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Business Process Model Reuse In A Multi-Channel / Multi-Product Environment–Problem Identification And Tentative Design

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BUSINESS PROCESS MODEL REUSE IN A MULTI-CHANNEL / MULTI-PRODUCT ENVIRONMENT – PROBLEM IDENTIFICATION AND TENTATIVE DESIGN

Research in Progress

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Abstract

Business Process Modeling has become a common activity in organisations. However, as the number of process models increases, so too does the number of duplicated models increase and the level of process model reuse has been found to be surprisingly low. In organisations which operate in an environment with multiple channels, products and customer types, complete process model reuse becomes especially challenging. Without a well-defined approach, such an environment could easily result in dozens of slight variations of what is essentially the same process which will lead to future model and repository management challenges. In response to this problem this paper reviews the literature of complete business process reuse in a multi-channel / multi-product environment. We find that there is a clear gap in the literature in terms of practical solutions that address the problem described but were able to distil five practices that can increase complete model reuse. This review and the practices described will help practitioners grappling with these challenges and paves the way for further needed research on this problem.

Keywords: Business process modeling, Model reuse

1 Introduction

Businesses face pressures on many fronts today. From increasing regulatory requirements, increasing competition, rapidly evolving technologies to increasing demands from customers for tailored products and improved service, a business must attempt to balance these demands whilst continuing to remain profitable. Compounding these pressures is the proliferation of new channels and organisations are now having to interact with customers through these channels (consider bricks and mortar, call centres, internet, mobile devices, email, social media, instant messaging and more) while customers are expecting seamless, improved and consistent experiences when dealing with the organisation (Seck and Philippe, 2011; Steinfield, Bouwman, and Adelaar, 2002). The integration (or not) of these channels has given rise to the terms multi-channel, cross-channel and omni-channel (Beck and Rygl, 2015): multi-channel retailing refers to an organisation using more than one channel to sell products and services but the channels are not integrated; cross-channel retailing refers to the selling of products or provision of services through more than one channel and where such channels are partially integrated in that the customer is able to interact using the channel of his choice and may even change channels during the same process; and omni-channel retailing refers to the full integration of all channels where the transaction is able to interact using more than one channel simultaneously. In this paper we will use the term "multi-channel" although the discussion also applies to cross-channel and omni-channel organisations.

At the heart of delivering anything (a physical product or a service) to the customer lies the process by which this is achieved. Possibly the most often quoted definition of a business process is that by Davenport (1993), who described a business process as "a structured, measured set of activities designed to produce a specific output for a particular customer or market" (p5). In order to understand their

business processes, Business Process Modeling (BPM) has become a common activity in large enterprises as it is fundamental to the improvement and automation of business processes (Indulska, Recker et al. 2009; Radgui, Saidi, and Mouline, 2013; Van Der Aalst, 2013). Process modelling has been defined differently by different authors (Kesari, Chang, and Seddon, 2003; Kim, 1995; Rosemann et al. 2009; Sayuri et al. 2011) depending on whether they are focussed on end-to-end process improvement (Indulska, Recker, et al. 2009; Sayuri et al. 2011), focussed on the interaction between the organisation and the customer (Kim, 1995), or based on a view that pictures are better than text generally (Kesari et al. 2003). However, the common theme in all these definitions is that a graphical representation of the business process is produced. Process models are built using modeling tools (software applications), a modeling technique (language), and modeling methods (conventions prescribing the process architecture, model types, symbol types and information to appear on the model). Several studies have compared modeling techniques (Aguilar-Saven, 2004; Recker et al. 2009) and the look and feel of the process model depends on the modeling technique used and the modeling method adopted. The selection of the tool, technique and method is important as not all modeling techniques are suitable for all purposes (Macintosh, 1993; Recker et al. 2009) and not all tools support all techniques. The selection of the tool, technique and method is dependent on the purpose of the model being constructed (Macintosh, 1993; Recker, 2006; Recker et al. 2009) and once these have been decided, process modeling can begin.

