A Lifecycle Model for Using Process Fragment in Business Process Modeling

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Abstract. Business organizations strive to increase the quality of their business processes and the productivity in modeling the business processes. Reuse of process modeling artifacts can contribute to achieving this goal. In this paper, we propose a lifecycle model for reusing process fragment in business process modeling, which (i) guides the business user in understanding and adopting the concepts of using process fragment in business process modeling; (ii) guides the development of business process modeling tool and business process repository that support reusing process fragment in business process modeling.

Introduction

The globalization of the economy and the ongoing change of the market challenge enterprises to adapt their business processes in a more systematic and agile manner to stratify increasing requirements on products and business services in order to stay competitive against their competitors [9]. Business Process Management (BPM) is an integrated concept designed to help organizations to analyze, model, execute, monitor and reengineer their business processes within or even across organizational boundaries. A governed approach of introducing and applying BPM in an organization is a basic prerequisite to ensure the success of the application of BPM. BPM Governance defines a set of guidelines and rules that helps enterprise ensuring the success and efficiency in carrying out BPM activities. One of the major ingredients of BPM Governance is Lifecycle Management.

[8] defines lifecycle as "*a series of stages through which something (as an individual, culture, or manufactured product) passes during its lifetime*". A BPM lifecycle model defines the stages in a BPM lifecycle and provides a methodology based on an iterative and incremental process for implementing business process management. Independent on the lifecycle models presented in recent works, business process modeling has been identified as a fundamental phase, because the quality of business processes resulted in the business process modeling phase is decisive to the success of business process management of an organization. However, modeling business process is time-consuming and error-prone. Therefore, how to help business

user to create high-quality business processes, increase process modeling efficiency and simplify works in business process modeling has become one of the topics that industry and academic are interested in. Reusing existing business process modeling artifacts can contribute to achieving this goal.

Reuse is not a brand new concept in information technology community. McIlroy has introduced software reuse as a means for overcoming software crisis in his paper "Mass Produced Software Components" [14] at the NATO Software Engineering Conference held in 1968. After that, different approaches have been discussed, experimented and applied in different domains of software engineering and development [4]. [3] proposed using process fragment as a container for reusable process elements in business process modeling.

A process fragment can be understood as a group of connected process elements that bear high potential reusability in modeling new business processes. The connectivity of the process elements is important property which eases the determination of the control flow of the process elements contained in the resulted process fragment. An important feature of process fragment is that it breaks down the complex process model into smaller and manageable fragments. These fragments are intended to be flexible and reusable building blocks for future process modeling. Reusing established process fragments in process modeling improves the quality of process models and enhances the efficiency of process modeling by avoiding reinvent the wheel. Process fragment provides a modular view of complex process models. This modularization reduces the complexity degree of verification, validation and analysis of business processes, since process fragments are less complex and are therefore easier to analyze. Moreover, different granularities of process fragments provide business user delimited views on process models, which eases the comprehensibility for business user [2].

Identifying and designing of reusable process fragments are not trivial. It requires a comprehensive understanding of the current business domains of the organization, while keeping the current and future business goals and strategies in mind. By studying the state of the art, we have noticed that the lifecycle models proposed either by the industry or by academic focus solely on the whole picture of business process management and are in general abstract. Although these models provide a solid foundation for BPM lifecycle management, there is no proposed lifecycle model for using process fragment in business process modeling.

In this paper, we propose a lifecycle model regards to using process fragment in business process modeling. We take the lifecycle model proposed in [13] as the baseline lifecycle model, which contains business process modeling, configuration, execution and analysis. The lifecycle model proposed in this paper can be considered as an extension and refinement of the business process modeling phase in the baseline BPM lifecycle model, which (i) guides the business user in understanding and adopting the concepts of using process fragment in business process modeling; (ii) guides the development of business process modeling tool and business process repository that support reusing process fragment in business process modeling.

