FIT GAP ANALYSIS – THE ROLE OF BUSINESS PROCESS REFERENCE MODELS

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ABSTRACT: *Enterprise resource planning (ERP) systems support solutions for standard business processes such as financial, sales, procurement and warehouse. In order to improve the understandability and efficiency of their implementation, ERP vendors have introduced reference models that describe the processes and underlying structure of an ERP system. To select and successfully implement an ERP system, the capabilities of that system have to be compared with a company's business needs. Based on a comparison, all of the fits and gaps must be identified and further analysed. This step usually forms part of ERP implementation methodologies and is called fit gap analysis. The paper theoretically overviews methods for applying reference models and describes fit gap analysis processes in detail. The paper's first contribution is its presentation of a fit gap analysis using standard business process modelling notation. The second contribution is the demonstration of a process-based comparison approach between a supply chain process and an ERP system process reference model. In addition to its theoretical contributions, the results can also be practically applied to projects involving the selection and implementation of ERP systems.*

Key words: *fit gap analysis, business process reference model, ERP system, reference model application, process comparison*

JEL Classification: M15

1. INTRODUCTION

Many companies have introduced ERP systems in order to stay competitive and to improve and change their business strategies (Winkelmann, 2012). ERP systems integrate standard business practices that suggest an effective and validated way to perform business operations. The business practices of ERP systems can be presented via reference models. Reference models are generic conceptual models that formalise recommended and generally accepted practices for a certain domain (Fettke & Loos, 2003).

A significant number of information system implementation projects are unsuccessful (Lyytinen & Hirschheim, 1988). Even the latest research shows that 10% of companies have recognised that their ERP project was a failure (Panorama Consulting Solutions, 2013). The

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main reason for this lies in underestimating the complexity of such a project that requires several organisational changes and the involvement of employees (Davenport, 1998).

These days ERP systems need to offer a lot of functionality in order to cope with a large number of business requirements. This functionality needs to be aligned with the business in order to create value for the organisation, confronting the organisation with the options of either configuring the enterprise system, the organisation, or a combination of both (Dreiling, Rosemann, Aalst, Sadiq, & Khan, 2005).

One key success factor when implementing ERP is a focus on business processes and business needs. Even though it is known in theory and in practice that the use of reference models brings many positive economic effects for business, such as a cost, time and risk reduction (Fettke & Loos, 2007; Hilt, 2007; Kirchmer, 2010; Küster, Koehler, & Ryndina, 2006), reference models are still rarely used in practice.

The aim of this paper is to present the use of reference models as a process comparison approach within fit gap analysis. The structure is as follows: based on a literature review, the first part introduces reference models and existing reference model application approaches. The second part explains the high-level and detailed fit gap analysis and suggests a fit gap analysis BPMN (Business Process Modelling Notation) process. The last part of the paper demonstrates a process comparison between a supply chain business process and an ERP process reference model.

2. REFERENCE MODELS

Process design is a key phase of the business process management lifecycle. The resulting models form the basis for process implementation and execution. The use of process templates significantly increases the efficiency and effectiveness of the process design phase. Process templates are generally called business process reference models (Kirchmer, 2010). Developing process models from scratch is a time-consuming and methodologically challenging task. Reference models are information models that are developed with the goal of being reused. They can be used as a starting point for developing company-specific models (Becker, Beverungen, & Knackstedt, 2010).

Reference models have the following characteristics (Fettke & Loos, 2003, 2007; Kirchmer, 2010; Scheer, 1998):

- they represent best practices (providing best practices for conducting business);
- they have universal applicability (representing a class of domains, not a particular enterprise); and
- they are reusable (they can be understood as blueprints for developing information systems, they can be structured to allow easy adaptation to company-specific situations).

Reference models play an important role in activities such as business process engineering (Scheer, 2000), information system development, customising ERP systems (Rosemann &

van der Aalst, 2007) and training and research (Thomas, 2006). In order to be able to use reference models, they must be adapted to the requirements of a specific enterprise.

Reference models represent the content of various domains. The most important types are the following (Fettke & Loos, 2003; Kirchmer, 2010):
- industry reference models (representing the best practices of a specific industry sector);
- software reference models (these can be traditional applications such as ERP systems or a reference model representing a sub-process supported by service-oriented architecture (SOA);
- procedural reference models (e.g., a project management reference model); and
- company reference models (representing best practices within a company or a company group).

The use of reference models has different economic effects on the modelling process (Fettke & Loos, 2007; Hilt, 2007; Kirchmer, 2010; Küster et al., 2006):
- a decrease in costs (reference models can be reused so the development costs of the reference model can be saved);
- a shortening of modelling time (the knowledge contained in the reference model reduces learning and development time, allowing the identification of and a direct focus on critical processes);
- an increase in model quality (reference models are proven solutions and provide better model quality and an awareness of own deficiencies);
- a lessening of modelling risk (the risk of failures when using a reference model can be reduced because reference models are already validated); and
- the reference model content usually bridges the business and the IT (Information Technology) domains. For example, business process models can be linked with predefined interface definition models and Web service models.

A possible disadvantage of using reference models is that an organisation might lose some advantage of its unique and perhaps better business practices. If a reference model is widely used by an industry sector, then it can hardly represent a source of a company's competitive advantage. A company should therefore identify which are the key business processes that contribute to its competitive advantage and which could be standardised without losing such advantage.