Naturally, organisations that have begun to model their processes wish to reuse these processes and the question of how to achieve process model reuse arises. In spite of now having been part of business innovation for almost two decades, one study showed that only 10% of process modelers reused complete processes while 55% reused elements of processes (Fellmann and Koschmider, 2014). Furthermore, while only 14% of users were satisfied with tool features for reuse, satisfaction was not dependent on the tool used. Models for process model reuse have been proposed (Erol, 2016; Nolte et al. 2016) but the reuse of process models in organisations has received less attention than knowledge sharing and reuse (Koschmider et al. 2014; Saarsen and Dumas, 2016). We believe that this is indicative of a broader issue relating to the reuse of complete process models in practice. Hence the objective of this research is to identify business process modeling methods to increase complete process model reuse.

This paper represents the initial steps of a design science research (DSR) process. Peffers et al. (2007) describe a process model for DSR, consisting of problem identification and motivation, objectives of a solution, design and development, demonstration, evaluation and communication. This paper comprises two steps in that firstly we review the literature to identify the problem and motivate for the research and secondly, we propose some tentative design features of the method. These artifacts will later be refined, demonstrated and evaluated in an organizational setting. The initial literature search was conducted in four steps. 1) Search Google Scholar using relevant search strings. 2) Identify and review relevant articles. 3) Review relevant articles which had cited those found in step 2. 4) Review any relevant references in the articles reviewed. The initial search strings used were "business process model reuse", "business process patterns" and appropriate permutations of these phrases. The following sections describe and motivate for the research.

A process modeling method that improves process model reuse would be of value to organisations that carry out process modeling in an environment with multiple channels, products / services, and customer types. Therefore, the research question posed for this research is: *What research has been conducted into business process model reuse in a multi-channel / multi-product environment?* The remainder of this paper is structured as follows: literature review, theoretical framework, approaches to process model reuse and conclusion. The contribution of this paper is to identify a problem that occurs in business process modeling into which limited research has been conducted. This presents opportunities for further research.

2 Literature Review

Business Process Modeling has become an important practice common to most enterprises because a process model can be used for different purposes in different areas of an organisation. Some of the uses of process models listed in the literature include communication between stakeholders, input to training material, requirements definitions, identification of SOA services and business process management (Alotaibi, 2016; Davies et al. 2006; Kesari et al. 2003; Krogstie, Dalberg, and Jensen, 2006; Rosemann et al. 2009). Furthermore, building process models is an essential step in all process automation initiatives (Radgui et al. 2013; Van Der Aalst, 2013). Among the benefits of process modeling cited in the literature are: facilitating process improvement, improving understanding of business processes, improved communication between stakeholders, improved process analysis (Dalal et al. 2004; Indulska et al. 2009), managing complexity and documenting procedures (Van Der Aalst, 2013). In one study the top ten perceived business process modeling benefits were listed as process improvement, understanding, communication, model-driven process execution, process performance measurement, process analysis, knowledge management, reuse, process simulation and change management (Indulska, Green, et al. 2009).

Process models are created using modeling tools which can take one of two broad approaches when storing the models. Either the process models are stored as separate files (e.g. Microsoft Visio) or the models are stored in a central database (process repository) which is accessible to all users. Storing each process model as a separate file is not a practical option for large process modeling endeavours and most large organisations usually try to build a centralized process repository (Recker, 2006). Examples of process modeling tools in use are Aris Business Architect and iGrafx, while ERP systems from SAP and Oracle, and Business Process Management Suites from IBM, Software AG and Tibco Software also include a process modeling tool (Hallerbach, Bauer, and Reichert, 2010; Recker, 2006). Process modelling tools support different modelling languages.

Process modeling techniques (also known as languages or notations) specify the symbols, relationships and types of diagrams used to represent the business processes. These techniques were developed for different purposes and therefore the one selected should be based on the purpose of the process modeling. Examples of common techniques in use include UML, DFD, Petri Nets, Flow Charts, RAD, EPC, BPMN and BPEL (Nagm-Aldeen, Abdel-Fattah, and El-Khedr, 2015; Recker, 2006)

