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THE THREE AMIGOS: THE ROLE OF ACTOR-NETWORKS, BOUNDARY OBJECTS AND STRATEGIC UNCERTAINTIES IN THE RISE AND FALL OF THREE INNOVATIONS IN A SINGLE COMPANY

By

David Emsley,

Macquarie University

ABSTRACT

This study reports on attempts to introduce management accounting innovations over a two year period in several plants at a manufacturing site of a multinational company. The study follows the efforts of three individuals (the amigos) to introduce different management accounting innovations at three different plants on the site. Although two of the attempts "failed", one innovation was "successful" to the extent that efforts were subsequently made to introduce it into two other plants. Consequently, five stories account for the different outcomes that can best be explained using a theoretical framework that combines actor-network theory, boundary objects and strategic uncertainties. In a number of ways this study complements previous research by Briers and Chua (2001) who also used actor-network theory and boundary objects to explain the process of innovation but, importantly, this paper also introduces Simons (1990) notion of strategic uncertainties to explain how different boundary objects wax and wane in importance over time, along with the networks attached to them.

1. INTRODUCTION

The topic of innovation has attracted researchers' attention in recent years because innovations are thought to enable organizations to successfully adapt to, and survive, volatile business environments (Rodgers, 1995). However, some doubts have been voiced about management accountants' ability to innovate because of the relatively low uptake of 'new' management accounting techniques such as ABC and balanced scorecard (Cobb et. al., 1992 Reeve, 1996; Chenhall and Langfield-Smith, 1998a; Lukka and Granlund, 2002). This evidence has motivated researchers to study management accounting innovations more deeply and a number of approaches have developed.

Probably the most common approach to studying management accounting innovations has been to take variables from the organizational literature and to apply them to management accounting settings (e.g. Shields, 1995; Gosselin, 1997; Krumwiede, 1998; Baines and Langfield-Smith, 2003). However, the results of this largely cross-sectional research have been mixed with some results being insignificant or significant in the *opposite* direction to that hypothesized.[1] Such results have been argued to be due to the inappropriateness of generalizing findings from the organizational literature to management accounting settings (Kaplan, 1986) and/or misspecifying the relationships between variables (Luft and Shields, 2003). Both these reasons are redolent of theoretical weaknesses and, consequently, research that strengthens the theory in order to better understand the innovation process in management accounting settings would be useful (e.g. Anderson 1995). This approach is consistent with comments from Hopwood (1987, p.227):

> *Rather than assuming to know what is driving innovation, the cases demonstrate the need for an appreciation of change to be based on a more detailed awareness of the means through which accounting change occurs*.

This paper contributes to our understanding about the development of management accounting innovations by adding to a growing school of thought that questions some of the assumptions that underpin the cross-sectional studies that have dominated the management accounting innovation literature to date; namely, the assumption that innovating is a rational and sequential process where organizations position themselves to readily perceive and eagerly adopt innovations (Mouritsen, 1994).

Managers' ability to behave rationally has long been doubted (Simon, 1957) especially in complex settings and developing innovations is a complex process partly for technical reasons (e.g. understanding how an innovation, such as ABC, works and can improve decision making) but also because of the many political and social forces within organizations. That is, innovations are

[1] For example, in the organizational literature, a positive relationship between decentralization and innovation has been found (Damanapour, 1991) but the opposite results were found in the management accounting literature (Libby and Waterhouse, 1996; Williams and Seaman, 2001.

not inserted into an inert and yielding environment but are subject to political and social forces within organizations that react to such intrusions. At one extreme these forces can reject the introduction of an innovation but for those innovations that are not rejected, these political and social forces do not just adapt or react to the innovation but they can actively mould, construct and fabricate the innovation such that ostensibly similar innovations can take on quite different forms in different settings. Whereas cross-sectional survey research necessarily skates over this complexity (and thereby misses the underlying subtleties of the innovation process), these nuances can be captured by longitudinal case studies especially where they are informed by appropriate theoretical frameworks. In this paper a theoretical framework that combines actor-network theory (ANT) with boundary objects and strategic uncertainties is used to explain the findings in this case study where three individuals pursuing innovations from the same starting point ended up with very different outcomes.

The remainder of this paper is organized into two main sections. The first section details the theoretical side of the paper that involves actor network theory, boundary objects and strategic uncertainties and the second section uses a case study to illustrate these theoretical concepts.

2. THEORETICAL DEVELOPMENT

2.1 Actor-network theory

Actor-network theory originates from the works of Latour (1979, 1987, 1998), Callon (1998; 1999) and Laws (1992) and is utilised in this study to describe how the agency of various heterogeneous actors affects the development of management accounting innovations. However, there has been some concern that the "philosophical rhetoric" and "ontological slipperiness" of ANT has made it inaccessible and difficult to understand clearly (Lowe, 2001; Heeks, 2001) which, in turn, has limited its potential to explain the innovation process. Consequently, there is a need to clarify ANT as it might relate to the process of innovating in management accounting

settings and perhaps ANT can be most easily explained, at least initially, by examining situations where actor-networks are not necessary.

Callon (1998) argues (in a similar vein to Ouchi (1979) and Williamson (1991)) that markets are appropriate means for determining and co-ordinating economic activity where uncertainty is low. In such settings, an individual can enter the market place as a stranger, make his/her purchasing decisions using price information alone, transact and then exit the market still as a stranger. However, as the uncertainty and complexity surrounding transactions increases, so does the amount of information that is needed to make an informed decision. One way to acquire this information is for individuals to no longer remain as strangers but to start to interact and exchange information with each other; that is, to start developing networks (Pinch et al, 1989, p.278).

ANT seeks to explain the complexity associated with such networks through the concepts of actors, framing, inscription devices, artefacts, entanglement-disentanglement and overflows/leakages. Each of these concepts will now be explained and illustrated using an example.

Actor-networks are “framed” (or defined) by the actors (individuals) involved in the process and, although Callon (1998) views actors both in terms of human and non-human forms, Chua (1995, p.117) describes actors in human form (because only humans have agency and can benefit from the actor-network), and this (latter) interpretation is continued in this study. Apart from assuming that actors seek to benefit in some way from their involvement in a network, ANT makes no other assumption about them, consequently, actors are likely to be heterogenous in terms of: (i) their goals and reasons for joining networks, (ii) their dominance and influence within networks, and (iii) their level of involvement in, and perspective of, the actor-network as a whole (Laws, 1992; Chua 1995, p.116; Pinch et al, 1989, p.274). While non-human actors do not have agency, they play a vital role in ANT but are described in this study in terms of inscription devices and artefacts. Inscription devices and artefacts as well as the interplay between them and (human) actors are described next.

Where a decision setting is uncertain, actors interact with each other using “inscription devices” which can be presentations, reports or discussion documents that may contain "calculative spaces" (e.g. numbers, formulae and graphs) presented as "facts" or “statistics”. These inscription devices largely determine what is (and is not) discussed which, in turn, serves to limit the scope of the interaction between actors. “Artefacts” refer to the resources available to actors (such as computer hardware and software) that can affect how the information in inscription devices is processed and presented. The interaction among actors as a result of these inscription devices is described as a process of “entanglement” where actors use inscription devices to discuss and debate issues with each other and exchange different opinions and points of view. This process of entanglement extends over a period of time because “overflows” and ”leakages” (i.e. issues that remain unresolved or have yet to be discussed) require on-going discussions among actors to resolve them. These issues may be resolved by developing additional inscription devices that enables consensus among actors to ultimately emerge and this iterative process serves to fabricate and construct reality within the actor-network. Subsequent reinforcement of that consensus serves to harden that reality further (Latour, 1979, p. 236) so that previously “soft” numbers (about which considerable doubt may initially have existed) become “hard” and this process continues until a point is reached where the actors have no need, or wish, to resolve the issues any further and their reality is as close to what they believe is the “truth” as is necessary for their purposes. At this point the issue effectively becomes resolved and is “black-boxed”. Thereafter actors “disentangle” (or disengage) themselves from each other and the actor-network disbands itself or moves onto other issues. The black box remains closed until a time when doubts about its veracity gather sufficient momentum to justify the non-trivial exercise of opening the box and revisiting all the issues again (Latour, 1979).

