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A SYSTEMATIC, STRUCTURED APPROACH TO ORGANIZATION CHANGE MANAGEMENT: PREDICTING UNINTENDED CONSEQUENCES OF ORGANIZATION CHANGE

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ABSTRACT

Change is difficult to manage and this is especially the case in large organizations. In part, problems arise because policies, business rules, organization parties, the roles they play, processes and information systems are all connected to themselves and each other in a variety of ways. The result is that, even seemingly minor change events, can cause major disruption because many impacts are not anticipated. In this paper, a decision support system, designed to search for and identify potential change impacts in a structured, systematic and rigorous manner, is described. Its initial application in a large Australian, public-sector organization is detailed.

Keywords: organizational change, change management, advisory decision support systems

INTRODUCTION

Given the complexity of the modern business environment, organizations face major challenges in their planning and control of change [35]. Even allowing for the plethora of organizational change management approaches and tools available, these have often failed to deliver desired or expected results [7, 12, 27, 46]. As has been noted by Cao and McHugh [7], *the success of any change innovation or practice is questionable unless all interconnected elements are captured and analyzed collectively to inform an overall change solution* (our emphasis).

In this paper, a decision support system (DSS) designed to assist with the identification of these interconnected elements is overviewed and its use within a non-trivial field setting is described. Briefly, the DSS contains a highly-abstracted and generic representation of organizational change which may be conveniently customized for a particular change initiative. This then allows the automated derivation of all parties, processes, systems etc. impacted by the specific initiative. The basic rationale for this approach is that, by conducting a systematic and rigorous search for change consequences, this should reduce the likelihood that potential impacts and unintended consequences will be overlooked. The DSS was field-tested by applying it to a significant change initiative in a large Australian organization. This validation exercise is described as a case study and its role within the overall research design (which is based on the idea of information systems development as a legitimate research method in its own right) is detailed.

The paper is organized as follows: first, some background to change management, the representation of formal models of organization and management theory (OMT) and the architecture of the change tool is presented. This is followed by an overview of the research design and, then, the case study. The final section contains concluding remarks.

BACKGROUND

Change Management Impacts

Perhaps the most significant early contribution to change management theory is that of Lewin [28]. His work, in turn, has been adopted and modified by a number of post-modern OMT theorists, including Buchanan et al. [4], Burnes [5, 6] and Coghlan and Brannick [11]. Von Bertalanffy's 'general system theory' (GST) was another very significant early contribution to change theory, with his analysis of internal processes in organizations, plus the components and interdependencies that comprise the organization and its position within the environment [14]. GST also viewed the system and its environment as living objects subject to constant change. This aspect had a significant impact on change theory as it highlighted the domino effect where changes in one sub-system or entity could affect changes in another. Further, its application to the organization as a system demanded the enterprise be viewed as a series of interdependent dynamic subsystems.

Among formalisms adopted by practitioners and academics to manage and understand change, Lewin's three-stage change model was one of the earliest and most popular [4, 8, 11]. Ginsberg's [18] strategic change model demonstrated the dynamics of the change process, while the 'Generalised Enterprise Reference Architecture Methodology' (GERAM) presented a more complex model in three dimensional form [22]. Small and Downey's [50] enterprise change model is another example where modeling formalisms have contributed toward a better understanding of change. They used a high-level IDEF(0) (Integrated DEFinition) model to present the activities and interrelations involved in a change program. However, while all these models specified essential change issues and identified interconnected tasks, they were limited in their scope to capture the dynamics of low-level interdependencies.

Many systems analysis and design (SA&D) methods are based on specifying a model of the existing organization and using that to derive a further model of a desired organization state [56]. Thus, SA&D may be viewed as a change management approach and, indeed, many 'Business Process Reengineering' (BPR) tools are clearly based upon well-established SA&D modeling approaches [1]. SA&D methods are employed to generate specific views of an organization and may focus principally on processes, data, functions, events or a number of other organizational aspects [29]. As an example, the IDEF standard comprises a suite of special-purpose methods used to communicate various enterprise views and information solutions including, but not limited to, function modeling, data modeling, and process modeling [9]. Over the past decade, several comprehensive modeling method and formalism evaluations have been undertaken (see e.g. Molina et al. [36], Noran [40], PLAIC [44], Shen et al. [47], Tatsiopoulos [51] and, more recently, Grossman et al. [20] and Khoury [24]). An outcome of these evaluations appears to be a consensus that formalisms permitting both lower-level modeling and meta-models are more capable of meeting the challenge of integrating multi-layer domains (interfacing the required organization activities and components) [3, 38].

As noted, the focus of this paper is on modeling key aspects of organizational change (and, in particular, links between these) with a view to using this to produce a change management aid that allows the ready identification of all potential impacts of a specific change initiative (with special emphasis on the less-obvious consequential impacts). The need for this type of structured and rigorous analysis was stressed more than 30 years ago by Kotter and Schlesinger [25] who argued that ". . . surprisingly few [experienced managers] take the time before an organizational change to assess who might resist the change and for what reasons". Instead, many managers go straight from change initiative to tactics using heuristics, such as: 'ensure all parties impacted are kept fully informed' and 'end-users must be heavily involved in IS development'. Such heuristics are often appropriate but can be counter-productive if the reasons for resistance are not first identified.

The emphasis of Kotter and Schlesinger's [25] work was clearly on only one (but very important) aspect of the change process: namely, resistance based on potential threats to organizational power sources. McGrath et al. [34] used this as a starting point in specifying their 'Model of Power in 1st-Order Logic' (MP/L1) and Pfeffer's [42, 43] comprehensive treatment of power within the organizational context was employed as the principal conceptual foundation on which the model was established.

Pfeffer defines power as "a force, a store of potential influence through which events can be affected", while politics "involves those activities or behaviors through which power is developed and used within organizational settings" [42]. He describes power as "a property of the system at rest" and politics as "the study of power in action" [42]. Pfeffer's stores of influence are power sources (examples of which are control over information flows, position in the communications network and expert knowledge). Many organization decisions may result in a perceived and/or real redistribution of power sources. There are winners and losers, and losers may resist change. It is this concept that is at the heart of MP/L1 and, while resistance is not automatic, Pfeffer [42, pp. 68-70] contends that it is likely: i) where there is disagreement about goals and objectives; ii) where uncertainty exists about the means required to achieve objectives; iii) where resources are scarce; and iv) where decisions are important. We maintain that all these are characteristic of much change management (in general and, especially, within the IS domain).

