The effects of uncertainty, trust, structure and resistance to change in the diffusion of management accounting innovations: an agent based modeling approach.

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Title: The effects of uncertainty, trust, structure and resistance to change in the diffusion of management accounting innovations: an agent based modeling approach.

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Abstract: This article considers the effects of uncertainty, structure, trust and resistance to change on the success or failure of management accounting innovations diffusion. The diffusion process is examined through a social network of nodes and ties. Ties represent communication channels through which the diffusion flows and nodes represent organizational actors who facilitate or impede the diffusion process. Trust is operationalized through strong ties and structure is modeled with the density of ties within organizational units and ties between organizational units. Uncertainty represents the degree of controversy that is often inherent to management accounting innovation and change. Initially, organizational actors can be in three possible states: adopters, detractors and non-adopters. Innovation adopters or detractors embedded in the organizational network will mobilize their own network of strong ties to convince non-adopters to adopt or reject the innovation. This research aims at exploring the effects of uncertainty, trust, structure and perception of a management accounting innovation on the likelihood of success of the diffusion process. The authors used an agent based modeling approach to simulate the behavior of organizational agents within an organizational context. The results suggest that mechanistic and organic structures are contingently conducive of success in the implementation of management accounting innovation. The likelihood of success depends on the interplay of the controversy of the innovation, the number of the initial adopters or detractors and the trusted component of network ties.

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I. INTRODUCTION

To improve organizational performance innovative management accounting systems have been designed and implemented in organizations in the past decades. The study of diffusion and implementation of management accounting innovations has inspired several lines of research. One line of research has focused on understanding how and why new management accounting techniques spread among organizations or population of organizations. Diffusion theory researchers in management accounting (Bjornenak, 1997, Malmi, 1999 and Ax and Bjornenak, 2005) mainly borrowed from Rogers (1995), Abrahamson (1991) and Wolfe (1994) frameworks. They aimed at studying through which channels a management accounting innovation diffuses among a population of organizations and at what rate the innovation spread through this population. They examined the number of adopters over time and the distinctive factors that explained the spread of the innovation. Diffusion theory frameworks have explanatory power and focus on a linear and sequential diffusion process in which an innovation is developed and delivered "ready for use" to organizations, regardless the organizational context. These frameworks are difficult to transpose within organizational contexts as they largely ignore the complexity of the diffusion phenomenon. A second line of research which contrasts with innovation diffusion theorists (Ezzamel, 1994; Chua, 1995; Briers and Chua, 2001; Mouritsen, 1999; Preston et al., 1992) is actor network theory (Callon, 1986; Latour, 1987; Callon, 1989; Latour, 1992; Akrich et al. 1988, Akrich, 1992) that contend that innovations follow a non-linear path in which technical aspects cannot be separated from social aspects. Actor network theorists argued that innovations do not follow a sequential process but are constructed between human actors and non-human actors that are embedded in networks. Actors and actants are linked together in networks that are built and maintained in order to diffuse an innovation. In order to stabilize the network, the diverse stakeholders' interests are translated through an "interressement" process that reduces behavioral uncertainties, and resistance to change, through the continuous interactions among network members in the search of a common solution.

Management accounting scholars have also studied the implementation of management accounting innovations at the organizational level. They focused on the determinants that led to the success or failure of management accounting innovation implementation. Shields (1995) developed a comprehensive behavioral model on the implementation of activity based costing. Shields (1995) built on Shields and Young (1989), Argyris and Kaplan (1994) and Cooper et al. (1992) and identified several behavioral and organizational variables (i.e. top management support, resources engaged) for successful implementation of an innovative management accounting system. In addition, contingency theorists have highlighted the role of user involvement (McGowan and Klammer, 1997), organizational strategy and structure (Gosselin, 1997) as critical in the implementation success of ABC. In a similar vein, Anderson (1995), Libby and Waterhouse (1996), Foster and Swenson (1997), Krumwiede (1998) and Anderson and Young (1999) have highlighted additional contextual variables.