Related Work

[1, 2] proposed the concept on using worklet in process modeling and execution to achieve more flexibility in workflows. A worklet is defined as a small, self-contained, complete workflow process which handles one specific task (action) in a larger, composite process (activity) [2]. A top-level process model captures the entire workflow at the macro level. Worklets are dynamically selected based on the context of each task in the macro process when the task has been initialized during execution. However, the work does not address the lifecycle model or the approach of reusing process modeling artifacts. [6] presented a mechanism for splitting a BPEL process into several process fragments so that each process fragment can be executed on different process engines. The splitting results in several process fragments and the message exchanges between these process fragments so that original execution semantic of the parent BPEL process can be hold. The mechanism focuses mainly from the perspective of run time on how to hold the original execution semantic while splitting a BPEL process into process fragments, while the concept on process fragment in this paper focuses on reuse of process modeling artifacts in design time. [11] presented a technique to enhance the analysis of the control flows of process models. The technique decomposes a process model into single-entry-single-exit process fragments, which are substantially smaller than the original process and therefore easier to analyze. Different lifecycle models for business process management have been proposed by leading BPM products vendors and by academic community. [SoJo05] presents a basic business process lifecycle model with three main phase, namely business process design, business process implementation, business process controlling. The BPM products of IBM support a lifecycle model with four phases: Model, Assemble, Deploy and Manage [12]. [13] presented a lifecycle model for Semantic Business Process Management and showed how the integration of semantic technologies can influent the baseline BPM lifecycle. However, none of the related work analyzed above focuses on using process fragment as a container for reusable process modeling artifacts in business process modeling and the lifecycle model for that.

A Proposed Lifecycle Model

In this section we propose a lifecycle model for using process fragments in business process modeling. The proposed lifecycle model reflects the ideal case, in which it begins with the planning phase, goes through the identification, (re-)design, annotation, storing, retrieving, tailoring, and integration phase and close the cycle by coming back to the planning phase as shown in Figure 1. Each of the phases in the proposed lifecycle has one or more purposes. In the following we go through each phase and show how each phase is related to and contributes to using process fragments in business process modeling.

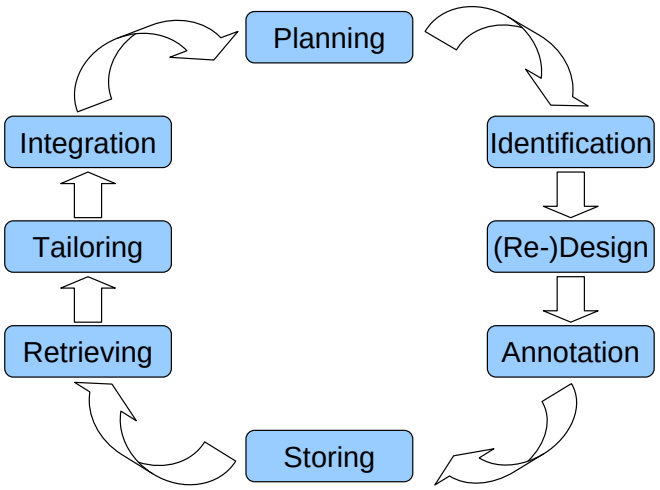

Fig. 1. A proposed lifecycle model for Using Process Fragment in Business Process Modeling

Planning

According to several surveys, most senior managers are concerned that the business processes and the applications that realize or support them, may not be properly aligned with the business goals and strategies of the organization [5]. Business goals and strategies that an organization strives for should always drive the downstream activities in a BPM lifecycle. In this way the business goals and strategies can be traced across the entire lifecycle from business goals, business processes and business services design, realization, to software components and applications [10]. For that reason, we propose to begin the lifecycle with the planning phase. The planning phase can be considered as a preparatory phase in the proposed lifecycle. In this phase the demand on and feasibility of introducing process fragment in modeling business processes in a business domain are analyzed. Design for reuse of business process modeling artifacts goes beyond the technical aspect. The driver of the (re-)design of business processes are manifold, it depends on factors such as business goals, strategies, regulations, and the feasibility of the operational implementation etc. in an organization. Change of these factors could lead to fundamental reengineering of the existing business processes, which reduces or even destroys the reusability of pre-modeled process fragments. Therefore, design for reuse is an investment bonded with risk and desires comprehensive consideration and support of management of the targeting organization.