The key to realizing the objective of identifying potential, consequential resistance in MP/L1 was the specification of a conceptual model linking generic power sources and connecting (some of) these to fundamental IS roles (e.g. system development, maintenance and ownership). We adopted a similar approach in specifying our 'Automated Change Management' (ACM) tool in this research but the scope was much wider than in MP/L1: namely, our focus moved beyond power, politics and resistance to all processes, parties, data assets and roles central to (and impacted by) organizational change initiatives. Nevertheless, the same broad conceptual modeling approach was employed and we now turn our attention to this aspect of our research project.

Formal Models of Organization and Management Theory (OMT)

Conceptual modeling has its origins in scientific theory (specifically mathematical and engineering theory), and covers a multitude of modeling methods and formalisms [39]. Organization modeling can be traced to the C17th when hand-drawn schemas and matrices were used to predict decision processes and outcomes [23, 35]. Modeling formalisms remained largely quantitative, predictive and goal oriented [49] until the 1930s when organization theorists embraced Ludwig von Bertalanffy's GST, where organizations were seen as complex, dynamic, interrelated structures [45, 49]. It was during this period social science emerged as a recognized theoretical domain. Following World War II, the Tavistock Institute of Human Relations formally identified the 'socio-technical' concept where the organization was viewed as a balance of social and technical components [52]. From this period forward, organization theorists, mostly, adopted some form of qualitative modeling formalism to illustrate the organization structure, components and dynamics. Qualitative conceptual modeling has since been adopted by numerous theoretical domains: for example, organization theory (specifically change theory), and technology theory (specifically SA&D). The acceptance of conceptual modeling as a valuable practice advanced organization and technology-focused modeling formalisms and tools.

Karl Popper, in Fawcett [16], stated that the conceptual model was the essential precursor to robust theory development. Indeed, conceptual (or theoretical) modeling has had a long and productive association with the sciences making valuable contributions through theoretical constructs, and theorems [53]. Simon [49] described modeling as the abstraction and separation of 'essential' elements from the 'dispensable'; or the capture of a 'simplified picture of reality' for the purpose of goal-oriented prediction and prescription. Pro-systems theorists adopted conceptual modeling to identify the interconnectedness of organization elements [46]. Simon [49] attributed the popularity of qualitative modeling to:

- the need to include multiple variables in complex system analysis;
- advanced graphics-based computer technology;
- advanced qualitative processing capability; and
- increased interest and research in human cognitive processes and systems complexity.

In parallel with this, over recent decades, an increasing body of computer science and software engineering research has addressed the benefits of formal OMT models as opposed to informal, literary theorizing. Bendor and Moe [2] claim that more formal representations clarify chains of reasoning and simplify the task of verifying that conclusions do indeed follow from assumptions; McGrath [33] points to the clarification of concept overlaps, ambiguities and inconsistencies; and Curtis et al. [13] suggest that the properties of multiple model perspectives can be analyzed more accurately where representation constructs are formally constrained. In addition, formal models can generally be implemented more readily and modeling both 'soft' and 'hard' data using a common approach reduces the possibility that the critical softer aspects will be overlooked.

Considerable attention has also been focused on the relative merits of qualitative and quantitative representations of organizations and OMT. Early models (see e.g. Forrester [17]) were highly quantitative: principally because, as noted by Masuch [32], if a computerized implementation was desired, model developers had little alternative. Masuch [32], though, further notes that much OMT is highly qualitative and this, combined with the relatively recent proliferation of powerful artificial intelligence tools outside laboratories, has resulted in a pronounced shift towards qualitative models. Despite this trend, however, he cautions against over-enthusiasm for the qualitative approach and, in our view, quite sensibly suggests that a quantitative conceptualization scheme should always be used where details of the phenomenon under study are most naturally expressed in quantitative terms. This is consistent with the view of Curtis et al. [13] who have argued that different modeling objectives, user diversity, conflicting requirements and the need for both large- and small-grained levels of abstraction all demand OMT modeling frameworks permitting representations that are qualitative, quantitative or a mixture of both. Here, domain knowledge is represented in entity-relationship (ER) form [10], implemented as a relational database and supplemented with rules (which operate on the relations and their attributes) specified in 1st-order logic [26].

Automated Change Tool (ACT) Model and Architecture

The original ACT model was derived from the change management literature and expanded and modified during the case study. Further case studies will (almost inevitably) result in further modifications. As is illustrated in the fishbone diagram presented in Figure 1, the domain is extremely complex, encompassing (among other aspects) policies, processes, systems, roles, responsibilities and relationships between all of these.

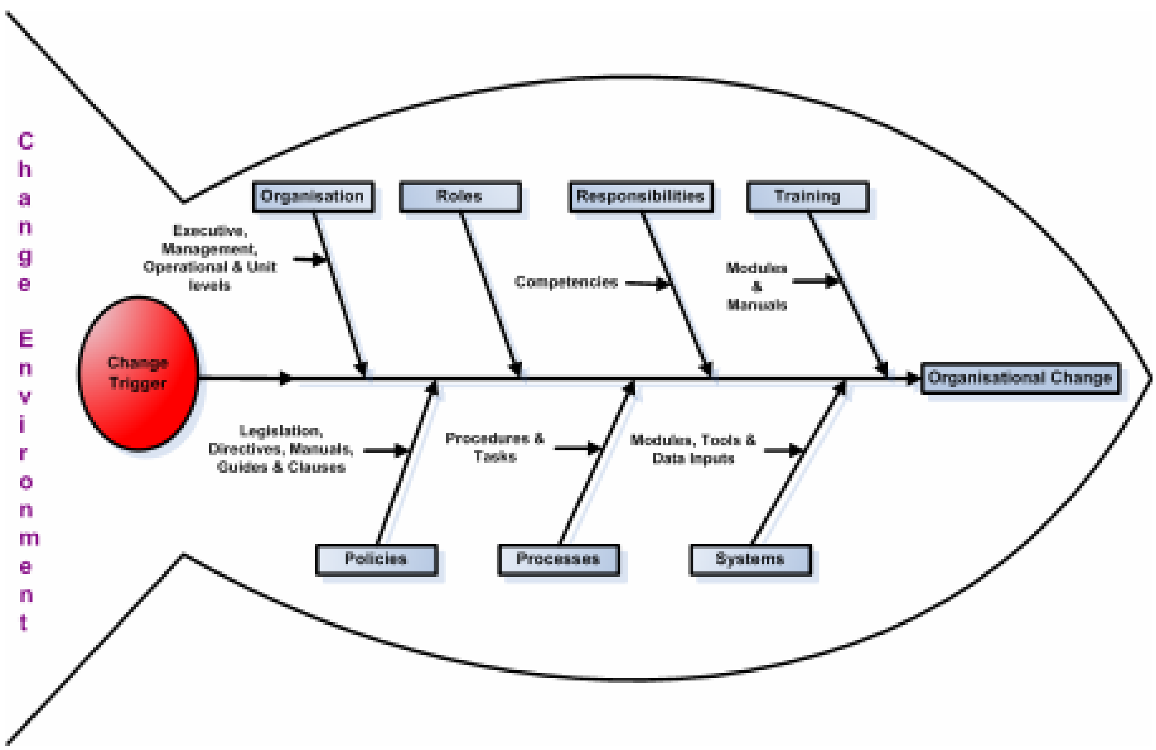

Figure 1: The Change Management Domain

This complexity is further emphasized in Figure 2, where a (relatively simple) example of links between a policy, processes, tasks, systems and roles is presented. A network model of this type can be derived for every policy (and its subclauses) and, collectively, these constitute the foundation for the ACT's impact assessment functionality (i.e. all network paths are traced and assessed systematically and comprehensively).

