December 2005

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Abstract

Enterprise Systems potentially lead to significant efficiency gains but require a well-conducted configuration process. A configurable reference modelling language based on the widely used EPC notation, which can be used to specify Configurable EPCs (C-EPCs), has been developed to support the task of Enterprise Systems configuration. This paper presents a laboratory experiment on C-EPCs and discusses empirical data on the comparison of C-EPCs to regular EPCs. Using the Method Adoption Model we report on modeller's perceptions as to the usefulness and ease of use of C-EPCs, concluding that C-EPCs provide sufficient yet improvable conceptual support towards reference model configuration.

Keywords

IS Development Methods, Process Modelling, Enterprise Systems, Configuration

INTRODUCTION

Many organizations suffer problems from badly implemented Enterprise Systems (ES) (Scott and Vessey, 2002). Both academia and industry state that these problems result from a misalignment between business and IT, which, once closed, would lead to significantly improved business performance (Sabherwal and Chan, 2001). The notion of (mis-) alignment embraces amongst others the process dimension – i.e. the alignment of IT functionality to the actual business processes of an organization (Luftman *et al.*, 1993). In many cases, it is observed that the system hampers the normal way of handling processes instead of supporting it.

This is even more surprising given the fact that business process orientation as a concept has been a major topic in both academia and practice at least since the 1990's,see for instance the famous book by Hammer and Champy (1993) on process re-engineering. Alongside this trend, the IS community has experienced the proliferation of an enormous number of process modelling methods, including the Event-Driven Process Chains (EPC) (Keller *et al.*, 1992), which itself is used within the market-leading Enterprise System SAP for reference modelling purposes. In the context of Enterprise Systems, *reference models*, which describe structure and functionality of the software packages on different levels of conceptual abstraction, are of particular interest (Curran *et al.*, 1997). They are, however, only of limited use to the ES configuration process, mainly due to a lack of conceptual support in the form of a configurable reference modelling language underlying the models.

Addressing this issue, we have been developing a new reference modelling approach which considers the configurable nature of an Enterprise System. The representation language of this approach is called a *Configurable EPC* (C-EPC). While previous research efforts have focused on the theoretical development of the meta model and the notation of C-EPCs (Rosemann and van der Aalst, 2005) and the process of model configuration for systems implementation (Dreiling *et al.*, 2005a; Dreiling *et al.*, 2005b), this paper considers an empirical perspective and seeks to evaluate the C-EPC notation from a user's perspective. The *aim of our paper* is the investigation of C-EPCs in terms of their perceived usefulness and perceived ease of use in comparison to traditional process reference modelling techniques in light of ES reference model configuration prerequisites and demands. We will show that C EPCs are not only perceived as conceptually more useful but also perceived as easier to use. We answer this research question through an experiment conducted with reference model users, a role that has been taken by trained postgraduate IT students at an Australian university.

Addressing our research objective, the remainder of our paper is structured as follows: We first discuss related research in the fields of Enterprise Systems and configurable reference modelling. Then, we briefly introduce the notion of the C-EPC modelling technique. After introducing the Method Adoption Model (MAM) (Moody, 2001) as an appropriate theoretical reference framework for assessing the user perception towards a newly introduced analysis and design method, we report on the design of our experiment and questionnaire and then evaluate and discuss the findings from our empirical testing of the C-EPC. This paper closes by proposing conclusions drawn from our research, discussing its limitations and presenting future research topics.

BACKGROUND & RELATED WORK

Enterprise Systems

The term Enterprise System (ES) – alias Enterprise Resource Planning (ERP) system – stands for integrated information systems that aim at holistically supporting the operational processes of organizations. Over the last decade, Enterprise Systems, encompassing a range of functionality for supporting routine business processes, have become a wide-spread means for organizations to overcome the limitations of fragmented and incompatible legacy systems. The academic community responded to that popularity, with contributions among others to the configuration of ERP systems (Soffer *et al.*, 2003), ERP modelling (Dalal *et al.*, 2004) and future ERP developments (Markus *et al.*, 2000). In their distributed form ES are highly generic packages, built to suit a wide variety of organizations throughout a range of business sectors. Business organizations, on the other hand, are highly specific and complex systems. The alignment of the wide range of ES functionality to business processes consequently denotes a major area of interest, both in practice and academia. Examples include amongst others well-documented lists of failure stories (Scott and Vessey, 2002) and ES implementation misfits (Soh *et al.*, 2003).

This academic discussion underlines a need for new, preferably process-aligned and model-driven, approaches towards ES configuration. This motivates the idea of transferring insights from existing ES reference models, which have already been developed to improve the understandability of software systems towards this task.

Configurable Reference Modelling

Although application reference models are distributed by Enterprise System vendors, they are seldom deployed in the process of configuring Enterprise Systems. Kesari *et al.* (2003) studied the usefulness of regular process modelling techniques in the context of Enterprise Systems implementation and concluded that current reference models provide little help as to the implementation of package application software, but are in general considered valuable in software implementation projects. Regarding current practice in ES configuration, SAP's Implementation Guide for R/3 Customizing (IMG) caters for configuration of ES by switching functionality on or off (Bancroft *et al.*, 1997) based on several thousand configuration tables, defining how the system should function, what a transaction screen looks like, or what kinds of information a process will require. Configuration decisions made within the IMG do affect processes within the ES landscape; however, there is no explicit support on how the actual processes are altered. There is also no intuitive conceptual layer "on top of the IMG" which visualizes and facilitates the configuration decisions.