To illustrate this process in a management accounting setting, take the example of a cross-functional team that has been set up to determine product profitability. Each of the actors is likely to have a different objective (or interest) in developing product profitability, for example, one actor may want to use product profitability to set prices, another to develop an incentive program, a third to justify redundancies and another to argue for discontinuing to make a product. A

preliminary product profitability report (inscription device) may be provided that forms the basis for initial discussions (entanglement) within the cross functional team (actors in the network). Team members will discuss the report, examine the assumptions behind the numbers and assess the accuracy of the calculations for their purpose(s). At first there may be little consensus about many of the issues (such as the appropriateness of certain cost drivers to allocate costs), but as these unresolved issues (overflows and leakages) are questioned and debated, additional analysis (inscription devices) may be provided. For example, an additional report may identify the correlations between costs and a number of different cost drivers. This analysis generates further discussion (entanglement) that continues until a growing consensus emerges about the most appropriate cost driver(s) to use (the fabricating and hardening process). While the “true” product profitability position is unlikely to ever be known for certain (and actors are only need a level of certainty that is sufficient to meet their own objectives), a point will be reached where they will accept the “reality” of their product profitability model and have no need or wish to pursue it further. At this point the product profitability model is “black-boxed” and the actor-network disbands. The product profitability model continues to be used until such time that growing doubt about its accuracy (for example, when costs fail to behave in the way the model predicts) leads to re-opening the black-box and revisiting all the assumptions inherent in the product profitability model (such as the correlations between costs and cost drivers). This non-trivial exercise might occur, for example, when considering whether activity-based costing would increase the accuracy of the product profitability model.

While ANT originates from the sociological literature, applying it to organizational settings needs to take account of the organizational context that can affect individuals’ behaviour within actor-networks. For example, communicating (between actors) is primarily a social act but is situated within a framework of organizational rules and routines that determine interactions and influence the behaviour of individuals (Caglio, 2003, p.125). Such organizational contexts include the formal hierarchy that determines hierarchical relationships as well as who works with whom, where individuals are located as well as how subordinates’ performance is evaluated, all of which can affect the interests and behaviour of individual actors.

However, while this section has described the way actor-networks operate, it does not address the reason why actor-networks form and, in an organizational context, this can be explained by using the concept of boundary objects as discussed next.

2.2 Boundary objects

Following Briers and Chua (2001), this paper views the purpose of actor-networks in terms of boundary objects. Boundary objects are a means to broker and support exchanges between different social worlds (Fischer and Reeves, 1995), but to understand “different social worlds” more fully, it is useful to introduce the terms ‘community of practice’ and ‘community of interest’ (Arias and Fischer, 2000). Applied to business organizations, a ‘community of practice’ represents practitioners who work within a single domain. For example, accountants within an accounting department might be regarded as a community of practice and engineers within an engineering department might be another. A community of interest is formed when different communities of practice (say, accountants and engineers) are motivated to work together because they have a shared interest in a specific task that requires each of them to go beyond their own area of expertise in order to achieve their own objectives (Hildreth, 2000).

Such situations are more likely to arise where a solution to a problem is ill-structured and knowledge from different communities of practice is needed in order to develop a solution, even though at the start of the process, the task and knowledge required might not be known precisely nor how the communities of practices might collaborate and work together in practice (Star and Griesemer, 1989). Solutions within a community of interest evolve incrementally over time as a result of collaboration between different communities of practice (Wenger, 1998) and this collaboration is facilitated where they share a language that enables them to forge closer relationships. However, while each community of practice is likely to understand how they are benefiting from the collaboration, they will be less certain about how other communities of practice are benefiting.

For example, assume that the engineers regard the introduction of the boundary object of TQM as important to their work, their eagerness to involve the accountants will depend on their perception

that the accountants know something about TQM that they (the engineers) don't know but need to know in order to fully benefit from TQM. If the accountants' knowledge is regarded as essential to implementing TQM and the accountants can invoke the language of TQM to articulate and communicate their TQM-related knowledge, the engineers are more likely to form a community of interest with them. However, while the engineers might understand what they hope to get from implementing TQM, they are less likely to understand what is motivating the accountants. That is, each party is likely to have a different reason for collaborating and neither is likely to fully understand the motivation of the other. However, they understand that they both have a shared desire to see TQM implemented and recognize that their disparate goals can best be achieved through cooperation and collaboration within the community of interest (Star and Griesemer, 1989).

Consequently, a boundary object (e.g. TQM) is rigid enough to maintain its own identity across different communities of practice (for example, they different communities of practice can all agree that they are talking about the same boundary object i.e. TQM) but malleable enough to adapt to the needs of individual communities of practices (Star, 1989).

Visionary and non-visionary boundary objects

At this point, it is also necessary to discuss the two different categories of boundary object that are used in this study: visionary and non-visionary boundary objects (Star and Griesemer, 1989; Briers and Chua, 2001).

Relative to non-visionary boundary objects, visionary boundary objects are more conceptual and intangible in nature and can attract the interest of different communities of practice because they are open to different interpretations about how each community of practice might benefit. TQM is such a visionary boundary object that can evoke similar responses from different communities of practice that, once accepted (black-boxed), can attract high levels of legitimacy. For example, the need to attain "world class manufacturing status" might be so obviously desirable that its legitimacy is difficult for individuals to refute, even though its reality and actual form is unknown until its application is customized to a particular setting (Fullerton and McWatters, 2002, p.717).

However, visionary boundary objects tend to be less durable (than non-visionary boundary objects) because there can be great uncertainty about the degree to which they actually exist and it is only when visionary boundary objects are reified through the inscription devices and artefacts of non-visionary boundary objects that they become durable and their existence is defined.[2] This suggests that boundary objects are not necessarily mutually exclusive or independent but are likely to be inter-related or nested within each other. For example, the visionary boundary object of TQM may support a number of non-visionary boundary objects (such as the 'cost of quality' and 'quality improvement teams') that are deemed subordinate to the dominant visionary boundary object of TQM because would not exist without it. However, each subordinate boundary object can support an actor-network and actors may be involved in more than one of these actor-networks and move between them depending on the issues affecting them at any given point in time. These subordinate and non-visionary boundary objects are important in this case study because they are the means through which the visionary boundary object of TQM is operationalized.

However, both ANT and boundary objects are dynamic concepts, even though those forces may be relatively stable at any given point in time. This study addresses the dynamism of boundary objects (along with the actor-networks that are attached to them) in terms of changing strategic uncertainties.

2.3 Strategic uncertainties

The concept of strategic uncertainties is most often associated with the work of Simons (1990) who linked them to the use of interactive controls. Interactive controls relate to tasks that are critical for strategic success but about which great uncertainty exists. Simons (1990) illustrated how the uncertainty and ambiguity of strategic uncertainties is reduced by managing them

[2] There is some confusion about the differences between boundary objects, inscription devices and artefacts because some of the terms have been used interchangeably and, consequently, the distinctions between them have become blurred. For example, while Briers and Chua (2001, p. 245) describe a standard costing system as both a boundary object and an inscription device, this paper views the standard costing system as the boundary object and the reports that emanate from it as the inscription devices with artefacts being the means by which these reports (inscription devices) are produced or presented. Similar confusion has occurred elsewhere within a single article (see Preston et. al. 1992) and between articles (see Laws (1992) and Star (1989)).

interactively (as opposed to diagnostically). For example, when managers receive information (inscription devices) about strategic uncertainties, rather than digesting that information alone, they discuss it interactively using face-to-face settings (i.e. actor-networks) where ambiguities and uncertainties (leakages and overflows) are resolved through discussion and debate.

Integral to the notion of strategic uncertainties is change; that is, as the environment changes so does an organization's strategy and, in turn, the strategic uncertainties upon which managers need to focus. Consequently, the strategic uncertainties that superiors manage interactively serve to signal to subordinates the important boundary objects with consequences for the viability and vitality of the actor-networks attached to them. That is, as superiors signal that one boundary object is more important than another, the enthusiasm and energy that actors devote to different actor-networks changes accordingly. For example, if the strategic uncertainty of TQM changes to business process reengineering, then actors will disengage from actor networks that deal with TQM and engage in actor-networks that deal with business process reengineering. The addition of strategic uncertainties to the Briers and Chua (2001) framework is important because it helps to explain how actor-networks wax and wane over time.

This concludes the theory section of the paper and the next section deals with the empirical part of the paper.

3. CASE STUDY OF CHEMICAL COMPANY

3.1 Case study as a method

This study uses a case study to demonstrate how ANT, boundary objects and strategic uncertainties can work together to explain how innovations do (and don't) develop. As such it is an exploratory study that is imperfect and incomplete because the researcher cannot control the research setting, consequently, not all aspects of the theory can be necessarily demonstrated. Nor does the study claim objectivity but is the researchers' interpretation of the interviewees' perspectives of events. However, validity is enhanced by being able to triangulate different

people's (actors) perspectives of a particular event together with direct observation of documents and events (McKinnon 1988). In addition, the reliability of actors' perspectives can be tested over time through repeated interviews.

