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What Are the Secrets of Successful Process Modelling? Insights From an Australian Case Study

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What Are the Secrets of Successful Process Modelling? Insights From an Australian Case Study

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RÉSUMÉ

L'intérêt suscité par la ré-ingénierie des processus et les technologies de l'information révèle l'émergence du paradigme du management par les processus. Bien que beaucoup d'études aient été publiées sur des outils et techniques alternatives de modélisation de processus, peu d'attention a été portée à l'évaluation post-hoc des activités de modélisation de processus ou à l'établissement de directives sur la façon de conduire efficacement une modélisation de processus. La présente étude a pour objectif de combler ce manque. Nous présentons les résultats d'une étude de cas détaillée, conduite dans une organisation leader australienne dans le but de construire un modèle de réussite de la modélisation des processus.

Mots-clés : Modélisation des processus, Facteur de succès, Mesure de succès, Méthode d'étude de cas.

ABSTRACT

Contemporary management and IT concepts emphasize the importance of process-oriented management concepts as a business paradigm. While there has been much research and publications on alternative process modelling techniques and tools, little attention has focused on post-hoc evaluation of actual process modelling activities or on deriving comprehensive guidelines on 'how-to' conduct process modelling effectively. This study aims at addressing this gap, and reports on a detailed case study conducted at a leading Australian organisation, with the aim of building a process modelling success model.

Key-words: Process modelling, Success factors, Success measures, Case study method.

1. INTRODUCTION

Business process management represents an integrated approach for the process-centered alignment of business and Information Technology strategies and infrastructures. Process models can be defined as "abstract descriptions of an actual or proposed process, that represent selected process elements considered important to the purpose of the model and that can be enacted by a human or a machine" (Curtis *et al.*, 1992, p. 76). "Process modelling is an approach for visually depicting how businesses conduct their operations; defining and depicting business processes, including entities, activities, enablers and the relationships between them" (Gill, 1999, p. 5). Process modelling has seen widespread acceptance, particularly in large IT-enabled Process Management projects (Davenport, 1993). Practitioners and researchers have discussed extensively the various applications of process modelling at different phases of an Information Systems project (e.g. Curtis *et al.*, 1992; Rosemann, 2000; Gulla and Brasethvik, 2000). While there has been much research on alternative process modelling techniques, little attention has focused on the post-hoc evaluation of actual process modelling activities or on deriving complete, comprehensive guidelines on 'how-to' conduct process modelling effectively. This paper reports on a study that aims to address this gap and proposes a process modelling success model with an embedded instrument derived from empirical research. The main research questions addressed herein are:

How can process modelling be conducted successfully?

- What are the important factors of successful process modelling?
- What contextual factors (if any) moderate this importance?
- How can the success of a process modelling initiative be measured?

The proposed success measurement model aims at evaluating not only the process models themselves, but the whole process modelling initiative. Thus, the unit of analysis of this study is the process modelling project, including both the evaluation of the product (the process model), and the evaluation of the process of designing and applying the model. In the context of this study, the process modelling project is regarded as successful if it is efficient and effective. Process modelling effectiveness can be described as the extent to which it supports the fulfilment of the objectives that underlay the modelling project. Process modelling efficiency is to conform to the resources (cost and time) assigned to the project.

The overall study proposes a multi-method approach; with multiple case studies followed by a survey. The study has completed the case study phase and reports herein, the results of the last case study (in isolation to the previous case studies completed) obtained from a detailed analysis at Telstra Australia, the nation's leading telecommunications organisation. Telstra was the third (and final) case study conducted in this research and this paper reports on the goals, conduct, analysis and finding of this single case study.

A literature review is first presented, followed by an introduction to the overall research design and the a-priori model. This paper then provides a brief introduction to the case study method, its methodological appropriateness to this study and its overall design. The next section introduces the case site and presents the findings obtained from the case study, finally concluding with a discussion on the study contributions, limitations and an overview to the next phases of the study.

2. LITERATURE REVIEW

Past studies have described and justified the use of process modelling at various stages of systems implementations. Process modelling is used for (1) model-based identification of process weaknesses, (2) adapting best business practices, (3) the design of a new business blueprint (as a form of documentation and communication), and (4) end-user training (Gulla and Brasethvik, 2000; Becker, Rosemann and Schütte, 1997; Rosemann, 2000; Curtis *et al.*, 1992; Bartholomew, 1999; Peristeras and Tarabanis, 2000). The literature also reports how process modelling has been employed in a range of different applications, including: activity based costing, supply chain management, customer relationship management, total quality management, workflow management, knowledge management, and simulation (Becker *et al.*, 2000, Rosemann, 2000; Curtis *et al.*, 1992). Information Systems (IS) success factor studies, especially those reporting on large-scale multimillion dollar implementations such as Enterprise Systems projects, explicitly and implicitly suggest the importance of process modelling and its contribution to the success of these projects (Wreden, 1995; Forsberg *et al.*, 2000; Bancroft, 1998; Clemons *et al.*, 1995; Parr *et al.*, 1999). Kesari *et al.* (2003) specifically state the advantages of process modelling in Information Systems projects and classify process modelling benefits into three main categories. These include documentation benefits (a common language with clients, a means for basic communication, and having a flexible template); design benefits (understanding the current business processes, generation of new possibilities and a means of planning for the project implementation), and use benefits (visual representation of processes, supporting the iterative development process of systems, and time efficiency).

