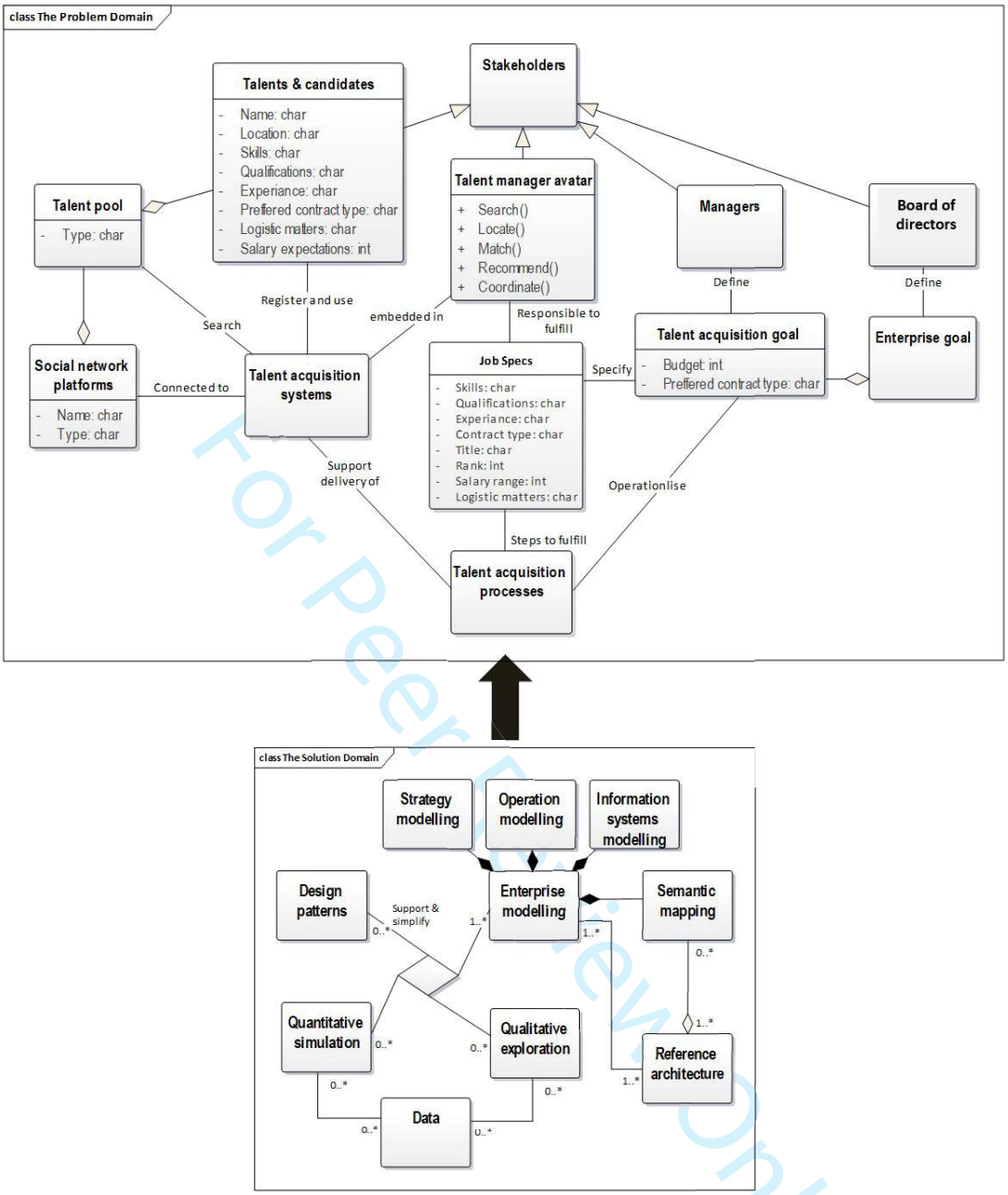


Figure 2: The components of the approach (Domain ontology)

The problem domain covers the talent acquisition system that involves a number of stakeholders such as the steering committee of the enterprise, those who determine enterprise motivation and high-level goals, and managers who are concerned with setting the goals and objectives of the talents needed which should support and be aligned with the strategic high-level goals. Such goals are translated into a set of operational activities and processes. Talent acquisition avatar is responsible for accomplishing talent acquisition activities (e.g. identify talent pool platform, identifying suitable talents, retrieve matching results, recommend, and coordinate for recruitment).

The avatar will match the job specifications and the talent profile in terms of skills, experience, education, location, contract type, other logistics issues relevant to relocating and distance work. Talents typically participate in social networks, job databases, or are directly registered with a profile in the talent acquisition system of the company. In all cases, the talent acquisition avatar should have access to the global talent pools using application programmable interfaces (APIs) available for different platforms, wherever they are to be found.

The solution domain addresses these problems in that it integrates several existing modelling and simulation techniques by exploiting methods from(a) enterprise modelling, (b) qualitative exploration using design rationale tools, and (c) quantitative simulation, using SD tools to integrate enterprise and intelligent IS development decisions. This multi-view approach will enable the effective use of available modelling tools with no need to develop a new modelling language or DSML. The proposed approach is supported by a set of tools each has its semantics and syntax, there is no intention to integrate these tools in their semantic level, rather the focus of this article is on the syntax and process of using them in an effective way to address the design problem. The set of selected tools will:

- Enable the development of a multi-view modelling approach by incorporating different views in different levels (strategic, operation and information systems design);
- Help to generate executable software components (e.g. services) for the implementation of intelligent IS;
- Improve the analytical capabilities that underpin enterprise design decisions.

Enterprise modelling effort can benefit from architectural frameworks as a reference to what artefacts should be modelled, it is understood that EA frameworks such as TOGAF, Zachman or DoDAF/MoDAF require significant effort and resources to be fulfilled. Thus, enterprises should be selective in choosing enterprise artefacts that they wish to model to address a challenge, achieve an improvement or design a specific system (Bernaert et al., 2015). Also, an enterprise can benefit from reusable enterprise design models which can be used in a plug-and-play manner rather than starting modelling effort from scratch. Finally, as a basis for making optimum decisions, the integration of EM, reasoning and simulation should exploit historical quantitative and

qualitative data, which is crucial for the success of the EM effort (Fayoumi and Loucopoulos, 2016). The approach we propose suggests that enterprise modelling should be supported by:

- Developing and using reusable enterprise design models based on all perspectives and at all levels of granularity;
- A reference enterprise architecture of high-level components and their relationships, which can be either generic or domain-specific, to guide the analysis and design process towards fulfilling an enterprise-specific set of artefacts that help to achieve the modelling exercise goals;
- The model semantics to align concepts from different enterprise levels (vertical alignment) and different enterprise perspectives (horizontal alignment);
- Data analysis to support the reasoning and simulation processes, thereby increasing the robustness of the design. The approach allows for designing the enterprise as a whole (business and IS), offers simulation and optimization capabilities, and allows for the development of operation performance matrices.

Table 1 describes how each of the items presented in the solution domain model (Figure 2) will be realised by modelling tools.

Table 1: Mapping to implement the approach components

Model construct	**Model Instances**
Enterprise Modelling	A set of enterprise models are constructed using modelling languages and must respond to a particular enterprise reference architecture. This paper considers models of domain, goals, processes, vocabulary and facts, rules and decisions, roles, and software services
Reference Architecture and semantic	The Business Motivation Model (BMM) is used as a reference architecture. BMM contains motivational elements, e.g. end, means, directives, influencers, assessment, organization and business processes. The semantic mapping is delivered through the BMM metamodel and its extensions. It manifests the relationships between concepts to present a knowledge map (refer to (OMG, 2010))
Qualitative Exploration	The design rationale technique supports qualitative design and architecture exploration and design-making.
Quantitative Simulation	System dynamic modelling can support both historical and predictive analysis.
Data Analysis	Data are analysed using qualitative and quantitative modelling and simulation (e.g. the historical data used in system dynamic modelling)

Enterprise Reusable Design Models	Enterprise reusable design models will support the plug-and-play capability of the modular models. These can be strategic models, process models, organizational models, software models or system models.

The next section will discuss the modelling languages used for each of the modelling languages and procedure based on Karagiannis et al. (2016) conception but in a flexible and abstract manner as stated earlier. We follow the suggestions of Buchmann and Karagiannis (2017) "*It must be stressed that the modelling procedure should be read as guidelines—fragments can still be employed for disjointed purposes*". With no intention of developing a modelling method, we believe the generic components of Karagiannis and Kühn (2002) can be followed in combining different modelling tools to address particular problem needs. We also highlight those modelling mechanisms are embedded in the tools that we are proposed to use i.e. abstractions, differential equations, visual argumentation, model-driven code generating.

