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Preliminary Insights from a Multiple Case Study on Process Modelling Impact

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Abstract

Process modelling – the design and use of graphical documentations of an organisation's business processes – is a key method to document and use information about business processes in organisational projects. Still, despite current interest in process modelling, this area of study still faces essential challenges. One of the key unanswered questions concerns the impact of process modelling in organisational practice. Process modelling initiatives call for tangible results in the form of returns on the substantial investments that organisations undertake to achieve improved processes. This study explores the impact of process model use on end-users and its contribution to organisational success. We posit that the use of conceptual models creates impact in organisational process teams. We also report on a set of case studies in which we explore tentative evidence for the development of impact of process model use. The results of this work provide a better understanding of process modelling impact from information practices and also lead to insights into how organisations should conduct process modelling initiatives in order to achieve an optimum return on their investment.

Keywords

Business Process Modelling, Process Modelling Impact, Information Systems Analysis and Design, Case Study

INTRODUCTION

An important element in organizational or systems design projects is process modelling – the design and use of graphical documentations of an organisation's business processes (Ould 1995). Process models specify tasks, information and data, resources, actors and their relationships (Curtis et al. 1992). It has become one of the most popular forms of conceptual modelling (Davies et al. 2006) and is one of the most popular approaches to specifying information systems requirements from a business perspective.

Research in the field of process modelling increased over recent decades (Recker et al. 2009). The growing significance of process modelling in practice requires returns on the substantial spending of organisations to discover, design, analyse and improve their processes. These investments can be in the form of software acquisition and implementation, licensing fees, training of employees – especially in large modelling projects (Bandara et al. 2005; Raduescu et al. 2006). Continuous modelling efforts are only possible if organisations succeed in reaping, quantifying and effectively communicating the corresponding value (Indulska et al. 2009b). This presents an important challenge, as the impact so far has been hard to identify let alone quantify.

Our research sets out to examine the type and form of impacts that are generated through process model use in organisational practice. In doing so, we address the following research question:

> What are the impacts generated through the use of process models?

The key assertion that guides our research is that process models and the business domain information contained within them – such as tasks, roles, and resources – lead to various impacts among stakeholders involved in the business process (Kalpic and Bernus 2002; Koubarakis and Plexousakis 2002). We further argue that the positive benefits manifest on individual, group and process levels as the impact of process model use. Thus, in our research we examine the use of process models across different intended purposes, across different stakeholder groups and across different organizational levels. Our work has implications for the management of process modelling projects in terms of expectation and value management, as well as for research that examines the type and consequences of process model use in practice (Recker 2010a).

We proceed as follows. The next section discusses the existing research work related to this paper. Subsequently, the employed empirical research design is laid out. The research findings are presented in section

4. Section 5 discusses the results, research limitations and important implications. The paper ends with concluding remarks.

THEORETICAL BACKGROUND

Process Modelling

Organisations that are actively attempting to manage or improve the way they execute their business processes are typically relying on business process models – graphical documentations of their business operations (Ould 1995). These models specify in a standardised, semi-formal language the activities, responsibilities and control flow in a business process (Curtis et al. 1992). They can act as an instrument for sharing knowledge (Luebbe and Weske 2011), providing common language for different roles within the organisation, e.g., business and IT (Kueng and Kawalek 1997), and a common frame of reference (Dalberg et al. 2005; Munkvold et al. 2005).

Research in this area has demonstrated that the use of process models as visual representations of process information is more time-efficient for individual users than plain textual descriptions, since they are easier to understand and interpret (Ottensooser et al. 2012) and offer a more understandable, transparent and distinct description of an organisation's processes (Kalpic and Bernus 2002). Other research has demonstrated how individual understanding of business processes can be further aided through specific design choices made in process modelling; for instance, related to the use of colours (Reijers et al. 2011a), modularization (Reijers et al. 2011b) or the choice of different grammars (Recker and Dreiling 2011).

There is also work that examines shortcomings of process modelling as well as alternatives. For instance, Indulska et al. (2009c) report that the most pressing challenges in process modelling relate to methodological (e.g., artifact evaluation) and governance (e.g., standardization) aspects. Other work has demonstrated that for certain types of users, e.g., untrained analysts, textual use cases appear more suitable than graphical process models (Ottensooser et al. 2012). Finally, recent work has examined cognitive difficulties in working with process models that are traced back to poor visual design of these models (Figl et al. in Press).