The empirical study extended over a period of twenty-six months that started before the innovation project started and enabled the researcher to view how innovations became constituted as "facts"; that is, before they were black-boxed. This approach views "science in action" rather than "ready made science" (Latour, 1979) and enables the researcher to follow events rather than solely depend on managers' beliefs about what is happening. However, in the final analysis, the theory's explanatory power is the extent to which the theoretical framework provides a satisfactory explanation of the success and failure of innovations that occurred (Yin, 1994) and any shortcomings in the explanation provide directions for future research.

3.2 Details of study period, the actors and boundary objects, data collected and contact with site

The data was collected in the form of a diary that recorded interviews, observations, collected internal documents and reported on meetings (both formal and informal) over a period of twenty-six months. The primary source was on-going informal interviews with the individuals charged with introducing the innovations and discussing their progress but these informal interviews also extended to interviews with the plant managers, site accountant and plant accountants. In addition, the researcher attended formal meetings of the weekly plant accountants, quality improvement team meetings, management meeting and one-off (extraordinary) meetings. In total, there were 262 entries recorded in the diary. Table 1 outline the frequency of the contacts in each plant.

Table 1: Frequency of diary entries across the amigos and plant

	Prior to start	Chlorine	Polypropylene	Olefines	Polypropylene	PVC
Total (n=262)	14	15	27	62	124	20

3.3 Introduction to Chemical Coy

The study was located at a manufacturing site of a multinational chemical company. The manufacturing site comprised of twelve integrated manufacturing plants, each of which reported to different business unit superiors at a (geographically distant) head office. The plants were capital intensive, produced many joint products and ran continuously (24 hours a day, 365 days a year).

The manufacturing site operated at two levels: site and plant level. At site level, manufacturing personnel held the important positions including the most senior position which was the site manager. The site manager was responsible for overall operations for all twelve plants on the site as well as the support departments – including the site accountant's accounting function. Direct day-to-day management of the plants was the responsibility of eight plant managers (some of whom were responsible for more than one plant).

At the plant level, maintenance, operations, technical and laboratory managers reported to the plant manager as did the plant accountant. However, while the maintenance, operations, technical and laboratory managers reported solely to the plant manager, the plant accountants had dual reporting lines and also reported to the site accountant. Plant accountants' functional allegiances to the site accountant were traditionally stronger (than to the plant manager) because most of the plant accountants' work involved financial compliance and control type work e.g. monthly reporting, transaction analysis and budgeting. This case study is mainly concerned with activities at the plant level.

3.4 Background to the innovation project

It is necessary to provide some background to the innovation project in order to understand the context in which the subsequent events took place. Central to this study is the visionary boundary object of TQM that had been implemented over a period of some thirty months prior to the start of this study across all the plants on the site and represented the strategic uncertainty for plant managers. This study commences at a point where the implementation of TQM within

manufacturing operations was complete (TQM was a black-box) and questions were starting to be raised by the plant managers about how management accounting was going to change as a result of implementing TQM (Bhimani, 2003). Pressure from the plant managers began to build on the site accountant (i.e. the plant accountants' functional superior) to produce accounting information that might help them better manage TQM from a financial perspective. As one plant manager said: *"We went through enormous change (implementing TQM) yet we were still getting the same stuff (reports) from accounting (as before) … I'm not sure what we should be getting but I'm pretty sure it shouldn't be the same"*.

Plant managers had become used to questioning every activity in terms of whether it was "value-adding" and increasingly it was questioned whether accounting itself was "value-adding". Such TQM nomenclature was pervasive throughout the plants and formed a *lingua franca* that became the vehicle through which organizational values were increasingly articulated and action legitimised (Ogden, 1997). Indeed, TQM had become a "black box" to such an extent that the site accountant felt unable to question the obviousness or logic of extending the principles of TQM to accounting, at least, not without great cost and effort (Latour, 1979, p.242). Eventually pressure from the site and plant managers for the site accountant to "do something" could no longer be ignored, although it seemed to matter less what was done so long as it was "something".

The site accountant's initial efforts to "do something" involved instructing the plant accountants to "do something". At that time, plant accountants' tasks were primarily focused on compliance and control type activities and they interpreted the site accountant's request to incorporate TQM into the accounting functions as managing their activities from a TQM perspective such as minimising the time to complete month-end reporting. In other words, the plant accountants applied TQM principles to their accounting processes rather than questioning how these processes, or rather the outputs from these processes (i.e. the inscription devices such as monthly reports), helped plant managers to manage TQM better. While any change was initially welcomed by the plant managers to the extent that some change was happening, the changes themselves seemed irrelevant to them because the information was neither "actionable" nor "value added". (One plant manager asked: *"How does reducing the time to produce month-end reports by two days help me*

to manage plant quality?") The plant managers felt that the changes made by the plant accountant were irrelevant to managing TQM in the plants and, consequently, were not aligned to the plant managers' visionary boundary object and strategic uncertainty of TQM.

From the plant managers' reactions, it soon became apparent to the site accountant that the plant accountants did not "get it" and that something else needed to be done. At this point it is uncertain whether the site accountant himself "got it" but nevertheless he was motivated to do something further in order to stave off criticism from the plant managers. During this period, the site accountant (as in Briers and Chua, 2001) attended a number of conferences to familiarise himself with contemporary management accounting thinking such as activity-based costing. As a result he became convinced that the answer to the call for accounting to complement TQM could be found in implementing ABC. However, none of the plant accountants had any experience of ABC and the site accountant proposed recruiting some "cosmopolitans" from outside the organization (Burchell et al, 1980; Kanter, 1995). Cosmopolitans are individuals who are not only technically competent and knowledgeable but are also adept at "penetrating spatial and cultural boundaries" (Briers and Chua, 2001, p.241); that is, they were more likely to be able to communicate with, and understand, plant managers' needs. Permission was granted to recruit three cosmopolitans and, specifically, the advert called for "three management accountants to implement activity-based costing" which reflected the site accountant's belief that ABC was the appropriate innovation to implement.

The cosmopolitans' contracts were considered to be lucrative by the plant accountants but they were only for 12 months and were initially paid from the site accountant's cost centre. After 12 months, payment for each cosmopolitan would become the direct responsibility of the plant manager (to whom each cosmopolitan was allocated) and he would need to be convinced of their value at that time in order to continue paying them. The site accountant believed that this approach would attract risk takers confident of their own abilities but, importantly, the contract provided a clear signal that the recruits needed to focus their efforts on meeting the needs of the plant managers (rather than the functional needs of the site accountant).

Three cosmopolitans were recruited (a metallurgist with a MBA and two specialist management accountants) and this study traces their experiences and examines their success or failure to introduce innovations (boundary objects) that were consistent with the overarching visionary boundary object of TQM.

3.5 The start of the innovation project

Adapting ANT to organizational settings needs to take account of the organizational context such as the effect of the formal hierarchy on actor-networks and one of the most important aspects of the formal hierarchy was that plant managers were central to any major decision in their plant (such as the formation of new boundary objects and membership of any actor-network). This was especially so given that each plant had relatively few employees (actors) and was physically isolated (the twelve plants were spread across 150 acres) meant that it was highly likely that plant managers would be aware of the actor-networks operating within their plant, especially as decisions were ultimately taken or ratified within a framework of formal meetings and committees that were overseen by the plant manager. Consequently, the plant managers acted as 'gatekeepers' in that all actors and actor-networks operated with the plant manager's imprimatur.

The significance of this situation for the three cosmopolitans was that it was imperative that they gain the approval of the plant manager in order to be given office space within the plant from which it would be then be possible to access the actor-networks (the cosmopolitans were initially located away from the plants at temporary desks in the site accountant's area). However, this step was difficult because the initiative to employ the three cosmopolitans had been the site accountant's (not the plant managers) and the plant managers had not committed themselves to accepting "help" from the cosmopolitans (nor did the site accountant have any formal authority to oblige the plant managers to accept the cosmopolitans). This was an issue because the plant managers had a relatively poor image of the plant accountants' ability to innovate (following the plant accountants' failed attempt to innovate by applying TQM to month-end reporting) and they tarred the cosmopolitans with the same brush. (One of the cosmopolitans said that a plant manager had said to him: "*Don't take this the wrong way but tell me why should I listen to you*").

As outsiders, the cosmopolitans found it difficult to counter this impression because they had no shared experience with the plant managers or “brand name” that heralded them as experts (such as a consultant from an established consulting firm might have).