Another line of research has been the study of change in management accounting. Change may often originate from the diffusion of innovations and is often accompanied by uncertainty and resistance to change. In-depth case studies have been motivated by the importance of studying management accounting in its organizational context (Hopwood, 1983, 1987; Kaplan, 1986). This voluminous research body has provided detailed evidence about the nature of management accounting change and resistance. Markus and Pfeffer (1983) drew upon the management information systems literature and developed the power and politics framework and argued that power distribution and organizational culture are structural factors behind resistance to change. The use of management accounting systems implies a redistribution of power between various stakeholders. Innes and Mitchell (1990),

Cobb et al. (1995) and Kasurinen (2002) have developed a change model based on a set of specific circumstances that they named motivators, catalysts and facilitators. Barriers to change, leaders and momentum for change as new element of the change model. Three types of barriers to change were identified during the change process, namely confusers, frustrators and delayers. Malmi (1997) explores the origin of resistance to ABC from economic, cultural, power and politics and suggested that these sources appear fundamentally structural, and are unlikely to be dealt with by employing implementation-based strategies. Granlund (2001) relates how economic, institutional, and human factors are tightly inter-linked and promoted continuity over factors driving change. Granlund (2001) argues that resistance was not an illogical, emotional, or irrational behavior, but rather there were some very legitimate concerns and fears behind it. Scapens and Roberts (1993) noted that resistance was due to the failure to secure the legitimacy of a new system, and an inability to find a common language between production and accounting. They point out that it is not sufficient to study organizational resistance only in terms of power usage, but that it should be coherently linked to structures of signification and legitimation as well. Drawing on old institutional and structuration theory, Burns and Scapens (2000) explored the complex and ongoing relationships between actions and institutions, and demonstrate the importance of organizational routines and institutions in shaping the processes of management accounting change. More recently, Jermias (2001) called on a social psychology framework, cognitive dissonance, to explore the mechanisms underlying the motivation to resist change and the impact of cognitive dissonance on people's judgments about new initiatives. Finally, Bhimani (2003) addresses organizational culture and « how the technical configuration of management accounting systems can evolve such as to embed particular organizational culture elements ». These descriptive in-depth case studies have highlighted how innovative management accounting practices could be perceive as threatening to organizational actors and create uncertainty and resistance to change in implementing them. In this vein, Sulaiman and Mitchell (2005) provided a typology of management accounting change to predict the likelihood of success of implementing management accounting innovations. Based on data collected from case studies, they argued that more radical innovations, i.e. additions and replacements of new techniques are problematic to implement and have a relatively low likelihood of success to implement. On the other hand, more incremental and more operational changes, i.e. management accounting changes as modification of information outputs and operational modifications are less problematic and have a relatively high likelihood of success. Therefore, the more radical and controversial an innovation ought to be, the more employees will resist the change and the less likelihood the success of the implementation process.

To cope with the uncertainty that emerges during the implementation process, recent studies have highlighted the importance of trust during the change process. Although considerable contextual factors have been examined in implementing management accounting systems, the linkage between trust and adoption has been scarcely debated in the literature (see Free, 2008 for a review on trust). While trust is gaining paramount in the study of inter-organizational arrangements and performance evaluation, it is a promising avenue to study the diffusion process of management accounting systems. The effect of trust on the adoption of management accounting systems has been study under a few perspectives. For instance, Busco et al. (2006) build on Burns and Scapens (2000) to illustrate how management accounting systems can act as sources of trust for the processes of change while at the same time being socially constructed objects of trust. Busco et al. (2006) note that trust is a mechanism that can reduce uncertainty in contexts of interactions and facilitate the functioning of organizational systems through the behavior of social actors. In an empirical research, Emsley (2005) posited that the more management accountants interact with

operational members, the more the likelihood they develop trust and the higher the likelihood business unit management accountant will implement management accounting systems. This situation is especially relevant for radical innovations. Emsley (2005) argued that resistance to change could be minimized when management accountants with a business unit orientation become a member of the "in" group (i.e. the business unit) and, consequently, will find it less difficult to get their views accepted within the business unit than management accountants with a functional orientation who will be viewed as members of an "out" group. In a similar vein, Masquefa (2008) draw on social network theory to explore how a management accounting innovation diffused along network ties of different strength. Strong ties or trusted ties provided an important resource to overcome uncertainty and resistance to change.