Obviously, however, specifying the complete set of networks (in a real-world, non-trivial case) is next to impossible. Consequently, an alternative representation scheme is required and, with the ACT, we begin with the highly-abstracted ER model presented in Figure 3.

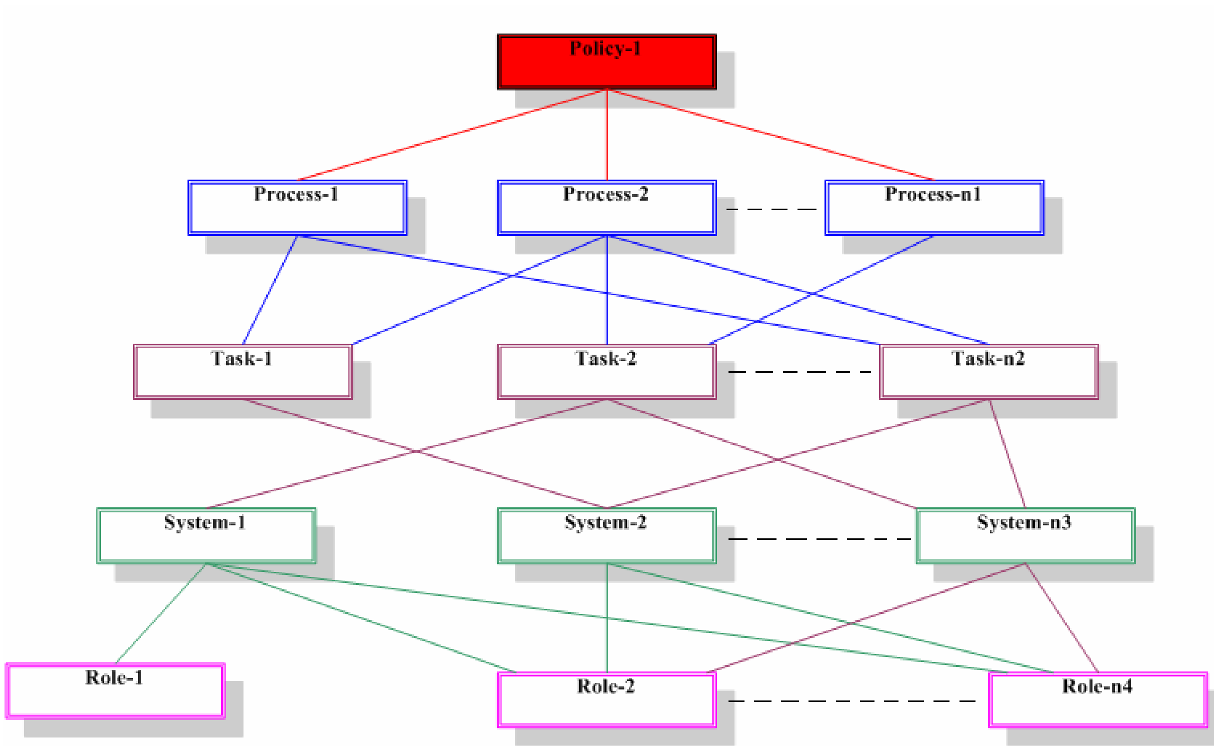

Figure 2: Change Management Domain – Network View

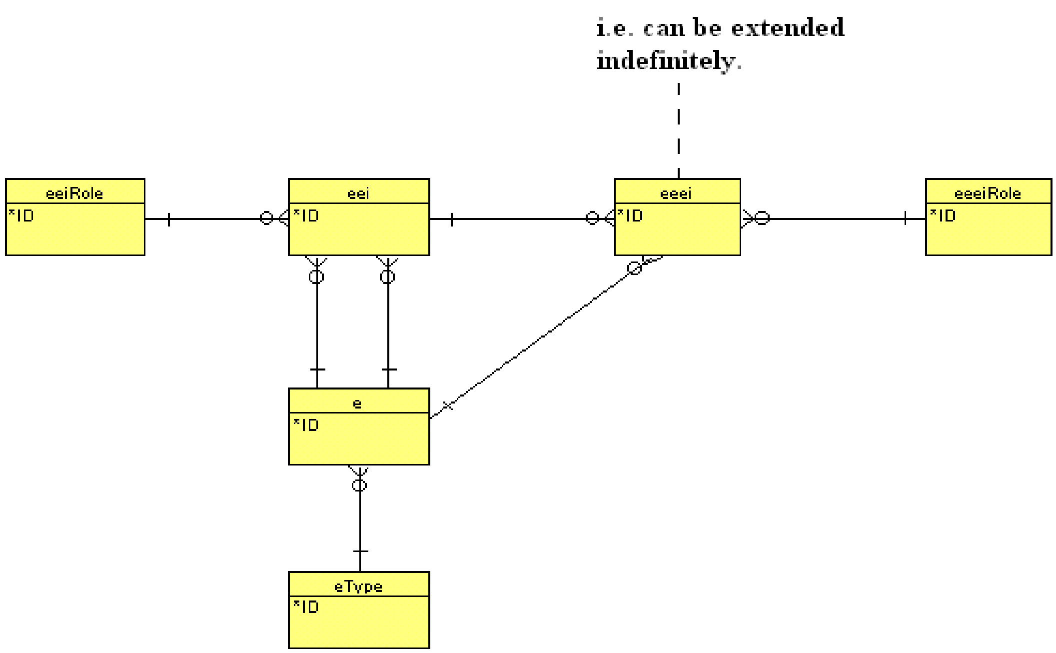

Figure 3: ACT Schema – Core Structure

Looking at the left-hand side of Figure 3, box, *e*, represents an *entity*, which must have a specific type and may be organization party, process, artifact, system, event or (business) rule (which encompasses policies, procedures, guidelines and constraints). Instances of entities may be linked to other entity instances (of the same or a different type) and these are represented as instances of *eei (entity-entity involvement)* relationships, each of which must have one (and only one) involvement role associated with it. The *e* and *eei* constructs in Figure 3 may be translated directly into 3NF relations and sample instance data is presented in Figure 4, where the *eei* data specifies the following: i) the procurement process is a subtype of supply; ii) the party, *e101*, supervises party *e102*; iii) party *e101* is also manager of the procurement process; iv) the guideline, *rule1002*, is derived from policy, *rule1001*; and, finally, v) the constraint, *rule1003*, is also derived from policy, *rule1001*.