While the plant managers were genuinely desirous of wanting more relevant management accounting information, the cosmopolitans were not a priority for them because the plant managers did not believe that the cosmopolitans knew anything more about TQM than they did, consequently, it was difficult for them to make an initial appointment to meet with the plant managers. Moreover, when they did, the cosmopolitans’ perception was that each plant manager would probably only give them a single chance to demonstrate their “value”. The ball was perceived to be very much in the cosmopolitans’ court to engage the plant managers' interest and demonstrate their potential to be "value-adding" by creating new boundary objects (innovations) consistent with the plant managers’ boundary object and strategic uncertainty of TQM. Achieving this would be critical to the gaining of office space in the plant and establishing a physical presence (Hopper, 1981) or "bodily positioning" (Rosenberg et al, 1982) that would increase their chances of worming their way into actor-networks within plants.

The difficulty of this hurdle was compounded by the plant accountants themselves who had reasons to want to see the cosmopolitans fail because the cosmopolitans very presence was a reminder of the plant accountants own failure to innovate. Moreover, plant accountants were located in plants and, consequently, they had daily contact with plant managers (especially during the monthly reporting cycle - another boundary object) that provided them with the opportunity to spoil the recruits' prospects with the plant manager. The recruits needed at least the plant accountants' neutrality to not hamper their progress, but there was a growing resentment among the plant accountants that, although the cosmopolitans were well paid, they appeared not to be the "experts" they had been led to believe because they had no instant proposals to implement ABC (ostensibly the reason for them being recruited). Consequently, some of the plant

accountants started to disparage the cosmopolitans by labelling them "the three amigos" and this label stuck.[3]

3.6 The three amigos arrive at the plants

Amigos 1, 2 and 3 were initially allocated to chlorine, polypropylene and olefines plants respectively and all started at the same time. The following sections deal with their progress and their success and failure will be seen initially in terms of their ability to link innovations to the plant managers' boundary object and strategic uncertainty of TQM. This reason seemed to explain the failure of amigo1 to make any headway and explained the initial success for amigos2 and 3. The subsequent failure of amigo2 related to the diversity of interests that could not be accommodated by the innovation. In contrast, the success of amigo3 stems from an innovation that was consistent with the plant manager's boundary object and strategic uncertainty of TQM through which the key actors also benefited from their involvement in that actor-network. However, this "success" was based on a slice of luck at the start of the process and was narrowly based with relatively few actors involved. It was not until amigo3 was transferred to another plant where he became engaged with a wider group of actors did the innovation develop along the lines suggested by ANT that involved greater involvement of inscription devices, artefacts, engagement and leakages/overflows. However, even he ultimately failed because when amigo3 was transferred to a third plant his innovation became irrelevant as the strategic uncertainty was in the process of changing.

3.7 Amigo1 at the chlorine plant

Amigo1 was assigned to the chlorine plant and was the least successful of all the amigos in terms of the length of time he stayed in the plant (three months).

Amigo1 was a metallurgist with a MBA rather than a specialist management accountant (as amigos2 and 3 were) and, while his background probably provided him with a better

[3] "The Three Amigos" is a slapstick comedy movie about three inept individuals who are unknowing recruited to rescue a Mexican town being terrorized by desperados.

understanding of the technical side of manufacturing, he did not have as great an understanding about ABC (as amigos2 and 3 did). Consequently, although all the amigos started off with the belief that ABC was the innovation (boundary object) that needed to be implemented (because that is what the job advert had specified), amigo1 did not appreciate the inappropriateness of ABC to the chlorine plant (where overheads were a relatively small percentage of the plant's costs and chlorine was the only main product).

However, amigo1 persisted with the belief that ABC was a boundary object that complemented the TQM boundary object and spent several weeks developing ideas about how ABC could enhance TQM. But, given its *prima facie* inappropriateness, he was unable to convince the plant manager that ABC was necessary for managing TQM, nor could the plant manager see how else he might benefit from ABC.[4] Although amigo1 was allowed to attend the weekly plant meetings that discussed different problem areas in the plant, he failed to actively engage the plant manager's interest in any innovation and, critically, was not given office space in the chlorine plant which further diminished his chances to become involved with actor-networks in the plant. Increasingly, he found himself gravitating towards tasks associated with the plant accountant's traditional job. Within three months, he had filled the plant accountant's job in another plant and pursued his professional accounting qualifications.

3.8 Amigo2 at the polypropylene plant

Amigo2 lasted nine months and quickly perceived that ABC was inappropriate to TQM in the polypropylene plant, consequently, he did not pursue it as an innovation. Nevertheless, he believed that some level of activity analysis was appropriate because, at his initial meeting with the plant manager, the plant manager had indicated problems in the maintenance department; specifically, with plant repairs not being done properly the first time leading to delays in getting the plant back on-line. Amigo2 focused on this issue and was able to articulate the notion that making "repairs-to-repairs" fitted into the language of TQM (*"make it right, first time"*), consequently, the

[4] Note that this is not to say that the link between ABC and TQM cannot be made only that it could not be convincingly articulated by amigo1 at the chlorine plant.

plant manager was sufficiently concerned and interested to create a small actor-network to examine the problem network that largely consisted of amigo2 and the supervisors of the maintenance department.

At the time the plant manager gave amigo2 approval to become involved, there was no boundary object around which the actors could coalesce and amigo2 developed one by undertaking a work-flow analysis that used critical path analysis to work out the time and cost of making repairs-to-repairs. However, he largely worked on his own because the supervisors in the maintenance department were reluctant actors since the project had the potential to threaten and embarrass them (by revealing their inefficiencies) rather than benefiting them. At that time they could not articulate this threat because that would have been to question the legitimacy of the TQM black-box. However, events came to a head when amigo2 generated the data for the critical path analysis that necessarily involved an analysis of the times different maintenance activities took. The prototype reports (inscription devices) amigo2 started to develop were articulated by the other actors as a time and motion study and this not only harnessed all the negative emotions associated with the language of scientific management but the supervisors successfully argued that the lack of trust associated with scientific management was inconsistent with the greater empowerment espoused by TQM. This effectively put an end to amigo2's initiative because he was effectively frozen out of the actor-network and the benefits from the exercise were not certain enough for the plant manager to back-up amigo2 against the maintenance supervisors. As the plant manager said: *"It (critical path analysis) wasn't important enough for me to upset the apple cart".*

While the plant manager was willing for amigo2 to start another project, amigo2 was approached by a conference organizer (along with amigo3) to present the findings of their initiatives at a conference. At that conference, a participant at the conference offered amigo2 a job (that he accepted) and this illustrates the contrasting benefits different actors gained from their involvement in the actor-network. While the polypropylene manager sought to benefit from improvements in the performance of the maintenance department, amigo2 benefited from gaining marketable skills that enabled him to develop his career.

In retrospect, amigo2 was unfortunate because he was in the right place with the right idea but at the wrong time. Just over a year later another visionary boundary object - business process reengineering (BPR) – started to take over from TQM as the plant managers' strategic uncertainty and the same issue about delays in maintenance was raised again. This time it was tackled head-on by the plant manager because redesigning processes was "temporally and spatially relevant" to this new boundary object and strategic uncertainty of BPR (Jones and Dugdale, 2000).

3.9 Amigo3

Amigo3 spent the longest time on the site (23 months) starting at the olefines plant (10-11 months) before moving to the polypropylene plant for 12 months (i.e. after amigo2 had left) and finally the polyvinylchloride (PVC) plant for 3 months. He attempted to introduce the same innovation in all three plants but with different results.

3.9.1 Amigo3 at the olefines plant

As with amigo 1 and 2, amigo3 found it difficult to arrange a time to meet with the olefines plant manager but when the meeting took place the plant manager talked about TQM and, in particular, Juran's form of TQM that had been implemented in the olefines plant. He explained that Juran's form of TQM differed from other forms of TQM (such as Demning's) because it involved calculating the cost of quality; namely, the price of conformance (POC) and the price of non-conformance (PONC) (see Shank and Govindarajan (1994) for a review of the different forms of quality management).[5] The plant manager said that PONC had not yet been calculated because there had been no one to do it and amigo3 immediately offered to calculate it. That is, the community of practice represented by the plant manager recognised the need to involve the community of practice represented by amigo3 in a community of interest. This offer was readily

accepted by the plant manager because until this point he had little but the language of TQM to manage TQM by. While the language of visionary boundary objects like TQM might be important for focusing attention and setting priorities, visionary boundary objects are not durable unless they are operationalized in some way to sustain the concept over the longer term (Laws, 1992). That is, the overarching visionary boundary object of TQM becomes knowable and visible by non-visionary boundary objects such as PONC along with the inscription devices that accompany them. Consequently, PONC became a new boundary object that in the plant manager's mind was clearly connected to, and nested within, the boundary object and strategic uncertainty of TQM.