Most of the published work pertaining to process modelling describes how to use certain modelling tools (e.g. Scheer, 1998a) or describes the application of modelling languages (e.g. Rosemann and zur Mühlen, 1997). Some articles provide descriptions in the form of case narratives based on reflective learning from past projects (e.g. Scheer *et al.*, 2002). New streams of process modelling research, such as the use of reference process models, are now emerging (e.g. Rosemann and Chan, 2000; Fettke and Loos, 2003). One framework deemed relevant and useful for the process modelling context is the Guidelines of Modelling (GoM) framework (Becker *et al.*, 2000). It presents six dimensions of quality that can be used to evaluate a process model. However, no empirical testing of the framework has been reported to date. Overall, empirical studies on process modelling are scarce and, to the authors' best knowledge, there have been no studies that identify and describe essential elements that should exist in a process modelling project or how to evaluate the overall success of a process modelling project. Addressing this gap has been the motivation for this study.

3. RESEARCH DESIGN

A comprehensive literature review was conducted at the first stage of this study; (a) to identify candidate process modelling success factors and measures and, (b) to identify and justify the methodology most applicable to studies of this nature. An a-priori process modelling success measurement model was derived and a multiple case study (to re-specify the a-priori model – theory building) followed by a survey approach (to test the derived model – theory testing) was selected as the two main data collection methods. The case study and survey methods, when combined, are complementary, each offsetting limitations of the other (Gable, 1994).

This paper reports on the findings derived from the last case study, conducted at Telstra Australia: the nation's leading telecommunications provider.

3.1. A-Priori model

An a-priori model was derived from the review of the literature ostensibly reflecting a complete set of critical success factors and success measures. Figure 1 depicts the resultant a-priori model and Table 1 defines its constructs. The model does not purport to reflect causality among the model constructs, but instead only identifies the overall crucial success factors and overall success measures of process modelling.

'Success' is a complex multi-dimensional phenomenon. Hence, having a correct and complete set of measurement dimensions is important (Garrity and Sanders, 1998, p. 31; Kallenis, Lycett and Paul, 1998). Thus, during the a-priori model building phase an attempt was made to identify major IS success frameworks and marry these with the study's context [e.g. De Lone and McLean (1992); Garrity and Sanders (1998); Seddon (1997); Myers, Kappelman and Prybutok (1998); Goodhue (1992)]. Due to the lack of any reported process modelling success studies, IS success frameworks were sought as a proxy to identify candidate process modelling success measures. Sedera, Rosemann and Gable (2002) describe and justify the identification, re-specification and adaptation of these success frameworks and extracted measures, relating them to the process modelling context. Five a-priori process modelling success measures were identified through this process (see Figure 1).

Critical success factors within the context of this research, can be defined as the key aspects (areas) where 'things must go right' in order for the process modelling initiative to flourish (following McNurlin and Sprague, 1989, p. 97). Due to the lack of theoretical and empirical evidence of process modelling critical success factors, a

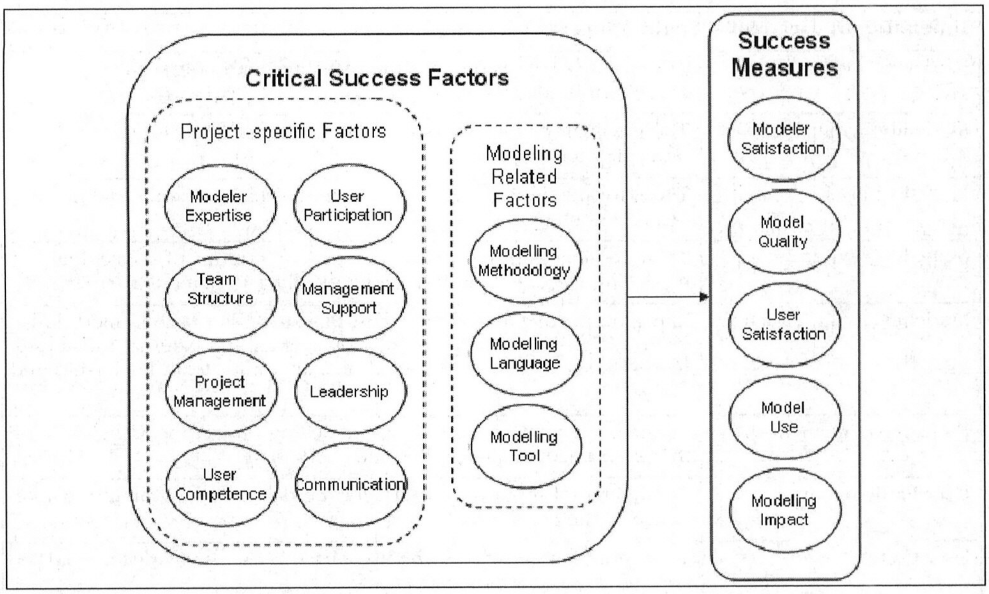


Figure 1: A-priori model.

review of the related literature was conducted to extract those factors that were directly or indirectly mentioned as important. Related domains were included in the review in order to obtain a list of candidate process modelling success factors that was as complete as possible. Sedera, Rosemann and Gable (2001) report in detail on the identification and justification of the selected analogous domains, and the rational for success factor adoption. A preliminary analysis of the factors extracted from the literature pointed to 11 potential candidate success factors, which were then clustered within the two groups of "modelling-specific factors" and "project-specific factors". The modelling-specific factors were (1) Modelling methodology, (2) Modelling language, and (3) Modelling tool. The project-specific factors were (4) Modeller's expertise, (5) Modelling team orientation, (6) Project management, (7) User participation, (8) User competence, (9) Communication, (10) Leadership, and (11) Top management support (Sedera *et al.*, 2001).