2.1. ERP system reference models

ERP systems are the world's largest and most complex enterprise systems. ERP systems primarily focus on core intra-company processes, that is, the operations that are performed within an organisation (Magal & Word, 2010). These systems are generic and the functionality they provide can serve a large variety of enterprises. ERP systems are not custom-developed, but are developed by commercial ERP vendors, e.g. Oracle, Microsoft, SAP. The implementing organisation either accepts or rejects the business processes that can be enabled by the ERP (Gulledge, 2006). The implementation of an ERP system

involves a process of customising the generic package and aligning it with the specific needs of the enterprise (Soffer, Golany, & Dori, 2003).

The implementation of ERP systems has become an industry on its own. In particular, small and medium-sized enterprises (SMEs) are unable to afford expensive ERP implementations. The fact that they can help reduce the cost of ERP implementation is one reason that modelling methods, architectures and tools have become increasingly important (Scheer & Habermann, 2000). Some ERP vendors have developed ERP-specific reference models which describe the structure and functionality of the system on a conceptual level. ERP reference models exist in the form of function, data, system organisation, object and business process models, although the latter is clearly the most popular type.

Business process reference models on different levels of granularity describe business processes that can be supported by an ERP system. These models are not only developed for the implementation team, but also for the end users who can gain relevant information about ERP system capabilities and how processes are connected together from the models (Rosemann, 2000). Reference models embedded in an ERP system may serve as a basis for matching the system with the company's requirements (Soffer et al., 2003). The most comprehensive ERP process reference model is SAP's R/3, developed largely in Event-driven Process Chain (EPC) notation. A reference model can also be linked to a system repository which enables the ERP system to be configured by the reference model (Scheer & Habermann, 2000).

2.2. Reference model application methods

From a conceptual point of view, reference modelling consists of construction and application processes (Fettke & Loos, 2007). The term construction process pertains to all activities relevant to the development of a reference model. The term application process refers to all steps required to develop enterprise-specific information models on the basis of reference models (Ahlemann & Gastl, 2007). In this paper, reference modelling will be associated with the reference model application process.

Fettke, Loos and Zwicker (2006) analysed and compared 30 process reference models. Thirteen of them covered some proposals and configuration options for model application. Most of them (twelve) have developed a procedural model for specific application purposes. Statements about concepts for reusing and customising elements within the reference model were only provided for nine reference models. Further, in nine cases the reference models were used on real projects. In the remaining 21 cases, statements concerning real applications were not available.

How a reference model is applied in practice is an important research question. Companies face several issues when they want to answer this question. Some issues are e.g. the different levels of process details, different notations, a partial view of processes, an overemphasis on process activities etc. Two process models can have different structures

and still be compliant with each other. Gerke, Cardoso and Claus (2009) developed an approach and an algorithm which allow the compliance of process models with reference models to be measured. The approach was evaluated by measuring the compliance of a German passenger airline process with the ITIL (Information Technology Infrastructure Library) reference mode. Van der Aalst (2005) introduced a delta analysis to compare the real behaviour of an IS with the expected, reference model behaviour. He employed data mining with transactional IS log data to analyse the underlying processes.

The process of configuring a reference model in line with the demands of an organisation requires users to have a thorough understanding of both the domain and the modelling language in which the reference model has been constructed. Users must not only be domain experts but also skilled in reading and adapting reference models. In practice, where users are unfamiliar with reference models, this assumption is unrealistic. La Rosa, Lux, Seidel, Dumas and Hofstede (2007) proposed a questionnaire-driven approach to reference model configuration. They linked the questions to reference model variation points. Users therefore do not need to deal directly with the reference model and only have to answer questions which are expressed in a natural language.

The development of a reference model is often costly, risky and extensive, which underpins the demand for easy to use adaptation approaches. Adaptive reference models enable automatic modifications of the original reference model, depending on company or project specifics. A few reference modelling approaches have been developed based on adaptive reference models.

Soffer et al. (2003) suggested the ERP modelling approach to capture process variants supported by the ERP system and the interdependencies among them. They used OPM (Object-Process Methodology) as a modelling language which was selected following an analysis of the desired properties a modelling language should possess to be applied in the constructing of an ERP system model. Rosemann and van der Aalst (2007) highlighted the shortcomings of existing reference modelling languages and suggested a configurable reference modelling language which allows the core IS configuration patterns to be captured. The authors pointed out the need for connecting model elements to the ERP system functions in order to perform the model and ERP system configuration concurrently. The configuration approach of each introduced approach is similar. Model variants for different application scenarios are integrated into one model and are predefined. The model variant that is considered the best for a specific application scenario can be selected for real application.

Configurable reference model approaches primarily focus on adapting a reference model to specific business characteristics. A reference model also has to be further adapted to the specifics of a company. Generic modelling approaches (e.g. aggregation, instantiation, specialisation and reusability) are considered appropriate for use when adapting a reference model. Becker, Delfmann and Knackstedt (2007) suggested recommendations for the construction of modelling languages that integrate configurative and generic reference modelling.