It is difficult to underestimate the importance that this opportunity provided amigo3 because it immediately justified his work and provided him with access to the plant. But unlike amigos1 and 2, amigo3 did not have to persuade and justify the plant manager of the link between PONC and the boundary object and strategic uncertainty of TQM because it was the plant manager who suggested the innovation (not amigo3). This event was entirely fortuitous and suggests that the innovation process can be more unpredictable and serendipitous (than predetermined and inevitable) where small chance events create windows of opportunity that can determine the outcome of the innovation process. For example, one can speculate what might have happened if the plant manager implemented some other model of TQM (such as Deming's that does not advocate calculating PONC), or he had not mentioned PONC or the need to calculate it to amigo3, or amigo3 had not picked up on the opportunity to calculate PONC. Any of these situations would probably have significantly reduced the likelihood of any innovation eventuating regardless of whether other favourable conditions were present.

Developing the PONC innovation as a boundary object

As a result of the plant manager agreeing to amigo3 calculating PONC, he provided amigo3 with office space in the olefines plant that enabled him to access the other actor-networks in the plant and, in particular, the actor-network that made up the plant's morning meeting. The morning

[5] The price of conformance (POC) is the value-adding cost of producing a product i.e. the cost a customer is prepared to pay for whereas the price of non-conformance (PONC) is any non value-adding cost (such as waste, inefficiencies, non-A1 product etc) which is a cost the customer is not prepared to pay for.

meeting (actor-network) brought together supervisors and managers from the main sections of the plant (operations, laboratory technical, maintenance etc) to review the previous 24 hours production. This actor-network was important because it enabled amigo3 to gather the data about PONC, for example, data about the amount of scrap or downtime. However, like amigo2, amigo3 largely worked independently and his level of involvement in the morning meeting actor-network was passive and limited to obtaining and clarifying information.

The two main actors in the PONC actor-network were amigo3 and the plant manager (although Juran had an important non-physical presence) but there was little substantial interaction between them before amigo3 had developed the first inscription devices for PONC.

Developing inscription devices meant calculating PONC and, although PONC is relatively well-defined by Juran (1988), a number of decisions had to be made about how to calculate it. In the absence of any defined formula to calculate PONC, it seemed to be more important for amigo3 and the plant manager to reach agreement about the calculation rather than faithfully replicating Juran's model of PONC because agreement was the means by which the PONC actor-network survived (and the benefits to amigo3 and the plant manager continued to be possible). Discussions (entanglements) between amigo3 and the plant manager about how to calculate PONC served to construct and fabricate the reality of PONC from which the soft numbers (about which considerable uncertainty existed) became hard. For example, there was debate about whether PONC should reconcile back to the monthly financial accounts. On the one hand the financial accounts were viewed as a bedrock and reconciling back to them would have provided greater credibility to the PONC numbers more quickly, but the financial accounts were also based on historical cost concepts that excluded opportunity costs. Opportunity costs represented the biggest PONC (e.g. cost of downtime was largely the value of production foregone) and to exclude it would have made PONC meaningless so agreement was reached not to reconcile back to the financial accounts.

These entanglements between amigo3 and the plant manager were relatively straightforward because they only involved agreement between the two of them and both were motivated to

reach agreement (because they directly benefited from PONC's development). However, for the PONC innovation to become more broadly accepted (and hence more influential since, as will be explained, the benefit to the olefines plant manager was dependent on this), other actors needed to become involved and convinced of PONC's credibility. Without being reconciled back to some "solid number" such as the monthly financial accounts, the credibility of the PONC numbers needed to withstand independent scrutiny (Ogden, 1997) and building up credibility occurred in a number of ways.

- Credibility of PONC initially rested with the influence of the olefines plant manager and the cosmopolitan amigo (whose "expertise" was now lauded by the olefines plant manager) but it also hinged on Juran's authority. For example, amigo3's initial PONC reports estimated PONC at about 20% of sales and while the plant manager initially expressed disbelief that PONC could be so high, such doubt diminished when it was pointed out to be consistent with Juran's own findings.

- To broaden PONC's acceptance, the olefine plant started to report PONC in his monthly report to his business unit superiors at head office and their acceptance of this PONC information added to its credibility among other plant managers. Indeed, the site manager and the other business unit managers (at head office) started to ask why other plant managers were not providing this information).

- Credibility was also enhanced by two serious production problems that occurred at about this time that resulted in a significant loss of raw materials and production time. The business unit manager at head office engaged an independent engineer to estimate the cost of these problems and the fledgling PONC calculations approximately agreed with this engineer's estimate; that is, they "shared the same numerical space" (Briers and Chua, 2001).

- The final example of enhancing PONC's credibility was amigo3's presentation of PONC to an external conference (the conference at which amigo2 was headhunted) where its broad acceptance and interest in the audience (which included of a number of head office personnel) also added to PONC's credibility.

While each of these steps were arguably relatively unimportant by themselves, they developed a critical mass and a momentum whereby new actors were increasingly prepared to accept PONC's authentication based on previous actors' acceptance of it, rather than seriously examining or questioning it themselves.

Using PONC inscription devices at olefines plant

At this point the prototype PONC reports (inscription devices) were not easily used by others, indeed, the plant manager did not distribute and use PONC within the plant (e.g. to provide feedback to the plant employees) but only used it externally at site level for political purposes when dealing with other plant managers and the site manager. This external use of PONC was also consistent with the way in which PONC's credibility was built up which, as explained, was also largely from external sources. PONC could be used politically because while TQM was the boundary object and strategic uncertainty for all the plant managers on the site, only the olefines plant manager had any systematically gathered information about PONC (inscription devices) and he started to use them to fight defensive political battles with other plant managers as well as to argue for additional resources.

For example, olefines was an upstream plant that supplied several downstream plants with raw materials and, when the olefines plant was unable to supply them, the plant manager was criticised by those downstream plant managers. However, the olefines plant manager was able to use the PONC reports (inscription devices) to defend himself by demonstrating and quantifying the effect of external events (i.e. those outside his control) on his plant. For example, the late arrival of ships carrying raw materials to the olefines plant caused problems with the supply of materials to downstream plants and, although these reasons were not new, they were now dressed up in the language of TQM and supported by PONC reports (inscription devices) that enhanced the legitimacy of the plant manager's argument that these events were beyond his control.

Moreover, the olefines plant manager also used PONC to argue for increasing resources to his plant by arguing that solving problems in (upstream) olefines was more important than

downstream plants because the benefits of solving those upstream problems would also trickle down to the other plants it supplied and the PONC reports (inscription devices) enabled him to do this more convincingly.

This illustrates how actors in different communities of practice (amigo3 as a management accountant and the plant manager as an engineer) formed an alliance to develop the PONC innovation that not only benefited each other in different ways but where the benefits that each derived largely unconcerned the other. For example, amigo3 was unconcerned that the plant manager used PONC primarily for political purposes (rather than for the ostensible reason of managing TQM), nor was the plant manager concerned that amigo3 used PONC to enhance his marketable career skills (as illustrated by amigo2 being recruited after his presentation at the conference). Moreover, none of these benefits could be described as rational from an organizational perspective.

At about this time, amigo3's 12 month contract expired and the olefines plant manager continued to pay his salary. However, shortly afterwards, the polypropylene plant manager (who was aware of PONC from his involvement with the olefines plant manager at site level meetings) asked about using amigo3 to set up a similar initiative at the polypropylene plant (i.e. the plant where amigo2 had been located) and so amigo3 was transferred to the polypropylene plant.

3.9.2 Amigo3 at the polypropylene plant

At the polypropylene plant, the plant manager initially asked amigo3 to *"just do for us what you did at olefines"*, but PONC turned out to be a significantly different innovation, largely as a consequence of a greater use of PONC within the polypropylene plant. Again, this was not a result of any predetermined plan but a consequence of opportunities that arose as a result of amigo3's involvement in plant's actor-networks.