As technology evolves, enterprises are expected to offer their products and services through an ever-increasing number of channels. The practicalities of this are further complicated by the number of products and services that need to be offered. Taking a bank for example, multiple products and services (current accounts, savings accounts etc.) must be offered through a number of channels (physical branches, call centres, internet banking, mobile applications etc.) to multiple client types (business client, retail client etc.). The internal structure of the organisation also complicates matters as the responsibility for the product design, technical solution and the operational servicing of the customer is usually the responsibility of different parts of the organisation. However, the processes executed in each area will likely share pieces of common logic. Depending on the process modeling approach, this shared logic may be modelled separately in each area (Branco et al. 2014). Hallerbach et al. (2010) described a similar situation relating to car components where more than 20 variations of the same process were found based on product, supplier and the development phase of the component. This is depicted in Figure 1 where each column corresponds to an end-to-end process to open a current account for a client in two different channels. At this stage of the discussion each channel is being treated separately. In the situation where multiple channels are available, Figure 1 shows that the initial part of such processes is channel specific. For example, the initial part of the process is different when selling the account through a branch or a call centre, then there is a portion of the process which is common to all scenarios, no matter which channel it was initiated on. Finally, there may be some administrative processes that are common to the product but may differ depending on whether the client was a business client or a retail client.

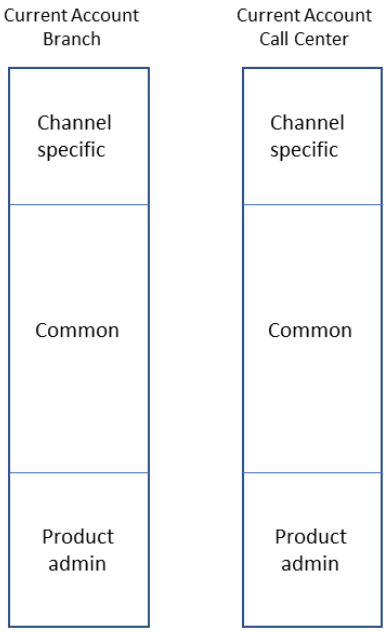

Figure 1: Commonalities and differences of a current account sale across channels

A client may wish to start in one channel and then switch to a different channel (e.g. possibly call the call centre) (Lockie, 2014; Verhoef, Kannan, and Inman, 2015). Due to the organisational structure issues referred to earlier, modeling this process flow becomes problematic because of the number of permutations that emerge. If there are four steps in a process, and two possible channels for each step, then there are eight possible permutations of process flow available. The permutations become even worse when there are four or five channels in use. This will be referred to as the multi-channel / multi-product dilemma in this paper.

While the benefits (Görsch, 2002; Herhausen et al. 2015; Lewis, Whysall, and Foster, 2014), integration requirements (Görsch, 2002; Lewis et al. 2014; Seck, 2013), and challenges (Lewis et al. 2014; Seck, 2013) of channel integration has been researched in the literature, no articles were found that addressed the multi-channel multi-product dilemma specifically. The mapping of business processes in a multi-channel environment is often carried out by different employees, in different parts of the organisation, for different projects and over an extended period of time (Branco et al. 2014). As the number of process models in the repository increases over time, new issues begin to appear (Hallerbach et al. 2010). Multiple versions of the same model, similar logic appearing in multiple models (Branco et al. 2014; Cuesta et al. 2015), difficulties in locating the correct version of a process model, and conflicting versions of a process model (Branco et al. 2014) are some of the issues that have been documented in the literature (Alotaibi, 2016; Hallerbach et al. 2010; Jonnavithula, Antunes, and Cranefield, 2015; Kumar and Yao, 2012; Reijers, Mans, and van der Toorn, 2009; Smirnov et al. 2012). One study found that only 10.2% of respondents reused complete process models (Koschmider et al. 2014) and this could be laying the foundation for future model and repository management challenges.

Process model collections are frequently stored in process repositories. As enterprises embark on process modeling, and the number of process models increases, so the size of the repository grows and the management of the model collection becomes more important. Model management has been listed as the 4th most important issue in business process modeling (Indulska, Recker, et al. 2009). The top 10 business process modeling issues identified in a study are shown in Table 1 (Indulska, Recker, et al. 2009).

Rank	Issue	Description
1	Standardization	Issues related to the standardization of modeling notations, tools, and methodologies.
2	Value of process modeling	Issues related to the value proposition of process modeling to the business.
3	Model-driven process execution	Issues related to the model-driven development of executable process code and the lifecycle of process modeling to execution.
4	Model management	Issues related to the management of process models such as publication, version, variant or release management.
5	Modeling level of detail	Issues related to the definition, identification or modeling of adequate levels of process abstraction.
6	Methodology	Issues related to the process of process modeling.
7	Governance	Issues related to the governance of process modeling efforts or projects.
8	Buy-in	Issues related to the acquisition or ongoing assurance of buy-in and commitment from process modeling sponsors.
9	Business-IT-divide	Issues related to the use of process modeling in IT versus business scenarios, application areas or communities.
10	Process orientation	Issues related to the development or education of a process-aware perspective in relevant stakeholders or organizational units.