5.1 Modelling Languages

For EM languages, we argue that OMG stack offers standard languages that can be used to fulfil the views required to model our problem domain. The OMG open consortium has an intention to provide holistic interoperable languages for both business and IT domains. The semantics of these languages are also refined in the language level, while cross languages interoperability depends on the why it was implemented by the tool provider. Also, they are better aligned to software service development and code generating while other tools have their own merit, the choices were made based on the researcher preferences and professional judgment toward achieving the research objectives. The authors decided that the BMM (OMG (2010) will be used as a reference architecture and a semantic model, as it offers fairly generic enterprise motivation concepts with robust semantics e.g. vision, mission, goal, strategy, tactic and influencers assessments. Unlike some other frameworks (e.g. Zachman (Zachman, 2004)) which do not offer a semantic map (metamodel), the BMM can offer both a framework and a semantic metamodel for enterprise motivation concepts. When an enterprise uses the BMM, what it does is driven by how it decides to react to change rather than being driven by change, and it does not require a specific process for reacting to change. Whatever process is used, the BMM will support traceability among different enterprise levels and perspectives. Another advantage of using the BMM is that the model works

adequately with other modelling standards that are also suggested by the OMG. Models of motivation and goals, organization, responsibilities, processes, rules and decisions need to be developed to offer multi-view of the enterprise. The software concerned models, through what is called model-driven development (MDD) (Clark et al., 2014; Schmidt, 2006), can generate codes in a fully automated process, unlike traditional software engineering approaches, which require lengthy processes that have now been shortened by making the development artefacts more abstract at the enterprise level. For instance, code can now be generated from process models (e.g. from BPMN model to XPDL and BPEL executable code), SBVR (SBVR to PPR or SBVR to UML), decision models (DMN and executable decision tables), and any UML-family model (UML to object-oriented programming languages) which is used for building and structuring IS applications. However, it has been argued that the current programming and MDD principles are limited, and that languages based on the recursive 'golden braid' architecture need to be considered to facilitate systems with more classification levels (Frank, 2014b). While these modelling techniques are enterprise modelling languages only, qualitative reasoning and simulation capabilities are embedded in these languages, thus in our approach we suggest combining enterprise modelling with Design Rationale and System Dynamics Modelling to intertwine the development with reasoning and simulation to increase the effectiveness and robustness of the enterprise design alignment.

Table 2 presents the modelling languages that are used in this paper. The modelling and simulation techniques used in this research are business process modelling and notation (BPMN) (OMG, 2013), the semantics of business vocabulary and business rules (SBVR) (OMG, 2006), system dynamic modelling and design rationale (Fayoumi et al., 2014; Regli et al., 2000; Sterman, 2000). The table shows the mapping between the elements of the approach and the modelling languages.

Table 2: Assigning modelling languages to the approach

Approach's view	Modelling languages/ tool
Motivation and goals	Business motivation model (BMM) as a reference architecture
Vocabulary and facts	Semantics of business vocabulary and business rules (SBVR)
Policies and rules	Semantics of business vocabulary and business rules (SBVR)
Decisions	Decision tables
Qualitative reasoning	Design rationale
Quantitative simulation	System dynamics modelling

Business processes	Business process modelling and notation (BPMN)
Information systems services	Service-oriented architecture modelling language (SoaML)

The following section describes how the alignment and modelling procedure is undertaken systematically to achieve the purpose of designing intelligent talent acquisition systems.

5.2 Alignment Procedure

The alignment procedure describes the logical steps that will be followed to undertake the modelling activities suggested by the approach. In this case, it addresses the dynamics of the enterprise, as enterprises are considered as systems that change or are exposed to rapid change. The assumption is that the processes of enterprise modelling, reasoning, and simulation are intertwined, and they evolve continuously throughout the lifetime of the enterprise. Figure 3 shows the alignment process of the suggested modelling approach, with identifying section numbers where the stage has been fulfilled in the case study (Section 6).

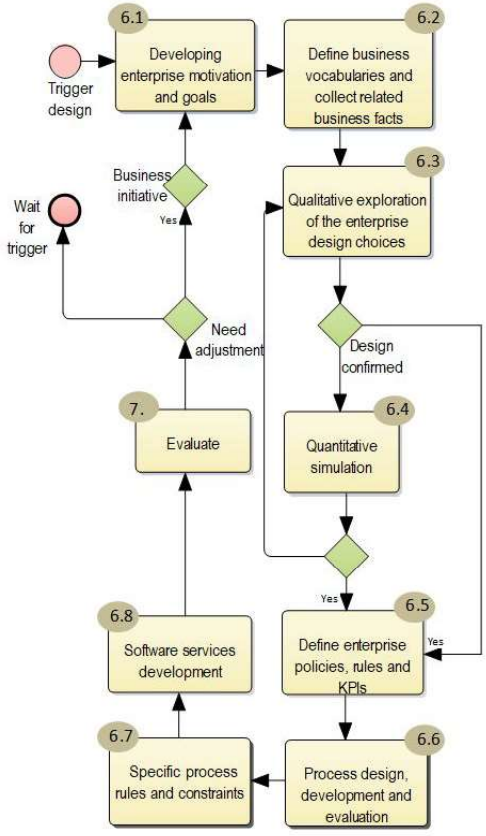


Figure 3: A procedure for enterprise alignment (modelling and simulation)

The suggested modelling procedure is an open loop with the following main stages:

Stage 1: modelling motivation and goals. This stage will use BMM concepts. The motivation and goals of the enterprise are first identified; these guide the enterprise in both long-term and short-term planning, and the design of the underlying activities will therefore respond to these established goals. In some cases, for the organization to make sure that the correct goals have been established, they may be accessed through reasoning processes, using a pre-defined set of criteria, e.g. SMART criteria. This can also act as a goal validation and verification test, this stage fulfilled in the case study Section 5.1.

Stage 2: defining all domain and enterprise key business vocabularies and business facts. These will be defined using the SBVR to make sure that stakeholders have a common understanding and to assess enterprise design, including both ends and means, against the listed facts. Similarly, the vocabularies and facts of the talent acquisition activities should be clearly defined to support the design of both processes and the underlying IS. The stage is fulfilled in Section 5.2.

Stage 3: qualitative reasoning and exploration of the enterprise design. The use of design rationale tools such as reasoning can support the enterprise design rationale by developing a qualitative visual representation and can support the assessment of the goals against the maximum capabilities that the enterprise may be able to develop. Once the motivation and goals (i.e. the end) are confirmed, a focus will be established on the goals that require talent acquisition to be realized. A sound review of the desired means to operationalize goal achievement will also be conducted. The stage is fulfilled in Section 5.3 as part of the case study.

Stage 4: quantitative simulation (using SD) This is employed when some aspects of the enterprise require further quantitative assessment, which is carried out under a set of assumptions and simulation constraints to predict the behaviour of the designed talent acquisition activities. The result will be fed back into the design of the models for fine-tuning and optimization. The simulation stage can benefit from historical data, behavioural patterns, and any

relevant business forecasting studies; the stage is fulfilled in Section 5.4 as part of the case study.

Stage 5: defining the business policies and rules that the enterprise needs to adhere to, particularly those influence talent acquisition activities. KPIs will also be defined to measure the performance of the operation design. In designing enterprise processes corresponding to the agreed goals, a set of alternative process models will be constructed using the BPMN to respond to the relevant talent acquisition goal and driven by the design requirements, the stage is fulfilled in Section 5.5.

Stage 6: design evaluation and assessment. A robust method of assessment will be devised to evaluate the efficiency and effectiveness of the processes, and this is then matched with the capabilities of the enterprise; the stage is fulfilled in Section 5.6 as part of the case study.

Stage 7: establishing rules and constraints for the specific process. Once the selected process has been agreed upon, the related governing rules and decisions will be linked to all of the process activities. The stage is fulfilled in Section 5.7 as part of the case study.

Stage 8: developing software services. In the next step, the focus will shift to identifying and developing software services using SoaML to provide automated processes, which will be integrated with underlying IS platforms. The software design is presented in Section 5.8.

Finally, continuous assessment is required to assess performance against the change in goals or processes. For example, developing new goals, making new decisions about them, confirming designs, developing supportive IS, and finally assessing their functionality and performance against the new enterprise goals. The overall evaluation of the applied approach will be presented in Section 6.

6. Application of the Proposed Approach to InfoCall Case Study

This section illustrates the implementation of the proposed approach. Data and information offered by the staff members of InfoCall were used to construct the models (The company name is created to protect the commercial right and avoid any competition sensitivity). The approach proposed above and the procedure

presented in Figure 3 are used to achieve the maximum strategy alignment and how IS are developed accordingly.