Both Emsley (2005) and Masquefa (2008) argued that the success of the implementation process is contingent to the development of trust, which, in turn, is affected by an organization's structure. In effect, in organic structures (Burns and Stalker, 1961), the removal of barriers between organizational activities are conducive to inter-units network ties enabling the organization to cope with uncertainty and adapting to unstable environment. On the other hand, mechanistic structures are organized around dense networks with multiple network ties within organizational units and fewer ties between organizational units to achieve efficiency and scale economies. Therefore, trust patterns of decentralized structures will be numerous between units and less abundant within units whereas trust patterns within centralized organizations will tend to develop within units rather than between units, therefore conducting to different success levels of management accounting system adoption of innovations. However, limited attention has been devoted to the study of intra-organizational social network perspective[2] examining the structures, types, and outcomes of network ties which is quite surprising because overcoming resistance to change has long been a central focus of organization development and change, and networks often are the locus of change acceptance or resistance. One particular prominent void is in the area of networks within organizations and the role that structure, in particular inter-unit ties, play in effective diffusion and implementation of management accounting systems. Researching change from a network perspective can significantly augment existing models of planned implementation and organizational adaptation.

The introduction section has respectively highlighted that implementing management accounting systems may raise uncertainty and resistance to change and trust and network structures may be conducive to reduce or exacerbate resistance and thus fostering or hindering the success of diffusing management accounting innovations. As such, this paper aims to explain and explore how and why management accounting innovations diffuse within organizations. This paper relies on social network analysis and the diffusion theory perspective within an organizational context to explore how uncertainty, structure, trust and perception of organizational actors towards an innovation interact in the diffusion process. More particularly, a computer simulation model is proposed to experiment the effect of different levels of an innovation controversy, different degrees of trust operationalized through strong ties, different network structures represented by the density of strong ties between and within organizations and different levels of resistance on the diffusion process. The study contributes in extending our knowledge about management accounting change and the importance of trust, network communication channels and structure in implementing management accounting techniques. The study introduces a novel and original methodological approach to the field of accounting and particularly to study the diffusion of management accounting innovations. This methodology is suited for and can contribute to

[2] To our knowledge, Chapman (1998) and Masquefa (2008) are the only studies that make use of social network analysis at the intra-organizational level.

increase our understanding in various fields within the management accounting discipline, namely the study diffusion processes, inter-organizational arrangements, open-book accounting, supply chain management.

The following section develops the theoretical underpinnings of our research. Section three introduces the methodology and examines the suitability of computer simulation and agent based modeling to generate novel theoretical insights in management accounting. Section four presents the results of the simulation and examines the relationship between uncertainty, trust, social network structure and resistance on the success of the diffusion process. Finally, the paper concludes by linking theoretical findings with practical issues.

2. THEORETICAL DEVELOPMENT

The following section introduces social network theory and the strength of ties argument as the main theoretical framework for our research. Diffusion of innovations can be defined as the process by which a few members of a social system initially adopt an innovation, then over time more individuals adopt until all (or most) members adopt the new idea (Valente, 1996). Such processes trace the communication of new ideas and adoption of innovations over time through channels of communication in a social system (Burkhardt and Brass, 1990). Networks play also an important role in facilitating the spread of organizational phenomena (Rogers, 1995). Rogers and Agarwala-Rogers (1976) noted that: "Network analysis is a method of research for identifying the communication structure of a system in which sociometric data about communication flows or patterns are analyzed by using interpersonal relationships as the units of analysis. This tool promises to capitalize on the unique ability of diffusion inquiry to reconstruct specific message flows in a system on these flows." Evidence suggests that various important managerial practices, including management accounting techniques, can spread through networks of weak and strong ties across inter and intra-organizational arrangements. Few researchers in management accounting have highlighted the role of networks as conduits in the dissemination of accounting techniques.