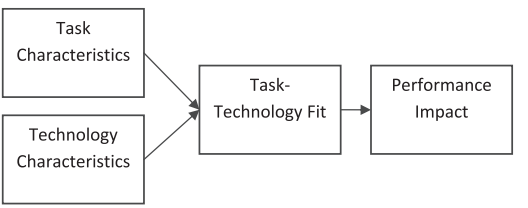
Parameterisation plays an important role in the customisation of a reference model. It allows the parameters or variants of a reference model's features (processes, functions, entities) to be set according to an enterprise's requirements (specific business processes and policies). Heuvel and Jeusfeld (2007) suggested a reference model transformation approach involving four steps: 1) the matchmaking: source model is compared to the reference model to identify which reference model is most appropriate; 2) selection: scenarios are chosen from the reference model; 3) enrichment: more details are captured and variants are selected; and 4) integration: the enriched reference model is integrated with target models.

Process merging is a technique that brings several processes models together to create a new process model. Merging can be performed according to a revolutionary or conservative approach. In the revolutionary approach, the reference model is taken as the initial TO-BE model. This model is iteratively customised by integrating parts of the AS-IS model. This approach is primarily used when companies are implementing ERP systems. In contrast, the conservative approach uses the AS-IS model as the initial TO-BE model. This model is then adapted by adding components of the reference model. Küster et al. (2006) introduced the process merging approach for a scenario which focuses on improving an existing AS-IS business process by using a process reference model. The two main steps of their approach are the comparison and derivation of the TO-BE model. In order to visualise relations between the AS-IS process and the reference model they used a tree structural view. They connected process tasks and identified types of task relations e.g. one-to-one, one-to-many, one-to-none, and none-to-one. Based on process mapping they incorporated parts of the reference model into the AS-IS process.

3. FIT GAP ANALYSIS

Task-technology fit theory (TTF) stresses the importance of an alignment between business processes and technology (e.g. ERP systems). TTF theory (Figure 1) holds that IT is more likely to have a positive impact on individual performance and be used if the capabilities of the IT match the tasks the user must perform (Goodhue & Thompson, 1995). Matching IT capabilities with user tasks is achieved by the fit gap analysis process.

Figure 1: *TTF diagram*



Source: D. L. Goodhue, D. L.Thompson, Task-technology fit and individual performance, 1995, p. 215

Fit gap analysis (also named "gap analysis", "gap fit analysis" or "system needs and product features analysis") is an important phase of an ERP selection and implementation methodology. A critical challenge when implementing ERP first involves identifying gaps between

the ERP generic functionality and a specific organisational requirement, and deciding how those gaps will be handled (Gulledge, 2006; Sawyer, 2001; Soh, Kien, & Tay-Yap, 2000). Fit gap analysis is used to determine the extent of a business process change required for a particular solution as well as determining software customisation and interfacing requirements (Blick, Gulledge, & Sommer, 2000). An organisational misfit requires massive changes to the adopting organisation's business processes, ERP system or both. Matching the ERP's functionality to the way the enterprise does business is a vital factor for the success of an ERP implementation (Laughlin, 1999). Hong and Kim (2002) defined the organisational fit of an ERP system as the congruence between the original artefact of ERP and its organisational context. The findings of a survey of 34 organisations showed that success in ERP implementation depends significantly on the organisational fit of an ERP system.

An ERP system requires extensive customisation in order to roll out production systems. Each organisation has its own unique set of requirements and processes. The fit gap analysis that typically accompanies a development effort represents a major financial drain (Arinze & Anandarajan, 2003). Soh, Kien and Tay-Yap (2000) surveyed the gaps between the functionality offered by the ERP system and that required by the adopting organisation. Their findings suggest that the fit might be worse in Asia because the business models underlying most ERP systems reflect European or US industry practices which are different from Asian business practices. Blick et al. (2000) presented fit gap analysis experiences with ERP implementation for the public sector. In that sector, business processes often differ from private sector processes and more attention should be focused on understanding the gap.

Fit gap analysis is usually built on a request for proposal (RFP) or a request for information (RFI). RFP/RFI summarises a company's business needs (general, technical, functional) that any future ERP system should cover. The fit gap process is often supported by vendor ERP consultants who bridge the gap between the business world and the world of technology (Sawyer, 2001). The main goal of fit gap analysis is to identify and document all fits and gaps based on a comparison of a company's business needs and ERP capabilities, followed by an analysis of each gap, the suggesting of possible alternatives and closing of the gaps by selecting the most appropriate alternatives.

Fit gap analysis is mentioned twice in ERP system implementation methodologies (Microsoft Corporation, 2011). High-level fit gap analysis is usually conducted in the pre-implementation or ERP system selection phase and a complete or detailed fit gap analysis is an essential part of an ERP system analysis phase.

3.1. High-level fit gap analysis

It is very important to select an appropriate ERP system. The selection process should be based on a comparison of business needs and the capabilities of a given ERP system. High-level fit gap analysis is an approach that helps determine how the ERP system supports a company's business needs (Sawyer, 2001). Important preconditions for conduct-

ing a high-level fit gap analysis are that business needs (business strategy, processes and requirements) have been identified and that executive project sponsor support is in place (Indihar Štemberger & Kovačič, 2008; Laughlin, 1999).

The objectives of high-level fit gap analysis are: 1) to validate and understand the degree of fit between an ERP system and business and IT needs; 2) to identify the major customisations that will be required to address those requirements; and 3) to provide an understanding of how the ERP system will work in the particular business environment.