Addressing this conceptual lack of support, various research has focussed the field of configurable reference modelling, amongst them the perspectives-based configurable reference process modelling approach by Becker *et al.* (2004). While their work focuses on adaptation mechanisms and proposes several mechanisms for transforming a reference model into an individual model, our research pursues a holistic model-driven approach towards ES configuration. Soffer *et al.*'s (2003) suggestions on ERP modelling are also close to our ideas. Following the concept of scenario-based requirements engineering, they evaluate the Object-Process Modelling Methodology in order to determine a most appropriate ERP system representation language. The so-called argumentation facet, related to the ability of a modelling language to express optionality-related information, is one of many of their criteria. Their work does not comprehensively analyse requirements related to modelling ERP configurability and focuses on technique evaluation rather than on technique development. Gulla and Brasethvik (2000) introduce three process modelling tiers to manage the complexity of process modelling in comprehensive ERP Systems projects. Their functional tier dimension deals with the functionality of the Enterprise System. However, they do not study how reference models fit into in this tier.

CONFIGURABLE EVENT-DRIVEN PROCESS CHAINS

Conceptual Foundation

Current reference modelling languages lack conceptual support towards the task of model configuration. Consider the SAP reference model (Curran *et al.*, 1997), which is depicted in the EPC notation: In the version

4.6 it covers more than 1,000 business processes and inter-organizational business scenarios. As any of the reference processes (represented by an EPC) typically not includes merely one proposed alternative for conducting business in a certain domain but a range of often mutually exclusive alternatives, it denotes an 'upperbound' of process models that may possibly be implemented in a particular enterprise. As an organization might merely favour one of the depicted alternatives, they potentially only refer to a subset of ES functionality to be implemented and accordingly only to a subset of the reference model. Up to today, however, these types of decision cannot be reflected within the 'upperbound' reference model due to lacking configuration support of the underlying reference modelling language. Existing reference modelling techniques do not support the highlighting and selection of different (process) alternatives.

Addressing these issues in the extension and refinement of the EPC modelling technique, our work was based on so-called *configuration patterns* that (re-) occur during configuration (Dreiling *et al.*, 2005a). These patterns were embodied within the EPC technique, leading to its extension towards the C-EPC. The notion of a configurable EPC has been introduced and formalized in (Rosemann and van der Aalst, 2005), therefore we only discuss the basic notation here (see Table 1).

Notation Element	Description	Graphical Representation
Configurable Function	A configurable function can be switched ON (is always executed), OFF (is never executed), or OPT (decision is deferred to run time).	Conf. Function
Configurable XOR-Connector	A configurable XOR-connector can be mapped to a regular XOR-connector. Or it may be mapped to a concrete sequence SEQ_i out of available *n* process sequences.	$\otimes$
Configurable OR-Connector	A configurable OR-connector can be switched to an OR, AND, or XOR, or to a concrete process sequence SEQ_i.	$\vee$
Configurable AND-Connector	A configurable AND-connector remains the same but the number of parallel sequences supported by this connector can be altered.	$\wedge$
Configuration Requirement	A configuration requirements depicts constraints as to the setting of certain inter-related configurable nodes.	REQUIREMENT *If* A = OFF *Then* B = ON
Configuration Guideline	A configuration guideline depicts recommendations as to the setting of certain configurable nodes.	GUIDELINE *If* A=ON *Then* B=ON

Table 1. C-EPC notation elements

In a C-EPC functions and connectors can be configured. Notation-wise, these configurable nodes are denoted by thick circles. *Configurable functions* may be included (ON), excluded (OFF), or conditionally skipped (OPT). To be more specific, for configurable functions, a decision has to be made whether to perform this function in every process instance during run time, whether to dispose of this function permanently, *i.e.* it will not be executed in any process instance, or whether to defer this discussion to run time, *i.e.* for each process instance it has to be decided whether to execute the function or not.

Configurable connectors subsume possible build-time connector types that are less or equally expressive. Hence, a configurable connector can only be configured to a connector type that restricts its behaviour. A configurable OR-connector may be mapped to a regular OR-, XOR-, or AND-connector. Or, the OR-connector may be mapped to a single sequence of events and functions (indicated by SEQ_i for some process path starting with node *i*). A configurable AND-connector may only be mapped to a regular AND-connector with a decision being made as to how many of *n* available process sequences are to be executed in synchronization. A configurable XOR-connector may be mapped to a regular XOR-connector or to a single sequence SEQ_i.

In order to depict inter-dependencies between configurable EPC nodes, the notion of *configuration requirements* has been introduced. Inter-related configuration nodes may be limited by these requirements (constraints, which are best expressed using logical *If-Then*-expressions). In order to provide input in terms of recommendations and proposed industry best practices, *configuration guidelines* may be used to guide the configuration process semantically. Summarizing, requirements and guidelines represent hard (*must*) respectively soft (*should*) constraints.