e : Table

eID	eName	eType
1	e101	party
2	e102	party
3	supply	process
4	procurement	process
5	rule1001	policy
6	rule1002	guideline
7	rule1003	constraint
(AutoNumber)		

eei : Table

eeiId	e1Id	e2Id	e1e2IRole
1	3	4	subtype
2	1	2	supervises
3	1	4	manages
4	5	6	derivedFrom
5	5	7	derivedFrom
(AutoNumber)			

Figure 4: Relational Implementation of ACT Schema – Sample Data

Returning to Figure 3, involvement relationships may be linked with additional entities in further involvements and this is the case with the *eeei* relationship. For example, linking *rule1003* with *eei* instance No. 3, might be used to specify that this constraint applies to *e101's* management of the procurement process. The dotted line indicates that extending our core construct in this way may be continued indefinitely.

Finally, this schema is implemented within the high-level ACT architecture illustrated in Figure 5. Here, organization parties, processes, roles etc. (and the relationships between all of these have generic properties and this is the basis for the schema (which was discussed above) and is updated and maintained via the 'Schema Updates and Maintenance' module. There are specific parties, processes etc. for each instance of an organizational change initiative and the 'Organization Model' is, essentially, an instantiation of the generic schema for the particular initiative. It is implemented as a relational database and updated via the 'DST Updates and Maintenance' module. The 'Change Management Team' feed the 'Impacts Analysis' module with change details (externally and internally generated) and predicted 'Impacts' are subsequently returned. In a later section, we discuss a case study where the decision support tool was applied and evaluated. Prior to that, we outline our research approach.

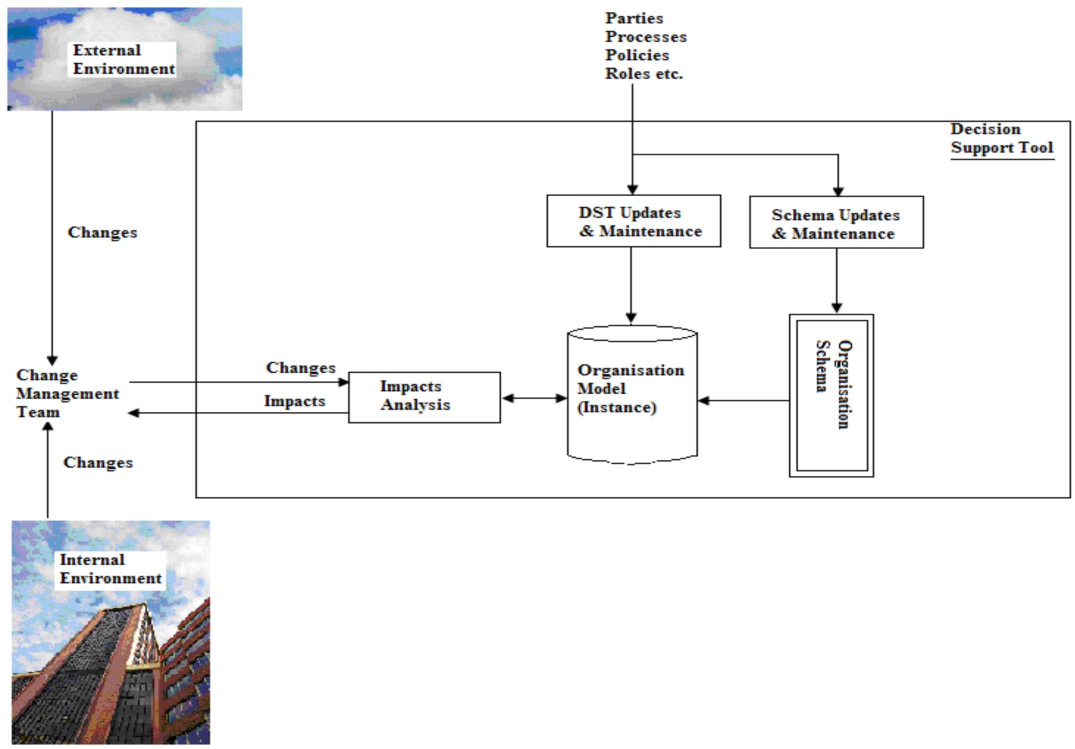

Figure 5: High-level View of Overall ACT Architecture

RESEARCH DESIGN

This explorative research posed the following two questions:

1. To what extent can a formal conceptual model (or schema) be used to adequately and effectively reflect the impact of (organization) change?
2. Can such a schema be translated into a 'useful', automated decision support tool?

As a relatively new field, information systems (IS) research borrows heavily from older disciplines; in particular, engineering and the design sciences. As Simon [48] has noted, "design sciences do not tell us how things are done but how they ought to be to attain some ends". Much the same applies to IS development and Gregor [19, pp. 12] has posed the question: "what constitutes a contribution to knowledge when research is of this type (oftentimes with no hypotheses, no experimental design and no data analysis per se)?"

Hasan [21, pp.4] responds to this by claiming that IS development, in many cases, should be considered a legitimate research activity (and method) because, not only is knowledge created about the development process itself, but also because "a deeper understanding emerges about the organizational problem that the system is designed to solve". Markus et al. [30] put forward a similar case in arguing that IS development is a particular instance of an emergent knowledge process (EKP) and that this constitutes original research where requirements elicitation, design and implementation are original and generate new knowledge on how to proactively manage data and information in complex situations. Hasan [21, pp. 6] further contends that this often involves a staged approach, where "systems evolve through a series of prototypes" with results of each stage informing requirements for the next and subsequent iterations.

Nunamaker et al. [41] take an approach consistent with the above but draw on an alternative research tradition in case studies and, in particular, action research. Again, using 'replication' strategies, each new instance (case or action research activity) builds upon and refines knowledge gleaned from previous studies [55]. Nunamaker et al. [41], however, nominate two features of IS development that distinguish it from more general action research: first, the techniques of IS development, the properties of the system itself and the situation where the system is to be deployed may all generate important knowledge; and, second, IS research projects are both constrained by the limits that current IT place on the development of systems and are enabled by the uniqueness of the technology (which can, as a tool, mediate knowledge generation and the communication of same).