While this knowledge to date has extended our understanding how individuals benefit from the use of process models and where limits to these benefits may be, the current research efforts fail to address two key issues: How does the use of process models in organisational practice lead to tangible benefits, and on what levels do these positive impacts of process model use manifest?

Process Modelling Impact

Several authors have attempted to examine the impact of process modelling on organisations. Through interviews with consultants, Kesari et al. (2003) identified documentation benefits (e.g., common language), design benefits (e.g., comprehending current processes), and use benefits (e.g., visual representation of processes) as advantages from process modelling. Aguilar-Savén (2004) argued that process modelling facilitates a common understanding and analysis of a business process. Danesh (2005) as well as Kock et al. (2009) found evidence for the impact of process model communication and information flow orientation on process redesign success, if the models were of high quality. Davies et al. (2006) identified a more effective stakeholder communication through process model use and the understanding of models' integration into business processes as important benefits and reasons to continue using conceptual modelling from a practitioner's point of view. Sadiq et al. (2007) found that BPM initiatives have positive effects of on process understanding. Through case study analysis, Krogstie et al. (2008) identified several valuable outputs of modelling work and model use, e.g., increased communication, the creation of a common frame of reference, and learning about the process. Indulska et al. (2009a) conducted a Delphi study across academics, practitioners and vendors, which lead to five categories (strategic, organisational, managerial, operational and IT-infrastructure) of perceived benefits derived from process modelling, with process improvement, process understanding and communication as the overall top three.

Based on the above literature review, we can make a number of key observations.

- Understanding, communication and common language describe a recurring theme of benefits from process modelling initiatives in the literature, suggesting that impacts from process model use stem largely from supporting the interaction between stakeholders involved with process models.
- The research efforts to date mostly suggest these and other advantages without having yet clearly demonstrated let alone measured these or other benefits – they report on expected, perceived and/or potential rather than actual and realised benefits.
- Current studies often neglect the process model end-user perspective but rather focus on the views and assessments of academics, vendors, consultants, or modellers (e.g., Indulska et al. 2009a).

These observations suggest that process modelling can increase communicative ability and enhance coordination and decision-making amongst those people involved in a process. To be able to envisage how these impacts manifest and work, we decided to examine process model use through the case study method to develop rich as well as deep observations and findings about these and other impacts.

RESEARCH METHOD

The primary objective in this stage of our research is the exploration of the existence, nature and complexity of impacts from process model use, thus suggesting holistic, multiple-case study to be an appropriate method (Eisenhardt 1989; Yin 2009). Several measures have been suggested to ensure rigorous case study research by increasing research reliability and reducing subjectivity from the person of the researcher (Maxwell 2005; Walsham 1995; Yin 2009). The following list describes the key measures and the mechanisms we chose to instantiate these measures:

- Preparing and applying a case protocol, incl. research topic and a semi-structured interview protocol. In our case, the protocol consisted of sections for participant background information, model use details and experienced impacts as elements of inquiry as well as data collection procedures.
- Recording and transcribing the interviews. In our case, we recorded and transcribed twelve interview hours, leading to a total of 203 pages of interview transcriptions (see Table 1).
- Using multiple data collection methods (interviews, document analysis) and sources of information. In our case, we relied on (1) interviews with employees from different positions (Finance, HR, Governance, Operations) from diverse hierarchical levels (Manager, Project Director, Business Analyst) who were involved in diverse processes (Debt Administration, Recruitment, Vehicle Leasing, Claims Handling, Underwriting, Outsourcing) and regularly worked with process models as informational objects, as well as (2) supporting documents such as process models and work instructions.
- Setting up and maintaining a case study database on a shared drive to store all case related information. We maintained interview protocols, audio recordings, transcripts, supporting documents, E-Mail correspondence, etc. for comprehensive access to the case data. This allowed us to compare and challenge data, emerging interpretations and conclusions as we proceeded with our analysis.