Identification

The identification phase aims at identifying potential reusable process fragments. A group of process elements connected through control flow connectors can be

identified as reusable process fragment, if they posses one of the two properties collectively: the group of process elements as whole occurs frequently in existing process models; the group of process elements as whole has been planned for reuse in future process modeling. The occurrence frequency is a metric for the popularity of the application of the given group of process elements and indicates accordingly the reusability in future process modeling. The definition of the occurrence frequency depends on individual user requirement. For example, only the group of process elements that occurs more than 3 times among the given business processes should be identified as reusable process fragment.

In some cases, a given group of process elements may occur only once among the exiting business processes. But according the planning of future process modeling or business process reengineering, the business logic that described by the given group of process elements will gain more popularity of application in future process modeling. It is reasonable to identify such groups of process elements as process fragments. For example, in a pilot business reengineering project an organization has determined that part of an experimental process should be adopted in the next release of business processes of the organization. This part of the experimental process can be identified as a process fragment for reuse in future process modeling.

For identifying reusable process fragments the relations and dependencies between business processes within a business domain or across business domains should be firstly analyzed. The result may be used to confine the target scope for identifying process fragments, in order to avoid considering the whole business process landscape which leads to time-consuming work and high analysis complexity. In other words, only the group of coherent business processes should be considered. This reduces the complexity and effort of the activities.

In order to detect candidates as reusable process fragments, the selected business processes should be compared with each other for repeated or similar business logics. The business processes to compare can be from the same business domain or even from different business domains, in which repeated business logics may occur. The identification can be followed in a manual or an (semi-)automatic manner. In the manual manner, business analyst must go through the target process models and try to detect candidates of process fragment based on their understanding of these business processes. However, according to the survey presented in [7], this kind of detection requires expert knowledge in the business domain and is time-consuming and imprecise. A (semi-)automatic way is therefore necessary for detecting process fragments among complex business processes.

(Re-)Design

A process fragment for reuse should have completed and closed business logic, clearly defined and independent data and control flow and other characteristics that foster the reusability of the process fragment. The identified process fragments in the previous phase should be extracted or designed from scratch for later reuse.

The process fragments identified in the previous phase must be extracted from the nesting business processes for storage. By extracting the identified process fragments, the resulted process fragments may need to be re-designed. For example, before

storing an extracted process fragments into a process repository, user may want to leave out some process elements or some attributes of the process elements to hide sensible information or just to make the process fragment a template fragment.

When modeling new business processes, new introduced business logics can be modeled as process fragments, if frequent application of the process fragments can be predicted in future process modeling. The prediction should base on the results in the planning and identification phases.

The process modeling tool should provide user features for selecting which process elements they want to encapsulate into one process fragment. The process modeling tool should help user to extract the process fragment that contains the selected process elements while keeping them connected in the resulted process fragment. In addition, the process modeling tool should allow user to model a process fragment from scratch.

Annotation

One of the key issues in reusing process fragment is the ability to discover them effectively. Only the inherent data that a process fragment bears may not be enough for that purpose. The annotation phase should allow user to enrich the (re-)designed process fragments with additional information, called meta-data, in order to enhance the efficiency in querying process fragments. Such meta-data could be, but not limited to:

- Business domain: To which business domains the process fragment belongs? E.g. billing.
- Business function: Which business functions the process fragment describes? E.g. invoice.
- Organizational unit: Which organization units are involved in the process fragments? E.g. owner of the process fragment, involved organizational unit, roles, etc.
- Compliance: To which policy or compliance does the process fragment conform? E.g. Payment Services Directive (PSD) of the European Union.
- Key Performance Indicator: Which key performance indicators the process fragment should achieve? E.g. the cost of the process fragment should lower than 2 Euro.