The latter feature has been studied extensively by scholars in 'activity theory' [54]. Notably, activity theorists emphasize the holistic nature of the IS development process and, in particular, the critical nature of the cultural and social context within which systems are developed (see, for example, Engestrom [15] and Nardi [37]). The socio-technical view of IS, where hardware, software, people and processes are integrated into a complex, purposeful whole, is one of the key features that make information and communication technologies "like no other in the history of mankind" [21, pp.4].

Thus, to summarize: the development of our DSS is a legitimate research activity in its own right, which draws on the more established, traditional research approaches of the design sciences and especially case study/action research. Each new application of the DSS (e.g. for a new change initiative) produces a new version of our prototype and extends our knowledge of the research domain. This is akin to employing a multi-case (study) research strategy - with each new case refining and extending results of previous iterations - and finally, many research findings and outputs are actually inherent in the various conceptual models (and implementations of these) that constitute the DSS.

The actual research process followed is illustrated in Figure 6. The study was conducted in a large Australian organization called the Company. A preliminary analysis of the change management literature, the IS literature and the Company itself (the study domain) resulted in some preliminary findings and a set of data and process models, which were then used to construct the initial version of the ACT (V0.0).

Both the ACT and the initial findings were then employed in the case study, with the Company's procurement processes selected as the primary unit of analysis. The study was conducted between 2007 and 2010, with current and historical documents and outputs of focused interviews (using the ACT) employed as principal data sources. Case study findings were used to refine the ACT into version V1.0 and these two artifacts (findings and the ACT) combined constitute the research results (which, it is anticipated, will be refined further with future applications of the software).

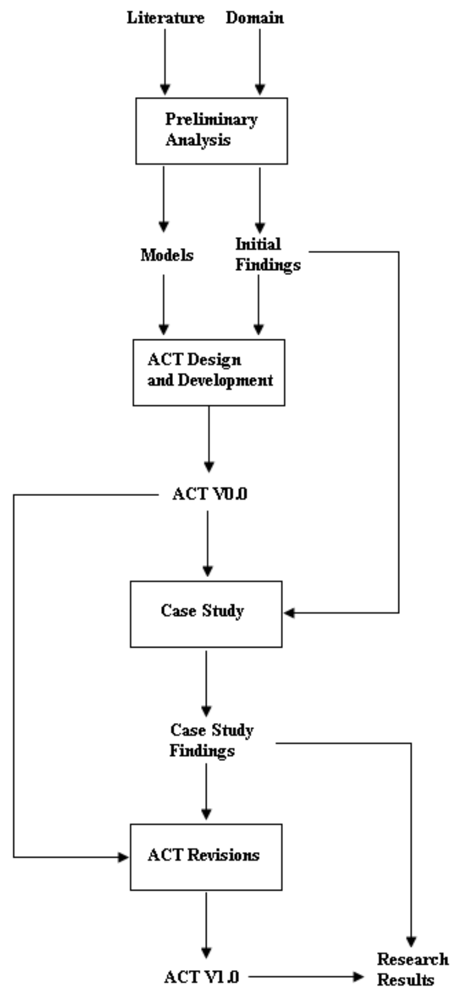

Figure 6: Overview of Research Design

The case study focus was narrowed even further to a retrospective analysis of a major change initiative. This concerned the Company's administration of the Australian Government's 2008 revised Commonwealth Procurement Guidelines (CPG), which were introduced to standardize finance and procurement processes across all Commonwealth agencies. All agencies governed by the Financial Management Accountability Act (1997) and the Commonwealth Authorities and Companies Act (1997), were governed by the CPG, and other associated materials. The revised CPG were a Commonwealth Government initiative introduced, in part, to support the Australia-United States Free Trade Agreement procurement arrangements. The initial arrangements, which came into effect 1 January 2005, governed a range of activities, which included: procurement activity and its management; tendering processes; and contract management. The most recent CPG amendments were introduced on 1 December 2008, and mandated changes to the following practices: value for money; competition; efficiency, effective and ethical use of resources; and accountability and transparency.

A major objective of the case study was to evaluate and test the accuracy and usefulness of V0.0 through an in-depth analysis of the particular change event selected. As with the first phase of the study, internal Company documentation was again an important data source. During the case study, however, this was supplemented with interviews with Company 'Subject Matter Experts' (SMEs). Twelve in-depth, open-ended interviews were conducted. Interview participants were chosen on their ability to provide an accurate and reliable overview of events within their environment. The SMEs comprised a mix of logistics practitioners, project managers, and business managers with lower, middle, and high-end responsibility ranking. The logistics practitioners provided expertise on operational matters while the project managers responded to issues concerning logistics (supply-chain) ICT projects. The business managers input centered on the Company's internal and external business interactions and strategic decision-making practices. In essence, the interviewees' expertise was sought to assist in filling out the detail of the CPG implementation (i.e. a 'coal-face' view) and to assist with the assessment and refinement of the ACT models and their DSS implementation.

CASE STUDY

The 'Company' and its Procurement Processes

The case participant was a large, Australian Government agency heavily engaged in complex, supply-chain (logistics) activities. The Company's supply-chain is underpinned by a 7-tiered hierarchy consisting of multiple functions (or high-level processes), sub-process, procedures, tasks, activities and transactions. The core functions include, but are not limited to inventory management, procurement/acquisition, repairs and equipment management, warehousing and distribution, and storage management. Each function is an amalgamation of multi-domain policies, processes, IS, and authority and responsibility arrangements. The Company has adopted a shared services model and, consequently the supply business unit is required to support all the Company's core-business operations (each of which have their own particular needs). The supply-chain is supported by approximately 120 IS, many of which are legacy systems. These systems support a large number and variety of business processes that encompass the Company's vast geographical expanse. Most of the supply-chain processes are transaction-dependent and hence, are system-based.

The Company has a current annual budget of $AUS104.4 billion and is supported by 77,500 operational personnel and 16,000 administrative staff. The Company's structure is essentially hierarchical, consisting of five executive groups, seven administrative groups and five operational groups. The executive group heads are representatives of the Company central committee, which reports directly to the Government. The administrative groups are the corporate nucleus supporting the Company's core business, while the operational groups are the Company's core business providers. The Company operates both nationally and internationally, and has a supply catalogue consisting of over 18,500 different items and has in excess of 4,000 separate product lines. Inventory is valued at more than $AUS80 billion, and is stored at 24 different national sites. Supply items vary from high-end capital equipment to pencils and pens. An efficient and effective supply-chain is absolutely critical if the Company is to meet its core business targets.