3.2. The use of case studies

"The case study method refers to a group of methods which emphasize qualitative analysis" (Gable, 1991, p. 31), and is defined as an "Empirical inquiry that investigates a contemporary phenome-non within its real-life context" (Yin, 1994, p.13). They can be conducted for exploratory, explanatory or descriptive purposes (Tellis, 1997; Yin, 1994). Case studies are applied to serve both exploratory (to identify important factors and measures of process modelling success) and explanatory (to aid in the design and interpretation of the survey) functions in this research.

Deciding if and when to use case studies will depend on (a) the type of research question, (b) the control an

Independent variables – Critical Success Factors	
Modelling Methodology	A detailed set of instructions that describes and guides the process of modelling.
Modelling Language	The grammar or the "syntactic rules" of the selected process modelling technique.
Modelling Tool	The software that facilitates the design, maintenance and distribution of process models.
Modellers' Expertise	The experiences of the process modellers in terms of conceptual modelling in general and process modelling in particular.
Modelling Team Structure	The 'infrastructure' that should exist in a successful process modelling team, such as an appropriate mix of internal and external members, representatives from all modeled business units, team leadership and vision.
Project Management	The management of the process modelling project including defining the project scope, aims, milestones, and plans.
User Participation	The degree of input from users, for the design, approval and maintenance of the models.
User Competence	The amount of knowledge the users have about the modelled domain and the modelling procedures.
Top Management Support	The level of commitment by senior management in the organisation to the process modelling project, in terms of their own involvement and the willingness to allocate valuable organisational resources.
Leadership	(a.k.a. project championship) The existence of a high level sponsor who has the power to steer the project, by setting goals and legitimate changes.
Communication	This describes exchange of information (feedback and reviews) amongst the project team members and the analysis of feedback from users.
Dependent variables – Success Measures	
Modeller Satisfaction	The extent to which the modellers (those who design the process models) believe process modelling fulfills the objectives that underlay the modelling project.
Process Model Quality	The extent to which all desirable properties of a model are fulfilled to satisfy the needs of the model users in an effective and efficient way.
Model Use	The extent to which the process models are applied and utilised.
User Satisfaction	The extent to which users believe process modelling fulfills the objectives that underlay the modelling project.
Process impact	Measures the effects of process modelling on the process' performance. Here, the 'process' refers to the processes or functions to which process modelling is being applied.

Table 1: Defining the a-priori constructs.

investigator has over the actual behavioural events and (c) the focus on contemporary as opposed to historical events (Yin, 1994). Benbasat *et al.* (1987) state that when the context of investigation 'takes place over time, is a complex process involving multiple actors and is influenced by events, that happen unexpectedly, a case study approach is well suited'; this holds true with research pertaining to business process modelling, thus justifying the use of case study approach for this research. Yin (1994) states the relevance of a single case study is high, when the researcher wants to identify new and previously unresearched issues. He also states that multiple case designs are desirable, when the intent of the researcher is to build and test a theory (Yin, 1994; Gable, 1994). Based on these foundations, a multiple case study has been included into the overall case design, and this paper reports on the findings of the final case study alone. The main goals of the case studies are: (i) To test the a-priori model that has been derived, (ii) to aid in the design of the survey and (iii) to aid in analysing the survey data.

The study integrated the findings of the previous case studies and analysed the a-priori model with a superset of all potential success factors and measures gathered from the literature and previous case studies. Figure 2 depicts the complete set of constructs that were tested within the Telstra case study. 'Importance', 'Complexity' and 'Culture' were three new constructs identified within the previous case studies.

- The 'Importance' construct captured how important the overall initiative is (in other words, what motivated one to do process modelling).
- 'Culture' described the organisational readiness to accept and participate in a modelling initiative.

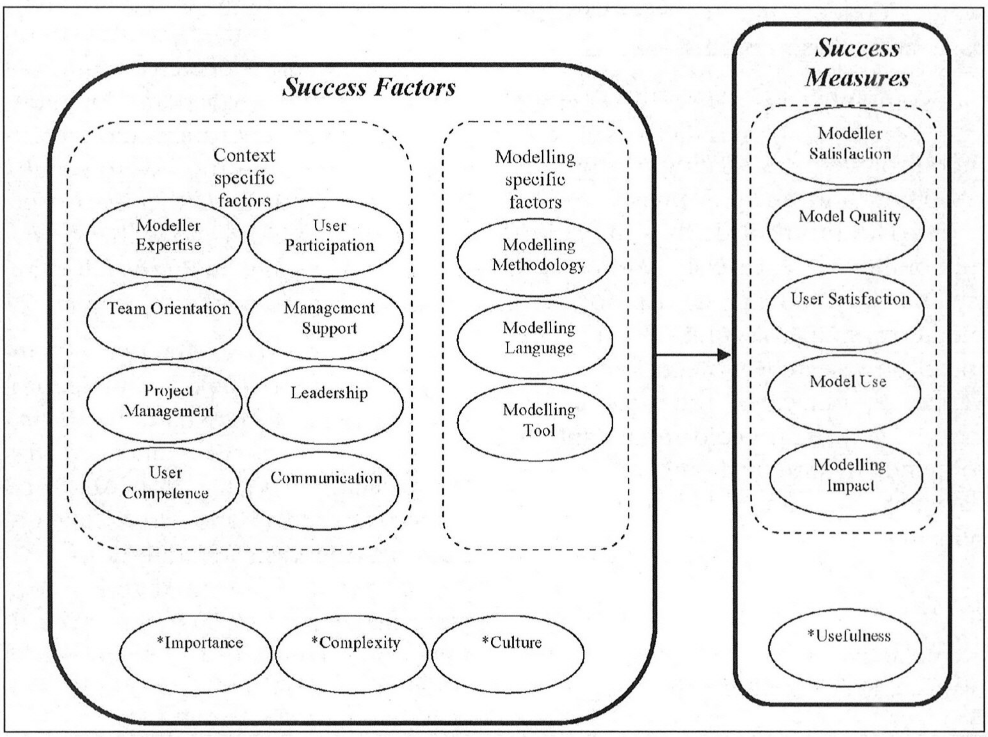


Figure 2: Re-specified Process Modelling Success Model used within the Telstra case study.