Concluding, we introduced a configurable reference modelling language that potentially facilitates a model-driven selection and modification of process flows and activities. Figure 1 shows an exemplary part of the SAP reference model for Invoice Verification in both EPC (left part) and C-EPC (right part) notation.

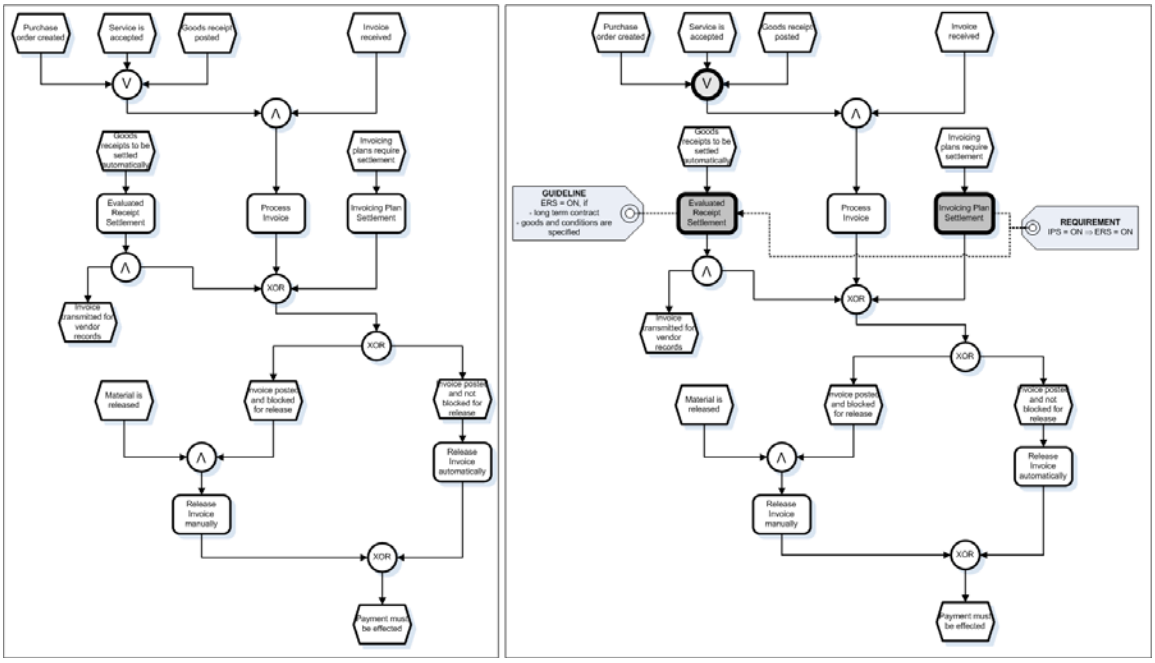

Figure 1: Example configurable reference model for invoice verification (in EPC and C-EPC notation)

Tool Support

The task of configuring reference models that have been deemed configurable by highlighting variation points embraces both a semantic and a syntactic dimension. While the former is concerned with making business configuration decisions in order to match organizational strategy and requirements, the latter is concerned with maintaining syntactical correctness within the configured models to ensure a lawful translation into executable process specifications at run time.

The semantic dimension of configuration was described in (Dreiling *et al.*, 2005a; Rosemann and van der Aalst, 2005). Basically, through the use of the C-EPC notation, process scenarios that are deemed desirable for a particular organization are selected. This is done by mapping configurable nodes within a C-EPC model to a desired setting, i.e. to a regular EPC node. Configuration requirements and configuration guidelines restrict respectively aid this task. The outcome of this phase is a C-EPC model where all configurable nodes have been switched to a certain setting. What, however, hasn't been ensured at that stage, is that these configured C-EPC models apply to the formal syntax of regular EPC. Inadvertently, the step beyond semantic configuration of C-EPC models from a business perspective is the task of re-establishing syntactical correctness and consistency, i.e. the translation of a configured C-EPC model into a lawful EPC model (Recker *et al.*, 2005).

In order to provide a viable and accepted approach towards this problem, we have developed a functional, tool-based solution for the configuration of ES reference models. The ARIS platform (Scheer, 1998) was chosen to implement and demonstrate an initial proof-of-concept prototype, called *Configurable ARIS* (cARIS). In (Dreiling *et al.*, 2005a) this prototype was outlined which we will now use for empirical testing. Since we are in this paper concerned with the user perception towards the C-EPC, we focus on the phase of *Visual Appraisal*, which basically denotes the "studying phase" during configuration. This phase is concerned with the prevailing pragmatic dimension that is manifested in the forms of intuitive understanding information and easy identification of procedures presented to the reference model user. As such, this dimension is prevalently concerned with increasing the *perceived ease of use* (Davis, 1989) of the reference model for a given task. The following three procedures were written to highlight perspectives of the process model that the modeller may want to quickly refer:

- *Show all Critical Functions*: This procedure highlights all non-configurable functions that are critical to the execution of the process.
- *Show Mandatory Configuration Decisions*: This procedure highlights all mandatory configuration decisions that the modeller has to make for the successful execution of the process.
- *Show Configuration Dependencies*: This procedure supports the identification of inter-relationships between configurable nodes, *i.e.* inter-dependent configuration decisions.

cARIS also supports the phases of *Perform Configuration* (configuring each configurable node via context menus) and *Commit Configuration* (saves newly configured models as regular lawful EPC models) (Dreiling *et* *al.*, 2005a). However, as we are here concerned with comparing the C-EPC to regular EPC with respect to reference model configuration support and as regular EPC cannot perform either of these two phases, we consider them out of scope and thus don't investigate them further.