2.1 The nature of intra-organizational network ties and structure

Organizations are composed of a mixed of weak and strong relations. Weak ties involve infrequent interactions and low emotional closeness. Because they are episodic, weak ties do not necessarily have affective content (Nelson, 1989). According to Granovetter (1973), whatever is to be diffused can reach a large number of people, and traverse greater social distance when passed through weak ties. They are more likely to link members of different small groups and provide people with access to information and resources beyond those available in their own social circles. Strong ties are frequent contacts that almost invariably have affective, often friendly, overtones and may include reciprocal favors. Strong ties are time-consuming to develop and maintain (Granovetter, 1973, 1982). Actors that are strongly tied to each other are likely to share and possess common knowledge of each other and develop a shared understanding of the utility of certain behavior as a result of discussing opinions in strong, socializing relations, which in turn influence their actions (Coleman et al, 1966 cited in Gulati 1998). This attachment can also be viewed as the capacity for social ties to carry information that diminishes uncertainty and promotes trust between actors (Gulati 1995; Granovetter, 1973). Because they are frequent, strong ties tend to develop and be concentrated within cliques. The work divisions create boundaries among groups who tend to develop relationships with the individuals of their own group. Granovetter (1982) recognized that strong ties have greater motivation to be of assistance. Citing Pool (1980), he added that

strong ties are more likely to be useful to the individual when he is in an insecure position and someone in such insecure positions will develop strong ties to reduce uncertainty and protect himself. Therefore, strong ties tend to be confined within organizational groups and tend to fragment the organization into small groups (see figure 1).

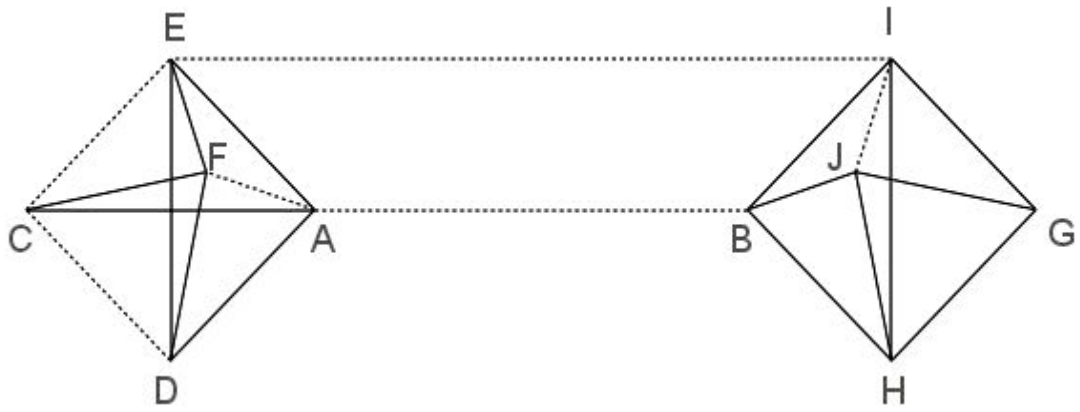


Figure 1. A social network composed of strong ties and weak ties (Granovetter, 1973)

Therefore, organizations can be conceptualized as loosely coupled having a core of strong and weak ties (Imai and Baba, 1989). The integration of these groups at the organizational level depends on people's weak ties, not their strong ones because weak social ties extend beyond intimate circles (Granovetter, 1973) and establish the inter-group connections on which macro-social integration rests (see Blau, 1974).

2.2 The strength of ties perspectives in diffusion processes

The above arguments suggest that innovations diffuse within organizational units through strong ties and between organizational units through weak ties. Nelson (1989) posited that people use strong ties for political mobilization and solidarity and weak ties for the transmission of novel information and diffusion of innovation. Strong ties serve as a basis for social control mechanisms and weak ties transmit novel information (Rowley et al., 2000). In the same vein, Weimann (1980) observed that weak ties provide "the 'bridges' over which innovations cross the boundaries of social groups…whereas the influence on the decision making is done mainly by the strong ties network within each group". According to the strength of weak ties perspective, weak ties propagate the change faster than strong ties because they provide a link between cliques that greatly accelerates the penetration rate of ideas. Information flows freely from one clique to another clique and the bridging tie remains open to allow the flow of information. Multiple links between cliques obviously speed the innovation process and can change the trajectory of penetration at the aggregate level (Midgley, 1992). Nevertheless, the strength of weak ties theory mainly applies to diffusion of innovations (i.e. rumors, new ideas) that do not raise resistance to change.