We studied process model use scenarios across three case sites, two Australian state government agencies and one private sector organisation. One government agency provides finance, HR, and further support services to other state government departments and agencies. The second government agency is the provider of vehicle leasing and fleet management services for the state government. The private sector company offers financial services, e.g., banking, insurance, and wealth management. The three organisations were deemed appropriate case sites, as they are active in managing their business processes on the basis of process modelling efforts. Thus, process models were in active for various purposes (see Table 1).

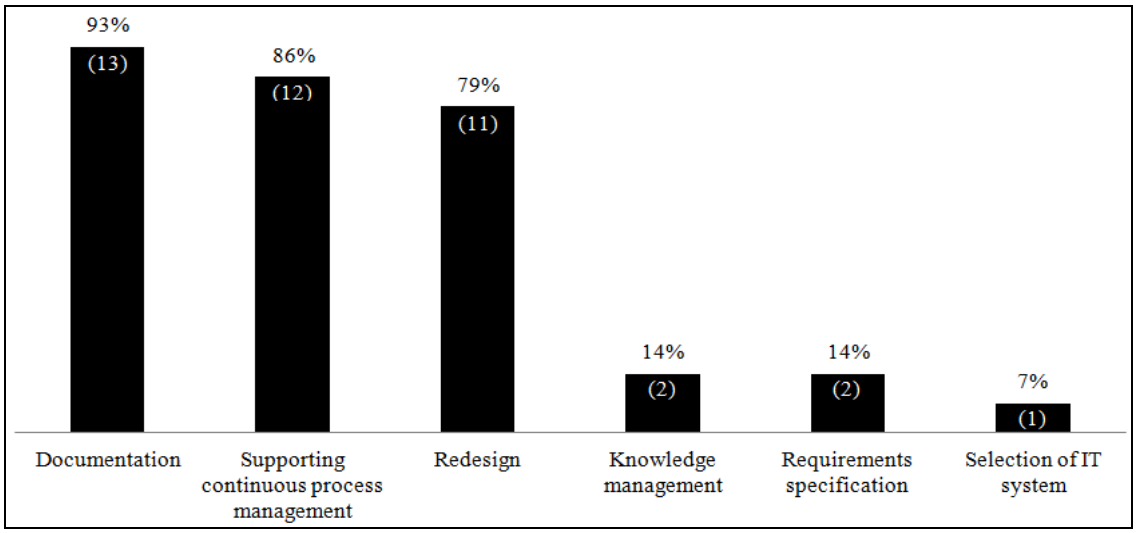

Figure 1: Relative/absolute Frequencies of Process Model Use Purposes across Cases (multiple answers possible).

Data was primarily collected using semi-structured interviews with process stakeholders that are working with models, such as key front-line staff, process team managers, or Business/Process Analysts. In addition to the prepared interview protocol, follow-up questions on responses were posed to clarify answers and achieve a

better understanding of certain issues. After each interview, the protocol was revised and, if deemed appropriate, refined. The interviews took ~55 minutes on average; the average transcript length was 15 pages. The second source of data was documents relating to the process team, most importantly process models, but also work instructions as well as training and development materials. The data collection period span from March to June 2012. Table 1 provides information about the case contexts and also categorises the primary uses of the process models in the cases alongside the primary application purposes reported by Recker (2010b). Figure 1 presents details of the purposes for which models are used across the case contexts studied.

Table 1: Case Overview.