THE USER PERSPECTIVE OF CONFIGURABLE REFERENCE MODELLING

Research Methodology

As we are concerned with developing a theoretically sound and practically feasible solution for the configuration of ES reference models, we need to evaluate the expressiveness and applicability of the C-EPC in reference modelling contexts. Ergo, for the development of the C-EPC we sought a comprehensive approach that incorporated theoretical considerations as well as empirical testing and observation. The need for such a comprehensive approach stems from our belief that theoretical investigations and considerations alone do not necessarily report on the practical adoption of modelling techniques, and, that empirical observations alone do not suffice to explain a technique's efficacy, understood as the combination of efficiency and effectiveness of a technique for a given objective (Moody, 2001). For theoretical guidance, we followed the Method Adoption Model (MAM) (Moody, 2001), which itself is based on the Technology Acceptance Model (TAM) (Davis, 1989). We deem MAM more useful in our research context as we seek to evaluate a IS design *method* rather than the adoption of a particular IT *artefact*. According to MAM, to prove that our conceptual solution effectively supports the configuration of reference models and will furthermore be adopted in business practice, we need to evaluate both the *actual* efficacy and the *perceived* efficacy of the C-EPC method. Figure 2 shows the Method Adoption Model, as used in our research context.

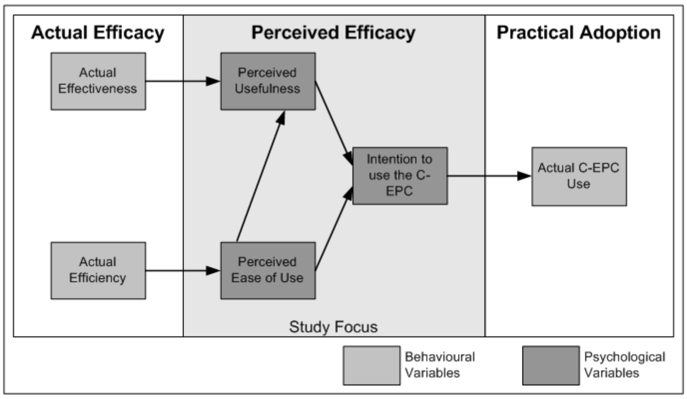

Figure 2: Method Adoption Model. Adapted and modified from (Moody, 2001)

As is shown in Figure 2, the evaluation of method adoption consists of three parts. In our research, we are solely concerned with the perceived efficacy of the C-EPC method. Our initial experiment did not focus on measuring the actual efficacy as we are not primarily concerned with model usage but rather with model understandability. However, a second study concerning the actual efficacy is currently underway. Also, as our research is still in the conceptual stages, we cannot evaluate the practical adoption of C-EPCs as they are not (yet) widespread in business practice. Instead, we focussed on evaluating the perceived efficacy, arguing that the antecedents of method usage in practice can be represented through the factors of *perceived ease of use*, defined as "the degree to which a person believes that using a particular method would be free of effort", (Moody, 2001, p. 255), and *perceived usefulness*, defines as "the degree to which a person believes that using a particular representation method will be effective in achieving its intended objectives", (Moody, 2001, p. 255). Based on MAM we postulate that the usage of the C-EPC by reference model users is determined by their intention towards it, which in turn is jointly determined by the perceived ease of use of the C-EPC and its perceived usefulness. The actual efficacy of the method, *i.e.* the actual efficiency and effectiveness only plays an indirect role in forecasting the practical adoption of the method, by determining perceptions of ease of use and usefulness, (Moody, 2001, p. 254). Nevertheless, as indicated in Figure 2, actual efficacy factors strongly influence the user perception. Hence, we propose the following hypotheses that the perceived usefulness (H1) and the perceived ease of use (H2) of C-EPCs, and ultimately the practical adoption of C-EPCs, will be positively influenced as follows:

H1: The C-EPC has more *expressive power* than the EPC in terms of identifying alternative configuration decisions in a reference model.

H2: The C-EPC *increases the clarity* of the configuration process in terms of selecting alternative configuration decisions in a reference model, as compared to the EPC.

Considering multiple theoretical and empirical modelling method evaluation approaches (Siau and Rossi, 1998), we selected a laboratory experiment with postgraduate students based on a questionnaire as an appropriate evaluation method in the context of MAM. This choice was made due to the following reasons: First, a laboratory experiment is deemed particularly useful for model/theory testing and exploration (Tichy, 1998), i.e. it may identify flaws in the theory (here: the C-EPC modelling technique) and it provides a way to open new areas for investigation (here: it provides a way to test a new modelling technique that, obviously, could not gain any support from a practitioner's side yet). Laboratory experiments have widely been used to explore variants and aspects of conceptual modelling techniques, both in the field of data modelling, see for instance (Bodart *et al.*, 2001) and process modelling, see for instance (Sarshar and Loos, 2005). The latter can be regarded as close to our research objective, as Sarshar and Loos use a laboratory experiment to compare EPC and Petri net control flows with regards to perceived ease-of-use and model comprehension. Second, a laboratory experiment provides the researcher with a controlled environment so that the external variables of consideration as well as their impact onto the evaluation objective can thoroughly and relative unbiasedly be examined. Third, due to the limited distribution of C-EPCs among reference model and Enterprise System practitioners, we deem ourselves unable to conduct more realistic evaluation research, as opportunities for case studies or action research methods do not yet prevail. Fourth, a student experiment gave us the opportunity to firstly educate the participants in the tested methods and tools to develop sufficient background experience.