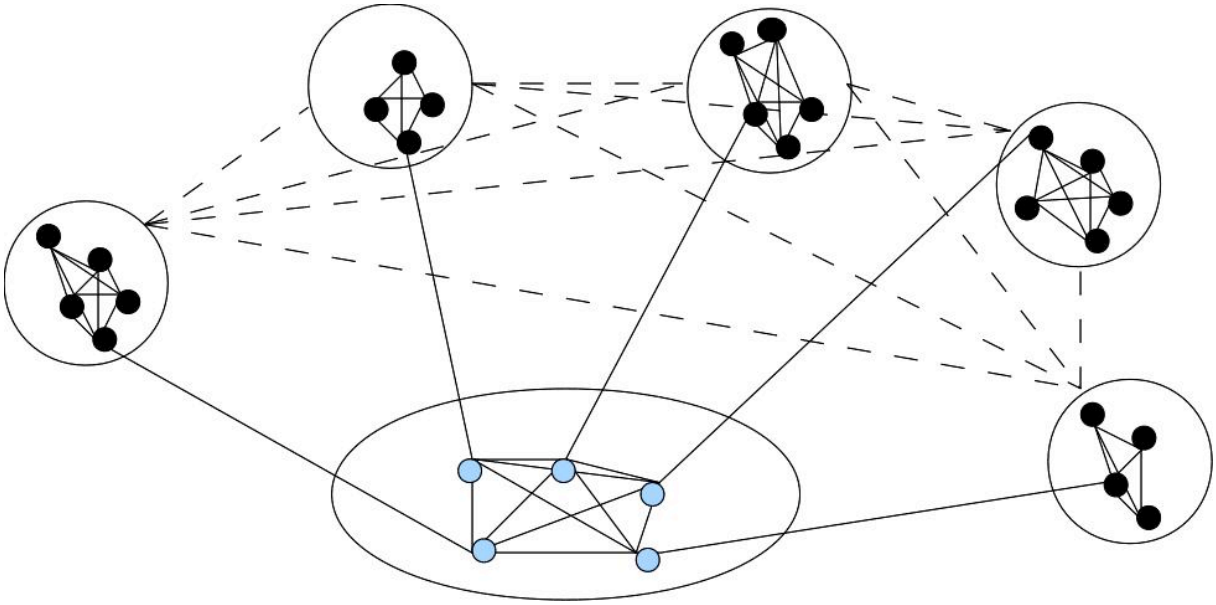


Figure 2. Networks of strong ties and weak ties within organizational and between organizational units.

Rogers (1995) notes that risky, controversial, expensive, and irreversible changes are likely to be diffused much more slowly and locally than are other, less weighty innovations and that such large-scale changes are less likely to be undertaken on the basis of information received from weaker, more distant, and less trusted ties (Rogers, 1995, cited in Kraatz 1998). When an innovation is controversial, that is, when it threatens the status quo in terms of standard routines of how decisions are made, then resistance to that change must be addressed before predictions can be made about the success of that change effort (Krackhardt, 1992). Facing uncertainty, trust in the propagator in the change is a major resource to bring about the diffusion process. Moreover, Krackhardt (1992) and Krackhardt and Stern (1988) posited that in case of severe change and uncertainty, people resist change and uncomfortable with uncertainty, strong ties constitute a base of trust that can reduce resistance and provide comfort in the face of uncertainty. Without current interaction, there is little opportunity to share critical or confidential information. Without the history, there is no experience to know how the other will use the confidential information or whom he or she will share it with (Krackhardt, 1992). Thus, controversial change is not facilitated by weak ties but rather by strong ties. Uncertainty is a source of risk and makes trust more likely to emerge (Rousseau et al., 1998).

In line with the above argument, diffusion can be accomplished through both weak and strong ties because when actions are undertaken with complete certainty, there is no need or possibility for trust to develop (see Lewis and Weigert, 1985). But with higher level of uncertainty, i.e. when the innovation is controversial, the diffusion process can only be accomplished through strong ties. However, in large organizations that are tightly structured - commanded by the division of labor- strong ties tend to develop within organizational units and are therefore uncommon across organizational units. In such circumstances, the propagator of the change will draw on their network of strong ties to diffuse the innovation. Therefore, weak ties would play a fundamental role in providing access to distant organizational units when the innovation is not controversial and strong ties would be increasingly important when the innovation is perceived as controversial by other organizational units. We expect that uncertainty, strong versus weak ties, and structure will have different effects on the in the implementation of a management accounting and control systems.