As at olefines, amigo3 started off by attending the morning meeting actor-network that brought together supervisors of the various sections of the plant (operations, laboratory, technical, warehousing etc) to discuss production over the previous 24 hours. However, compared to the

olefines plant, this discussion was much more structured because it formally analysed differences to nominal daily targets for output and quality by identifying the problems that had caused those targets to be missed. Because representatives of all the sections were at the meeting, there was often a lively, though constructive, discussion (entanglement) about what the problems were, where they occurred and what caused them. Amigo3 started to collect data in a database to calculate PONC but unlike at olefines where information about *outcomes* was collected (e.g. how much downtime and scrap had occurred), the basic data was in the form of individual problems that had *caused* those outcomes (as this was the basis of the discussions at the meeting). This subtle difference had significant consequences for the PONC innovation and was, again, fortuitous rather than predetermined.

Once a week, the morning meeting actor-network was enlarged to include all plant employees and was intended to provide feedback about the previous week's performance. After a couple of weeks, the plant manager asked amigo3 to present a summary (i.e. an inscription device) of the previous week's performance from a PONC perspective. The data for this summary was based on data from the week's morning meetings which listed the individual problems that had caused either a loss of production or sub-quality product and these were contained in a database that started to form part of the plant's organizational memory. Amigo3's presentation was introduced by the plant manager and this signalled PONC's importance to everyone in the plant that, in turn, made further interactions between amigo3 and actors within the plant more likely. The development of PONC reports occurred in three phases with each development becoming more significant.

First, actors from the morning meeting were initially interested in <u>where</u> the problems causing PONC had occurred within the plant (i.e. location), consequently, weekly meetings thereafter provided a list of problems by location in the plant. Again, this generated discussion (entanglements) because a problem in one location (say, an incorrect test taken in the laboratory) could manifest itself in the reactor (where incorrect adjustments to the reactor were made on the basis of the incorrect laboratory results) that subsequently caused scrap production. Arguably, these discussions (entanglements) would not have occurred were it not for the PONC

report/presentation (inscription device) and this entanglement created a leakage (or overflow) that led to the second development of PONC.

The second development in the PONC reports was as a result of comments from actors about the inability to compare the physical data being produced, for example, actors started to ask which was worse, a ton of lost production or a ton of non-A1 production? Calculating the cost of PONC became important but was much more complicated in the polypropylene plant (than olefines) so amigo3 arranged for the actors who attended the morning production meeting to reconvene in order to calculate costs for the major problems such as downtime and non-A1 production.

This meeting resulted in convoluted discussions (entanglements) between actors because there were numerous product grades in the polypropylene plant including experimental product grades each with its own price and cost of production. Discussions (entanglement) continued for some time about what revenues and costs to include and further inscription devices (reports and discussion documents) were developed to resolve these issues. For example, discussions about how to calculate the cost of downtime (i.e. generally agreed as the contribution margin foregone) was not determined by amigo3 dictating that a particular method was the most appropriate but by generating three alternatives and discussing which was most appropriate: (1) contribution margin of the product grade being made when the problem started; (2) average contribution margin for the plant as a whole; (3) contribution margin of the product grade that the plant would make (for inventory wherever spare capacity was available). Arguments about the relative merits of each method bounced back and forth between actors. These arguments are superfluous to this study which is not concerned with the “correct” solution so much as describing the process that led to agreement. This process was helped by developing further inscription devices that estimated the difference between the three alternatives. Eventual agreement committed the actors to the decision and legitimised the dollar numbers which subsequently became uncontroversial (the black-box had been closed).

At this point PONC was used primarily as feedback within the plant aware of different aspects of PONC, however, the third and most significant development of PONC went beyond providing feedback and involved using PONC for analytical purposes.

PONC as an analytical device

The third development of PONC was as a consequence of amigo3's involvement in the actor-network meeting that discussed and resolved the costing of problems causing PONC. Following that involvement, amigo3 subsequently became aware of two other actor-networks that, like PONC, were subordinate to the visionary boundary object of TQM, each of which had been set up to solve two persistent and puzzling operational problems. The analytical approach to solving these problems was copied by amigo3 to analyse the PONC information to solve production problems. This development illustrates how ideas that are embedded in one setting (manufacturing operations) can be disembedded and re-embedded into another setting (PONC) and this process confers a legitimacy on PONC that would have taken longer to earn on its own. Furthermore, it illustrates the process of serendipity because, again, this development was not predetermined but a consequence of meetings between amigo3 and other actors involved in the costing exercise. These two persistent and puzzling problems are described as follows.

The first problem concerned a mysterious and irregular rise in off-specification production which was caused by a sudden drop in temperature in the reactor for which there seemed to be no rational answer. An actor-network was assembled in the form of a quality improvement team to tackle the problem and they started by analysing reports (inscription devices) that plotted the incidence of the problem against a range of different factors such as the time of day when the problem occurred. Using this analytical approach, the actor-network found that the problem only occurred at a particular time of the day and only on sunny days. The next sunny day, members of the actor-network visited the reactor at the particular time and saw a shadow cast itself over the inspection hatch to the reactor that created the temperature drop inside the reactor. The problem was solved by providing shade over the inspection hatch and this became a celebrated "war-story" that was later written up for a professional engineering journal.

The second problem concerned the number of accidents in the plant requiring medical attention. One initiative was to produce a report (inscription device) that plotted accidents over a 24-hour clock dial (recall that the plant operated continuously). The expectation was that there would be an equal spread of injuries over the 24 hours but certain spikes occurred that led actor-networks to question (an entanglement) what was happening at those times to cause injuries. For example, spikes occurred after meal breaks and just before the change-over in shifts and led the actor-network to question why people's attention was not properly focused on their tasks at those times (and what could be done about it).

Both these analyses are similar in that they were reports (inscription devices) that correlated incidents of problems against various criteria and, where problems were highly correlated with a criterion, it would be viewed as a potential cause and it formed the basis for discussion (entanglement) among the actors involved from which solutions could be proposed. Amigo3 disembedded this analytical approach from manufacturing operations and re-embedded it using problems in the PONC database. The fact that the method had already been accepted in the two examples above gave the process credibility and a prototype of the analytical method using problems from the PONC database was developed for a special meeting of the polypropylene plant management committee (another actor-network) who subsequently authorised resources for its further development and implementation. As with the earlier meeting that agreed on PONC costs, once the method had become accepted by the polypropylene management committee, it formed a ‘black-box’ and became a means to analyse problems that was difficult for anyone to dispute (Latour, 1979, p.242).

At about this time, in the same way that amigo3 was transferred from olefines to polypropylene, amigo3 was transferred to the polyvinylchloride (PVC) plant.

3.9.3 Amigo3 at the PVC plant

When amigo3 reached the PVC plant, he was in a much better position to implement PONC than in any of the other plants because he had developed a track record and had been invited into the PVC plant by the PVC plant manager. However, when he tried to repeat the process, the PONC

innovation failed because, although PONC's link to TQM still existed, amigo3's arrival at the plant coincided with the rise of a new strategic uncertainty: business process re-engineering (BPR). The plant manager's switch of strategic uncertainty to BPR signalled to actors in the plant that their attention needed to shift from TQM to BPR and there was a reluctance to engage with an actor-network relating to PONC. In other words, PONC had run its course and amigo3 only lasted 3 months at the PVC plant.

This concludes the case study and the final section of this paper discusses the results and provides some conclusions.

4. DISCUSSION AND CONCLUSION

This discussion and conclusion section consists of several parts. First, it reflects upon the theoretical framework that was used to explain the findings in this paper and asks whether a simpler theory might not have explained as much. Second, the major empirical contributions are outlined and, third, some of the limitations and ideas for future research are discussed.

Theoretical framework

This paper used a theoretical framework that combined ANT, boundary objects and strategic uncertainties to explain the development of management accounting innovations in a manufacturing company. These findings provide evidence that innovating is a complex process but that, once the actor-networks were penetrated (by linking innovations to strategic uncertainties), the process is well mapped by the concepts within actor-network theory and boundary objects. These concepts take account of the many fluid and varied relationships between actors, inscription devices and artefacts which are developed in fragile, serendipitious and non-linear ways where small changes can result in radically different innovations or no innovation at all. These actors, inscription devices and artefacts coalesce around different boundary objects (such as PONC and QITs) that, collectively, reified the overarching innovation (of TQM).

This process was most obviously demonstrated with amigo3 in the polypropylene plant where the actor-network was extensive. The initial PONC reports (inscription devices) were used to initially engage actors at the weekly production meetings but led to unresolved issues (leakages and overflows) such as the costing of PONC that, in turn, were resolved by further engagement among the actors (e.g. the meeting to cost the PONC). Consensus evolved as a result of developing further inscription devices (i.e. calculating the differences between alternative cost models) and each iteration enhanced the credibility and consensus in the innovation by resolving points of contention (overflows and leakages) that, in turn, served to fabricate (harden) the reality of the innovation for the actors involved. This process continued until the actors reached a point where there was no need to go further and the black-box was closed. At this point the innovation (PONC) had established credentials and other actors accepted the innovation without closely examining the innovation themselves.