We are well aware of the constraints and criticism related to such a laboratory experiment, *e.g.* the artificiality of the experiment setting, the simplicity of the experimental tasks, and the probable lack of realism (Siau and Rossi, 1998). Nonetheless we still find the experiment conducted well-suited for our research objective as we are primarily concerned with determining the perceived usefulness and the perceived ease of use of our approach *in comparison* to existing methods.

Experiment Design, Participants, and Data Collection

Initially, two reference process models were created, one in the traditional EPC notation and one in accordance to the C-EPC notation. Thereby, we were able to gather information as to the direct comparison of EPCs to C-EPCs. In addition, the participants were given access to the cARIS prototype to study the implementation of the C-EPC in a process modelling toolset. As there is no explicit tool support available for configuring classical EPC we did not compare the C-EPC tool support against EPC tool support but instead evaluated merely the perceived usefulness and ease of use of C-EPCs with or without tool support. A questionnaire[1] was designed to seek answers as to the perceived usefulness and perceived ease of use of the two different notations and the tool prototype, respectively. Sixteen postgraduate students in Information Technology, who have been selected based on their experience in EPC modelling, their training in the ARIS toolset and their education in the field of reference modelling, participated in the experiment. All participants received a set of instructions containing the sample scenario and the details of tasks to be performed.

Our experiment consisted of four parts: first, the students were to give demographic background about their level of experience in our research context. Second, they were to rate the conceptual support of the EPC modelling technique with respect to the questions outlined above. Third, they were to rate the conceptual support of the C-EPC modelling technique with respect to the questions outlined above. Fourth, they were to rate the tool support for the C-EPC modelling technique with respect to the questions outlined above.

Our experiment was based on a sample reference process for invoice verification, as shown in Figure 1. Both models were developed and made available in the ARIS toolset, with the C-EPC model also featuring an implementation of the cARIS prototype extension to ARIS.

Findings and Implications

The questionnaire conducted was three-fold: One set of questions was related to user opinions about the provided conceptual support in the phase of visual appraisal with respect to the tasks of identifying different configuration *alternatives*, *recommendations* as to performing a configuration, *prerequisites* of configuration decisions, and *consequences* and implications of configuration decisions. The interviewees were to rate the *perceived usefulness* of EPCs, C-EPCs, and C-EPCs with tool support on a scale from one (not at all useful) to ten (extremely useful). The results are summarized in Figure 3.

The results obtained show that for each task, C-EPCs were found to be more useful than EPCs, even more so if tool support is added via cARIS. This holds true especially for the identification of configuration requirements and recommendations. Except for the identification of configuration consequences, responses for C-EPC (without and with tool support) were relative evenly distributed, indicated by a substantial decrease in variance and standard deviation of responses (*e.g.* configuration requirements: variance (EPC): 6.308; variance (C-EPC):

[1] A copy of the interview protocol and the experiment draft is available from the authors on request.

2.797). In each of the four cases, the C-EPC with tool support was found to be most useful. However, it has to be noted that as to the conceptual support towards the identification of configuration consequences a) the C-EPC was not found to be extremely useful (average (C-EPC with tool support): 6.107), and b) responses varied extremely as to the usefulness of both EPC and C-EPC (variance (EPC): 6.242; variance (C-EPC): 4.835; variance (C-EPC with tool support): 5.468). This indicates an area of improvement as the conceptual support towards configuration consequences is deemed not yet sufficient.