6.1 Developing the Enterprise Motivation and Goals Model

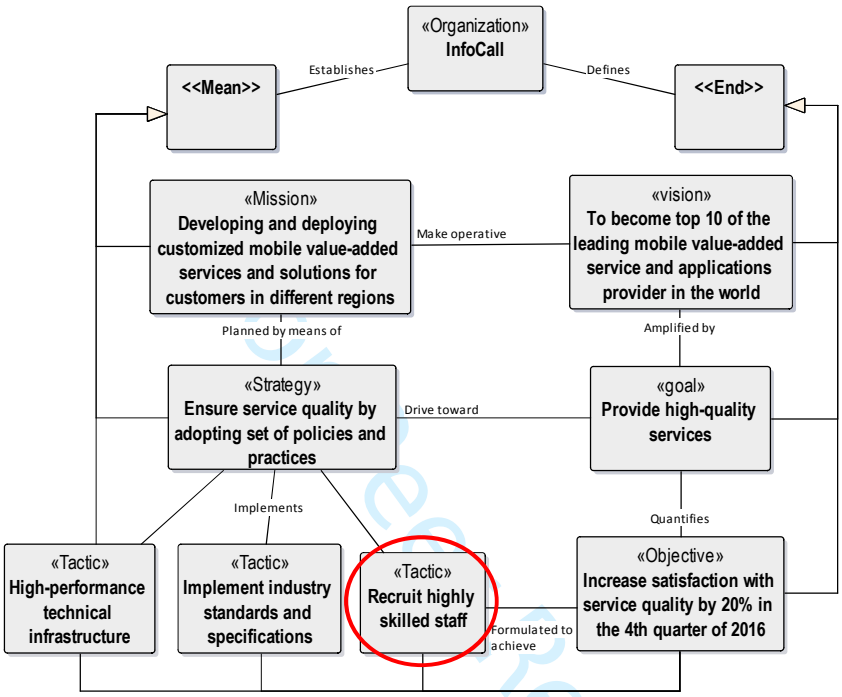


Figure 4: The InfoCall motivation model (short version)

Figure 4 shows InfoCall's motivation model, which describes the ends and means of the organization. All the other activities undertaken by the organization must contribute in a way or another to achieving this motivation. The rest of the enterprise models will correspond to the motivation model, and provide granularity on how operations and systems can be implemented. As discussed with managers in InfoCall, this representation shows that high-quality services can benefit from employing new talents for a) timely handling of customer requests b) solve more problems with no need to escalate tickets to senior members, and c) follow industry-wide standards for customer service delivery. The following models aim to illustrate only the rationale for designing elements that are relevant to the tactical goal of 'recruiting highly skilled staff' by designing an effective talent acquisition system.

6.2 Business (domain) Vocabularies and Facts

The SBVR-controlled natural language was used in this case study to enable shared understanding between stakeholders, and to reduce the possibility of misinterpretation of business concepts and requirements. Figure 5 provides a sample of the repository of

the business vocabularies and facts, which supports the business design. This repository will ensure that all stakeholders understand the business terms, and the facts made evident by either common sense or observed evidence. Items in orange describe operator, quantifier or qualifier. Those underlined in green colour represent nouns, and green items represent facts. Verbs are represented in blue.

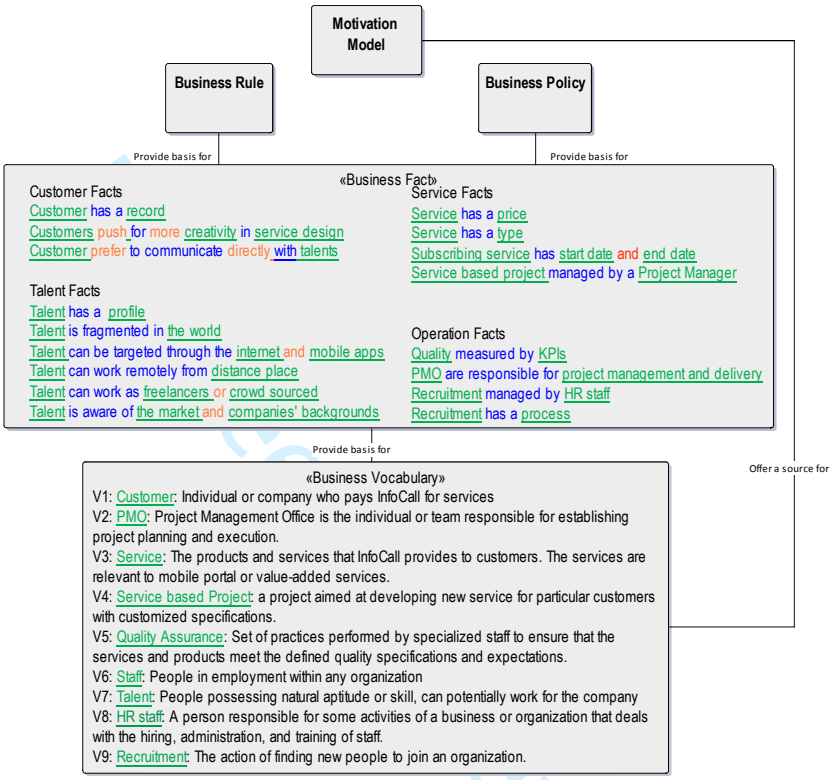


Figure. 5: InfoCall business vocabularies and facts (sample)

6.3 Qualitative Exploration Using Design Rationale

To understand and justify design decisions, a reasoning model using the design rationale tool was developed based on QOC argumentation. This qualitative analysis was developed collaboratively, with several stakeholders externalizing and sharing their thoughts. The reasoning model (Figure 6) will help identify the next steps in how the tactics of talent acquisition activities should be designed and implemented.

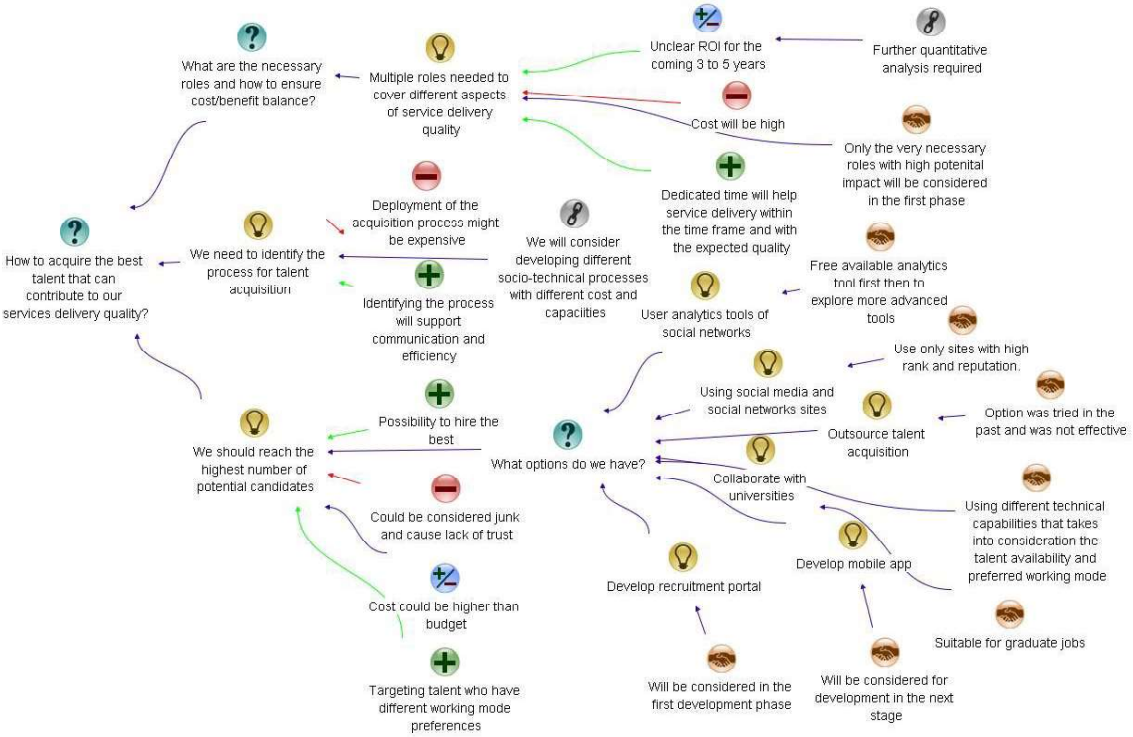


Figure 6: Tactical and operational reasoning model

6.4 Quantitative Simulation using System Dynamics

An initial decision was taken, based on qualitative assessment, to hire three staff members to fulfil three roles. The dynamic model will highlight the expected improvements in service delivery quality as a result of hiring the right personnel to fulfil important positions, and this will ultimately contribute to the overall business growth of InfoCall. The case study analysis shows that several factors influence InfoCall's revenue:

- Third parties: third party companies contribute up to 20% of InfoCall's revenue. However, in 2010, third party company purchasing accounted for only 7% of total revenue, a 60% reduction in the usual purchasing rate of third-party customers;
- Operators: services delivered through operators make up 75% of the total revenue of InfoCall. Any change in operator trends, policies, or delivery may directly influence revenue;
- Competitors: in the last three years, competitors have increased by a steady rate of 4% per year; such increases might also influence revenue;

- Content providers: these usually ask for a yearly minimum grant to provide content to InfoCall. This minimum grant could be changed year on year;
- Customers: VAS customers are increasing gradually, and this can be presented as a formal growth rate of 7% yearly;
- Talent hiring: talent hiring is expected to contribute to service delivery and increased quality and thus to result in an average fixed growth rate of 15% in total revenue as an assumption used for simulation purposes. The details of InfoCall revenue are presented in Table 3.