The meta-data presented here are only a subset of relevant meta-data. Some meta-data can be automatically annotated by the process modeling tool or the process repository, e.g. creator, timestamp of modification and so on. In practice, an organization should define a catalog for meta-data that can be used to annotate process fragments and process models. The process modeling tool should provide user the capability to annotate process fragments and process models based on the pre-defined meta-data catalog.

Storing and Retrieving

With the growth of the numbers of process fragments, a systematic management mechanism of process fragments and process models should be provided. The business process repository plays an important role in reusing process fragment in business process modeling. The designed and annotated process fragments should be stored in a process repository for later reuse. The process repository should store not only process fragments and process models but also the meta-data that are associated with them. In addition, the process repository should provide extended functionalities for organize and search process modeling artifacts, e.g. user management, access control, version control and query capability. An advanced repository may also derive the relations or dependencies between process modeling artifacts automatically or utilize auditing information to provide extended features.

Before modeling a business process completely from scratch, the business process repository should be queried for process fragments that are appropriate to fulfill the business requirements from the business perspective, e.g. business functions implemented by this process fragment and to integrate with modeled process elements of the aiming business process from the technical perspective, e.g. modeling language used etc. The result of the query against the business process repository may be a total match, a partial match, or even no match. A total match indicates that the process fragment found satisfies all the criteria that business user specified for query. In this case, the process fragment can be entirely reused and integrated into the new business process. By partial match, the process fragment found can be customized by business user, in order to make it suitable to fulfill the new requirements. If no match was found, business user then have to model the artifacts from scratch. However, for the last two cases, it is worth to analyze and consider whether the tailored process fragment and the new modeled process elements should be added to the business process repository as new process fragment for later reuse.

Tailoring

As we have discussed before, design for reuse is bound with risk. Even process fragments are designed for reuse; they may not be completely satisfying the new business context. In this case, business user may want to tailor the process fragment. Tailoring a process fragments consists of loading a process fragment into the modeling environment and changing it. New process elements may be added; deprecated process elements may be deleted or replaced; the sequences of the process elements may be changed, process elements and attributes of process elements should be completed and so on.

Integration

The integration phase closes the cycle in the proposed lifecycle model. The selected process fragment with or without tailoring will be reuse to make the business process being modeled more complete. The integration of the selected process fragment may

follow a manual or (semi-)automatic manner. In the manual manner, business user must stitch the loaded process fragment with the pre-modeled process elements together. In the semi-automatic manner, the modeling tool should suggest reasonable possibility of composing the process fragment with the pre-modeled process elements. The automatic manner integrates the process fragment without human intervention. However, it is highly complex and desires intensive research.

Conclusions and Future Work

The application of reuse in business process modeling contributes to increase the quality of business processes and the productivity of business process modeling. In this paper we proposed a lifecycle model, which (i) guides the business user in understanding and adopting the concepts of using process fragment in business process modeling; (ii) guides the development of business process modeling tool and business process repository that support reusing process fragment in business process modeling.

Future work should continue refining the lifecycle model. In addition, a lot of issues that included in each phase in the proposed lifecycle model have to be addressed, e.g. modeling tool support, annotation mechanisms, version model in process repository, query processing, and etc.