- 'Complexity' captured the complexity of the process being modeled.

Furthermore, 'Usefulness' was also integrated. Prior case study analysis raised concerns about the 'Use' construct (i.e. in terms of difficulty to measure and irrelevance to the context of process modelling). Similar concerns had been raised in IS suc-cess literature. These studies had proposed usefulness in place of use (i.e. Seddon, 1997). Thus, usefulness was integrated into the respecified a-priori model for this case study.

3.3. Case study design

Case study research is often criticised for potential shortcomings (Benbasat *et al.*, 1987). Potential weaknesses were identified and addressed in the case study design of this research.

A comprehensive case study protocol[1] was derived, carefully documenting all procedures relating to the data collection and analysis phases of the study. The protocol defines the structure of the overall case study effort and is specially advantageous for exploratory studies as this, as (1) they force the researcher to consider in advance, the objectives and goals of the study, (2) to help avoid redundant effort, and any potential omissions of the data collection and finally (3) to support the communication and documentation efforts (Gable, 1991; Yin, 1994).

Qualitative data collection mechanisms including indepth interviews, and content analysis of existing documentation were used to collect 'rich' evidence about the process modelling projects. Observations and documentation were used only to augment and corroborate interview data, which was the main input to data analysis. Whenever possible, interviews were conducted with multiple stakeholders in the process modelling project(s), namely the modellers and the project sponsors.

The interviews were semi-structured, each completed within 60-90 minutes. All interviews followed the same structure and format (as pre-specified by the case protocol), commencing with an open discussion on perceived success/failure factors and measures of process modelling success in relation to the selected project. Subsequently, the individual constructs of the a-priori model were introduced (for the first time), and the respondents' opinions on the overall relevance and importance of these constructs were sought. This approach enabled the researchers to obtain new ideas to enhance the model, while simultaneously validating existing a-priori constructs.

All relevant data (interview transcripts, research memos, sample process models, documented modelling guidelines, etc.) were maintained in a 'case database' (Yin, 1994; Mile and Huberman, 1994) and close linkages between the research questions, evidence, interpretations and conclusions were maintained throughout the analysis. The qualitative data analysis tool NVivo 2.0 was utilised during this

1. A copy of the case protocol can be obtaines from the principal author upon request.

phase to capture, to code and to report the findings of the case study.

Reliability was enhanced through the use of a detailed case protocol and a structured case database. Construct validity was strengthened within the study through the use of multiple sources of evidence, establishing a chain of evidence with a well-structured case database, and, by having the key informants review draft case study reports at the completion of data analysis at each case site. Predictive validity was increased by the application of prior established data analysis techniques such as pattern matching and explanation building (Yin, 1994). External validity, or extensibility of the findings, has been improved to a certain degree through analysing multiple process modelling projects within the single case site.

4. INTRODUCTION TO THE CASE SITE

The reported case study was conducted at Telstra, Australia. Telstra was selected as a case site for this study due to their experience and expertise in process modelling, accessibility to the requirements of the sampling frame and their overall interest and support for the study.

Telstra is a semi-government telecommunications organisation, with over a century's history of providing telecommunications services to the whole of Australia. Telstra's vision is "To be a world-class full-service integrated telecommunications company helping Australian and Asia-Pacific customers and communities prosper through their access to innovative communications services and multimedia products" (Telstra web site). The company's origins date back to 1901, when the Postmaster-General's Department was established by the Commonwealth Government to manage all domestic telephone, telegraph and postal services. Since then, the company has been transformed and renamed several times. The company first received the title "Telstra Corporation limited" in 1993 and went through the first phase of partial privatization in November 1997.

Telstra strives for its success in a very competitive global market, and are continuously revising their strategies and business processes. Small and large scaled projects have been initiated within the organisation for the continuous improvement of its products and services. Process modelling has played a significant role in many of these corporate initiatives. Telstra utilized at the time of this study two main process-modelling tools, namely Extend (for detailed simulation modelling) and Holosofx (for general business process modelling) for conducting the process modelling activities within the organisation.

Four process-modelling projects within Telstra were analysed, to identify process modelling success factors and measures. Table 2 summarizes the characteristics of these projects. The case study was conducted over a period of two months. 6 key respondents were interviewed over 11 meetings, and a range of project related documents (e.g. project charters, business cases, mod-

Project	Purpose	Tool used
Interim Mini Satellites Ordering Project	The purpose of the project was to build a simulation model of the stock levels on interim mini satellites including the variation in the time to return the unit. The primary goal was to establish forecasts of the demand on the stock levels and establish the required volume to be ordered to meet demand and minimum stock levels. The primary benefit is to enable a more efficient inventory management of the technology overtime, with the ability to ensure that no stock shortages will occur and thus be able to provide quality services to customers with cost efficiency.	HOLOSOFX and EXTEND
Supplementary Worker Project	The purpose of modelling in this project was to understand the possible business benefits of supplementing a full time staff member with workers who are guaranteed an agreed number of hours. The proposal was brought in as part of an Enterprise Bargaining Agreement in 2002, but was not implemented. The modelling activities were initiated to analyse the financial and operational impacts of having a supplementary worker, under different scenarios.	HOLOSOFX and EXTEND
Internet Provider (IP) Telephony Assurance Project	The purpose was to develop a simulation model for the IP Telephony Assurance process, and perform dynamic analyses to identify cost reduction opportunities. Modelling was conducted as a systematic and scientific mean of identifying and quantifying opportunities to reduce costs and delays of the process.	EXTEND
Payphone Faults Detection process	The primary purpose of this project was to reduce the volume of incidents where payphones are re-reported as faulty by the public. The increased number of re-reported payphone faults was incrementing the number of field trips, thus boosting the costs incurred with fault repairs. Process modelling was applied in this project to map the current scenarios (as-is) of the payphone faults processes, with the primary goal of documenting the process in detail with its issues and identifying elements for improvements.	HOLOSOFX