Table 3: InfoCall Revenue

Year	Third parties	Operators	Content providers	Customers	Total (thousand)
2007	25	70	7	14	£124
2008	27	77	8	16.5	£136.5
2009	29.5	82	6	18.5	£143
2010	14	83	6	21	£130
2011	30	87	5.5	23	£151

The iThink® system dynamic model includes stocks, flows, converters and connectors, and these general modelling constructs were used to represent different aspects of the InfoCall revenue model. The iThink® simulation tool transforms standard modelling constructs into a set of equations, which are solved using a numerical integration technique. As shown in Figure 7, the data was imported into the model to show the changes in InfoCall's revenue. Changing the input values or discovering more influencing factors will give more insight into potential future scenarios and encourage greater strategic (causal loops) thinking.

In this case, the behaviour was tied to what is operationally driving the changing values, e.g. customer growth and third-party decline. The model uses historical developments and 2011 values as a basis for extrapolating to later years. The model has a structure that drives third party revenue down to 7% of total revenue by 2017 (i.e. the end of 2016). Since it cannot change instantaneously, it only falls to 8% by then. This is controlled by the graphical function 'third parties' fraction target', which sets the target over time. The model has a structure to deal with grants for content providers: changing 'content providers' actual grant' results in a change in the simulation result. The model also shows the impact of competitors taking away some of the new business. The value

of the 'competitors' convert fraction can be modified to change how much new business competitors are taking away from InfoCall. Staff costs overall amount to between 30% and 35% of overall revenue; however, although the costs of talent acquisition activities and the additional salaries of the new staff will increase overall spending, the activity is expected to contribute positively to total revenue in subsequent years. It should be noted that this model does not include a structure for influences on operators from changes in operator trends, policies or delivery, because such information requires data to be gathered and analysed over a longer period than was possible within the constraints of this study.

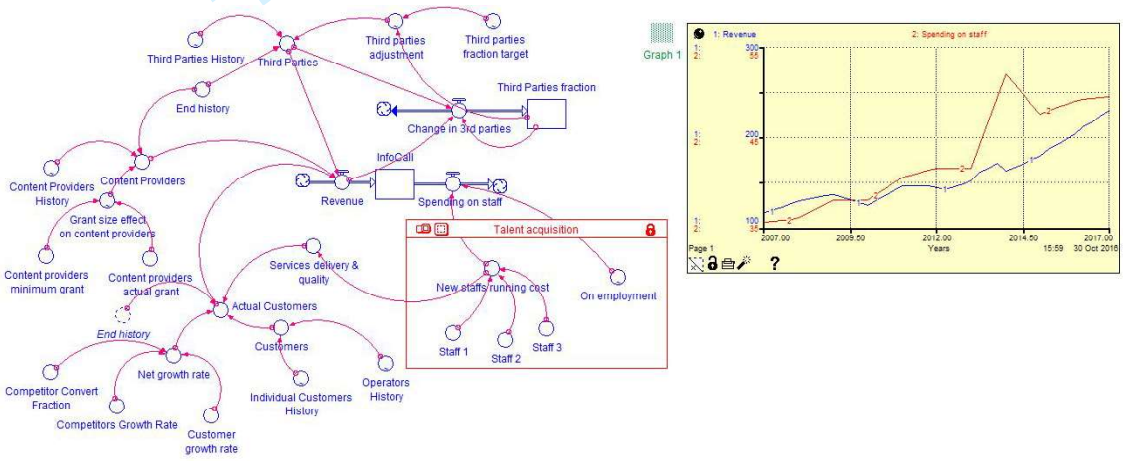


Figure 7: System dynamic model and simulation

While the objective of increasing satisfaction by 20% is achieved through 3 tactical elements, the focus of the illustrated example is on the recruitment of talents. The simulation in Figure 7 shows that when new right talents (competencies identified by the company) are employed there is a potential increase in service quality and profit. The alignment here is IS-business alignment rather than talents qualities to strategic objectives alignment, this is why the competencies were not included in the paper nor we tried to seek permeation to do so. The processes designed later in the case study illustrate three alternatives of how InfoCall can implement and automate this process. Typical business processes are socio-technical activities where human and IS intertwine tasks. A judgement from managers need to be taken to determine the level of automation and sophistication they are looking for in the meantime.

The spending on the implementation of the three tactical elements is not considered for the 20% increase in customer satisfaction, yet the simulation can show that there is a potential for profit growth as a result of the main objective fulfilment. SD model is a

powerful simulation tool that enables forecasting based on a) historical data and c) a set of hypotheses while the DR model is a powerful qualitative tool for collaborative argumentation and decision-making. These models are essential elements of our approach for alignment as intertwining analytics with enterprise design is inevitable for filling the strategy execution gap.

6.5 Regulations, Policies, Rules and KPIs

Activities related to one tactical goal and its correspondent process were then analysed and designed, namely the tactic of recruiting highly skilled staff. The guidelines, regulations and key performance indicators (KPIs) for the talent acquisition process are presented in Figure 8. An assessment exercise was conducted to identify those roles, which needed to be acquired urgently. A focus group discussion identified three important roles for which the process should be implemented immediately to fulfil them.

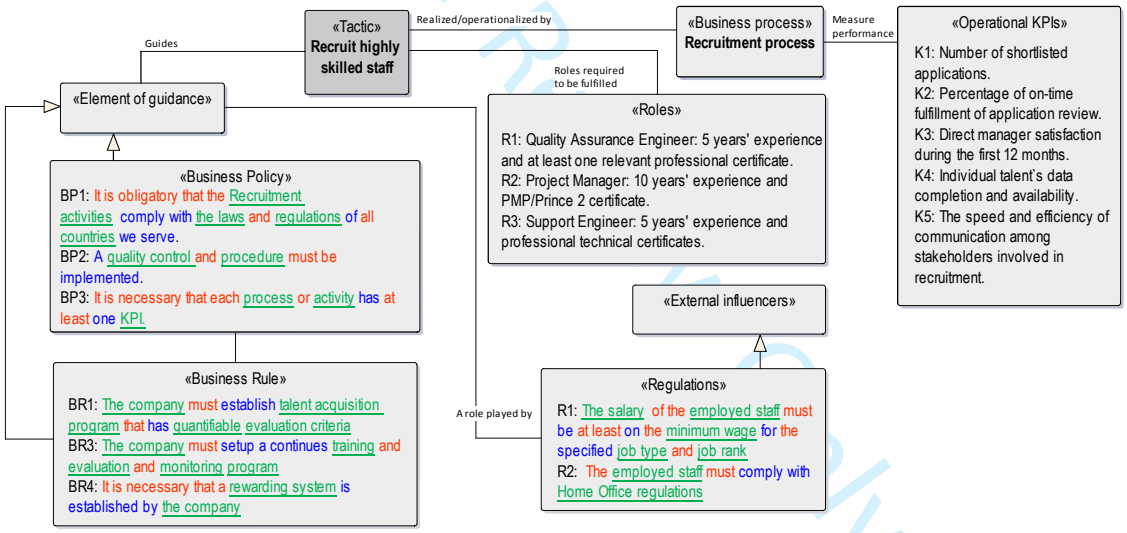


Figure 8: Regulations, policies, rules and KPIs in the operational model

6.6 Process Design, Development and Evaluation

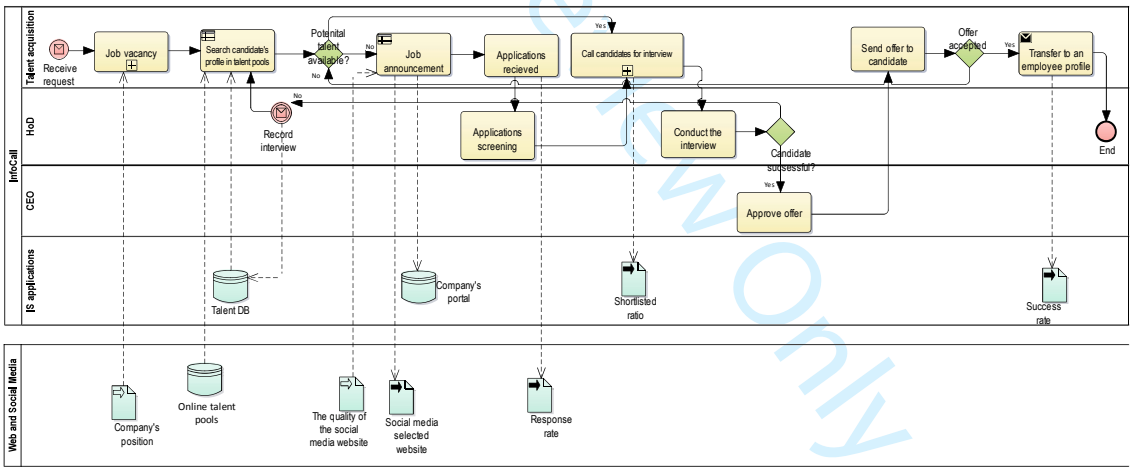
The design of the talent acquisition process is presented as a process model and several alternatives were designed to offer enterprises the choice of selecting the process that is most suitable for their requirements and that best matches their resources and capacity. The notion of process reusable models will also support the reusability and configurability of the business process (Koschmider et al., 2014), in some cases, reusable models are deployed in COTS business applications, while there are several

initiatives to create an open repository of enterprise and systems models. It is crucial to mention that reusable models might have a downside on creativity and rethinking the deployment, but we see this as a pre-execution step where designers examine various enterprise components and check for potential optimisation. InfoCall will conduct an assessment based on the criteria specified in Table 4.