A high-level fit gap analysis process is presented as a BPMN model in Figure 2. The process consists of the following steps:
- a review of business needs and ERP system capabilities;
- the selection of a comparison approach; and
- a comparison of business needs with ERP system capabilities and the documentation of fits and gaps.

Reviewing business needs and ERP system capabilities

The initial step is to review the company's business needs and existing legacy systems. Business needs are best described by an organisation's strategy and business processes (Indihar Štemberger & Kovačič, 2008). Business needs should be connected to the company's process architecture. This is important for it allows companies to know how their business needs are linked to their business process activities and which processes are affected. Business needs should also have a defined priority and the impact they have on business and the business strategy. On one hand, ERP capabilities can be presented by ERP consultants, user and training materials, or company reference visits. Another way to present the capabilities of an ERP system is to use process reference models.

Selecting a Comparison Approach

The most commonly used fit gap analysis approach is simulation-based, whereby a company's business processes are executed within the ERP system and set up as a pilot or sandbox test system. The review of business needs within the company is usually done through detailed workshops involving key users and ERP system application consultants. A workshop serves to identify gaps in the ERP system compared to the customer's needs. The consultant executes business processes in the system and the key users monitor and review whether all of the required activities in the business process can be executed. If the key users have been trained to use the ERP system, they may themselves execute the business processes. Users usually compare the new ERP system with the solutions that are currently in use. It is recommended to include a business analyst in order to ask critical questions and help key users understand the ERP system. However, a simulation-based method might restrict the fit gap analysis solely to a comparison with the test implementation and miss important process optimisation opportunities.

Other popular fit gap comparison approaches in business practice are (Prakash & Madhup, 2011):

- Brainstorming discussion based: Highly skilled ERP system consultants present and discuss capabilities with other stakeholders of a project. Such an approach is most appropriate for an upgrade project or resolving critical issues of an implementation.
- Questionnaire based: This approach is based on a questionnaire prepared by ERP consultants. The questionnaire contains questions related to both the company's needs and ERP system capabilities. Key domain expert users provide answers and attach additional data and documents. This method is suitable for companies that are already using an ERP system, i.e. for upgrade or implementation project types. The main advantage of the questionnaire method is that it is fast to execute although, on the other hand, there is a risk that not all of the required information will be obtained if responses are poor in quality. A questionnaire-driven approach to reference model configuration was proposed by La Rosa et al. (2007). Their main idea was to link questions to the reference model. End users therefore do not need to have knowledge of the reference model or the language in which the reference model was written. They only need to answer domain-specific questions written in a natural language.
- Process-based: A description and demonstration of a process-based comparison approach is presented in section 4.
- Hybrid: With a hybrid approach, all of the approaches suggested above can be used. It usually starts with a brainstorming discussion followed by ERP system simulations. At the end, questionnaires are administered. The hybrid method provides the best output of a fit gap analysis, but it also requires the most effort and investment.

Comparing business needs with ERP system capabilities

Based on the selected comparison approach we first compare each business need with the capabilities of an ERP system. If the ERP system does not support a business need, we document the business need as a gap and give estimations of the time and costs required. Gaps can arise from company-specific, public-sector-specific or country-specific requirements that do not match the capabilities of an ERP system (Soh et al., 2000). If an ERP system supports a business need, there are two options. If additional configuration of an ERP system is needed then we document the business need as an ERP system configuration and estimate the configuration time and costs while, on the other hand, if no configuration is needed then we document the business need as a standard ERP system functionality.

Potential outputs of a high-level fit gap analysis are (Microsoft Corporation, 2011):

- a high-level fit gap list of requirements with an explanation of how these would be addressed as part of an implementation and an estimation of the effort that this work would require; and
- a high-level fit gap report explaining the business needs discusses the functionality fit of an ERP system, reviews the key design points, discusses customisations and integration requirements, and reviews the proposed conceptual design and lists any assumptions made.

The degree of fit is an important indicator of business alignment with the standard ERP system functionality. It is calculated as the sum of all business needs that fit, divided by all business needs. Besides standard ERP system capabilities, the business needs categorised as fit are ERP system configurations and adaptations of a company's business processes. In addition, each business need should be weighted in terms of its importance (e.g. nice-to-have or critical). The degree of fit helps companies understand the risk of not meeting the project's scope and provides an important estimation needed in the ERP system selection process (Babić, 2009a).

Alternatives characterised within a high-level fit gap analysis as a business fit are:
- standard ERP system capability; and
- ERP system configuration.

Standard ERP system capability

Standard capabilities are met by the system out-of-the-box, without requiring additional effort or configuration time. This is by far the most preferable outcome. In practice, there are typically many of these because the majority of tasks and processes are common to all companies and are therefore supported by ERP systems. Examples of standard ERP system capabilities are: the possibility to handle inventory in multiple locations, establishing and observing credit limits for customers or handling reservations of goods throughout the system (Babić, 2009a).