Table 2: Characteristics of the modelling project analysed within Telstra.

elling related procedures, project management documentation, etc.) were analysed in comprehensive detail.

5. FINDINGS

"The analysis of case study evidence is one of the least developed and most difficult aspects of doing case studies" (Yin, 1994, p. 102). A comprehensive literature review on case study methodological publications was conducted by the researchers in the quest for addressing this issue within this study.

Pattern coding ["a way of grouping the summaries into a smaller number of overarching themes or constructs" (Miles and Huberman, 1984, p. 68-9)] and 'Pattern matching' were conducted to 'compare an empirically based pattern of variables with the predicted one'; the a-priori model. Internal validity is enhanced when the patterns coincide. If the case study is an explanatory one the patterns may relate to the dependent or independent variables (Gable, 1991; Tellis, 1997; Yin, 1994). The core purpose of this exploratory/explanatory case study was to test the completeness and correctness of the constructs of the a-priori model and to get preliminary insights in to the inter relationships among the factors and measures, which would aid in the survey design and analysis stages of the study. Instances of factors for the success and/or failure of the projects were coded and analysed together with constructs, which were mentioned as potential success measures.

Explanation building was also applied within the analysis of this case study. To some extent it is a special type of pattern matching with the goal of analysing the case study data by stipulating a set of explanations; causal links and trying to 'explain the phenomenon' (Yin, 1994; Audet and d'Amboise, 2001). In this study, with the purpose being to test the completeness and correctness of the constructs in the a-priori model, we used explanation building only at instances where the empirical evidence suggested a change to the a-priori model.

5.1. Testing the success model

Explicit or implicit counts are often reflected in qualitative analysis when judgments are made. For example we "identify themes or patterns that happen a number of times and that consistently happen a specific way" (Miles and Huberman, 1984, p. 215). The analysis of the case study data was conducted mainly by coding the data (through the use of NVivo 2.0), thereby yielding counts and data points that were then analysed further.

A predefined set of codes ["Codes are tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study"; Miles and Huberman, (1984, p. 55, 57)] was derived as a starting point. These codes were refined as the analysis evolved. A tree like node structure was initially created within NVivo to depict the success factors and success measures of the a-priori model. The coding of the interview data was then conducted in three phases. Phase 1; coded any direct or implied existence of the constructs (of the a-priori model) within the data, simultaneously identifying any new constructs. Phase 2; analysed the information already coded within phase 1, (extracting the information already coded under each of the constructs) to confirm the appropriateness with the categorisation. Furthermore, the codes assigned to the data were refined to distinguish between citations that indicated mere existence of the constructs, versus those that specified the criticality of the construct. Phase 3 conducted in-vivo coding[2], identifying the key words stated under each construct as a means of identifying potential sub-constructs (which would be input for the design of the subsequent survey, hence, the results of this phase of coding are not discussed in this paper). Figure 3, summarizes the main phases of the coding process.

The analysis commenced by summarizing the total number of general citations (each time the construct was merely mentioned) within each interview transcript. The primary goal of this analysis was: (a) to evaluate the sufficiency of the set of model constructs, and (b) to evaluate the necessity of each model construct. In addition to analysing the general citations for each construct, we also (a) conducted redundancy checks

2. A method of coding available through NVivo, in which the selected document text becomes the title of a new node, created to hold that text.

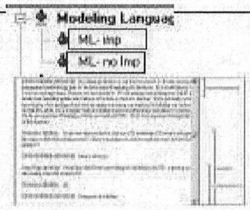
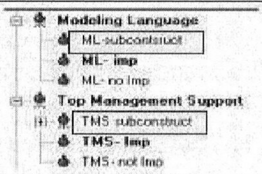
Phase	Description	
•Phase 1: Map data to constructs of the a priori model	This phase populated the nodes created with the A priori constructs (whenever the construct was mentioned or hinted at, it was coded with the relevant node(s)). When potential new constructs were identified, new nodes were created and data coded. This round was conducted twice and sometimes, data that were coded only under one construct were coded under more constructs when relevant.	
• Phase 2: Analyse the coded constructs	The data coded under each node was re-analysed, to make sure that they did belong to the coded node. Further more, the coded data was then further coded to separate between citations that indicated mere existence of the constructs versus those that specifically stated the criticality of the construct	
• Phase 3: Conduct in-vivo coding	Once the data which belonged to the overall constructs were extracted, in-vivo coding (coding with the key words identified within the text) was conducted as an attempt to tease out potential sub constructs that should be considered when developing the measurement instrument	

Figure 3: Summary of the data coding process.

with[5] 'matrix intersection and difference' searches through the NVivo tool, and (b) analysed each construct against its general citations and those instances in which it was specifically stated as important for a successful process modelling initiative (hereafter referred to as specific citations).[4] Proximity searches were conducted through NVivo, at times to strengthen the analysis.