Table 4: Process design-related KPIs and quality factors

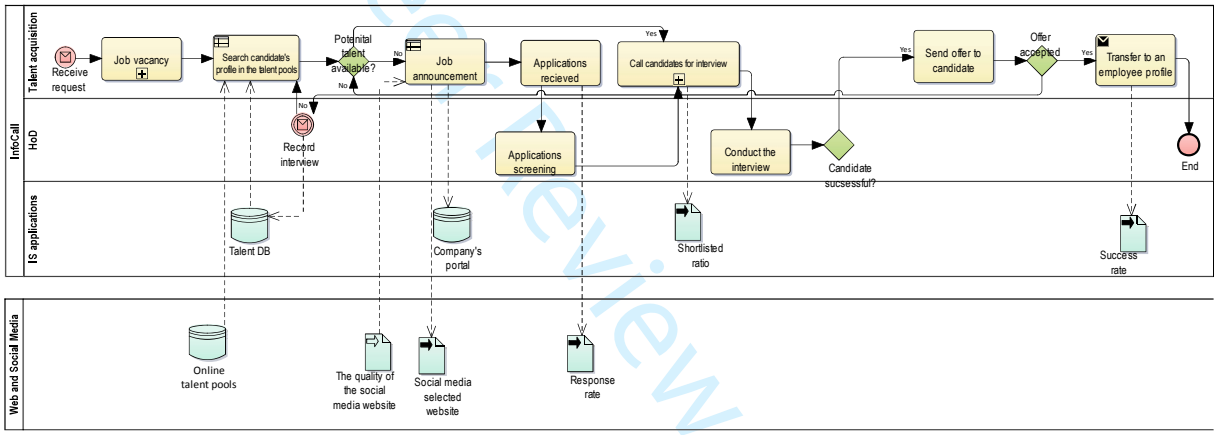
Assessment criteria	Implementation cost, implementation time, execution time, efficiency, maturity
Quality factors	Accuracy, response time, integration time, automation level, reduction of human error

The process requires both social and technical capabilities to be established. Several alternative operational (process) models are presented to fulfil each particular tactical goal by choosing a business process design. In this case, it is the process of searching and recruiting talents is presented. This process design choices were identified to address the tactical goal (to recruit highly skilled talents to ensure the quality of services). Figures 9 to 11 show these alternative design models for talent acquisition processes together with descriptive information.



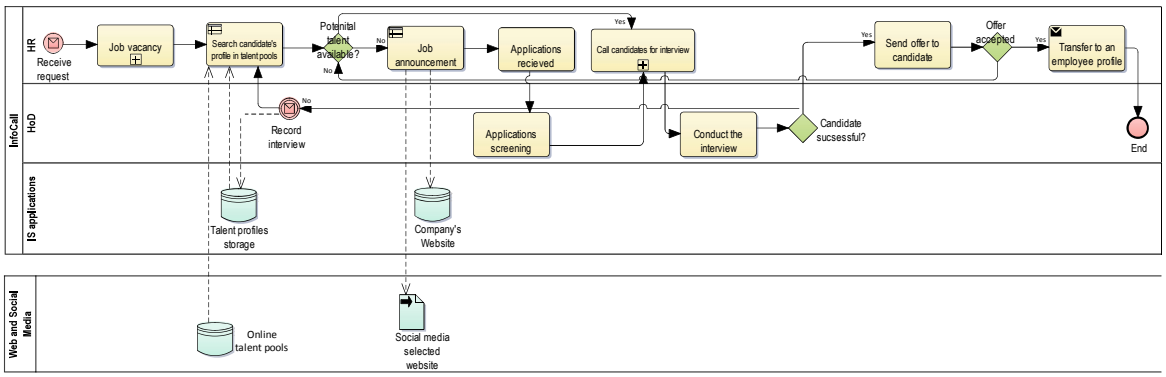
Process Name	Talent Acquisition Process 1
Goals	Deliver intelligent talent acquisition that makes use of the full potential of automated avatar and current emergent technologies
Capabilities	- Store applications in database for future use - Several stages of assessment and interviews - Use data analytics tools - Evaluate current talent pools on social media - Automatic optimization of talents who match the criteria
Limitations	- Information systems cost - Long deployment life-cycle - Challenges in integration
Consequences	Implementation and fulfillment is time-consuming (~ 6 months)
Suitable Implementation	Enterprise and medium size companies with large number of applications and positions requiring highly skilled talents.
Implementation Requirements	Workflow, database, multi-agent systems, interaction platform, APIs, social media, BI/data analytics and dashboards (e.g. Google analytics, Google trends, Google alerts), Competitors' tracker (e.g. IFTTT or Zapier)
Alternative Implementation	Use cloud based infrastructure or completely outsource the process deployment.

Figure 9: Alternative talent acquisition process model (1)



Process Name	Talent Acquisition Process 2
Goals	Deliver mature and intelligent talent acquisition process that make use of the automated avatar and current emergent technologies
Capabilities	- Semi-automated process - Use of social media talent pools - Collaborative decision making
Limitations	- Not necessary to involve top management (Less governance) - Limited exploit of the avatar capabilities, in some cases, it is not enough to conduct one interview with the talent which is time consuming.
Consequences	Lack of governance and potential human error, minimal informed-decisions
Suitable Implementation	Holding and umbrella companies, universities and federal independent entities.
Implementation Requirements	Multi-agent systems, database, workflow, communication and collaboration platform, APIs, Analytics and dashboards (e.g. Google analytics)
Alternative Implementation	HoD can take responsibility for advertising, screening applications with senior members, using one time recruiter, or using agency to manage and store applications.

Figure10: Alternative talent acquisition process model (2)



Process Name	Talent Acquisition Process 3
Goals	Deliver structured and semi-automated talent acquisition process with minimal use of IT system
Capabilities	- Lack of automation - No need for technology - Lower implementation cost
Limitations	Basic storage for talent profiles, possible human errors, lack of governance
Consequences	Losing applications and records, minimal availability of data to support decision-making, potential ad-hoc completion.
Suitable Implementation	Companies that are not willing to invest in IT systems or in HR department
Implementation Requirements	Manual, newspaper advertisement, basic IS use (e.g. PC, office application email and file storage, internet)
Alternative Implementation	In case of lack of availability of the HR team, staff at management level can take responsibility for the advertising, screening and selection

Figure11: Alternative talent acquisition process model (3)

To select the optimum process, InfoCall can evaluate the alternatives against a set of pre-defined non-functional criteria, and the company can use either qualitative or quantitative assessment. In this case, a qualitative assessment using a scale from 1 ('very low') to 5 ('very high') was used to evaluate and select from the alternative processes, as shown in Table 5.

Table 5: Process evaluation and selection criteria

	Talent acquisition Process 1	Talent acquisition Process 2	Talent acquisition Process 3
Cost	4	3	2
Implementation time	4	4	3
Execution time	3	2	3
Efficiency	4	4	2
Maturity	5	4	2
Sustainability	5	4	2

Mid-level and technical managers in InfoCall were consulted to evaluate the processes in a focus group setting. We looked into the level of automation, the cost of underlaying

systems, the expected performance, the implementation time and the process execution time (i.e. number of steps and automation complexity), and how far it meets current and future requirements. InfoCall managers decided to implement Talent Acquisition Process 2, to be assessed after one year for potential upgrading to Talent Acquisition Process 1.

6.7 Talent Acquisition Process Rules and Constraints

The process-related rules, constraints and decisions presented in Table 6 are what govern InfoCall's talent acquisition process. The table also contains the rules and decisions embedded in the IS that govern the interaction with other IS platforms in cyberspace. These rules and decisions are grouped according to their relationship with each of the process activities.