ERP system configuration

ERP configuration (also called customisation) entails choosing from among the reference processes and setting the parameters in ERP to reflect organisational features without changing the ERP source code (Brehm, Heinzl, & Markus, 2001; Glass, 1998). Business needs are met out-of-the-box, but the ERP system has to be configured or set up using the front-end tools before it can be used. Configuration of an ERP system requires some consulting work, but without custom code development. If a gap can be closed through configuration, the costs and risks are minimised (Blick et al., 2000). Configuration costs and time must be estimated, including the configuration settings and setup values. Examples of business needs addressed by an ERP system configuration are: handling sales or purchase approval workflows (no programming), setting up specific requisition planning systems, defining organisational units or the creation of standard reports (Brehm et al., 2001).

3.2. Detailed fit gap analysis

A detailed fit gap analysis is executed within the analysis phase of an ERP system implementation. If a high-level fit gap analysis has already been completed, then it is used as a starting point for a detailed fit gap analysis. The steps in conducting a high-level fit gap analysis were

described in the previous section. In a detailed fit gap analysis, we focus on how the identified gaps can be resolved. An overall detailed fit gap analysis process is presented in Figure 2.

Documented gaps serve as the basis for the consulting team to validate gaps, find resolutions and propose the most appropriate alternatives. Alternatives can be evaluated and compared based on analysis, e.g. SWOT analysis or cost benefit analysis (CBA). CBA is a structured evaluation of the cost of various plausible and viable alternatives to a gap, compared to the business benefit of each. Although the least cost alternative is often determined to be the most attractive, this is not always the case. That is because qualitative, legal, and human resource aspects may need to be considered and factored into the decision. It is often useful to list alternatives, document the alternative resolution options, the costs versus benefits of each, the formal recommendation, and the reasoning behind it. The selected gap resolution is a business decision that needs to be made by the customer's business decision maker (senior-level executive project sponsor who monitors the implementation project).

Business needs identified as a gap can be resolved by (Microsoft Corporation, 2011):
- adapting a company's business processes;
- adapting an ERP system through customisation;
- adding a new business solution and/or software vendor; or
- providing a workaround so that the business can function.

Adaptation of Business Processes

A company decides to undertake a process change when a reasonable match between a business need and a standard ERP system exists, and adaptation would otherwise be required. This alternative is also named a technology-driven approach (Arif, Kulonda, Jones, & Proctor, 2005). It means that best practices implemented in these software packages have to be applied within an organisation. Although it is theoretically the best way that allows an organisation to take all possible advantage of an ERP system, such changes are very hard to implement in practice. It means that an ERP system implementation project has to include a business process redesign project, rendering the situation much more complicated. Many vendors are concerned with the complexity and therefore with the strong threat of failure. Besides, an organisation might lose the advantage of having a unique and perhaps better business practice (Davenport, 1998; Indihar Štemberger & Kovačič, 2008; Trkman, 2010).

Adaptation of an ERP System

Technological adaptation refers to adjustments and changes following the installation of a new technology in a given setting (Tyre & Orlikowski, 1994). The adaptation of an ERP is selected if a business need cannot be met by standard ERP system functionalities and requires some or even extensive custom development. It requires changing the package code to perform a unique business process. Due to the way ERP systems are designed, some tailoring is always required to get them up and running. The extent of the adapta-

tion can vary from one organisation to the next, based on several factors. One factor is the degree of fit between the features and functions of the package and the business processes of a particular organisation (Brehm et al., 2001).

A general ERP vendor recommendation is that any alternatives that count as a fit should be always considered beforehand. Adaptation of an ERP system is not a desirable outcome (Babić, 2009b; Brehm et al., 2001). It can cause high additional costs, increase project time and risk (Laughlin, 1999). Moreover, it presents difficulties with maintenance and upgrading to new releases. Therefore, this alternative can lead to the failure of a project. ERP system customisation is appropriate for those companies which believe their business processes are better than those implemented in an ERP system and do not want to lose their competitive advantage (Indihar Štemberger & Kovačič, 2008). ERP system customisation time and costs must also be estimated in this phase. Examples of custom-developed business needs are: integration with industry or best-of-breed systems, workflow programming, interface development, extended reporting, automated customer billing etc.

Combining with Other Solutions

The placement of third-party solutions (also called bolt-on or add-on solutions) reduces the effort required to configure and otherwise tailor an ERP to industry-specific needs. If the implementation partner cannot meet business needs, it is possible to engage a third-party vendor (independent software vendor, ISV). The new vendor can provide a vertical or industry solution that supports a customer's specific needs. Further, the third-party vendor is responsible for quality assurance and maintenance, reducing the burden on the adopter. However, third-party solutions introduce complexity. In addition, there may be a release lag whereby a third-party vendor is supporting an older release of an ERP system than the one the implementation partner is currently offering to its customers. This is likely to be an issue during upgrading of an ERP system (Brehm et al., 2001). When selecting a third-party vendor, it is important that it complement the ERP system and add strategic value to the customer. New software should round out the solution and give a competitive advantage to the customer. Also important in the selection is a consideration of the impact of the third party on the entire project (Microsoft Corporation, 2011).