Redundancy checks enabled the researcher to identify possible instances where two or more constructs overlapped each other, and when potential sub-constructs were incorrectly depicted as core constructs in the a-priori model. The tool's (NVivo 2.0) capacity to maintain a chain of evidence with its provision to move back and forth from the summary matrixes to the original transcripts and memo notes in the case database aided the researchers to carefully analyse and justify modifications to the model, raised through these redundancy checks.

Gathering citations which merely mentioned a construct and comparing these with the instances that specifically stated its importance, was used to justify the criticality or necessity of each construct. These 'specific' citations were analysed in conjunction with the gener-

3. Matrix Intersection search is a type of Boolean search made available through NVivo. It takes one feature from each collection at a time, and finds passages in the documents or nodes, which contain both. Matrix Difference search is a type of Boolean search made available through NVivo. Taking one feature from each collection at a time, it finds passages in the documents or nodes having the feature from the first collection but not the second, returning a table of results.
4. Proximity search: A search which finds passages with specified features which are close to each other.
5. Complete evidence of this data analysis results (such as sample citations and resulting matrices) were not included due to space constraints, but can be provided upon request from the principal author.

al citations, redundancy matrixes and proximity search results as further evidence when deciding the inclusion/exclusion and merging of a-priori constructs for the re-specified model. The following section describes the process of deriving the re-specified model. It summarizes how the independent (success factors) and the dependent (success measures) variables were tested and re-specified.[5] Evidence is provided with direct quotes derived through the interviews, however, the specific sources are unidentifiable to maintain confidentiality.

The success factor

The primary goal of the analysis of the success factors was; (a) to identify if all relevant constructs have been captured within the model, and (b) to identify and remove any interdependencies within the independent constructs of the a-priori model.

The overall general citations for the different factors were extracted and analysed to check for the completeness. Table 3 – column 2 depicts the overall general citations that each success factor received. Table 3 – column 3 depicts citations that specifically stated that the factor was important and Table 3 – column 4 depicts citations that specifically stated that the factor was not important. The following section describes the refined success factors in detail and the process of deriving them.

A new success factor was identified through this case study. The respon-

Candidate Success Factors	Total number of citations	Citations stating factor is important	Citations stating factor is not important
Project management	29	8	–
Modeller expertise	23	10	–
Communication	17	6	–
Top management support	16	7	–
User participation	13	6	–
Modelling tool	13	2	–
Leadership	12	6	–
Modelling methodology	9	4	1
Complexity	9	1	–
Modelling Technique	6	2	–
Importance	5	4	–
Culture	5	2	–
User competence	4	0	4
Team Orientation	3	1	–
'Getting information' (Information Resources)	35	9	–

Table 3: List of success factors and their relative importance.

dents continuously referred to the 'difficulty of getting data' for the modelling activities as a serious concern. The study picked this concept and analysed it further, the result was a new success factor; "Information Resources" – defined as 'Those resources available to inform the modelling project". It had in total 35 general citations and 9 citations that specifically stated its criticality to the success of a modelling project (i.e. "Fundamentally, it was accessibility of meaningful data that was probably one of the major issues"). Thus, indicating this to be a very important aspect, within the context of process modelling at Telstra.

All of the a-priori success factors except for 'User Competence' and 'Modelling Methodology' had citations that stated they were critical for the conduct of a process modelling project and had nil citations that stated they were not important. It is difficult to objectively conclude the criticality of the constructs, based on the number of citations, as they could have been biased based on the interview protocols. However, 'Project Management', 'Modeller Expertise', 'Communication', 'Top management support', 'User participation' and 'Leadership' received the highest number of citations, indicating their relative importance over the other factors.

Incidents that stated the a-priori success factors were not relevant were analysed in depth. The single instance that indicated the unimportance of the modelling methodology, actually only stated that the modelling methodology was not documented (not that it was not important), and indicated that there is no need to document the methodology if the modelling is done only by a single modeller throughout. Further more, there were a number of citations that stated the importance of having a modelling methodology. Thus, this construct remained as an independent variable in the refined model. However the 'User Competence' construct was removed, as all citations that discussed the construct stated its irrelevance as a process modelling success factor (i.e. "The user competence in modelling is not important. You can get a lot of information by just talking to people").

In addition to the completeness check of the identified constructs, an analysis was also done to remove any potential overlaps within the constructs. Table 4, depicts the results after a matrix intersection search through NVivo, where the numbers in the individual cells show, the number of citations that were coded under both nodes of the matrix, thus pointing at potential redundancies and proximities.

While 'Project Management' demonstrated a high relevance as a success factor for process modelling, it seemingly overlapped with a number of other constructs (i.e Communication, Information Resources, Modeller Expertise, etc.). Careful analysis of the 'Project Management' construct showed its multidimensional nature. For example, Project Management in the context of process modelling consisted of sub-dimensions as Scope and Objective definitions, Quality Management, Knowledge Management, Time Management and Communication Management. Referring to the results of past case studies and the past studies conducted in operational definition of project management and its measurement, it was decided that the primary sub-dimensions of the project management construct remain within this construct and any overlaps to be removed from the model.

The primarily overlapping construct was 'Communication'. A matrix difference search was conducted with the data coded under the Communication construct. This analysis depicted that there are two main dimensions to Communication within a process-modelling project; (a) the communication with the modelling members and the process stakeholders and (b) the communication among the modelling team members. The first dimension was captured with the 'User Participation' construct while the second dimension was captured within the 'Project Management' construct (under the 'Communication Management' sub construct). Thus the 'Communication' construct was removed from the model.