Table 1: Overall top 10 business process modeling issues (Indulska, Recker, et al. 2009)

Many of the issues listed in Table 1 are related. Addressing one (or not) improves (or worsens) another. For example, lack of agreement within an enterprise regarding "Modeling level of detail" (Issue #5) could lead to two models being created for the same process with different levels of detail. This in turn will aggravate "Model management" (Issue #4) which is likely to negatively impact "Value of process modeling" (Issue #2). This is just one demonstration of the linkages between the issues listed in Table 1.

The lack of reuse of existing processes results in a number of negative outcomes for the organisation both in the short term and in the longer term. Firstly, it leads to unnecessary duplication of process models in the repository. The simple act of recreating a process model unnecessarily means that that effort is an unnecessary cost to the organisation. Secondly, the additional process models in the repository result in a larger repository, thereby increasing the management overhead associated with the repository. This impact is not immediate but evolves over a longer time period. Thirdly, multiple versions of the same process in the repository result in additional investigation being required in the future when that process ought to be reused. It is then not clear which version of the process should be used and time is wasted trying to figure the answer out. This problem may even set up a vicious cycle whereby it becomes easier for the process modeler to just create another version of the process which in turn exacerbates the problem. Fourthly, the number of process models in the repository which are no longer used increases, again impeding reuse for the same reasons as just explained.

All of these issues increase the cost of modeling and managing the business processes which eventually leads to the "Value of process modeling" (Issue #2) being brought into question. It is therefore in the interest of the organisation that the reuse of existing business process models be maximized where appropriate. This is supported by a study where process model reuse was identified as the 9th most important benefit that was expected and was also identified as a future challenge (Indulska, Recker, et al. 2009). It is intuitive that increasing the reuse of models in a collection will result in fewer new models having to be built. However, reuse of process models in practice is proving difficult due to limited support for process model reuse currently offered by vendors of modeling software (Koschmider, Fellmann, Schoknecht, and Oberweis, 2014). This in itself will increase the cost of the process modeling unnecessarily as it ought to be less expensive to reuse a process model rather than create it from scratch.

3 Theories for Process Model Reuse

Four types of process model reuse have been identified (Nolte et al. 2016):

- Initial Use: the original creation of the model.
- Revision: An update to the original model.
- Continued use: the sustained use of the model in support of one particular work task (e.g. continued use in a process improvement project).
- Repeated use: the repeated use of the model across multiple tasks (e.g. multiple projects).

A similar definition of reuse is "the post-creation usage of process models, thus using them for a different purpose, by a different user, or at a different point in time" (Nolte, Bernhard, and Recker, 2013). In the context of this study, we are interested in the "Repeated use" of a process model across multiple tasks and projects at a different point in time and the determinants of this type of reuse.

The factors driving the reuse of business process models have been investigated in a recent research paper (Nolte et al. 2013). The factors influencing the "intention to reuse" of the modeler were investigated as these were likely to translate into actual reuse. They wrote that "variance in an individual's intention to re-use a process model is dependent on (a) factors describing properties of the process model considered for re-use, and (b) characteristics of the individual process model user. These relationships are being moderated by (c) organisational factors that determine the extent of social and normative pressure on re-use behaviour, and (d) attributes of information systems that provide access to a model". This model is depicted in Figure 2.

Process model factors refer to issues relating to the process model that will influence the intention to reuse. Such factors include the perceived accuracy (credibility) of the model as well as the ease with which the model can be understood. Individual factors relate to issues such as the experience of the modeler and the motivation of the modeler to reuse. Technological factors are those which could be provided by the modeling tool in use. While making the existing models easy to find and access does not guarantee reuse, difficulty in finding models will ensure minimal reuse. Organisational factors are those factors which impact how modelers operate within their area. If a superior is not seen to reuse models, reuse is less likely to be practiced by the employee. If process model reuse is an accepted culture within the organisation, then a new modeler is likely to follow suit.