Case #	Case context	Primary use purposes of process models	# of inter-viewees	Interview duration (minutes)	Transcript length (pages)
1	Support and improve finance and process change projects, e.g. system selection	*Selection of IT system*	1	59	15
2	Support, improve and standardise recruitment services	*Documentation; redesign; supporting continuous process management*	1	43	11
3	Support, improve and standardise bank reconciliation; debt administration; salary payment	*Documentation; redesign; supporting continuous process management*	1	42	12
4	Support and improve finance processes; system improvements	*Documentation; redesign; supporting continuous process management*	1	75	20
5	Support, improve and standardise insurance claims handling; system design	*Documentation; redesign; supporting continuous process management; software development requirements specification*	1	39	10
6	Support, improve and standardise construction and engineering underwriting; new staff training	*Documentation; redesign; supporting continuous process management; knowledge management*	1	40	11
7	Support and improve credit control, activity and recovery work	*Documentation; redesign; supporting continuous process management*	1	45	13
8	Support large-scale outsourcing project	*Documentation; redesign; requirements specification*	4	15 (avg.)	5 (avg.)
9	Support, improve and standardise insurance operations	*Documentation; redesign; supporting continuous process management*	1	30	10
10	Compliance and risk control of insurance processes; breach reporting process	*Documentation; supporting continuous process management*	1	68	18
11	Project management	*Documentation; redesign; supporting continuous process management; knowledge management*	1	68	21
12	Continuous improvement framework (support program change teams and corporate strategy)	*Documentation; supporting continuous process management*	1	73	19
13	(incremental and large-scale) Improvement projects, e.g. business-IT alignment	*Documentation; redesign; supporting continuous process management*	1	49	14
14	Support, improve and standardise insurance claims handling	*Documentation; redesign; supporting continuous process management*	1	30	9
			Σ	721 (12h 1m)	203

Both authors were involved in the qualitative analysis of the collected data. NVIVO was used as a data analysis tool. The authors allowed for concepts as well as categories to emerge from the data. The primary author performed the open coding, while the second author selectively sampled the data and the emergent codes to

challenge the interpretation and mitigate subjective interpretation bias. In a first coding step, we identified dimensions of impact from process model use as reported by the interviewees. These dimensions were identified as higher-level categories emerging in the open coding phase through regular cross-comparison of the data and engagement with the literature on impact. Table 2 provides definitions and literature for each identified impact dimension.

Table 2: Impact Dimensions, Definitions, and Key References.

Impact Dimension	Definition	Key reference(s)
Coordination	Interactions and combination of activities of the process participants.	Gattiker and Goodhue (2005)
Communication	The exchange of information amongst the process stakeholders.	Bassellier and Benbasat (2004)
Decision-Making	The selection of a course of action among several alternative scenarios considering potential problems and decision implications.	Wixom and Todd (2005)
Learning & Understanding	The acquisition of new knowledge about the process and the business domain depicted in process models through exploration and learning.	Mayer (2002)
Process Improvements	The ability to improve business processes (in terms of reduction of process costs, increase of process productivity, increase of process quality, improved customer service and/or reduced process execution time).	Indulska et al. (2009a)
Satisfaction	A process model user's degree of favourableness with respect to the process.	Wixom and Todd (2005)
Process Objectives	The degree to which process performance and/or conformance goals are being or have been accomplished.	Gattiker and Goodhue (2005)

Table 3 summarises how the different impact dimensions manifested across the model use scenarios considered in our study. Due to space limitations we cannot provide a detailed model of our coding results (e.g., types of statements; impact sub-level codes). These findings can be obtained from the authors upon request. Still, Table 3 provides some qualification of the findings in terms of the strength of the evidence identified for each impact dimension as manifested in the data. The evidence is classified as strong, limited or non-existent.

Table 3: Overview of Data Analysis.

Case #	Supporting Coordination	Enabling Communication	Enhancing Decision-Making	Enabling Learning & Understanding	Achieving Process Improvements	Increasing Satisfaction	Achieving Process Objectives	∑
1	(✓)	✓	✓	✓	✓	✓	✓	6 ✓ 1 (✓)
2	✓	✓	(✓)	✓	✓	✓	✓	6 ✓ 1 (✓)
3	✓	✓	x	✓	✓	(✓)	✓	5 ✓ 1 (✓)
4	✓	✓	✓	✓	✓	✓	✓	7 ✓
5	x	✓	✓	✓	✓	✓	✓	6 ✓
6	x	✓	x	✓	✓	(✓)	✓	4 ✓ 1 (✓)
7	✓	x	x	✓	✓	(✓)	✓	4 ✓ 1 (✓)
8	✓	✓	✓	✓	✓	✓	✓	7 ✓
9	✓	(✓)	(✓)	✓	✓	(✓)	(✓)	3 ✓ 4 (✓)
10	x	✓	x	✓	✓	✓	✓	5 ✓
11	x	✓	(✓)	✓	(✓)	✓	(✓)	3 ✓ 3 (✓)
12	✓	✓	(✓)	✓	✓	✓	✓	6 ✓ 1 (✓)
13	✓	✓	(✓)	✓	✓	✓	✓	6 ✓ 1 (✓)
14	x	✓	✓	✓	✓	(✓)	(✓)	4 ✓ 2 (✓)
∑	8 ✓ 1 (✓)	12 ✓ 1 (✓)	5 ✓ 5 (✓)	14 ✓	13 ✓ 1 (✓)	9 ✓ 5 (✓)	11 ✓ 3 (✓)	