'Team Orientation' was another construct that did not hold strongly against the others. There were only 3 citations within the whole case study database and only one instance that stated its importance. This too related to how the different team members should communicate, and thus overlapped with the 'Project Management – Communication Management' sub-construct. As a result,

Candidate Success Factors	**Project management**	**Modeller expertise**	**Communication**	**Top management support**	**User participation**	**Modelling tool**	**Leadership**	**Modelling methodology**	**Complexity**	**Modelling Technique**	**Importance**	**Culture**	**User competence**	**Team Orientation**	**'Getting information' (Information Resources)**
Project management	29														
Modeller expertise	4	23													
Communication	8	4	17												
Top management support	0	1	0	16											
User participation	2	1	3	0	13										
Modelling tool	0	0	0	0	0	13									
Leadership	2	0	0	6	0	0	12								
Modelling methodology	1	0	0	0	0	0	0	9							
Complexity	0	3	0	0	0	1	0	0	9						
Modelling Technique	0	0	0	0	0	2	0	0	0	6					
Importance	0	0	0	2	0	0	0	0	0	0	5				
Culture	0	1	0	2	0	0	0	0	0	0	0	5			
User competence	0	0	0	0	0	0	0	0	0	0	0	0	4		
Team Orientation	1	0	1	0	0	0	0	0	0	0	0	0	0	3	
'Getting information' (Information Resources)	5	5	8	3	7	0	1	0	0	0	2	2	1	0	35

Table 4: Potential interrelationships among the success factors.

the 'Team Orientation' construct was removed from the model.

The 'Leadership' construct received a high number of general citations and specific citations that supported its relevance as a success factor. However, a proximity check conducted in NVivo depicted that the respondents most often referred to 'Leadership' and 'Management Support' as synonyms (for example "You have to have a lot of support ... I had a lot of support from the team leader because she really wanted to know the answer. Whereas other projects you might work on, support may come from a senior manager..."). There was a significant overlap between the data coded under 'Top Management Support' and 'Leadership'.

Similar to Leadership, User Participation also received significant evidence supporting its relevance as a success factor within this case. However further analysis into the construct depicted that, instead of 'users' (i.e. model users), the significance relies on the participation of the process stakeholders (those who are involved with the processes that are modeled; who may or may not be model users), for the primary purpose of gathering the relevant information to construct and validate the models, at the various different stages of the modelling lifecycle. This significantly overlapped with the new Information Resources construct. A proximity search was run in NVivo, and we found that every critical statement of User Participation relates to the information gathering process. Thus, it was concluded that User Participation will be renamed as Process-Stakeholder-participation, and that this will be a sub-construct under Information Resources. As a consequence, User Participation was removed from the model.

Culture, identified as a potential success factor within the previous case studies, did not hold strongly for Telstra. While there was only 5 citations within the case database that discussed culture and its impacts in a modelling project only two specifically agreed upon its importance, and both these instances discussed how organisational culture can support or inhibit the process of collecting relevant details for the modelling project. This significantly overlapped with the new constructs identified in this case study titled "Information Resources" (introduced above). Thus, Culture was removed from the model.

'Complexity' and 'Importance' were also additions to the initial a-priori model from previous case studies; they were supported by the data gathered from Telstra. 'Complexity' had 9 different citations and one that specifically depicted its relevance (i.e. "Complexity definitely has got an impact on the process"). Importance had 5 general citations and 4 that specifically stated its relevance with a process-modelling project. Further analysis into these led to the conclusion that they are important moderating variables in this model (rather than success factors) due to; (a) the moderating[6] effects they had on

6. Example: Complexity acting as a moderating variable on Modeller Expertise:
"*yes, **complexity** is important...I think it is learning .... For the process modeller. I know when we first kicked off, I think we were mapping way to low in the detail and it was only **through experience** did we find a common ground for our customers in terms of the level of details that we need to model.*"

		Total number of citations	Citations stating measure is relevant	Citations stating measure is not relevant
	Modeller satisfaction	2	2	–
	Model quality	4	1	–
	Model use	2	2	–
	User satisfaction	11	8	1
	Usefulness	5	5	–
Impacts	Individual impacts Process impacts	6 3	5 3	– –

Table 5: Overview of the citations on success measures.

other success factors and (b) the fact that they are characteristics of the process modelling initiative rather than factors that can be controlled. Thus, 'Complexity' and 'Importance' remained in the revised model, as moderating variables (instead of direct success factors).

The success measures

The amount of data coded under the success measurement nodes was quite low compared to the success factors (see Table 5).

Further analysis of the data concluded that the respondents were not very familiar with concepts of 'measurement', especially within the context of process modelling. Similar to the analysis of the success factors, first a preliminary analysis was conducted on the overall suitability of the a-priori success measures (see Table 5 for a summary). Table 5 – column 2 depicts the overall general citations that each Success measure received. Table 5 – column 3 depicts the total number of citations that specifically stated the investigated Success measure as a relevant measure of process modelling success. Table 5 – column 4 depicts the total number of citations that specifically stated the investigated Success measure is not a relevant measure of process modelling success. Potential redundancies amongst the success measures were also analysed through matrix intersection and proximity searches through NVivo (see Table 6 for a summary).

All a-priori success measures were validated through this case study. User satisfaction; had the highest number of citations indicating its relevance, but also had one citation that disagreed on it relevance as a success measures. The negative statement made towards Use Satisfaction only indicated the difficulty of measuring such an abstract construct and pointed out the danger of getting negative responses from the model users/process stakeholders, if the modelling did not prove what they had initially expected for.