Over the decades, the Company has demonstrated a chronic inability to respond readily to change, leaving it in a state of flux. This change has predominantly been externally driven and, inadvertently, directed at the coal-face of the Company's supply-chain activities. The Company's documents revealed a succession of anomalies within its supply-chain environment, which became stressed when exposed to change. The documents revealed that, as the Company expanded, its supply-chain became increasingly fragmented and its control (governance) frameworks skewed. A number of authority and responsibility demarcations were implemented to remediate these issues. In some instances these arrangements added to the existing supply-chain anomalies and further undermined the Company's performance and efficiency levels.

As an example, responding to one externally-induced change initiative the Finance Group authorized modifications to the Company's core finance system which, in turn, triggered anomalies in the overall supply-system (e.g. supply systems had not been amended to provide the finance systems with the new data required). These anomalies were overlooked and the degree of overlap was not apparent until the finance system redevelopment was well underway: an oversight that cost the Company dearly. The Company was at times overwhelmed by the depth and breadth of change, mostly because the change triggers were externally driven. Often the changes involved modifying its information and communication technology (ICT) environment. This was a major challenge because the Company's ICT was foremost managed by a number of individual groups who frequently neglected to consult others on matters relating to system, policy or process interdependencies. Another factor that resulted in substantial inconvenience was the impact of these changes on system users where, in some instances, they were no longer able to perform even the most basic of duties.

Often, irregularities of this type were recognized by stakeholders at the coal-face of the supply-chain but disregarded at the executive level, where the majority of strategic decisions were shaped and then delegated to the appropriate authority for action. The Company's high-end managers often tended to disregard their obligation to communicate impending changes to supply-chain stakeholders. Consequently, there were notable communication deficiencies between the decision-makers, authority and responsibility delegates, and supply-chain operatives at the coal-face. There were many incidents where the inability to identify and manage supply-chain interdependencies set in play a domino effect of dysfunctional activities. When problems were identified there were often no mechanisms in place to remedy these problems.

Table 1: Logistics Management Process Hierarchy (Source – Internal Company Documentation)

Function	Process	Sub-Process	Procedure	Activity	Task
Logistic Management	Supply Stores & Inventory Management	Cataloguing			
		Supply Management	Inventory Management		
			Stores Accounting		
			Stocktaking & Reporting		
			Disposal		
		Purchasing	Supply-Chain Purchasing		
			Determine Method of Procurement	Determine Mandatory Requirements	Choose Efficient, Effective & Ethical Use of Resources
					Use Company Standing Offers
					Use Stated Contracts
					Comply with Engineering Requirements
					Choose Proposal Approver
					Seek Delegate Approval
					Ensure Delegates Meet Competency Requirements
				Select Method of Procurement	Determine Procurement Complexity
					Determine Supply History
					Establish Market Knowledge
					Determine Urgency of Need
					Consider QA Factors
				Review Purchase History	Ascertain Current Supplier
					Determine Standing Offer Status
					Exercise Market Testing Discretion
				Review Engineering Requirements	Obtain Prior Authorisation
				Review Methods of Procurement	Assess Direct Purchase Options
					Assess Standing Offers
					Solicit Quotations
					Assess International Option
				Determine Sourcing Options	Assess Market Knowledge
					Assess Other Options
				Approve Method of Procurement	Purchase Through Standing Offer
					Purchase Internationally
					Purchase Directly
			Commercial Purchasing		
			International Sales		
			Manual Purchasing Methods		
		Item Repairs Management			
		Equipment Maintenance			
		Warehouse & Distribution			
	Logistics Performance Management				
	Logistics IS Capability Management				
	International Logistics				

As noted, the Company's supply operations involved multiple functions, processes, organization groups, systems, policies and roles and responsibilities. This case study restricted itself to a single function (or high-level process), and its associated sub-processes, tasks and activities. The process hierarchy is illustrated at Table 1. Although there were many anomalies present throughout the supply-chain, investigating all activities implicated in a change process was beyond the scope of this study. Logistics management was the high-level supply-chain process chosen and, more specifically, the sub-process purchasing. All of the Company's operational groups performed some procurement activities in support of their operations, including purchases of capital equipment and related supply items. The administrative groups' purchases were largely consumables, including corporate equipment, stationery, and ICT peripherals, to name but some. These items were non-capital equipment but nonetheless, they were essential to the day-to-day running of the organization. Importantly, all capital equipment purchases were transacted using the Company's supply-system. Consumables were transacted using the corporate credit card or purchase orders. These procurement methods were governed by the same financial and procurement policies, and authority and responsibility arrangements.

In addition, capital equipment purchases were governed by a series of mandatory requirements over and above the Company's procurement policies and authority and responsibility arrangements. These requirements covered item identification, supply-system purchases, purchase pre-requisites, and purchasing levels. Capital equipment purchases were considerably more complicated than non-capital items purchases, having an additional eight procurement stages, and fourteen equipment-specific and supply system guidelines. Moreover, operational groups were governed by unique (operation-specific) policies and processes, which were deemed essential if their diverse operations were to be conducted in an integrated and consistent manner. Furthermore, each operational group head was assigned the role of business owner, with each being held accountable for their respective operations. Synchronizing the operational groups' procurement processes was a far from trivial task, given they managed different equipment and, justifiably, had unique acquisition (procurement) and support requirements. In almost every instance, the operational groups informally tailored the Company's procurement policies to better serve their respective needs.

Study Findings and ACT Refinements

Implementing the 2005 CPG revisions was a major challenge for the Company and extensively impacted its operations. The 2008 CPG revisions created even greater turmoil. The 2005 changes brought in a series of Commonwealth Government mandated finance and procurement changes. The Company had struggled to implement these changes in a timely manner and its supply-chain performance and effectiveness had suffered as a result. These changes had a flow-on affect with the Company struggling to administer and resource the 2008 CPG requirements. A major disappointment for the Commonwealth agencies was the Government's refusal to compensate them for implementation costs (which amounted to hundreds of millions of dollars).

To facilitate interaction with interview subjects, a cross-functional process model (CFPM) was employed. The CFPM model was modified extensively and iteratively during the interview process and the final version is presented in Figure 7.