2.3 Strength of ties role in the diffusion of management accounting innovations

In line with the above arguments, Masquefa (2008)[3] described the two-step process of an innovation diffusion. The innovation diffused initially within the case organization through an inter-unit diffusion process that was followed by an intra-unit diffusion process. The inter-unit diffusion process occurred through weak ties and the intra-development diffusion process occurred through strong ties. The overall diffusion process between organizational units and within organizational units observed in Masquefa's account was consistent with the social network literature stating that "weak ties are more likely to link members of different small groups than are strong ones, which tend to be concentrated within particular groups" Granovetter (1973). However, during the intra-diffusion process, several diffusion scenarios emerged depending on organizational actors perception of the innovation. To highlight those differences, the authors will describe the following three cases:

Case 1: When the change agents did not perceived the innovation as threatening, that is when uncertainty was low, they acted as a bridge and diffused the innovation to their own development division and obtained validation from their division's director. Masquefa (2008) proposed that in the absence of resistance to change, weak ties provide efficient conduits and propagate management accounting systems because they provide bridges to distant organizational units. When the degree of controversy of the innovation is low, i.e. when uncertainty is low, the strength of weak ties argument holds and individuals transmit information over weak ties. Under these conditions, information circulates among the dense strong ties within a clique and can freely make the jump over weak tie bridges to adjacent cliques. This renders weak ties "strong" because they can serve as vital inter-island links.

Case 2a: When there is resistance to change, stronger ties rather than weaker ties, are more suitable conduits to implement management accounting systems because the trust component that has been developed through frequent interactions helps to overcome resistance to change. When the degree of controversy is high, individuals are reluctant to transmit the information through weak ties (cf. section 2.2). Information can no longer jump over weak tie bridges to adjacent cliques and instead, becomes trapped within the clique that first received or originated the information: information flow through the network may then cease. Under these conditions, inter-clique information flow depends on anomalies in the island-bridge structure of the network. In other words, information flow will be observed only in the relatively rare instance where strong (rather than weak) ties link together the members of different cliques.

Case 2b. Nevertheless, when resistance to change is observed, trust can also act in detriment of the change process. This situation is well illustrated by Masquefa (2005): "*Business Unit 1 representative opposed to the change perceived the change as threatening to her. She acted as a barrier to the change process. The likelihood of the diffusion process could be jeopardized as she opposed to the change and would transmit a negative message in her organizational unit. Structural, political and cultural factors were identified with resistance, She looked for political support with someone she trusted, her direct superior, who then also became opposed to the proposed innovation. The conflict became overt and*

[3] To our knowledge, Masquefa (2008) is the only article that draws on social network analysis and the strength of ties conceptual frameworks to explain the implementation of a management accounting innovation. However, the empirical evidences on which the model rests (cf. case 1, case 2a and case 2b described below) concern a more mechanistic type of structure. The author have not found in the literature, detailed descriptive evidences concerning the diffusion of management accounting innovations in truly organic structures. Therefore, one of the intentions of this study is to explore, through a computer simulation model, the effects of our variables on the purely organic structures.

escalated to a higher hierarchical level. For Business Unit 1 representative who was opposed to the change, the strong tie with her hierarchical superior constituted a base of trust that reduced resistance and provided comfort in the face of uncertainty". The case evidence suggests that when a management accounting innovation is controversial, it triggers uncertainty and resistance and thus an opponent to the change process searches for support in her network of strong ties to impede the implementation of the innovation. As well as in case 2a, when the degree of controversy is high, individuals are reluctant to transmit the information through weak ties and transmit the innovation through strong ties (cf. section 2.2). In cases 2a and 2b, positive or negative information spread within organizational units and can no longer jump over weak tie bridges to adjacent cliques but instead becomes trapped within the clique that first received or originated the information: information flow through the network may then cease. Under these conditions, inter-clique information flow depends on anomalies in the island-bridge structure of the network. In other words, information flow will be observed only in the relatively rare instance where strong (rather than weak) ties link together the members of different cliques.

The above theoretical development suggests that the likelihood of success or failure of the diffusion process is a combination of degree of controversy, structure, tie strength and organizational perception of an innovation. Individual perceptions and tie strength within a social network have a direct effect on the diffusion process of management accounting change. Therefore, the study intends to explore simultaneously the interaction of four variables, namely uncertainty, structure, trust and individual's perception of the innovation on the success of the implementation of management accounting innovations.