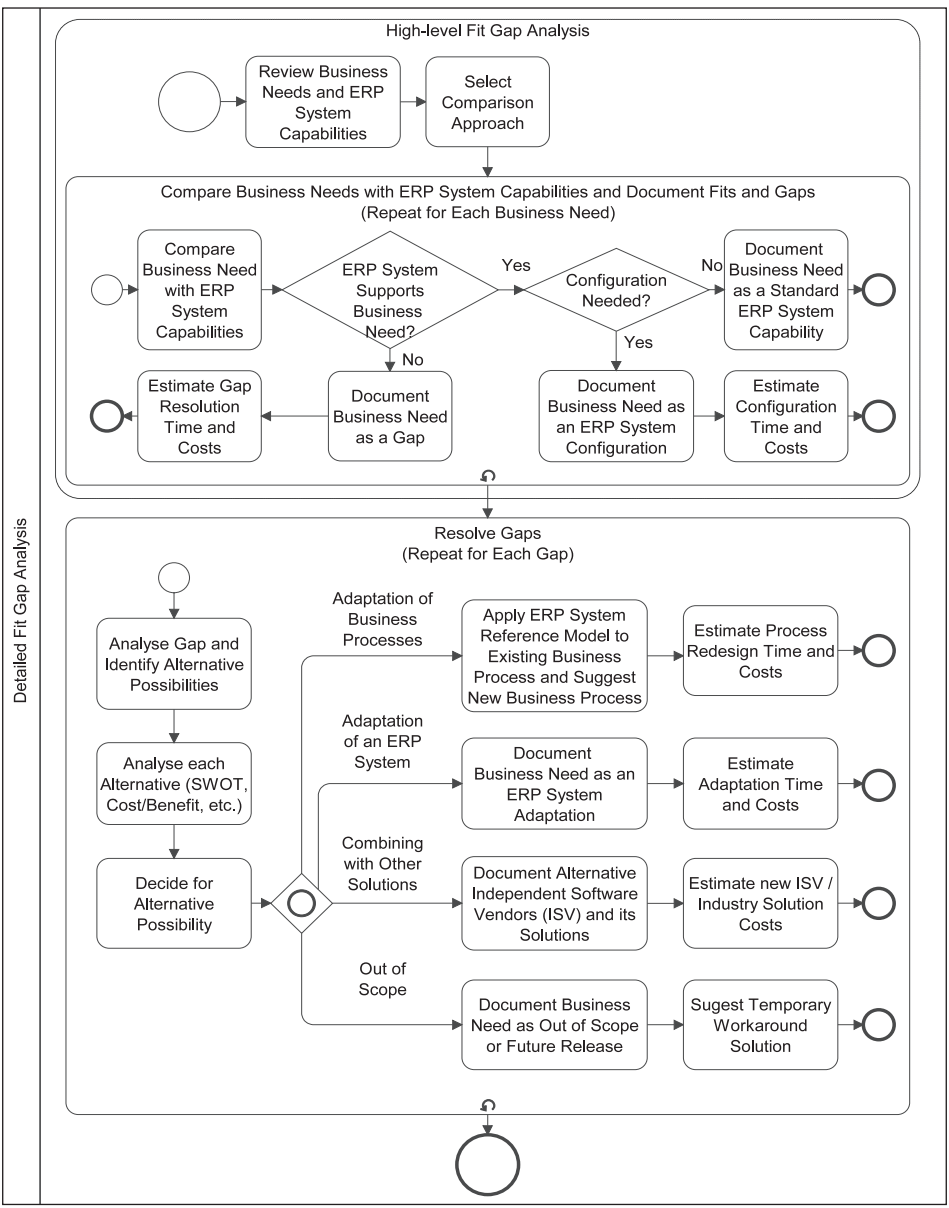
Out of Scope or Future Release

Business needs in the current project will not be supported and will be documented as out of scope or planned for future releases. This alternative leads to 'living with problems', which means that an organisation uses an ERP system that is not tailored to the way business is done. To enable the business to function, a viable workaround must be provided, e.g. using Microsoft Office tools.

Identified resolutions must be discussed with the customer when the complete solution approach is finalised and documented. The best possible alternative in the majority of

cases has proved to be a composite approach, i.e. a blend of acquired (ERP), integrated (best-of-breed) and engineered (adapted or built) applications. It seems optimal for standard business processes (e.g. accounting processes) to adapt to best practices, whereas customised business processes (e.g. order fulfilment) should in many cases adapt to company's business needs (Indihar Štemberger & Kovačič, 2008).

Figure 2: *Detailed Fit Gap Analysis Process*



4. DEMONSTRATION OF A PROCESS COMPARISON APPROACH

The traditional approach to scoping an ERP project is based on a modular-oriented functional fit gap analysis. This means that the functionality of each ERP module is compared with some definition of the functional requirements of the receiving organisation. In most of such consulting engagements, ERP consultants are asked to provide an unbiased analysis of the alignment of standard software with the business processes of the implementing organisation. Modules are isolated silos, and a modular-based fit gap analysis compares functionality within silos. Business processes flow across the silos and they hence represent the output/capability delivery of the implementing organisation. A fit gap analysis with a business process orientation provides an understanding of how the software would enable the end-to-end business, as opposed to comparing static functions within silos (Gulledge, 2006).

Process comparison is one of the fit gap analysis approaches such as simulation, brainstorming discussion or questionnaires. Each business need should be connected to an ERP system reference model process or activity. The process-based approach is often combined with other approaches, e.g. the questionnaire-based approach. A strong motivation for ERP vendors to develop reference models for their solutions has been to support the process-based selection of their systems (Rosemann, 2000).