Coding Legend	
✓	The case data provided strong evidence for a particular impact dimension, as measured by the associated codes appearing multiple times in the course of the interview(s) and/or supported by the document analysis.
(✓)	The case data provided limited evidence for a particular impact dimension, as measured by the associated codes appearing once in the course of the interview(s) and/or supported by the document analysis.
x	The case data did not provide any evidence for a particular impact dimension.

FINDINGS

Through the empirical exploration of process model use cases, we can make a number of observations, which we discuss alongside the following impact themes. We provide selected statements reported by interviewees as indicatory evidence for the coding.

Interviewees frequently noted the importance of process **understanding** generated through process model use, which translates to the development of knowledge about the process on an individual level ("*need to map that to understand that first";* "*we would never have known until we actually mapped it*"; "*when you think in pictures it always makes it easy to understand*"). Especially the formal and hence structured display of information was mentioned as an important process model feature that aided this knowledge development process; for example: activities that have to be executed as part of the process, hand-over points to other process participants – especially across departments, details about customer interactions or the involvement of IT-systems ("*get a bird's eye view of the process"*). These findings are in line with arguments and evidence in the literature (Davies et al. 2006; Indulska et al. 2009a; Kesari et al. 2003; Krogstie et al. 2008). Is has to be noted, however, that each

user's prior knowledge about the process influenced the extent to which interviewees reported knowledge gains to emanate from process model use – which is consistent with prior experiments (Mendling et al. 2012).

End-users were notably more **satisfied** with their work on a process (*"if we didn't have the process models, we would have been struggling"; "there's absolute value in [process models]"*), which in turn leads to an increased use of process models ("*we would never drive the company any other way than this way now"; "we kept on referring to your process model"*). This congruent with the arguments of Wixom and Todd (2005), who state that object-based attitudes (in this case, attitudes about a process) can predict individual's behaviours. In case of processes that span across intra-organisational boundaries, the existence of process models has also been observed to reduce silo thinking and frustration among different participants of the process.

Communication ("*the picture told the story for us"; "tool to explain"*) and **coordination** amongst the process team ("*the right people are looking at it at the right time*") was clearly facilitated by the use of process models, ultimately adding to **decision-making** capabilities related to the process ("*decision-making is based on the findings from the process model*"; "*the model will always help me think about what will happen"*). Even though this relationship is inconsistent across cases, 10 out of the 14 cases reported at least some degree of influence of process model use on decision-making capabilities. Model-based communication was also utilised to induce new staff into the process team ("*once I had it visually it made sense to [the new team member]*"), to educate staff with customer contact, and to explain the process to various internal stakeholders, such as senior management ("*I [the manager] understand and that makes sense now and the pieces fall together*"). Models furthermore allowed for quick and accurate derivation of detailed work procedures for day-to-day use by front-line staff.

We also noted how interviewees frequently referred to impacts of process model use that relate to the identification of process **improvement** potential explicated through the models ("*I like to do a process model to be able to identify where there's a problem in the process, to identify whether an improvement makes sense"*), enabled by visualising the as-is process ("*if it looks like spaghetti it probably is spaghetti*") and by gaining an enhanced understanding of the process. Areas of improvement entail, but are not limited to, coordination ("*unnecessary handoff that we eliminated*"; "*change the order that things might have been done previously*") and performance ("*if we do it this way it will save us time*"). These findings are in line with the results from the benefits Delphi study by Indulska et al. (2009a).