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References

1. Adams, Michael J.; ter Hofstede, Arthur H.M.;Edmond, David; van der Aalst, Wil M.P.: Facilitating Flexibility and Dynamic Exception Handling in Workflows through Worklets. In Bello, Orlando; Eder, Johann; Pastor, Oscar; Falcao e Cunha, Joao (Eds.) Proc. of 17th International Conference on Advanced Information Systems Engineering (CAiSE'05) Forum, CEUR Workshop Proceedings, Vol. 161, pp. 45-50, 2005
2. Adams, Michael J.; ter Hofstede, Arthur H.M.;Edmond, David; van der Aalst, Wil M.P.: Worklets: A Service-Oriented Implementation of Dynamic Flexibility in Workflows. In: Meersman, Robert; Tari, Zahir (Eds.) Proc. of OTM Confederated International Conferences On the Move to Meaningful Internet Systems 2006, LNCS Vol. 4275, pp. 291-308. Springer, Berlin / Heidelberg, Germany, 2006
3. Karastoyanova, Dimka; van Lessen, Tammo; Leymann, Frank, Ma, Zhilei; Nitzsche, Jörg; Wetzstein, Branimir; Bhiri, Sami; Hauswirth, Manfred; Zaremba. Maciej: A Reference Architecture for Semantic Business Process Management Systems. In: Proc. of Multikonferenz Wirtschaftsinformatik 2008 (MKWI 2008) (To Be Appear)
4. Frakes, William B.; Kang, Kyo: Software Reuse Research: Status and Future. In: IEEE Transactions on Software Engineering, Vol. 31, Iss. 7, pp. 529-536. IEEE Press Piscataway, NJ, USA, 2005

5. Harmon, Paul: Second Generation Business Process Methodologies. In: Business Process Trends, Vol. 1, No. 5. 2003
6. Khalaf, Rania; Leymann, Frank: Role-based Decomposition of Business Processes using BPEL. In: Proc. of IEEE International Conference on Web Services (ICWS 2006), pp. 770-780. IEEE Computer Society, Washington, DC, USA, 2006
7. Koschmider, Agnes: Ähnlichkeitsbasierte Modellierungsunterstützung für Geschäftsprozesse. Dissertation. Karlsruhe University Press, University of Karlsruhe, Karlsruhe, Germany, November 2007. ISBN 978-3-86644-188-0 (In German)
8. Merriam-Webster's Online Dictionary.
9. Ma, Zhilei; Wetzstein, Branimir; Anicic, Darko; Heymans, Stijn; Leymann, Frank: Semantic Business Process Repository. In: Hepp, Martin; Hinkelmann, Knut; Karagiannis, Dimitris; Klein, Rüdiger; Stojanovic, Nenad: Proc. of the Workshop on Semantic Business Process and Product Lifecycle Management (SBPM 2007) in conjunction with the 3rd European Semantic Web Conference (ESWC 2007), CEUR Workshop Proceedings, Vol. 251, 2007
10. Papazoglou, Michael P.; Van Den Heuvel, Willem-Jan: Service-Oriented Design and Development Methodology. In: International Journal of Web Engineering and Technology (IJWET), Vol. 2, No.4, pp. 412 - 442. 2006
11. Vanhatalo, Jussi; Völzer, Hagen; Leymann, Frank: Faster and More Focused Control-Flow Analysis for Business Process Models Through SESE Decomposition. In: Krämer, B.J., Lin, K., Narasimhan, P. (Eds.) Proc. of 5th International Conference on Service-Oriented Computing (ICSOC2007), LNCS Vol. 4749, pp. 43-45. Springer, Berlin / Heidelberg, Germany, 2007
12. Wahli, Ueli; Avula, Vedavyas; Macleod, Hannah; Saeed, Mohamed; Vinther, Anders: Business Process Management: Modeling through Monitoring Using WebSphere V6.0.2 Products. International Business Machines Corporation, 2007
13. Wetzstein, Branimir; Ma, Zhilei; Filipowska, Agata; Kaczmarek, Monika; Bhiri, Sami.; Losada, Silvestre; Lopez-Cob, Jose-Manuel; Cicurel, Laurent: Semantic Business Process Management: A Lifecycle Based Requirements Analysis, Proceedings of the Workshop on Semantic Business Process and Product Lifecycle Management (SBPM-2007), Vol-251, CEUR-WS, June 2007, ISSN 1613-0073
14. McIlroy, Malcolm Douglas: Mass-Produced Software Components, Software Engineering Concepts and Techniques. In: Proc. of 1968 NATO Conference on Software Engineering, pp. 88-98. Petrocelli/Charter, New York 1969.