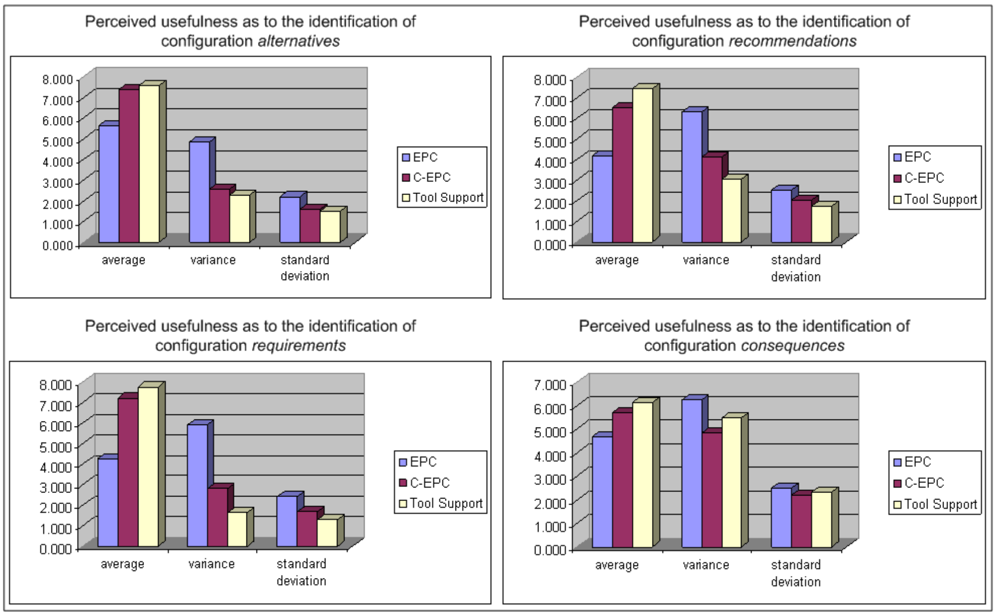

Figure 3: Perceived usefulness of approaches towards model configuration: Results

Another set of questions was related to the perceived ease of use of the C-EPC notation. The interviewees were to rate the *definition* and the *notation* of C-EPC constructs as to the unambiguousness and meaningfulness of the definition and as to the clarity of their visualization on a scale from one (lowest) to ten (highest). Figure 4 summarizes the responses.

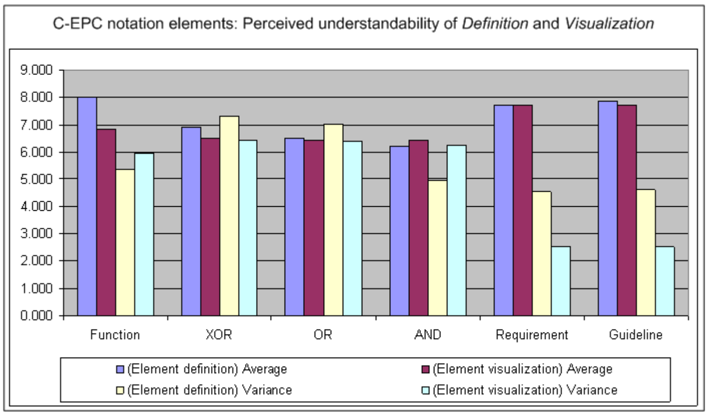

Figure 4: Perceived understandability of C-EPC notation constructs: Results

The results obtained indicate that the construct definitions for configurable function, requirement and guideline were perceived to be rather easy to understand whereas the definitions for configurable connectors were deemed somewhat harder to understand. This is indicated by the relative low average of responses (average (XOR): 6.929; average (OR): 6.500; average (AND): 6.214) as well as by the relative high degree of variance in the respective responses. As to the graphical visualization of the C-EPC, responses indicate that the depiction of configurable nodes may need refinement, whereas the depiction of requirements and recommendations was found to be sufficiently intuitive, indicated through a relative high average of responses and a relative low degree of response variance (variance (requirement): 1.590; variance (recommendation): 1.590). Overall, we conclude that the definition of the C-EPC needs to be refined in terms of understandability and in terms of visualization in order to overall improve its perceived ease of use.

A third set of questions was related to the actual execution of the tasks in the visual appraisal phase of configuration. The interviewees were asked how many configuration alternatives, recommendations, requirements, and consequences, all of which had been described in a textual outline of the scenario provided, they were able to identify *directly* from the reference model (both in EPC or C-EPC notation). Thus, we sought to answer questions related to the perceived ease of use of the two notations in terms of the Visual Appraisal stage of reference model configuration. Figure 5 summarizes the results.

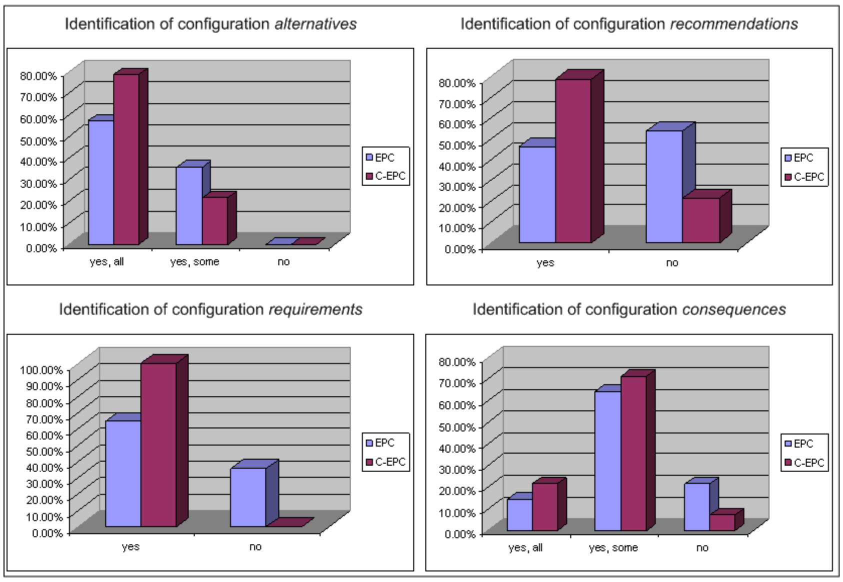

Figure 5: Perceived easiness of identifying model configuration facets: Results

The responses obtained clearly indicate that the C-EPC was perceived to provide an easier and more useful approach (compared to EPCs) towards these four tasks. This is indicated through the higher percentage of 'yes' answers in each case. It has to be noted, however, that the C-EPC, though it is perceived more as being more useful than the regular EPC, was not found to be sufficiently easy to use as to the task of identifying configuration consequences, as merely 21.43 % of the interviewees were able to identify all possible consequences of configuration decisions. On the other hand, this might also be an indication for lacking interviewee's experience in the field of configurative reference modelling.