Based on this model, it is possible to identify interventions which would be expected to increase the level of reuse in an organisation. However, no practical guidance is offered to the process modeler to increase reuse.

Erol (2016) presented the process model for business process model reuse depicted in Figure 3. The meta-requirements for each activity were identified. At a high level, this model can be summarized as "Either find and adapt an existing model or create a new model". Again, no practical guidance is offered to the modeler.

These models of process reuse describe the factors influencing reuse and the steps that lead to reuse and although they make intuitive sense, no practical advice or solutions are offered regarding what an organisation and modelers should do to increase the level of reuse. Some potential approaches were identified and are now described.

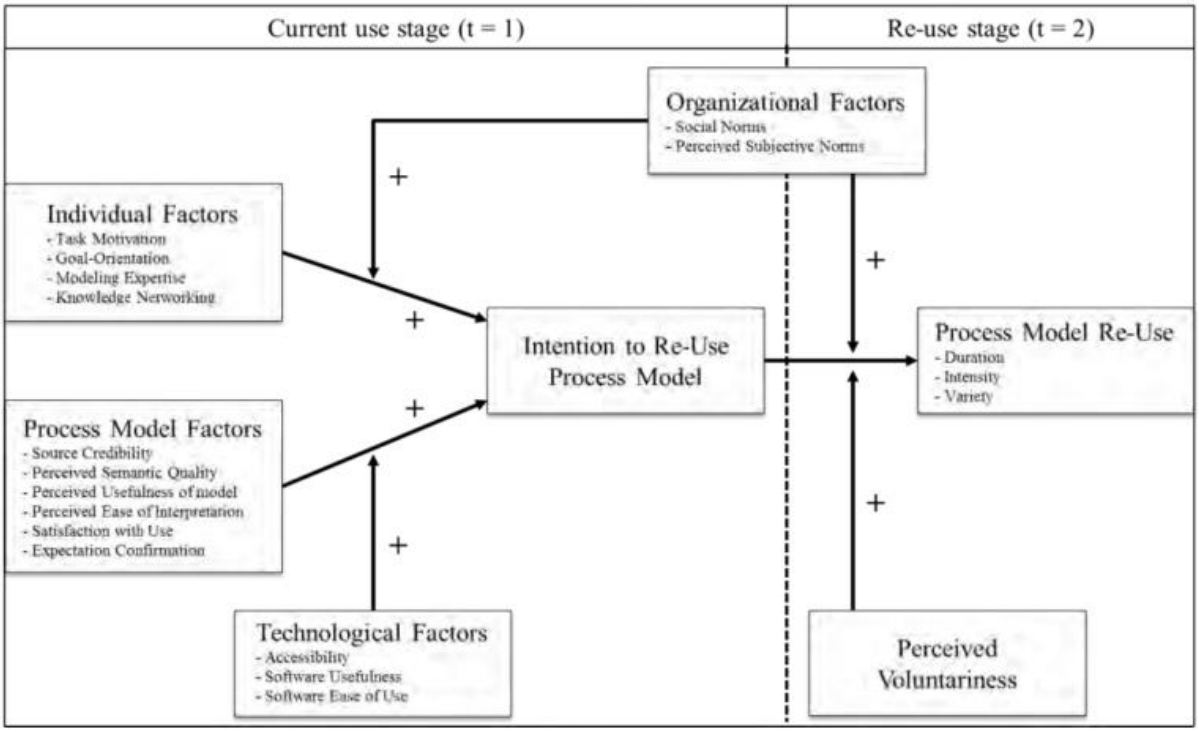

Figure 2: A Two-Stage Model of Process Model Re-Use (Nolte et al. 2013).