3. RESEARCH METHODS

3.1 Computer simulation

In order to explore the interacting effects of uncertainty, trust and structure on the diffusion of a management accounting innovation, the present study will draw on an agent based modeling computer simulation. A growing number of scholars have been using computer simulation in the field of management (Cohen and Cyert, 1965; Cyert and March, 1963; Levinthal and March, 1981; Abrahamson and Rosenkopf 1993 are notable examples) and several calls have been made (Harrison et al., 2007; Davis et al. 2007) to increase the use of simulation modeling for the development of theory. Although extensively used in psychology, economics and political science, and increasingly used in the field of management, computer simulation is scarcely used in management accounting. Mouck[4] (2000) explores various Santa Fe Institute agent based modeling, studies and their implication for capital investment theory and capital investment strategy. He commented citing Lane et al. "…that the identity of agents, the attributes of artifacts and the possibilities for action tend to be emergent phenomena that are generated by the interactions of agents." Simulation enables the elaboration of rough, basic theory that is often derived from inductive cases or formal modeling into logically precise and comprehensive theory (Davis et al., 2007). This theory can then be effectively examined further using deductive logic and empirical evidence. Simulation involves creating a computational representation of the underlying theoretical logic that links constructs together within these simplified worlds. These representations are then coded into software that is run repeatedly under varying experimental conditions in order to obtain results. Davis et al. (2007) note that "Simulation is especially useful in the "sweet

[4] To our knowledge, Mouck (2000) is the only reference to agent based modeling in the management accounting literature.

spot" between theory creating research using such methods as inductive multiple case studies (Eisenhardt, 1989) and formal modeling (Freese, 1980) and theory-testing research using multivariate statistical analysis (Pfeffer, 1983)."

Simulation is particularly useful for theory development when simple theory exists, that is undeveloped theory with few constructs and related propositions with modest empirical or analytical grounding (Davis et al., 2007). Simulation is an adapted methodological method when the theoretical focus is longitudinal, nonlinear or processual, or when empirical data are challenging to obtain. Simulation is particularly suited to the development of simple theory because of its strengths in enhancing theoretical precision and related internal validity and in enabling theoretical elaboration and exploration through computational experimentation (Davis et al., 2007). The computational rigor of simulation forces precise specification of constructs, assumptions, and theoretical logic that creates strong internal validity (Davis et al., 2007). This theory can then be effectively examined further using deductive logic and empirical evidence.

Among the richness in variety of computational simulation, the study here draws on agent based modeling as the primary unit of study is the agent, or individual. In an agent-based modeling approach, the model simulates the behaviors of the organizational actors and their interactions. Agents interact with each other in a repetitive process. It is from this repetitive process and from interactions between agents that global or macro-trends evolve and aggregate macro-scale behaviors emerge (Garcia, 2005). Agent based modeling is best suited to domains where the natural unit of analysis is the individual and when both micro-level behavior of individuals and macro-level patterns from the interactions of these individuals are of interest (Garcia, 2005). Agent modeling provides a methodology in which these patterns can be replicated (behavioral) and then manipulated to study contingent outcome (Garcia, 2005). Agent based modeling is particularly adapted to study innovation diffusion considering the interactions among organizational actors and the influence one can have during the diffusion process.

Next section will introduce the computational representation of the theory and represent the operationalization of our theoretical constructs, the building of our algorithm and the specification of the assumptions that bound the theory and the results (Davis et al., 2007).

3.2 The model

Constructing a simulation model involves identifying the underlying processes thought to play key roles for the behavior of an actor (or organizational system) and formalizing them as mathematical equations or sets of computational rules. Then, the resulting program is run on the computer for multiple time periods to produce the outcomes of interest. Simulation enables to analyze multiple interdependent processes operating simultaneously and provides a laboratory in which to discover implications of the theory's assumptions that are not intuitively obvious (Harrison, et al., 2007).