However, the demise of PONC as an innovation was not so much a consequence of failing to provide relevant information about the strategic uncertainty of TQM but resulted from changes to the plant managers' strategic uncertainties. As plant managers' strategic uncertainties changed, the relevance of innovations and the actor-networks that supported them diminished along with the benefits that actors could derive from their participation in those actor-networks. Eventually, these benefits reduced to a point where the actor-network became unviable as actors disengaged from it as illustrated with amigo3 in the PVC plant.

As such, the study has contributed to a growing body of literature (Dent 1991; Briers and Chua, 2001) that views the innovation process as much a social process (at least at plant and department level) as a rational one but was such a complicated theory necessary or could the same results be explained by a simpler theory?

Simpler theory?

The theoretical framework of actor-network theory, boundary objects and strategic uncertainties is relatively complex and begs the question whether a "simpler" theory based on the existence of

champions might not explain just as much.[6] While parsimony is a valuable attribute for a theory, explanatory power is probably more important and the evidence from this case is that innovating is more complicated than could be explained in such simple terms. Champions are individuals who initiate and drive innovations (Heng et al., 1999) but the outcomes for the three champions involved in this study (amigos 1, 2 and 3) were very different. While these outcomes might be explained in terms of personality and competency differences, such differences were, arguably, minimized because all the amigos were selected using the same recruitment process (that presumably had uniform selection criteria) and they were also all motivated by an identical 12 month contract. Furthermore, any differences in personality and competence were controlled when examining the one champion – amigo3 – who worked in three of the plants. In the olefines and polypropylene plants, amigo3 experienced "success" but he "failed" in the PVC plant where, arguably, his likelihood of success was greatest. Consequently, while personality and competency are no doubt important, organizational circumstances are likely to be more important such as the ability to establish mechanisms that develop consensus between participants (Shane, 1994). However, such consensus building mechanisms are better explained with the theory developed in this paper (that combined actor-network theory, boundary objects and strategic uncertainties) than by some personality variable of champions.

Contributions of the study

There are four main contributions to summarise.

(i) Access to the actor-networks: linking the innovation to the strategic uncertainty. In this study, accessing the actor-networks (from which an innovation might develop) was problematic and stands in contrast to previous studies that have usually started from the point where actors were already involved in a network (e.g. Briers and Chua, 2001). Access to actor-networks was difficult (at least initially) because the plant managers as 'gatekeepers' needed to be convinced that the amigos' innovations would help in managing the boundary object and strategic

uncertainty of TQM. This problem of access was explained in terms of the difficulties in forming different communities of practice into a community of interest and this task was exacerbated in this study because, as outsiders, the amigos had no shared experiences with the plant managers (that might have provided the amigos with the latitude to develop innovations more gradually), nor did they have any "brand name" (such as a consultant from an established consultancy might have) that might have convinced plant managers of their technical abilities.

These difficulties contributed to amigo1 being unable to convince the plant manager of the link between his innovation (ABC) and TQM that, in turn, prevented amigo1 from accessing the actor-networks in the chlorine plant. Amigo2 overcame these difficulties by seeking common ground with the plant manager by evoking the language of TQM to articulate the problem of rework (making repairs-to-repairs was articulated as "*getting it right first time*"). In contrast, amigo3 was fortunate because the olefines plant manager had already recognized the innovation (PONC) and its link to the boundary object and strategic uncertainty of TQM and all amigo3 had to do was convince the plant manager that he could calculate it. When amigo3 was subsequently invited into the polypropylene and PVC plants, the plant managers had already convinced themselves of the link between PONC and TQM (hence the invitation). However, this link became redundant when the plant managers' strategic uncertainty changed to BPR (shortly after amigo3 joined the PVC plant).

(ii) Actors' benefits from the innovation. Once the amigos had penetrated the actor-networks, in order for actors to become involved with the innovation, they needed to realise how they might benefit from the innovation. For the polypropylene plant manager, the most obvious benefit was the normative one of improving quality performance that, in turn, would improve his own rewards and prospects. Less obvious, but arguably just as important, was how the olefines manager used the PONC innovation to gain political leverage over other plant managers. In terms of the amigos, they benefited by developing marketable job skills as demonstrated by the headhunting of amigo2. The site accountant and plant accountants also benefited from having the pressure taken

[6] It should be noted that the role of champions has yet to be studied in management accounting settings (using the keyword 'champion' in the *Science Direct* database there were no hits in the mainstream accounting literature such as

off them to innovate. However, many of these benefits were not necessarily efficacious to the organization and where actors did not benefit (such as the maintenance supervisors in the polypropylene plant), they were instrumental in the innovation failing. This illustrates the variety of ways actors can benefit, the necessity for them to do so and the difficulties in identifying how they might do so. It is also important to note that none of the actors seemed to understand (or care about) how other actors might benefit from the innovation.

(iii) Different uses for the same innovation. One advantage of this study was the opportunity to identify how the same nominal innovation – PONC – evolved differently in the olefines and polypropylene plants. Despite the intention to implement PONC in the polypropylene plant in a similar way to the olefine plant (recall the polypropylene manager told amigo3 to *"just do for us what you did at olefines"),* PONC evolved very differently and largely as a result of the interactions with the actor-networks rather than any preordained purpose.

The olefines plant manager mainly used PONC information to manage external relations (e.g., for political gain when negotiating with other plant managers) and the innovation was designed to facilitate this purpose. For example, classifying PONC problems that were caused by factors outside the plant as "external" in order to help the plant manager defend his performance against other plant managers. Other plant managers did not dispute the PONC information because its credibility was largely derived externally, for example, head office had endorsed the use of PONC information in plant managers' monthly reports and the PONC calculations agreed with independent head office calculations. While it was notable that there was no internal validation of PONC information within the olefines plant (beyond the plant manager and amigo 3), this was not necessary for the (external) use to which the PONC information was put.

In contrast, the polypropylene plant manager mainly used PONC information to manage internal relations (e.g., to signal and provide feedback to staff about quality issues) and the innovation was designed to facilitate this. For example, by providing feedback about where different PONC problems had occurred within the plant. Credibility for PONC information was also derived

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internally, for example, by applying a problem solving technique that had been used elsewhere in the plant to the PONC information, and there was no need to validate PONC information externally.

These findings imply that the use to which innovations are put is not preordained as the normative literature would suggest (despite the intention) and that actors tailor innovations to situations in order to accommodate their particular needs at that particular time.

(iv) The role of serendipity. In many ways the innovation process was characterised by serendipity and fortuity that denied a logical and sequential structure to the process. For example, the "success" of amigo3 at the olefines plant was primarily a consequence of the plant manager mentioning PONC and amigo3's ability to recognise and grasp the opportunity to calculate it. But, if amigo2 had been in amigo3's position, would PONC have been developed? And would it have developed in the same way? If innovating is such a fragile process that is susceptible to such small events, the question arises as to how the innovation process can be managed? One way to think about this issue is to suggest that while it is not possible to determine exactly how innovations will eventuate, it may be possible to stack the odds by isolating variables that are commonly associated with “success”. While putting the right ingredients (variables) together does not guarantee the development of an innovation, these ingredients might give a significantly increased chance of an innovation developing, even though the process cannot be precisely predetermined.

Limitation and future research.

The limitations of this case study are largely in terms of control over the research setting which could not be controlled by the researcher; however, to some degree control was exerted by being able to examine multiple efforts to innovate within the one company. Moreover, the two year study provided opportunity to triangulate events through documents and meetings as well as different actors interpretation of events. Indeed, over the period it was also possible to examine the consistency of actors’ interpretations of a single event at different points in time. Other limitations include not being able to generalize the findings but these limitations need to be put into

perspective by understanding the purpose of the study which was to provide a description of how innovations developed. As such the study produced evidence of complexity of the innovation process and while cross-sectional studies may have explanatory power in statistical terms (i.e. significant r^2), the theoretical explanation of events is inferred from the statistics and underestimates the complexity of the innovation process when observed.

References

Anderson, S.W., 1995. A framework for assessing cost management system changes: the case of activity-based costing implementation at General Motors, 1986-1993, *Journal of Management Accounting Research*, 7, 1-65.