CONCLUSIONS, LIMITATIONS, AND OUTLOOK

In this paper, we reported on the empirical investigation of the C-EPC reference modelling technique. We conducted a laboratory experiment with postgraduate IT students in order to evaluate the C-EPC language in comparison to classical EPCs and our cARIS prototype tool support towards reference model configuration. We concentrated on assessing the perceived usefulness and perceived ease of use. The reduced sample size of our experiment did not allow for statistical hypothesis testing as Chi-square or t-tests did not provide significant results. While in general the results of our empirical study are to be treated cautiously and considered in the context of its limitations regarding internal and external validity, our research findings nevertheless lead to the following conclusions:

- Regular EPCs seem to lack configuration support with respect to identifying and selecting Enterprise System configuration alternatives. The results obtained strongly suggest a perceived lack of usefulness and ease of use if regular EPCs in terms of reference model configuration.
- C-EPCs seem to provide an easier approach than EPCs towards the identification of configuration alternatives, requirements, recommendation, and consequences. For each question, the perceived usefulness and ease of use of the C-EPC was rated higher than the EPC. However, the results also suggest that the perceived usefulness of the C-EPC may be gradually increasable through adequate tool support.
- Without appropriate tool support, the C-EPC itself seems to lack usefulness and ease of use towards the task of identifying configuration consequences. The results obtained suggest a need for more conceptual and visual support towards the identification of process changes implied through certain configuration settings. It needs to be said, however, that such a task – similar to the task of performing and committing configuration – cannot be handled by a mere modelling language but instead needs to be supported through adequate modelling and configuration tools, which need hence to be further developed.
- The C-EPC technique may need refinement in terms of construct definition. Notation-wise, some configurable nodes may need more appropriate visualization. Definition-wise, configurable connectors

may need a more comprehensive definition of purpose. Ergo, the perceived ease of use of C-EPCs may be substantially increased by refining its formal definition and notation.

Overall, we conclude the results from our initial laboratory experiment suggest that our hypotheses H1 and H2 can be supported. However, the statistical validation of this claim is still outstanding. The results obtained indicate that both the expressive power of C-EPCs was perceived to be more useful than EPCs and the clarity of the configuration process was perceived as substantially increased in comparison to EPCs. There are as well certain indications for improvement, e.g. the notation needs to be refined, and tool support needs to be further extended and enhanced. The results also suggest that the task of ES configuration via configurable reference models is to a large extent dependant on appropriate and sophisticated tool support.

Our research has a few limitations: First, we did not compare the C-EPC against other configurable reference process modelling languages as, at the time of writing, we are not aware of such techniques. Second, our student experiment entirely focussed on perceived efficacy only and did not investigate actual efficacy. Third, our experiment does not report on the phases of *perform* respectively *commit configuration* but is instead limited to the phase of *visual appraisal* as the current prototype functionality for these two phases is not yet at a stage where it can be rigorously tested. Fourth, we conducted this experiment with students, who can only be to a certain degree an appropriate proxy for practitioners. Yet, the purpose of this research was to gain *initial insights* into the user acceptance of C-EPCs and as such, our study proved to be a good proxy for real business settings.

Our future research will take on the limitations. Based on the outcomes of this study we will revise and refine our investigation method, taking into account prevalent findings on the Unified Theory of Acceptance and Use of Technology (Venkatesh *et al.*, 2003), and apply it to real-world business scenarios to gain support for our hypotheses from practitioners. Also, we will develop a more sophisticated comprehensive tool support, based on currently undergoing collaborative research on a variant scheme of the EPML interchange format that will be used to ensure syntactic validity of our approach as well as to facilitate the interchange of C-EPC to other process languages. Accordant research is currently underway (Mendling *et al.*, 2005).

REFERENCES

Bancroft, N.H., Seip, H. and Sprengel, A. (1997) *Implementing Sap R/3: How to Introduce a Large System into a Large Organization*, Prentice Hall, Englewood Cliffs.

Becker, J., Delfmann, P., Dreiling, A., Knackstedt, R. and Kuropka, D. (2004) "Configurative Process Modeling - Outlining an Approach to increased Business Process Model Usability" in M. Khosrow-Pour (ed.) *Proceedings of the 14th Information Resources Management Association International Conference*, IRM Press, New Orleans, pp. 615-619.

Bodart, F., Patel, A., Sim, M. and Weber, R. (2001) Should Optional Properties Be Used in Conceptual Modelling? A Theory and Three Empirical Tests, *Information Systems Research*, 12, 384-405.

Curran, T., Keller, G. and Ladd, A. (1997) *SAP R/3 Business Blueprint: Understanding the Business Process Reference Model*, Prentice Hall PTR, Upper Saddle River.