Table 6: Rules and Decisions for Talent Acquisition Process

<table>
<tr><th>process Activity</th><th>Related Rules</th><th>Related Decisions</th></tr>
<tr><td>Activity 1</td><td>The vacancy should be aligned with urgent strategic needs
The vacancy should be approved by the CEO</td><td>n/a</td></tr>
<tr><td>Activity 2</td><td>The avatar must search the available database before using free or paid advertising</td><td>Screen available database first. If this is not sufficient, use advertising methods
<table>
<tr><th>Resumes available in database?</th><th>Screening successful?</th><th>Application successful?</th><th>Advertisement needed?</th></tr>
<tr><td>Yes</td><td>Yes</td><td>Yes</td><td>No</td></tr>
<tr><td>Yes</td><td>No</td><td>-</td><td>Yes</td></tr>
<tr><td>Yes</td><td>Yes</td><td>No</td><td>Yes</td></tr>
<tr><td>No</td><td>-</td><td>-</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Activity 2</td><td>The avatar needs to optimize search results and filter suitable candidates</td><td>- Locate the suitable talent pools for search
- Identify the suitable talent pool for advertisement
- Identify skills, education, experience, expected salary
- Identify location
- Identify the preferred contract type
- Identify logistic aspects (relocating, visa, etc.)
- Collect and conduct a prescriptive data analysis that is collected from various social media websites
-Match the previous with the job specifications and make recommendation</td></tr>
<tr><td>Activity 3</td><td>The avatar will check the background and reputation of the advertisement website
The talent acquisition avatar needs to choose the most suitable platform for the type of job</td><td>
<table>
<tr><th>Is it sensitive and confidential?</th><th>Does the work require personal communication?</th><th>Is the work repetitive?</th><th>Advertise for:</th></tr>
<tr><td>Yes</td><td>-</td><td>-</td><td>Full-time</td></tr>
<tr><td>No</td><td>Yes</td><td>-</td><td>Full-time</td></tr>
<tr><td>No</td><td>No</td><td>Yes</td><td>Crowdsourcing</td></tr>
<tr><td>No</td><td>No</td><td>No</td><td>Distance work or freelancing</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>Activity 4</td><td>Each application must be submitted only once for the same position

Applicants can submit more than one application if they want to apply for different positions</td><td>n/a</td></tr>
<tr><td>Activities 5 and 6</td><td>The talent acquisition avatar screens applications and shortlist the most suitable candidates for the next stage

The talent acquisition avatar calls the candidates to arrange interviews</td><td>n/a</td></tr>
<tr><td>Activities 7 and 8</td><td>The interviewer must use the assessment form to assess the applicant’s suitability for the position

Applicants are considered unsuccessful if they fail in any of the scheduled interviews</td><td><table><tr><th>Meets requirements?</th><th>Agreement on work mode, expectations and tasks?</th><th>Approved by HR, HoD and CEO?</th><th>Successful?</th></tr><tr><td>No</td><td>-</td><td>-</td><td>No</td></tr><tr><td>Yes</td><td>No</td><td>-</td><td>No</td></tr><tr><td>Yes</td><td>Yes</td><td>No</td><td>No</td></tr><tr><td>Yes</td><td>Yes</td><td>Yes</td><td>Yes</td></tr></table></td></tr>
<tr><td>Activity 9</td><td>The employment offer must state all the employment conditions</td><td>n/a</td></tr>
<tr><td>Condition/ Activity 10</td><td>HR staff must receive an acceptance letter from the applicant before creating an employee profile</td><td>n/a</td></tr>
</table>

6.8 Software Services Development

One of the main reasons why InfoCall wants to implement a talent acquisition system is to reduce expenditure and increase both efficiency and effectiveness of talent search and acquisition. It is most likely that Process 1 is not suitable, as the automation and

development required might increase the costs and time for executing it. If InfoCall decides to develop an automated process, the service-oriented architecture (SOA) platform is the most suitable option. The following steps describe how to move from the business process model to the implementation model using SoaML (OMG, 2012) to build automated services for the business process activities. It should be noted that InfoCall has no legacy applications, and therefore the development of the service must start from scratch.

1) Use Cases Identification: 'Use cases' are those in which a human agent needs to take action in the process (see Table 7). Other activities not specified as use cases will be assumed to be automated.

Table 7: Use cases

Use Case	Description
Search resumes or profile	The talent acquisition avatar should be able to retrieve and view resumes which are available in the system database and talent pools websites.
Advertise vacancy	HR staff should be able to change the status of the position to vacant so that the vacancy will appear as available.
Apply for vacancy	The applicant should be able to view and apply for any open vacancy.
Schedule interview	The talent acquisition avatar should be able to schedule interviews and notify applicants.
Update status	HR staff need to update the status of the application ('successful', 'unsuccessful', 'on hold', 'under review', etc.) on the system.
Send offer	Talent acquisition avatar should be able to send employment offers to successful applicants and wait for and record the response ('accepted', 'not accepted').

2) Software Services Design: Designing and developing the service using SoaML (OMG, 2012) will comply with the functional and non-functional requirements that should be fulfilled by service participants. Participants may be people, organizations, or systems. To build intelligent services, it is necessary to define the participants in the service delivery process. Participation in a service contract requires each type of participant (provider and consumer) to have a port with the corresponding service interface. There are two types of access point, 1) a request point is a port for requesting (consuming) a service. It should be noted that the logic of provided and required interfaces is reversed at a request point: the port requires the provider interface and provides the consumer interface. 2) a service point is a port for providing a service. The

port provides the provider interface and requires the consumer interface. The use of a service contract is modelled as a UML collaboration use. The relative interface dependencies of the request point and the service point 'fit together' to allow a logical connection between the service consumer and the provider.

In the next step, the service architecture must identify the contracts among all of the service participants, Figure 12 shows a fragment of these contracts.

The service architecture was then built, containing the participants and contracts among them. This is a high-level service structure: it specifies the service without regard for realization, capabilities or implementation. It describes how participants work together for a purpose by providing and using services expressed as service contracts. It is modelled as a UML collaboration, where the service contract is the specification of the agreement between providers and consumers of a service as to what information, products, assets and values will flow between them and their obligations. 'Participant' here refers to a party, which provides and/or consumes services. Figure 12 shows a fragment of participants in the interview scheduling service.

An activity diagram was created to capture the interactions among the participants sequentially. It is assumed that the applicant initiates the process by submitting a job application. The activities shown in the figure are software automated workflow activities. Each participant in the activity diagram has a 'swim lane', which contains the actions carried out by that participant within the automated workflow. What happens overall emerges as an orchestration of all the actions carried out by each of the participants. Figure 12 shows a fragment of the development of the service contract between two participants (Avatar and applicant).

The operation of a service contract may also be modelled using other kinds of UML interaction models. It is modelled here as an interaction using a sequence diagram. Each role in the contract is given a lifeline that acts as the source and target for the sending of messages. Messages are modelled as being passed via 'calls to operations' on the interfaces to the roles. Condition flows can be modelled using interaction fragment constructs within the sequence diagram. Message type patterns are developed to be used with a little amendment to pass the messages between the specified roles in a service contract; message types are also modelled as UML classes.