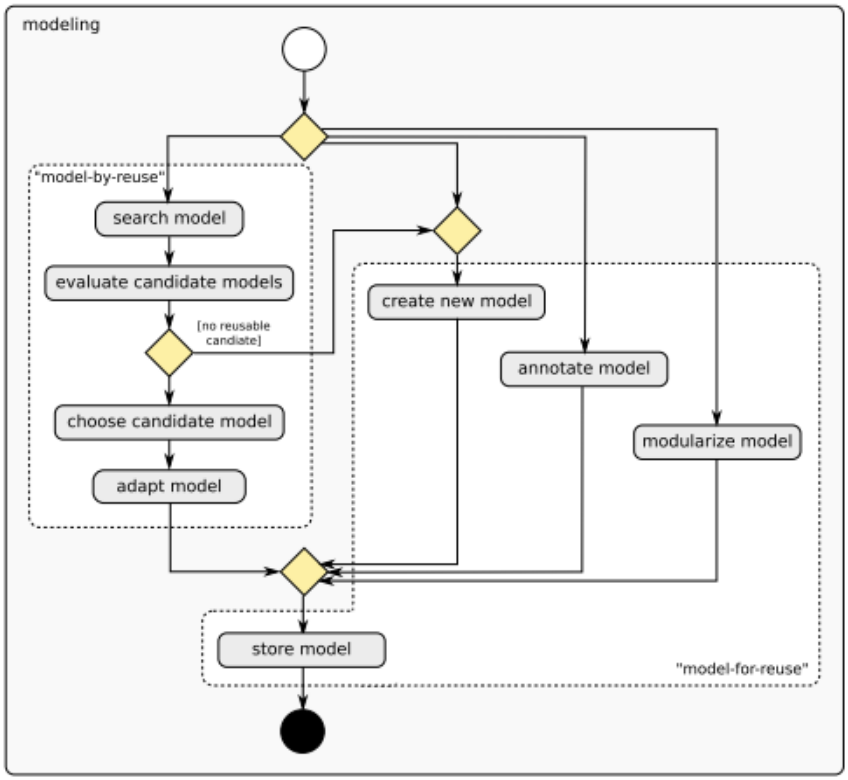

Figure 3: Process Model for business process model reuse (Erol, 2016)

4 Approaches to process model reuse

The approaches identified in the literature to increase process model reuse can be categorized into five high-level approaches:

- Identification of similar models
- Locating the models to reuse
- Separating Business Rules from the process models
- Variation Management
- Process Templates

4.1 Identification of similar models

Those organisations that have modelled processes for a long time will already have a repository containing possibly thousands of models with such models frequently sharing redundant logic (Dumas, García-Bañuelos, and Dijkman, 2009; Raduescu et al. 2006). In this case, the challenge becomes one of identifying similar (or identical) process models and then rationalizing such models.

In a survey of process similarity measures (Becker and Laue, 2011), eight properties that a similarity measure should have (e.g. it should be computationally quick to calculate) were proposed and twenty-three process similarity measures that had been reported in the literature were assessed and compared. This was done by starting with a base model and then applying different changes to the base model to create variants of the base model. The base model and these variants were used in the calculation of the similarity measures. It was shown that different similarity measures might rank the similarity of the processes differently and that no similarity measure fulfilled all eight desirable characteristics that were originally identified. Therefore, the similarity measure selected should be based on the use case.

These similarity measures offer an opportunity to identify similar / identical models in the repository and this information can serve as a basis for removing redundant process models from the repository. In the theoretical model of reuse this is a “Technological Factor” as it improves the “Accessibility” of the remaining process models in the repository.

4.2 Locating the models to reuse

The ease with which a modeler is able to find the appropriate process model in a repository is an issue in process modeling. Business process models are usually modelled in a hierarchy, whether this hierarchy is built from the top-down or from the bottom-up. Navigating process models through a hierarchy can be difficult and it is easy for the modeler to lose sight of exactly where he is both in the hierarchy and in the actual process (Figl, Kriglstein, and Koschmider, 2013). These difficulties will adversely impact the “Intention to reuse process model” parameter (through “Accessibility” in the “Technological Factors”) in the theoretical model which is directly linked to the actual level of reuse of the process model.

Three common approaches used to represent hierarchies are node-link, treemap and nested graph. The preferred method based on a survey of 14 experts was the node-link approach (Figl et al. 2013). An example of the node-link representation is shown in Figure 4.

This view of the process model hierarchy enables a modeler to navigate through the hierarchy more quickly than would be the case having to open each process model and then navigate from that model down to the next level in the hierarchy. Building a node-link view of the process models in the process repository would assist modelers to find the correct process model. However, none of the process modeling tools evaluated were able to create this view of the process models automatically (Figl et al. 2013).