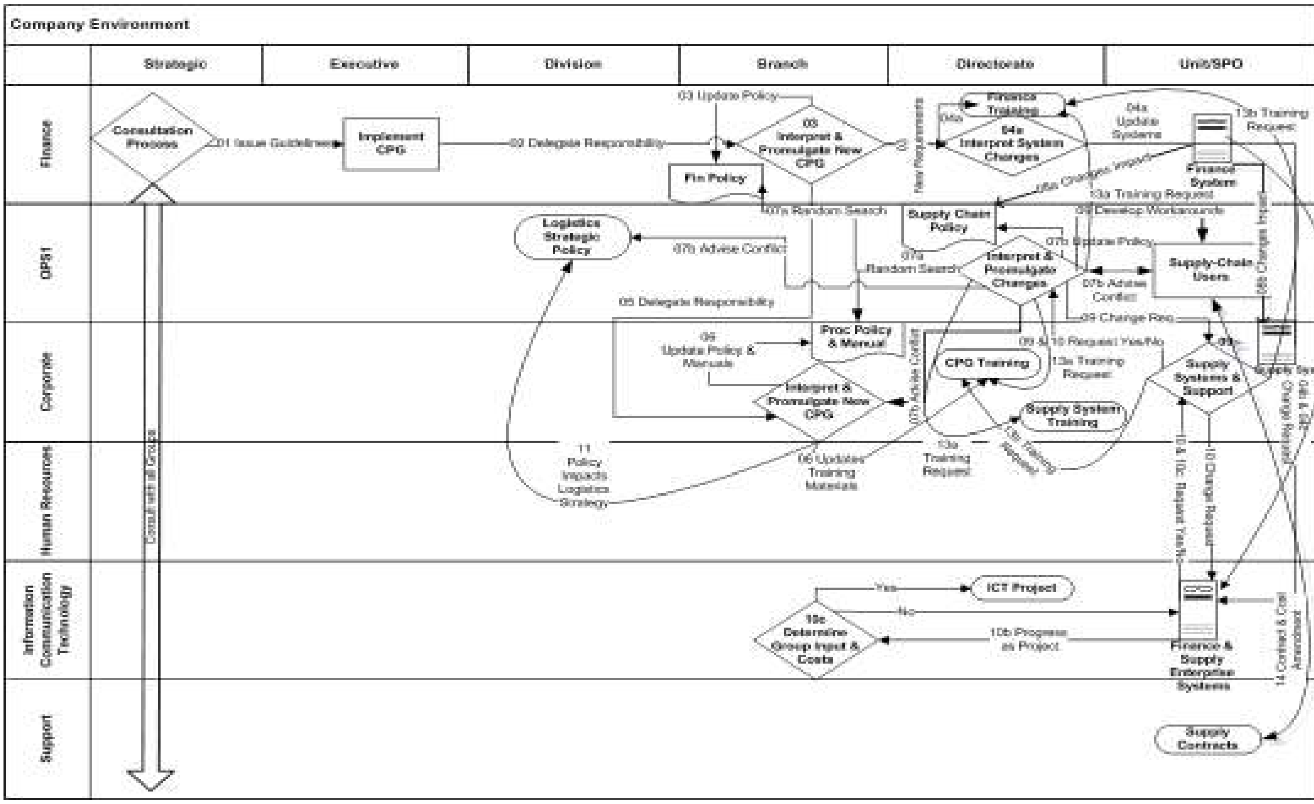

Figure 7: CPG Cross-Functional Process Model (CFPM)

The CFPM mappings revealed a number of change activities had severely impacted the Company's supply-chain entities. Examples of problems that occurred, which are detailed below and mapped against the activities numbered in Figure 7, included the following:

- Stakeholders were not notified of pending policy changes or new policies resulting in chaos. The Commonwealth Government Financial Management Control Committee (CGFMCC) advised the Company's Finance Executive Committee (members of the Company's Chief Finance Officer Group (CFOG)) of the amended CPG instructions (activity 01 and 'consult with all groups'). The Finance Executive delegated responsibility to the CFO Financial Controls Framework Branch (FCFB) (activity 02) who interpreted the CPG instructions then formulated and promulgated the Company-wide procurement and finance policy changes (activity 03). However, the Company's procurement policy was, in part, the responsibility of the Corporate Division. This oversight created operational disparity between the CPG amendments and the Company's operational procurement and financial guidelines documentation. The Corporate Branch interpreted the CPG procurement amendments in accordance with advice from the Finance Group. However, their interpretation and implementation of the changes greatly impacted logistics strategic policy (activity 11). The CPG amendments were promulgated across the organization with the respective documentation updated (activity 06). There was no consultation with, or feedback from, stakeholders prior to implementing the CPG changes. While each CEO was responsible for disseminating policy changes within their Group, there was no formal distribution process alerting stakeholders of the changes other than the amended financial and procurement policies posted on the Company's website.

Consequently, (using our case study sample) it was the responsibility of the Ops 1 supply chain subject matter experts (SMEs) to trawl the website for relevant finance and procurement policy changes (activity 07a), interpret, promulgate and update supply-chain policies and manuals, then notify the Corporate Branch, Logistics Strategic Division and supply- chain users (or vice-versa with respect to the latter) of any anomalies (activity 07b). Many of the impacts of organization-wide policy changes were overlooked at the transaction level and supply-chain SMEs had to develop workarounds in order for users to perform their basic, day-to-day tasks (activity 09).

- Conflict between existing supply-chain policy and processes, and new CPG requirements resulted in user confusion leading to productivity loss. For example, new CPG procedures required modification of the Company's supply automated purchase orders system. This impact was not picked up until users discovered they were unable to reconcile supply item purchases through the core financial system. As a result, supply system users had to establish procedural workarounds (as discussed above), which included manually creating, recording and storing mandated finance audit documents (i.e. financial reports and purchase orders). There were instances where these workarounds remained unresolved for 2-3 years and, in some cases, are yet to be fixed.
- Finance and supply-system changes were authorized (or not) without notifying supply-chain stakeholders leading to misalignment of procurement policies, processes and system interfaces. The Company's supply-chain activities consisted of multiple-domain transactions and system interfaces. A large number of these transactions required finance system updates. The Company's finance system underwent major report changes as a result of the CPG amendments (activity 04a). As a consequence, the finance system (activity 04b) and the supply system (activity 04c) required further changes. These configuration changes were made without consulting the supply System Owner (OPS 1) or supply-chain users. The result was that a large number of supply-procurement policies and transactions were impacted (activities 08a, 08b) which, in turn, resulted in a need to reconfigure the supply system's core modules (activity 08c).
- The CPG changes resulted in significant amendments to the Company's major supply systems and these needed to be managed as projects. For example, to resolve the number of workarounds, the core supply chain system underwent major redevelopment to accommodate new financial data processing requirements and data exchange between the core finance and supply enterprise systems. The finance system is Systems, Applications, Products (SAP)-based and the supply system is a heavily-modified proprietary inventory management system over 30 years old. Integrating these two systems was arduous with batch files often required for data exchange. OPS 1 SMEs requested configuration changes (activity 09) through the Corporate systems program office (SPO) (responsible for supply systems support to OPS 1 supply-chain users) to the ICT Group (the Company's technical authority responsible for configuration change requests for all enterprise systems) (activity 10). Major change requests were progressed as a project (activity 10b) with Group responsibilities and costs assigned (activity 10c). Project approval was dependent on the availability of funding, with the change initiator notified of the outcome (activities 10 & 10c, 9 & 10). The cost of the CPG changes, in terms of the supply system redevelopment, was in the order of hundreds of millions of dollars, which the Company had to fund. As it turned out, funding was provided for only part of the required changes, which left supply-chain users having to continue using cost- and time-inefficient workarounds.
- Revised training manuals and competency requirements were unavailable (or overlooked) making it impossible to execute the new CPG activities. The CPG changes altered existing purchasing procedures to the extent that users could not undertake their normal tasks (activity 07b). The effect was that procurement and supply system training manuals were not aligned with the new CPG arrangements resulting in supply-chain users having to seek verbal authority from outside