This approach requires both an ERP system reference model and AS-IS company process models. At least until the beginning of the ERP selection, the process models should not be too detailed. Such a process model comparison has to deal with (Rosemann, 2000):

- different levels of abstraction in the models;
- different modelling languages (Soffer et al., 2003);
- different scopes (length and width) of the processes;
- differences in additional information (organisational units, input data, documents, related transactions); and
- different ways of naming.

TTF theory states that only standardised processes bring standardised tasks that can be supported by a proper technological solution. The use of business process reference models within ERP implementation projects is leading to an increase in the standardisation of processes – one of the critical success factors of BPM (Trkman, 2010).

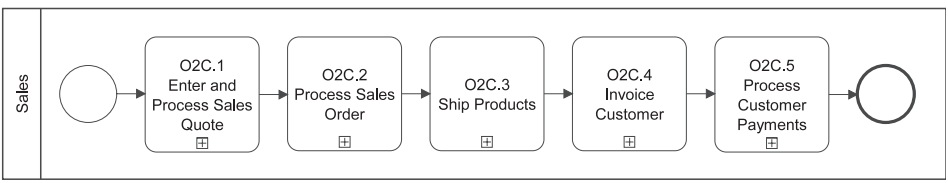
A process comparison could be achieved by using the reference model application methods found in the literature, e.g. the process merging technique suggested by Küster et al. (2006). Our demonstration shows how a company's supply chain processes are compared to an ERP system process reference model. The comparison approach is part of a high-level fit gap analysis. First, the Microsoft Dynamics NAV process reference model is presented and, in the second section, supply chain processes are connected to an ERP system process reference model. Process models are designed using BPMN notation, the world renowned standard (Object Management Group, 2011).

4.1. The Dynamics NAV process reference model

Dynamics NAV is an ERP system for SMEs (25–250 users). It is part of the Microsoft Dynamics business products family. Dynamics NAV is globally present, supporting 42 localisations – versions for a specific country or region. More than 94,000 organisations are using Dynamics NAV to support their daily operations. The system is implemented by Microsoft certified partners (value-added resellers) which have full access to the system business logic source code (Microsoft Corporation, 2013).

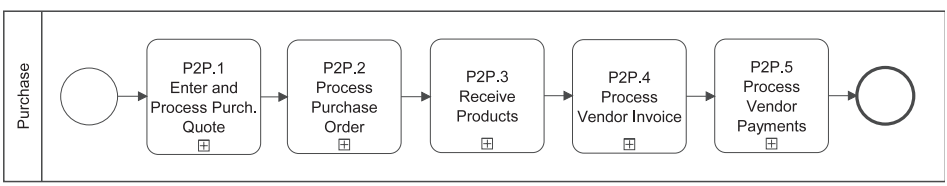
The reference model processes we are using for the demonstration case are available online (Pajk, 2013). The main reference processes used in the comparison are the sales and purchase processes.

Figure 3: *Reference model process: Sales Process – Order-to-Cash Cycle*



The sales process is also known as the "Order-to-Cash" (O2C) cycle. The overall process includes all activities from marketing and sales to customer-care processes. The sales reference model starts with a sales quotation process. After a quotation is confirmed, it is converted into a sales order. The order is further processed, confirmed and prepared for delivery. The warehouse staff pick up, pack and ship the orders. After the items have been sent out, an invoice is prepared and sent to the customer. At the end, money is collected and customer payments are recorded within the system.

Figure 4: *Reference model process: Purchasing process – Purchase-to-Pay Cycle*



The purchasing process or Purchase-to-pay (P2P) cycle covers the activities of requisitioning, purchasing, receiving and paying for goods and services. The purchase initiative can originate from make-to-order sales or production processes. Most companies base their purchases on sales forecasts. The process starts with RFQ (Request for Quotation) which is sent to a number of vendors by the purchasing department. The quotations received are compared with each other and the vendor is selected. The process continues