Dalal, N.P., Kamath, M., Kolarik, W.J. and Sivaraman, E. (2004) Toward an integrated framework for modeling enterprise processes, *Communications of the ACM*, 47, 83-87.

Davis, F.D. (1989) Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology, *MIS Quarterly*, 13, 319-340.

Dreiling, A., Chiang, M., Rosemann, M. and van der Aalst, W. (2005a) "Towards an Understanding of Model-Driven Process Configuration and its Support at Large" in N. C. Romano (ed.) *Proceedings of the 2005 Americas Conference on Information Systems*, Association for Information Systems, Omaha, Nebraska, pp. 2084-2092.

Dreiling, A., Rosemann, M. and van der Aalst, W. (2005b) "From Conceptual Process Models to Running Workflows: A Holistic Approach for the Configuration of Enterprise Systems" in *Proceedings of the 2005 Pacific Asia Conference on Information Systems*, Bangkok, Thailand, pp. 363-376.

Gulla, J.A. and Brasethvik, T. (2000) "On the Challenges of Business Modeling in Large-Scale Reengineering Projects" in P. P. Chen, D. W. Embley, J. Kouloumdjian, S. W. Liddle and J. F. Roddick (eds.) *Proceedings of the 4th International Conference on Requirements Engineering*, IEEE, Schaumburg, pp. 17-26.

Hammer, M. and Champy, J. (1993) *Reengineering the Corporation: A Manifesto for Business Revolution*, Harpercollins, New York.

Keller, G., Nüttgens, M. and Scheer, A.-W. (1992) *Semantische Prozessmodellierung auf der Grundlage "Ereignisgesteuerter Prozessketten (EPK)"*, Working Paper, Institut für Wirtschaftsinformatik der Universität Saarbrücken, Saarbrücken.

Kesari, M., Chang, S. and Seddon, P.B. (2003) "A Content-Analytic Study of the Advantages and Disadvantages of Process Modelling" in J. Ang and S.-A. Knight (eds.) *Proceedings of the 14th Australasian Conference on Information Systems*, School of Management Information Systems, Perth.

Luftman, J.N., Lewis, P.R. and Oldach, S.H. (1993) Transforming the Enterprise: The Alignment of Business and Information Technology Strategies, *IBM Systems Journal*, 32, 198-221.

Markus, M.L., Petrie, D. and Axline, S. (2000) Bucking the Trends: What the Future May Hold for ERP Packages, *Information Systems Frontiers*, 2, 181-193.

Mendling, J., Recker, J., Rosemann, M. and van der Aalst, W. (2005) "Towards the Interchange of Configurable EPCs: An XML-based Approach for Reference Model Configuration" in U. Frank and J. Desel (eds.) *Proceedings of the Enterprise Modelling and Information Systems Architectures 2005*, German Informatics Society, Klagenfurt, pp. In Press.

Moody, D.L. (2001) *Dealing with Complexity: A Practical Method for Representing Large Entity Relationship Models,* PhD Thesis, Department Of Information Systems, University of Melbourne.

Recker, J., Rosemann, M., van der Aalst, W. and Mendling, J. (2005) "On the Syntax of Reference Model Configuration. Transforming the C-EPC into Lawful EPC Models" in E. Kindler and M. Nüttgens (eds.) *Proceedings of the Workshop on Business Process Reference Models*, Nancy, pp. 60-75.

Rosemann, M. and van der Aalst, W. (2005) A Configurable Reference Modelling Language, *Information Systems*, In Press.

Sabherwal, R. and Chan, Y.E. (2001) Alignment Between Business and IS Strategies: A Study of Prospectors, Analyzers, and Defenders, *Information Systems Research*, 12, 11-33.

Sarshar, K. and Loos, P. (2005) "Comparing the Control-Flow of EPC and Petri Net from the End-User Perspective" in W. van der Aalst, B. Benatallah, F. Casati and F. Curbera (eds.) *Proceedings of the 3rd International Conference on Business Process Management*, Springer, Nancy, France, pp. 434-439.

Scheer, A.-W. (1998) *ARIS - Business Process Frameworks,* Springer, Berlin et al.

Scott, J.E. and Vessey, I. (2002) Managing risks in enterprise systems implementations, *Communications of the ACM*, 45, 74-81.

Siau, K. and Rossi, M. (1998) "Evaluation of Information Modeling Methods -- A Review" in D. Dolk (ed.) *Proceedings of the 31st Hawaii International Conference on System Sciences*, Computer Society Press, Big Island, pp. 314-322.

Soffer, P., Golany, B. and Dori, D. (2003) ERP modeling: a comprehensive approach, *Information Systems*, 28, 673-690.

Soh, C., Sia, S.K., Boh, W.F. and Tang, M. (2003) Misalignments in ERP Implementation: A Dialectic Perspective, *International Journal of Human-Computer Interaction*, 16, 81-100.

Tichy, W. (1998) Should Computer Scientists Experiment More?, *Computer*, 31, 32-40.

Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D. (2003) User Acceptance of Information Technology: Toward a Unified View, *MIS Quarterly*, 27, 425-478.

ACKNOWLEDGEMENTS

This research has been funded by SAP Research and Queensland University of Technology with the ARC Linkage project “Modelling Configurable Business Processes”. SAP is a trademark of SAP AG, Germany.

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