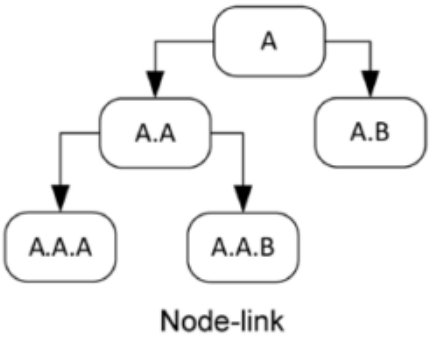

Figure 4: Node-link example (Figl et al. 2013)

4.3 Separating Business Rules from the process models

One of the reasons an organisation has many variations of a process is because business rules have been modelled in the process logic itself (Van Eijndhoven, Iacob, and Ponisio, 2008). The problem that arises is when another area in the organisation has a slightly different version of the business rule, it then becomes necessary to make a "copy" of the process and update the business rule at the appropriate place in the "new" process variant.

4.4 Variation Management

Managing, finding, and reusing process models has seen an exponential increase in the numbers of papers published (Dijkman, La Rosa, and Reijers, 2012). These cover areas of interest such as identifying similar models, making recommendations to modelers regarding which process to use, and modeling techniques based on templates.

One approach is where the model is treated as an asset and an "asset tree" is used as a mechanism to store the model versions and its variants (Narendra et al. 2012). The "Asset Capability and Analysis Model" (ACAM) is used to specify the capabilities of the models and the "Asset Requirements and Constraints Model" (ARCM) to define the requirements. Algorithms were proposed that matched the capabilities to the requirements and the degree of match that was found (Narendra et al. 2012).

Another line of research relates to identifying recurring fragments of a process model and the reuse of such fragments (Markovic and Pereira, 2007; Smirnov et al. 2012). A fragment is a standalone piece of a business process that occurs frequently in the process repository. Fragments could be used to autocomplete a new process model or they could be substituted into a placeholder in a process template

4.5 The Use of Process Templates

The use of templates is a common practice in organisations to ensure a standard structure and "look and feel" for documents. They also ensure that important sections that should be in the document are not accidentally omitted. Similarly, process templates offer another approach that can be used to increase reuse of process models. Process templates can be used in business process modeling in two fundamentally different manners. Firstly, the process template can be used to generate a new process in the repository based on the template (Kumar and Yao, 2012), or the template can be used with configuration data which defines the instantiation of a process using the template (Tran, Coulette, and Vu, 2011). However, although using the template to generate a new process in the repository ensures consistency among the processes that were generated using the same template, it still results in additional process models in the repository which require maintenance. Changes required to one of the models that was based on the template may also have to be made manually to the other models that were also based on the same template. Worse still, a change made to a model based on the template but not needed in the other models, will mean that the updated model is now inconsistent with the original template that was used. Secondly, Reference models (e.g. SAP R3, ITIL) are another type of template that can be used. Soffer, Reinhartz-berger, and Sturm (2007) present a formal approach to customizing a reference

model to ensure the integrity of the result. Nevertheless, reference models must be used with care as the reference model may not be applicable to a given situation (Recker, 2006).

5 Conclusion

We showed how multi-channel / multi-product organisations need to cater for many permutations of the same or similar processes and such organisations will need to reuse complete business process models if redundant process models are to be avoided. Most reuse is related to reusing elements of process models with limited reuse of complete process models taking place and this would suggest that most modelers are creating new process models in their process modeling activities. Furthermore, the situation is likely to be even worse in an environment where the multi-channel / multi-product dilemma exists. There appears to be little published research that addresses business process modeling challenges in multi-channel / multi-product environments. Only one paper (Hallerbach et al. 2010) mentioned this problem directly and that was only in the context of the number of variations in the process that resulted. None of the literature reviewed offered any practical guidance to modelers and organisations regarding process model reuse. We believe that the issues that arise from a lack of process model reuse will continue to increase unless model reuse is addressed practically from the perspective of the practitioner. Accordingly, we identify four possible lines of research:

- What process model reuse approaches are best suited to reusing complete business process models?
- What are the characteristics of business process models that enable their complete reuse in multi-channel / multi-product organisations?
- What are the characteristics of multi-channel / multi product organisations that are successfully reusing complete business process models?
- Develop a process modeling method which is based on the reuse of complete process models.

As a first step, we have identified five approaches to model reuse which can potentially form part of a method we hope to design to address the model reuse problem.

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