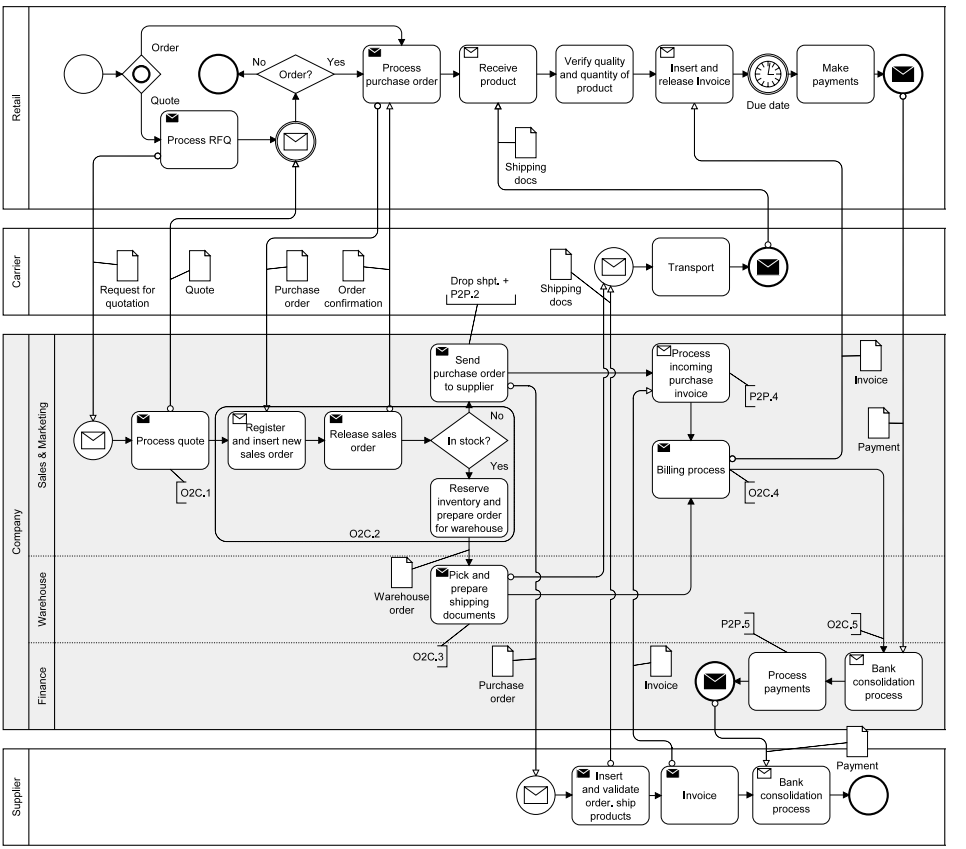
by creating and confirming the purchase order. When receiving goods the receipt document must match the company's purchase order. The invoice received from the vendor must be compared to the purchase order and receipt. Accepted and confirmed vendor invoices are posted in the system and paid via electronic banking on the due date.

4.2. A company's supply chain process

The case demonstrates the comparison of a company's supply chain processes to an ERP system process reference model. Figure 5 not only shows a company's processes but also the retail, carrier and suppliers' processes. The process model clarifies how processes are executed through the supply chain and displays the information flow with the related documents that are exchanged among the supply chain nodes.

The company would like to support its business processes by implementing an ERP system. An important phase of the ERP selection is a high-level fit gap analysis. The com-

Figure 5: *The Company's Supply Chain Process*



parison approach selected was a process comparison. The comparison is achieved by using the Dynamics NAV process reference model described in section 4.1.

The process comparison could be done by process domain experts or key users with the help of ERP system application consultants. Key users must therefore have basic knowledge of the business processes and BPMN notation. The process activities are linked to process reference model sub-processes at workshop meetings. Each process activity has a corresponding sub-process number, e.g. O2C.1, O2C.2, P2P.5 etc. The company's supply chain process visually shows how the process activities are connected and supported by the Dynamics NAV ERP system.

The process comparison could be used as a starting point for a detailed fit gap analysis or as a visual estimation of how a selected ERP system fits with the company's business needs.

Conclusion

Reference models have been defined in this paper as generic conceptual models which formalise recommended practices for a specific domain. The concept has been introduced to improve the selection and implementation phases of ERP systems. Reference models enable a company to use validated business processes and apply them to its specific needs.

Many companies are concerned that, by applying general reference models, they could lose the advantage of having a unique and perhaps better business practice. The decision about following the best practice approach or innovating is strategic. It calls for a clear prioritisation and categorisation of business processes. On the other hand, changes in demand and economic instability are forcing companies to react to changes in the business environment quickly and effectively. Following validated business practices in dynamic business environments could improve the agility of a company, which in turn could represent a strategic competitive advantage.

An important criterion used when selecting an ERP system is the fit with a company's current business processes. Fit gap analysis holds important consequences for project success (Hong & Kim, 2002). One of the output metrics of the analysis is the degree of fit. Even though the metric is only an estimation, it provides a high-level overview and understanding of the project risk. A low degree of fit could also lead to a decision to select an ERP system of another vendor or to not select an ERP system at all.

This paper focused on reference model application approaches. As an application approach, we described a process comparison as part of a fit gap analysis. In a process comparison, enterprise-specific models are compared with the ERP reference model. The fit gap analysis BPMN process model represents the first contribution of the paper. It provides a description of activities, steps and possible outcome alternatives. The dem-

onstration of the process comparison approach constitutes the practical contribution of this paper. The comparison approach can be used within fit gap analysis as a standalone or in combination with other comparison approaches. The suggested process comparison approach compares the Dynamics NAV process reference model and a supply chain business process.

The paper has many limitations and possible avenues for future work. It is necessary to conduct more empirical research on the application of reference models to determine how a reference model can be used in practice (Fettke & Loos, 2007). In this paper, the reference model process comparison approach is presented based on a supply chain process example only. A survey or multiple case studies analysing process comparison approaches used in practice (e.g. by Slovenian companies) is one opportunity for future research. Robust fit gap techniques are also needed to enable customers to identify the differences between an ERP system and their current business processes and needs (Sawyer, 2001). The development of process-based fit gap approaches using reference models relying on design science research recommendations is an important area of future research, especially for practice. Process reference models can be used in all phases of an ERP implementation lifecycle (Rosemann, 2000). Microsoft Dynamics Sure Step is a product-specific ERP implementation methodology. Possible future work could involve the application of process reference models within all Dynamics Sure Step implementation phases (Diagnostic, Analysis, Design, Development, Deployment and Operation).

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