While the a-priori model had only one primary construct called 'Process Impacts', during the analysis this single 'impacts' construct was broken down to two constructs: Individual impacts and process impacts. This was supported by the evidence gathered from a proximity

	Modeller satisfaction	Model quality	Model use	User satisfaction	Usefulness	Individual impacts	Process impacts
Modeller satisfaction	2						
Model quality	0	4					
Model use	0	0	2				
User satisfaction	0	0	1	11			
Usefulness	0	0	1	2	5		
Individual impacts	0	0	0	1	1	6	
Process impacts	0	0	0	1	2	1	3

Table 6: Potential interrelationships among the success measures.

search through NVivo. 'Individual Impacts' referred to how process modelling has influenced the process stakeholders as individuals, and consisted of sub constructs such as understanding and awareness. 'Process Impacts' referred to the overall effect of process modelling on the processes modeled, and had sub constructs such as organisation wide understanding of the processes and business process change.

While it is difficult to precisely justify any overlaps with the few number of citations, there was evidence to indicate that the Usefulness construct overlapped with the User Satisfaction and the Impacts constructs. Thus, it was removed from the model.

5.2. The final model

The sections above reported on the separate analysis of the independent and dependent variables of the a-priori model. Figure 4 summarizes the re-specified success model derived as a result of analysing the data gathered from the Telstra process modelling projects.

In summary of the analysis of the success factors:

1. A new success factor titled Information Resources was integrated into the model;
2. Information Resources, Project Management and Modeller Expertise were identified as the 3 most critical success factors in the context of Telstra;
3. Leadership, Team Orientation, Communication, User Competence and User Participation were deleted from the model as individual success factors;
4. Importance and Complexity were defined as moderating variables instead of direct success factors;
5. Modelling specific factors such as Modelling Tool, Modelling Technique and Modelling Guidelines denoted lesser significance in comparison to the context specific factors.

In summary of the analysis of the success measures:

1. Two levels of potential process modelling impacts were identified;
   a. Process modelling impacts at the individual process stakeholder level and,

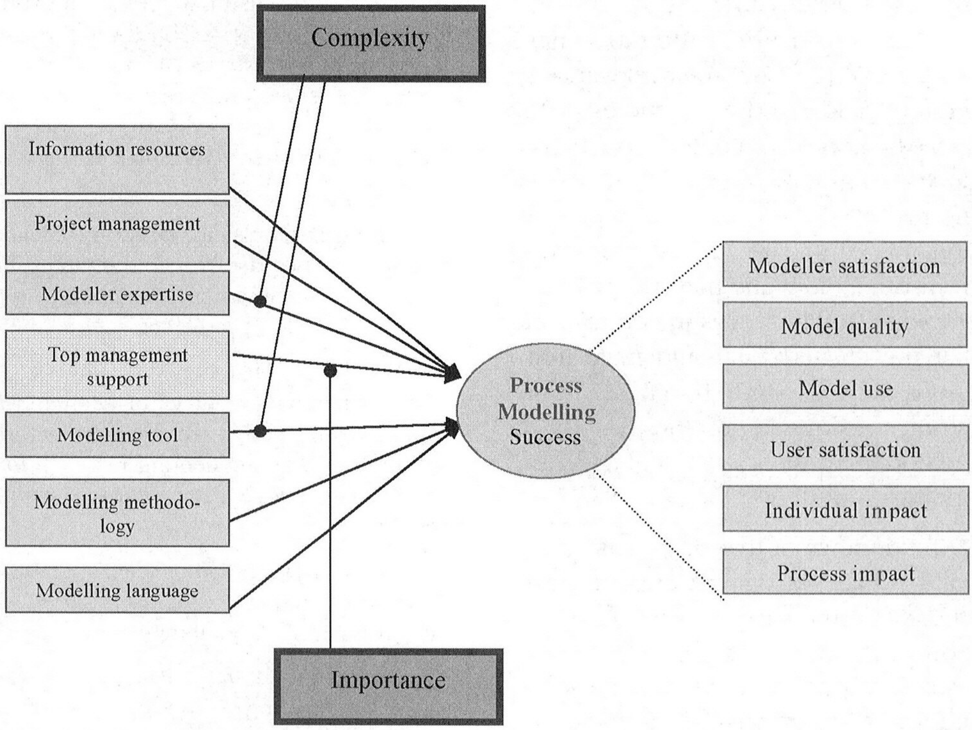


Figure 4: The re-specified success model derived after the Telstra case study.

b. Process modelling impacts at the overall process level;

2. The Usefulness construct was removed from the model due to perceived overlaps with the other measurement constructs;

3. All other measurement constructs (Modeller Satisfaction, Model Quality, Model Use, User Satisfaction, Individual Impacts and Process Impacts) were accepted through the case study analysis.

6. CONTRIBUTIONS, LIMITATIONS, OUTLOOK

This paper reported on a process modelling success model validated through a detailed case study. The identified success factors (both modelling specific and context specific factors) can be usefully applied by practitioners to plan and conduct a modelling project. The reported process modelling success model also provides a mechanism to effectively measure the effectiveness and efficiency of a modelling project. The study findings contribute to academia, by presenting a validated process modelling success model that can be applied and tested with other modelling domains.

The study is novel, factor based and measurement oriented. Given the study's nature, relying on extant theory was inappropriate. The study draws heavily on referent domains to elicit the initial set of candidate success factors and measures. Attempts have been made to justify their relevance as referent fields, and case studies of the process modelling contexts were conducted to modify the model. However, the researcher is aware that the elicitation of candidate model constructs from other domains may be problematic (due to differences in context) and that the elicited list could have influenced the case study findings. The inherent weaknesses of the case study method may also have impacted the findings reported.

The findings of this single case study will be analysed against the other case studies (multi-case analysis) and a worldwide survey targeting practicing process modellers will take place in order to test the derived model.

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