Arias, E.G. and Fischer, G. 2000. Boundary objects: their role in articulating the task at hand and making information relevant to it. *Intelligent Systems and Applications*, 1-8.

Baines, A. and Langfield-Smith, K. 2003. Antecedents to management accounting change: a structural equation approach, *Accounting, Organizations and Society, 28, 7-8, 675-698.*

Bhimani, A. 2003. A study of the emergence of management accounting system ethos and its influence on perceived system success. *Accounting, Organizations and Society, 28, 523-548.*

Briers, M. and Chua, W.F. 2001. The role of actor-networks and boundary objects in management accounting change: a field study of an implementation of activity-based costing. *Accounting, Organizations and Society, 26,* 237-269.

Burchell, S., Clubb, C., Hopwood, A. and Hughes, J. (1980). The roles of accounting in organizations and society. *Accounting, Organizations and Society,5*, 5-27.

Callon, M. 1999. Actor-network theory - the market test. In Law, J. and Hassard, J. (eds). *Actor Network Theory and After* (Blackwell, Oxford).

Callon, M. 1998. The embeddedness of economic markets in economics. In Callon, M. (ed) *The Laws of the Markets* (Backwall, Oxford).

Calgio, A. 2003. Enterprise resource planning systems and accountants: towards hybridisation. *European Accounting Review*, 12, 1, 123-153.

Chenhall, R.S. and Langfield-Smith, K. 1998a. Adoption and benefits of management accounting practices: an Australian Study. *Management Accounting Research*, **9**, 1-19.

Chua, W.F. 1995. Experts, networks and inscriptions in the fabrication of accounting images: a story of the representation of three public hospitals. *Accounting, Organizations and Society, 20*, 2/3, 111-145.

Cobb, I., Innes, J. and Mitchell, F., 1992. *Activity based costing: problems in practice,* Institute of Chartered Management Accountants, London.

Crawford, T.H. 1993. An interview with Bruno Latour. *Configurations*, 1.2, 247-268.

Dananapour, F. 1991. Organizational innovation: a meta-analysis of the effects of determinants and moderators. *Academy of Management Journal*, 34, 3, 555-590.

Dent, J. F. 1991. Accounting and organizational cultures: A field study of the emergence of a new organizational reality, *Accounting, Organizations and Society, 16, 8, 705-732.*

Fischer, G. and Reeves, B.N. 1995. Creating success models of cooperative problem solving. In Baecker, R.M., Grudin, J., Buxton, W.A.S. and Greenberg, S. (eds) *Readings in human-computer interaction:toward the year 2000*, Morgan-Kaufmann Publishers, Los Alto, Calif.

Fullerton, R.R and McWatters, C.S. 2002. The role of performance measures and incentive systems in relation to the degree of JIT implementation, *Accounting, Organizations and Society, 27, 8, 711-735.*

Gosselin, M. 1997. The effect of strategy and organizational structure on the adoption and implementation of activity-based costing. *Accounting, Organizations and Society*, 22, 2, 105-122.

Heeks, R. 2001. What did Giddens and Latour ever do for us? *Academic Writings on Information Systems and Development*, 11, 1.

Heng, M.S.H., Trauth, E.M. and Fisher, S.J. 1999. Accounting, Management and Information Technologies. 9, 3, 193-222.

Hildreth P., Kimble C. and Wright P. 2000. Communities of Practice in the Distributed International Environment. *Journal of Knowledge Management*, 4, 1, 27-38.

Hopper, T., 1981. Role conflicts of management accountants and their position within organization structures, *Accounting, Organizations and Society*, 5, 4, 401-411.

Hopwood, A.G. 1987. The archaeology of accounting systems, *Accounting, Society and Organizations*,12, 207-234.

Jones, T. and Dugdale, D., 2001. The ABC bandwagon and the juggernaut of modernity, *Accounting, Organizations and Society*, 27, 121-163.

Juran, J.M. 1988. *Juran's quality control handbook*, 4th ed, McGraw-Hill, New York.

Kanter, R.M. 1995. World Class: thriving locally in the global economy, Simon and Schuster.

Kaplan, R.S. 1986. Accounting Lag: The Obsolescence of Cost Accounting Systems, *California Management Review*, 28, 2, 174-199.

Keele, R. 2003. What is ANT? In Ryder, M. http://carbon.cudenver.edu

Krumwiede, K.R. 1998. The implementation stages of activity-based costing and the impact of contextual and organisational factors. *Journal Of Management Accounting Research*, 10, 239-277.

Latour, B. 1979. *Laboratory Life: the social construction of scientific facts.* Sage Publications, Beverly Hills.

Latour, B. 1987. *Science in action: how to follow scientists and engineers through society,* Harvard University Press, Cambridge, Mass.

Latour, B. 1998. On recalling ANT. In Law, J. and Hassard, J. (eds) *Actor Network Theory and After,* Blackwell, Oxford.

Laws, J. 1992. Notes of the theory of the actor-network: ordering, strategy and heterogeneity. Centre for Science Studies, Lancaster University.

Libby, T. and Waterhouse, J.H. 1996. Predicating change in management accounting systems. *Journal of Management Accounting Research,* 8, 137-150.

Lowe, A. 2001. After ANT: an illustrative discussion of the implications for qualitative accounting case research. *Accounting, Auditing and Accountability Journal,* 14, 3, 327-352.

Luft, J. and Shields, M. D., 2003. Mapping management accounting: graphics and guidelines for theory-consistent empirical research, *Accounting, Organizations and Society*, 28, 169-249.

Lukka, K. and Granlund, M., 2002. The fragmented communication structure within accounting academia: the case of activity-based costing research genres, *Accounting, Organizations and Society*, 27,165-190.

McBride, N. 2003. Using actor-network theory to predict the organizational success of a communications network. Working paper, De Montfort University, UK.

McKinnon, J. 1988. Reliability and validity in field research: some strategies and tactics. *Accounting, Auditing and Accountability Journal*, 1, 34-54.

Mouritsen, J. 1994. Rationality, institutions and decision making: reflections on March and Olsen's rediscovering institutions. *Accounting, Organizations and Society,*19, 2, 193-211.

Ogden, S.G. 1997. Accounting for organizational performance: the construction of the customer in the privatised water industry. *Accounting, Organizations and Society, 22,* 529-556.

Ouchi, W. 1979. A conceptual framework for the design of organizational control mechanisms. *Managament Science*, 25, 833-848.

Pinch, T., Mulkay, M. and Ashmore, M. 1989. Clinical budgeting: experimentation in the social sciences: a drama in five acts. *Accounting, Organizations and Society,14*, 271-301.

Reeve, J.M., 1996. Projects, models and systems, *Journal of Cost Management*, 10, 2, 5-16.

Rogers, E.M., 1995. *Diffusion of innovations*, 4th edition. NY: Free Press.

Rosenberg, D., Tomkins, C. and Day, P. 1982. A work role perspective of accountants in local government service departments. *Accounting, Organizations and Society,7, 123-137.*

Shane, S.A. 1994. Are champions different from non-champions? *Journal of Business Venturing.* 9, 5, 397-421.

Shank, J.K. and Govindarajan, V.J. 1994. Measuring the "cost of quality": a strategic cost management perspective. *Journal of Cost Management*, 8, 2, 5-17.

Shields, M. 1995. An empirical analysis of forms' implementation experiences with activity-based costing. *Journal of Management Accounting Research,* 7, 148-166.

Simon, H.A. 1957. *Models of Man,* Wiley: New York.

Simons, R.S. 1990. The role of management control systems in creating competitive advantage: new perspectives. *Accounting, Organizations and Society,* 15, 1/2, 127-143.

Star S. L. 1989. The structure of ill-structured solutions: boundary objects and heterogeneous distributed problem solving. In L. Gasser and M. N. Huhns (eds), *Distributed Artificial Intelligence*, 2, 37-54 Pitman, London.

Star, S.L. and Greisemer, J.R. 1989. Institutional ecology, "translations and boundary objects: amateurs and professionals in Berkeley's museum of vertebrate zoology, *Social Studies in Science*, 19, 387-420.

Wenger, E. 1998. Communities of practice - learning, meaning and identity, Cambridge University Press, UK

Williamson, O. 1991. Comparative economic organization: the analysis of discrete structural alternatives. *Administrative Science Quarterly*, 36, 2, 269-296.

Williams, J.J. and Seaman, A.E., 2001. Predicting change in management accounting systems: national culture and industry effects, *Accounting Organizations and Society,* 26, 443-460.

Yin, R.K. 1994. *Case study research: design and methods,* Sage Publications, Beverly Hills.