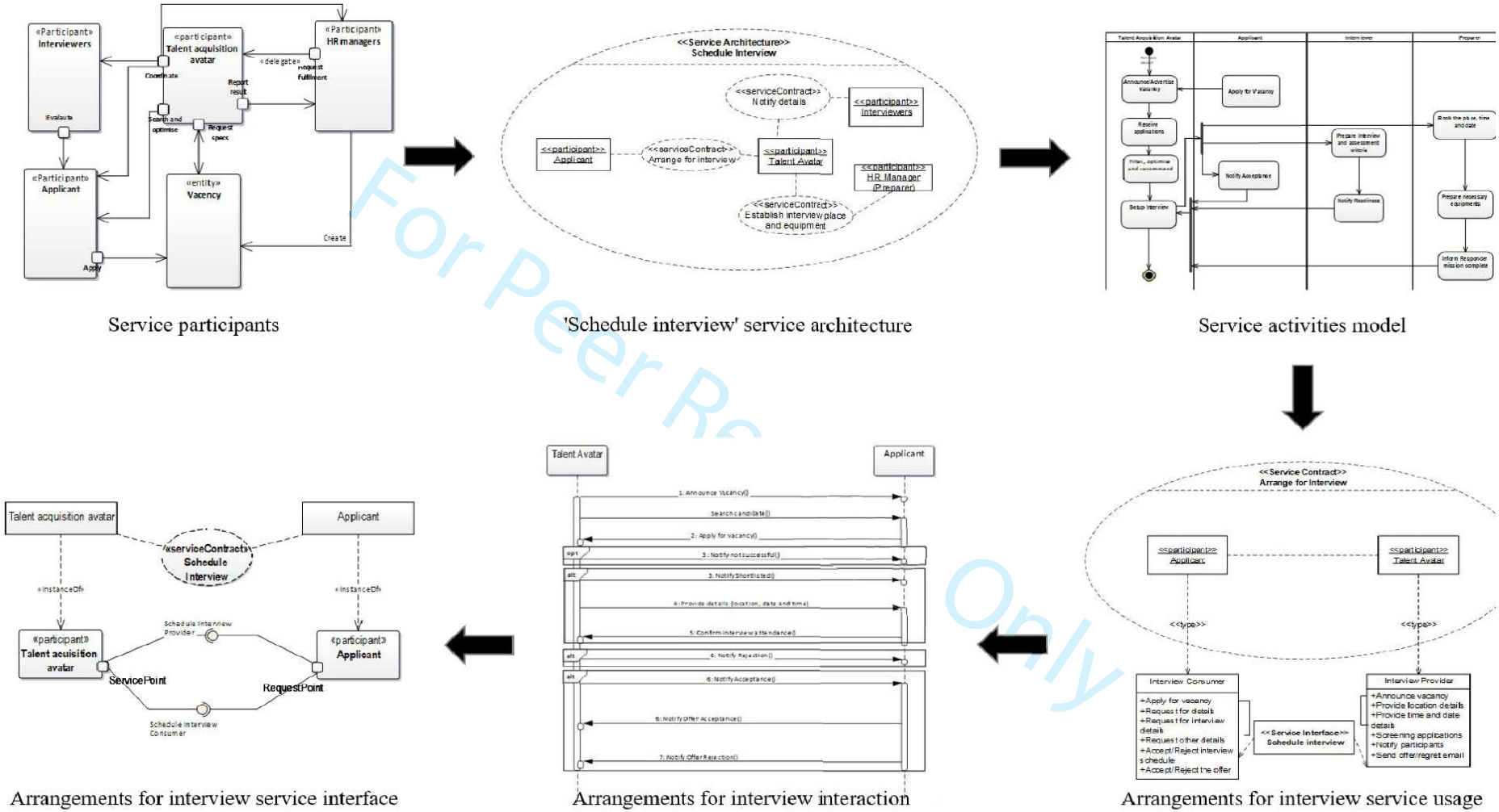


Figure 12: Fragments of SoaML models' development

Services will provide structures for software algorithms and it will help to construct an overall system architecture that identifies the main components that need to be deployed to realise the notion of an intelligent talent acquisition system as presented in Figure 13. *Managers* will identify criteria that are required for meeting a certain business outcome, the system should be semantics-friendly where all identified requirements are structured and classified as a *semantic information* map. The classification and semantics map should adhere to general business and logical rules that are stored in a *rule-based repository*. *Machine learning* and *natural language processing* (NLP) algorithms for extracting keywords, *indexing*, classifying and *ranking* candidates' profiles and CVs will be used to aid the *talent manager avatar*. The talent manager avatar is a software agent with chatting capability to enable the avatar to negotiate with specified *talents* in a structured and controlled manner e.g. after *matching* and *ranking* candidates, the avatar will ask whether the candidate will be interested in a new job offer, and exchange some details with the right candidate as a pre-step to an official interview. The *talent manager avatar* will inform the *managers* about the rank and interested candidates to arrange for official interviews. Through APIs, the system will extract candidates' profiles from various talent and *job websites* and social media platforms as candidates' pools. *Talents* can also apply for the open jobs directly through these *websites* or the company *jobs portal*.

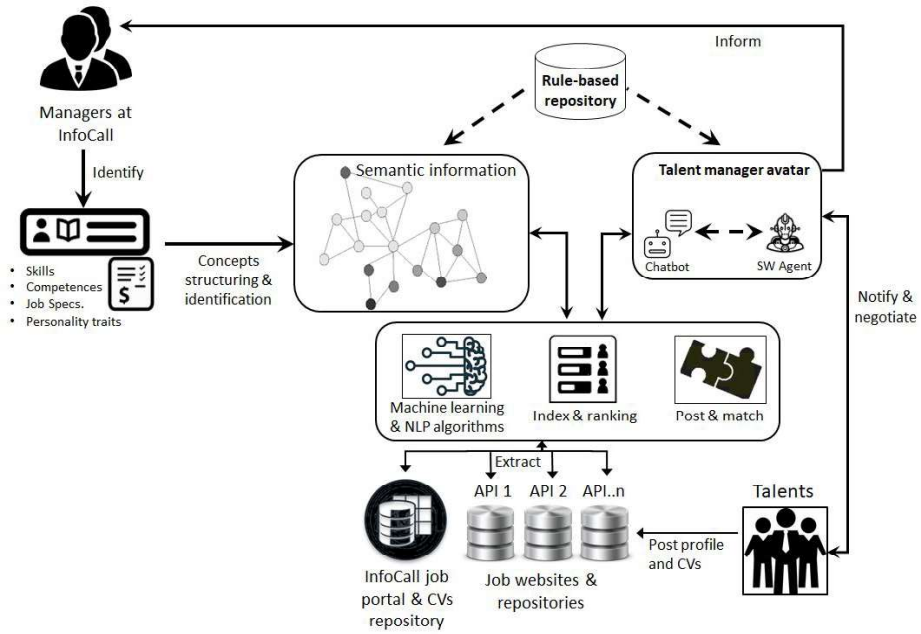


Figure 13: High-level Intelligent Talent Acquisition System Architecture

7. Evaluation

In this section, two types of evaluation are presented for the approach discussed, namely practical and theoretical, to reflect on both the practicality of this work and on its contribution to the existing body of knowledge of the enterprise modelling and the design of talent acquisition systems. We draw on the evaluation criteria presented by Prat et al. (2014) in both evaluations presented in this section.

7.1 Practical Evaluation

A credible form of scientific evaluation is industry-based evaluation, which has the aim of understanding InfoCall managers' perceptions of the proposed approach. This includes understanding the value generated for the industry when set against the time, effort and cost of such an enterprise modelling effort. Wallis (2008) argues that a theory must be acknowledged as valid in a practical sense by those outside academia if it is to receive the recognition of external professionals. Yin (2009) stresses the importance of strengthening the construct validity of research by asking experts their opinion of the *efficacy and utility* of the approach. During the validation, the managers of InfoCall were asked about their opinion and recommendations in relation to the *efficacy* and *validity* of the approach for organizations. The funnel interview concept advocated by Sekaran (2003) was adopted, meaning that the questions were initially formulated broadly, and then gradually narrowed to focus on more case-specific details. One of the challenges of assessing the strengths and weaknesses of the approach developed is to continue to pay attention to its *robustness*, *completeness* and *efficiency*. The managers were aware of the inverse relationship between robustness maturity and flexibility that is needed due to *learning* and evolvability, and also these between ease of use and utility (e.g. quality vs speed). The suggestions and recommendations for improvement that they made are discussed below.

The operation manager answered questions relating to the *utility* of the developed approach, saying "it is obvious that a tremendous amount of work has been done, the knowledge presented in the case study document was rounded". When asked about models and their inter-relations (homeomorphism), such as these between goal models, the design rationale and SD, his opinion was that "the models look interesting, and mapping hierarchical goals is important for operations managers to keep an eye on the long-term goals". In relation to the design rationale, he said that he "always encourages employees to use mind-mapping tools to organise their thinking and collaborative tasks, and that design rationale tool should be

beneficial in a way, especially in brainstorming meetings when mid- and high-level managers discuss strategic decisions and choices". He wondered whether there was a collaborative version of this tool available to share and exchange the rationale models with managers. The manager was not sure about the *utility*, *understandability*, and *ease of use* system dynamic model, and said "if we were able to expect something might affect the business, it will not be difficult to understand its impact on the business". It was explained to him that when the data set became much larger, the dynamic model would be an easy and handy way to visualize behaviour and pick up behaviour patterns from the model, while the managers would be able to change variables to test different 'what if' scenarios. He was excited to see the impact of such a modelling capability on a larger data set. The manager was happy to see the mapping between strategy and operations, and said that they had already started a process modelling initiative a year before, and started modelling all of the processes in the company. He highlighted that it was important to map this to the strategy and objectives which is a good *fit with the organisation* needs. It was also important to reason about it, and that the most interesting thing was to analyse the issues related to the employees to work out the gap between design specifications and practices within the organisation, as such, issues cannot be realised purely by only modelling and documenting the processes which can be considered as a *side effect*.

Regarding the advantages and disadvantages of the approach, the service manager answered, "with no doubt, the approach seems to enlighten us in several ways and I am very keen to keep at least part of the practices we learned from this experience in the organization… this is the reason why I was keen to collaborate in this study".

In relation to the limitations or disadvantages, he said, "I can see how the approach can contribute for the long term; I just cannot see how long this will take to get sufficient Return-On-Investment (ROI). And I can see the expected high cost and difficulty of learning all the sets of tools proposed in the approach, so to get successful implementation needs an experienced and determined analyst to realize the benefit", these can be seen as *side effects* to organisation. He added, "I can't see why I need to define all this set of vocabulary and business terms, this should be really exhausting work!" which can be seen as *side effects* to people. The importance of establishing a common understanding between all employees was explained, and especially among those from different departments, and the importance of building a rule management IS of specification standards was fully integrated with business applications was pointed out. In relation to the avatar development *clarity*, IT manager

suggested, "We still need some time to trust or relay completely on intelligent systems, nevertheless, the avatar can be improved by enabling us to reconfigure the optimisation criteria. For example, relaxing the optimisation requirements to decide whether we want to retrieve more and wider talents profiles, we believe machine learning will be useful tool that augments human intelligence." He questioned the importance of software modelling for developing the avatar "Why not to develop the intelligent avatar rather than creating models?". Overall, the operation manager was happy about the effort made and the meaningfulness of the approach for business improvement and alignment. He suggested, "….simplifying the process and integrating it with industry best practices" to contribute to its *understandability* and *ease of use*.