In terms of process **objectives**, which entail performance (such as time and quality) as well as conformance (such as standardisation, risk, compliance) aspects, the data suggests that model-supported processes are executed faster in general, or single tasks are performed more quickly ("*it happens quicker*"). Similar to our results, Kesari et al. (2003) reported that model-supported work leads to higher time-efficiency. Furthermore, employees reported to make fewer mistakes in their work, such as missing process steps, as they can relate to the model in case of uncertainties. Process models can also support standardisation ("*we mapped [...] the process so that we would be able to be a bit closer to [business unit xyz] who also use the same system as we were going to go onto")* and risk-management efforts *("we can better identify areas where more stringent risk control may be implemented").*

DISCUSSION

The findings reported above substantiate previous findings, but also provide further evidence about the types of impacts that are generated in organizations through the use of process models in various use scenarios. Moreover, our analysis indicated a set of interactions to exist between the different types of impact that stem from process model use. Figure 2 visualizes our attempt of integrating the findings and emergent relationships in a conceptual model of process model impact. The model describes visually how process model use leads to impacts on an individual, group and process level and also depicts several relationships that represent how the impacts are being realised conjointly and over time. The strength of a relationship is expressed though its arrow width. We explore the propositions inherent in the conceptualisation below.

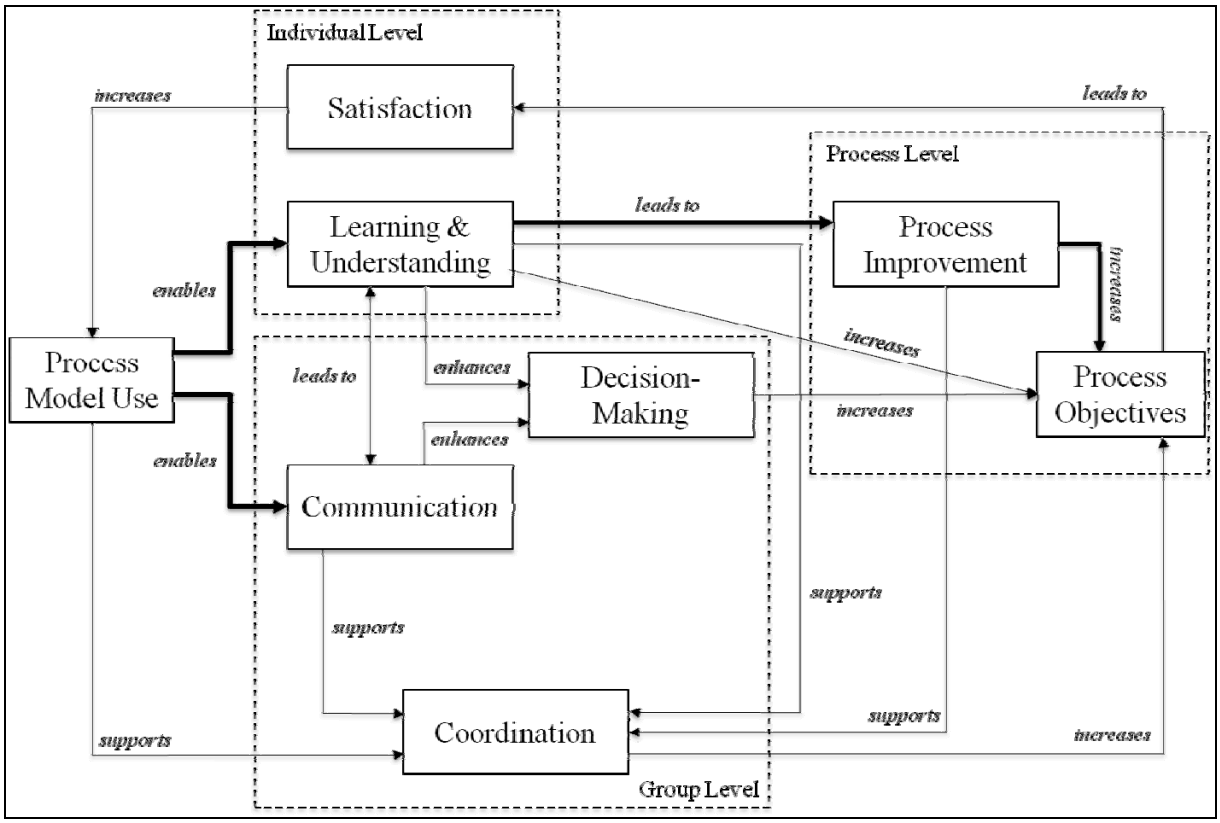

Figure 2: Impact Realisation Model.