their work environment to deploy workarounds in order to execute the new procedures (activity 09). Existing financial delegation arrangements were also impacted. The result was that financial delegates could not exercise their authority because they did not have the required competencies/training mandated by the CPG changes. The competency/training programs had not been developed. This meant new contracts could not be established, supply items could no longer be purchased under the terms of existing contracts, and in some instances, contracts had to be renegotiated at great cost to the Company. OPS 1 SMEs identified new financial, procurement (CPG) and supply system competency/training requirements for supply-chain users (activities 13a.). Supply system support staff were also impacted by the new training requirements and had to undergo finance and CPG (procurement) instruction (activity 13b).

- Contract amendments were needed to accommodate additional/changed workflows, which incurred considerable costs. The Company supports its operations with contract labor. In some instances, the new CPGs resulted in additional activities being added to the procurement workflow. This resulted in the need to amend contractor deliverables – or employ more contractors - to accommodate the additional workload (activity 14). This proved a costly exercise as it impacted multiple contracts valued at hundreds of millions of dollars. Again, the Company was not compensated for costs incurred by the mandated CPG changes.

Insofar as ACT refinement and enhancement is concerned, the most significant developments that occurred as a result of the case study were concerned with the system's usage: specifically it emerged that, even dealing with a relatively small part of an organization's operations (in this case, procurement), the number of entities and relationships is prohibitively large and considerable care needs to be taken in instantiating the DSS database (i.e. preparing the organization model – see Figure 5). If not, the database is liable to be populated with a significant number of irrelevant relationships (costing considerable time and money) and this, in turn, means that impact searches will lack focus and generate substantial, irrelevant clutter (in query outputs).

To understand this better, the search for change impacts employs the following recursive algorithm:

EntityX hasSubtype EntityY if eei(_, EntityX, EntityY, subtype).

EntityX hasSubtype EntityY if eei(_, EntityX, EntityZ, subtype) and

EntityZ hasSubtype EntityY.

That is, given a declaration that a change management event impacts on an organizational activity at a given point in the process hierarchy, the above may be employed to return all subtype (and super-type) processes that might also be impacted. Impacted systems, roles, guidelines etc. may also be identified through an examination of the respective entity hierarchies declared for each of these entity types. The problem is that this type of naïve algorithm only retrieves entities that might be impacted and a careful examination of each returned result is required to determine if it is, indeed, relevant.

It was determined that much of this wasted effort can be avoided if impact search is restricted to only those process-process relationships that are explicitly declared in the database and, moreover, it was discovered that most of the work required to determine the relevant set of these process-process relationships (plus their connections to systems, roles etc.) had previously been undertaken by the Company (in various information architecture development, business process modeling and BPR exercise conducted over the years). In particular, sets of matrices linking processes, roles, systems, organization units and business rules, developed and maintained as part of the Company's 'Corporate Information Architecture', proved to be particularly useful. (For further detail concerning information architectures and their development, see Martin [31]).

CONCLUSION

This research addressed the broad questions of whether formal conceptual modeling techniques (as employed in the IS domain) could be used to effectively model key aspects of organization change and whether such a model could be implemented (as a DSS) in a way useful to practitioners. The development of the model, its implementation as the ACT and its preliminary validation (via its application to a real-world, non-trivial change initiative) were described. While the validation exercise was retrospective, the ACT was well-received by the practitioners involved in user testing: in particular, the system's ability to indicate the less-obvious change impacts (and to do so systematically) was seen to be of considerable benefit. Consequently, it is probably reasonable to conclude that early indications are that the conceptual change model (and its ACT implementation) may well, indeed, prove to be 'useful'.

The merits of modeling the key components and interdependencies of organizational change and the value of a change management tool capable of identifying the potential impacts of a change process were detailed. The paper presented the findings of an in-depth case study that investigated the impact of unintentional and systemic change within a complex supply-chain environment. The findings clearly demonstrated the supply-chain interdependencies but, moreover, highlighted the domino effect where changes in one sub-system or domain could affect changes in another. The research outcome was significant for OMT and practice as it demonstrated the complexity and dynamics of a change process contributing toward a better understanding of the entities and interrelations involved in an organizational change program.

Formal conceptual modeling was an important feature of this project: specifically, the identification and specification of the entities and relationships involved in organizational change and the implementation of the conceptual model as the ACT (our change management tool). We have demonstrated the significance of the ACT in its ability to identify and report the potential impacts of a specific change process. Without this structured and rigorous analysis, potential impacts would not be identified, with a possible outcome being the chaotic events revealed in our case study. We acknowledged that the need for this type of automated tool was promulgated decades earlier.

We specified the ACT development process, providing an overview of the mix of change management and IS literature used as the basis for the conceptual model. The accuracy and usefulness of the initial ACT was evaluated using an in-depth analysis of the CPG change event. An important part of this process was supplementing the preliminary materials with interviews from Company SMEs and strategic decision makers. The interviewees' expertise assisted in detailing the 'coal-face' view of the CPG changes and refining the ACT schemas and their DSS implementation. This was important, as the material enabled the functionality of the ACT to be extended to systematically and comprehensively link policy, processes, tasks, systems and roles etc to the lowest denomination and single record instance. Moreover, experience gained with this particular study enabled us to establish guidelines regarding population of the ACT knowledge base designed to reduce the impact query search space and improve the relevance of results.

It is our intention to further test the ACT across other domains and industry types with a view to producing new versions with each successive application. Parallels between this IS development method (best described as 'prototyping') and classical, case study research were drawn.

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