7.2 Theoretical Evaluation

In InfoCall case study, a current 'as-is' business model and a candidate future 'to-be' tactical development of talent acquisition systems were developed and evaluated based on the business objectives of InfoCall stakeholders. An enterprise modelling and simulation activity was carried out for the company in a relatively short period compared to the usual time required for enterprise architecture (EA) implementation projects, and this was because it focused on a particular activity (talent acquisition). The proposed approach made possible the alignment of business strategy, operations and IS. The strategic choices were identified, allowing a better understanding of the challenges of talent acquisition and confirming the most suitable practices to be implemented with careful consideration of contextual knowledge. This approach helped to increase business transparency, collaboration, and the sharing of understanding between stakeholders (shared knowledge) which contributes to its *efficacy* and *utility*. The rules embedded in the IS designed encouraged managers to become more engaged in the acquisition process. The approach also helped to identify the acquisitions needed to close the gap in the skills the company required to achieve its main objectives, and then to design a talent acquisition process that also aligned to the underlying software services development. The approach proved to help overcome a set of challenges

faced by organizations in talent acquisition, as discussed in the previous section. One of the important outcomes of this study is that we noticed that 'as-is' architecture does not always perform as it was documented and meant to perform. This causes the organization to end up having two different 'as-is' architectures, 1) the actual 'as-is' and 2) the documented 'as-is', the difference between these two can be seen as a discrepancy between the plan and actual practice which can be seen as a consistency side effect of people practices. Moreover, the design of 'to-be' architecture should also consider what 'might be' under specific circumstances, and here simulation and reasoning can help to justify choices and understand exceptional scenarios as part of the contentious evolution of business and environment where *learning capability* plays a role in its success. The approach also helped in identifying the gap between the current state of the enterprise as documented, and the current state as performed. It will also help to identify the enterprise's future target state while considering the fact that the enterprise is gradually evolving and changing due to different influencing factors (e.g. economy and policy changes), and we call this 'it will be'. As a notion stresses that, the 'to-be' model is not static and that change is expected, so continuous alignment, assessment, and development are required to achieve the enterprise's goals (Figure 14). A summary of the discussion on evaluation criteria can be found in appendix B.

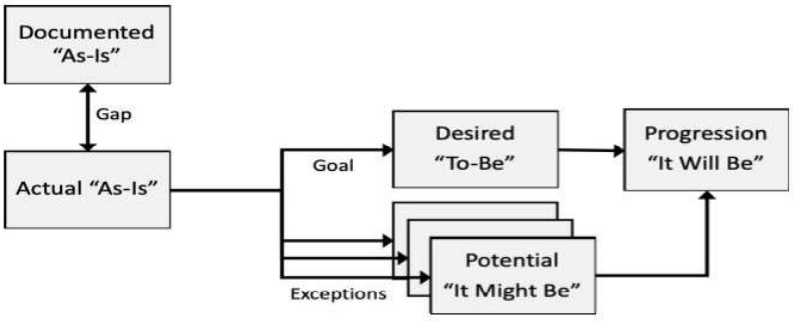


Figure 14: Enterprise Model States

8. Conclusion

This paper has presented a multi-view approach for building intelligent talent acquisition systems that integrates enterprise modelling and simulation. The approach can offer an understanding of the dynamic behaviour of the enterprise by quantifying 'what-if' scenarios. The scenarios are typically relying on sets of assumptions to support predictions of future needs for talents. The approach incorporates the continuous alignment of the enterprise's strategy, operation and IS by using an extension of the BMM. A set of enterprise modelling languages are used, namely SBVR, BPMN, decision tables and SoaML. The qualitative exploration is performed by means of the design rationale tool, while the simulation is based on the use of SD modelling. Enterprise modelling and simulation outcomes are used to develop software services for the intelligent talent acquisition system. The software services were chosen and developed from one of the four alternative processes that is considered the most aligned to the company's capabilities and resources at the time of the study.

For future work, the researchers might consider integrating the processes with data sources in order to a) analyse actual data on different forms of employment and skills distribution, then b) to design an integrated system that alert enterprises about the messing skills and link them directly to a suitable talent available online on talent pools websites. Another future direction can be implementing the approach using the action research method to address the continuous challenges and team learning that emerge during the approach implementation.

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Appendices

Appendix A: Research methods

Mixed methods are used in the case study, which combines interviews with the key stakeholders and the analysis of documents as a form of qualitative inquiry (Johannesson and Perjons, 2014; Patton, 1990; Yin, 2009) to gain the level of detail required for the modelling and design. The semi-structured interview questions were developed to collect the information needed to build enterprise models using the proposed approach. They were based on the questions presented by Singh and Woo (2009) to collect both the strategic and operational insights required as a basis for constructing enterprise models and improving business-IT alignment through goal-oriented approaches.

The interviews were conducted with 12 senior managers, middle managers and operation staff members from various departments across the company. The interview schedule was designed so that interviews lasted for an average of one hour, which enabled the researcher to gain insightful knowledge and sufficient details relating to the enterprise and the issues they encounter. The participants represent three organisational levels (strategic, mid-level managers, operational) across different departments. The table below describes the participants and the number of interviews.

No.	Participant's Designation	Participant's Department	Years of Works with I2C	Length of Interview
IS1	Founder & CEO	Company Director	20	45 mins
IT1	CTO	Technical Department	8	4 x 60 mins
IT2	QA Specialist	Technical Department	4	70 mins
IT3	Software Engineer	Technical Department	2	60 mins
IT4	Support Engineer	Technical Department	1	50 mins
IT5	Project Manager	Technical Department	5	35 mins
AF1	HR Manager	Admin & Finance Department	6	55 mins
AF2	CFO	Admin & Finance Department	8	40 mins
CM1	Account Manager	Commercial Department	3	60 mins
CE1	Content and Editorial Manager	Content & Editorial Departments	2	60 mins
CE2	A/V Team leader	Content Department	5	120 mins
OM1	Operation Manager	Operation Department	5	70 mins

Appendix B: Evaluation criteria based on (Prat et al., 2014)

System dimensions	Evaluation criteria
Goal	Efficacy: the analysis shows that the aim of the multi-view approach is to bridge the gap between strategy, operation and IS design, which for greater degree the suggested approach was successful in doing.
	Validity: We can claim that the approach is reliable with caution. It is top-down where it is not always the case of alignment challenge
	Generality: The approach can be applied and reused with certain level of adaptation to meet a particular context needs. The set of integrated models are well known and used for varieties of business and IS purposes
Environment	Consistency with people: While generally there is a sufficient degree of consistency with people, there are some challenges in some of the models in terms of ease of use and understandability which is understandable when using scientific methods for general service-based SMEs.
	Consistency with organisation: There is a strong fit with the organisation and the utility was demonstrated in the case. InfoCall started a process mapping initiative prior to this study which is consistent with the EM effort, the side effects of cost and skills are acknowledged
	Consistency with technology: EM are platform independent practices and approaches. While service design uses the SoaML in high-level, the implementation can take any form and based on any suitable COTS or

	open source technologies. The technical architecture is sound and can be deployed as bespoke IT application.
Structure	Completeness: As context evolves, there is no complete artefact as a design, rather it should continuously evolve with the context and system's need
	Simplicity: The designed approach is simple in its principles but challenging when fulfilling instances. We assume this is a necessity flexibility feature but also against robustness
	Clarity: while expert modellers might feel more comfortable with the approach, average business users might find it difficult to use the suggested specialised tools
	Style: Globally, simple but can be considered time consuming and cognitively heavy when developing detailed models.
	Homomorphism: there is no redundancy is view or purpose, nevertheless, some of the modelling techniques can overlap and be used interchangeably
	Level of detail: the modelling artefacts are in high-level, thus flexibility in the way they used is achieved.
	Consistency: We are certain to a great degree that the consistency is high since OMG are achieved a sufficient degree of semantics. Nonetheless, the detailed semantic in tools level is not part of the study as the tools and their deployed semantics are COTS
Activity	Completeness: As context evolves, there is no complete artefact as a process, rather activities should continuously evolve with the context and system's need
	Consistency: consistency is achieved in an integrated implementation process but nothing beyond how best these tools should be used
	Accuracy: Globally, the work confirms with previous works in terms of a) top-down EM effort b) multi-view integrated models (e.g. Fayoumi and Loucopoulos, 2016)
	Performance: Since the artefacts are procedural and for modelling purpose, performance depends on the modeller experience
	Efficiency: context dependent, can be considered high-medium in the presented case.
Evolution	Robustness: highly agile in the way it can be used, we can claim the robustness is high accordingly
	Learning capability: learning is imbedded in the approach in terms of a) evolving experience of the modeller b) collaborative learning in term of using DR model and other collaboratively constructed models.