The emergent model identified five key propositions. The first proposition is based on strong evidence from the case study and thus seems to be very common across use purposes, model features or user characteristics. It conceptualises the immediate impact that emanates from the use of process models and suggests the primary consequence of model use is to facilitate communication amongst stakeholders involved in the process and the results of these interactions.

Proposition 1: *Process model use primarily enables communication among process stakeholders and increases the potential to develop knowledge about a process.*

Following from the enablement of communication and knowledge development, stakeholders working on a process achieve better shared informational input to decisions about the process, for instance, in the context of choosing between process redesign alternatives or selecting a most appropriate information system to support the modelled process. However, decision-making only received limited support in the data. This points to individual, model-related or organizational factors that may hinder the development of decision-making capabilities on the basis of process communication and understanding.

Proposition 2a: *Through enabling increased knowledge and communication means, group decision-making is enhanced.*

Furthermore, increased knowledge development about a process helps stakeholders to identify improvement possibilities, as issues and constraints of the process are visualised. Also, alternative future states of the process can be displayed, discussed, evaluated and implemented. However, the degree to which the user is willing or able to perceive the improvement possibilities arguably depends on his goals, modelling expertise and experience.

Proposition 2b: *Through enabling increased knowledge about a process, the development and implementation of process improvement ideas is supported.*

Process model use supports the coordination of activities of process participants, leading to efficient task allocation and optimisation of handovers, among other effects, and also enhances decision-making capabilities through the enablement of communication and knowledge development. In turn, this leads to better process performance (such as less time or lower costs) and conformance (such as increased standardisation or reduced risk) metrics – an influence that is likely to depend the task at hand and thus, the goals of the model user(s).

Proposition 3: *Improved group coordination and group decision-making lead to an increased ability to meet process objectives in terms of performance and/or conformance objectives.*

A process model user that realises an increase in process performance, e.g., through process improvements, has a higher level of satisfaction regarding the process and consequently is more likely to continue to make use of process models and increasingly rely on them in the future.

Proposition 4: *Process model use increases the user's satisfaction with the process, which in turn leads to an increased utilisation of process models.*

LIMITATIONS

We caution against the limitations pertaining to our work at this stage, most notably the reliance on experience data reported by selected case study informants, the limited number of cases and the geographical restrictions of the cases in the Australasian sector. Furthermore, our data analysis did not differentiate between cases with different model use purposes and various respondent backgrounds due to a lack of an appropriate sample size. In turn, our findings remain tentative and inconclusive – yet are useful for ongoing theory development as well as further operationalisation of impact constructs and measurements as they relate to process model use.

CONCLUSIONS

This paper reported on our ongoing research efforts in defining and exploring the ways in which process modelling create impacts in organisational practices related to organizational redesign, system development or IT implementation projects. Our discussion of our research work to date was necessarily brief due to the page restrictions. Nonetheless, the number of cases and data points examined give us confidence in our conclusions and the evidence indicates the appropriateness of our approach. We believe our work will have significant implications for our understanding of process modelling as a key practice in organisational and systems design projects. To the best of our knowledge, this study describes the first comprehensive and rigorous empirical study that attempts to identify and theorize about modelling impacts in the context of conceptual modelling practice that goes beyond single-case studies and anecdotal descriptions. Understanding how impact emanates from such practices will better our understanding of organisational and systems development projects in general.

In our future research we aim at empirically validating our concepts using more quantitative methods, and also attempt to add to the insights into how process models affect not only individuals and groups of process model users, but also the entire organisation. Moreover, the influences of user characteristics (e.g., role in the modelling project / initiative, experience or goals), task features (e.g., modelling purpose, routineness, degree of change) or process model characteristics (e.g., understandability, information relevance, abstraction) on modelling impacts, which seem to be important factors of the case context, make for a highly interesting avenue of further research.

A first step for us is to continue our theory development efforts following established guidelines (e.g.,Weber 2012), before developing appropriate measurements for quantitative testing of the emerging theory.

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