In stochastic models the simulation outcomes will vary somewhat from run to run, depending on the random numbers generated, so the results of one run may not be representative of the average system behavior (Harrison, et al., 2007). To assess average system behavior as well as variations in behavior, multiple iterations are necessary—that is, the simulation run must be repeated many times (using different random number streams) to determine the pattern of outcomes (Harrison, et al., 2007). Finally, the entire simulation process described above may be repeated with different variations. Both the parameter values and the initial conditions can be varied for two reasons. First, the behavior of the system under different conditions may be of interest; the examination of such differences is often a primary reason for conducting simulation experiments (Harrisson et al., 2007).

The experimental design consists of five elements: the initial conditions, the time structure, the outcome determination, iterations, and variations. The computational model specifies how the system changes from time *t* to time *t*-1, but not the state of the system at time 0, so initial conditions must be specified. The time structure sets the length of each simulation time period and the number of time periods in the simulation run. Once the time period is determined, the number of time periods to be simulated can be set to obtain the desired total duration of the simulation run, or a rule may be established to stop the run once certain conditions (e.g., system equilibrium) are met. The outcomes of interest are often some function of the behavior of the system and need to be calculated from system variables. Outcomes may be calculated for each time period or only at the end of the run, depending on the simulation's purpose.
We now determine the parameters and the simulation dynamics of our computer model. It is important to remember that it is the interplay of structure, tie strength and controversy rate that determine the effectiveness of innovation diffusion. The principles of the model are the following:

Our first macro-level construct, structure, is represented through a social network composed of organizational agents (cf. section 2.1). Ties or links may exist (positive value) or not (or null value) among organizational agents. To illustrate, let's suppose our network is composed of n agents, then we construct a n*n matrix (cf. figure 3). Organizational agents are grouped into divisions or cliques.

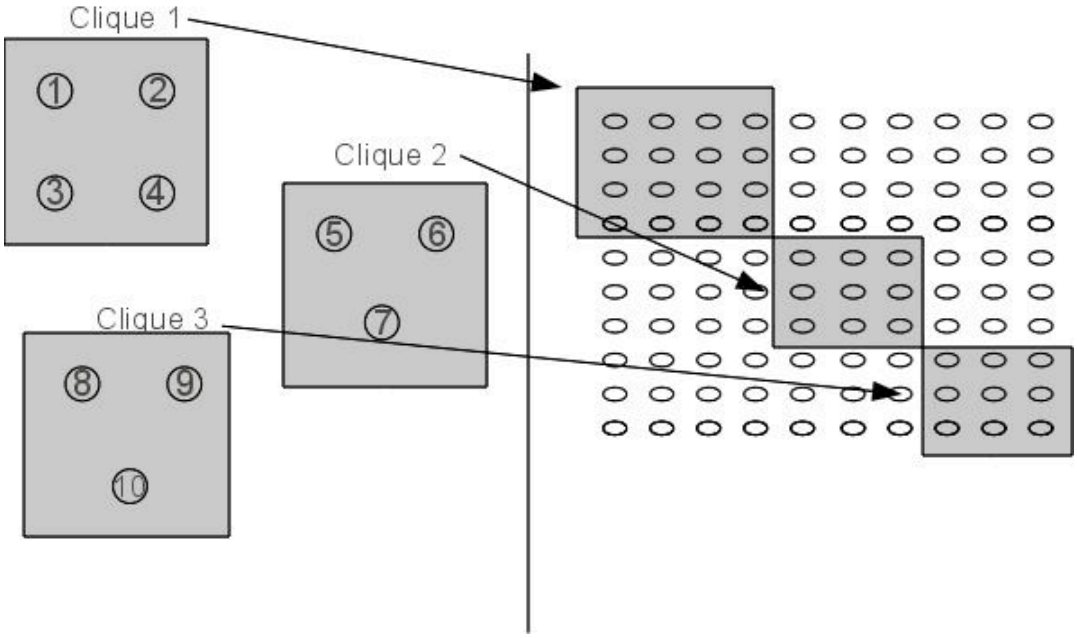


Figure 3. Network structure composed of 10 agents grouped in 3 cliques.

The organizational structure is modeled through two levels of tie density, one density for ties within cliques (cf. figure 4) and one density for ties between cliques (cf. figure 5). To illustrate within clique ties density, the following figure represents 10 agents grouped into 3 cliques (with respective size of 4, 3 and 3 agents). Referring to figure 4, the density of intra-clique is set at 50%. This configuration supposes that half of all potential links exist, that is 6 links out of 12 possible intra-cliques links.

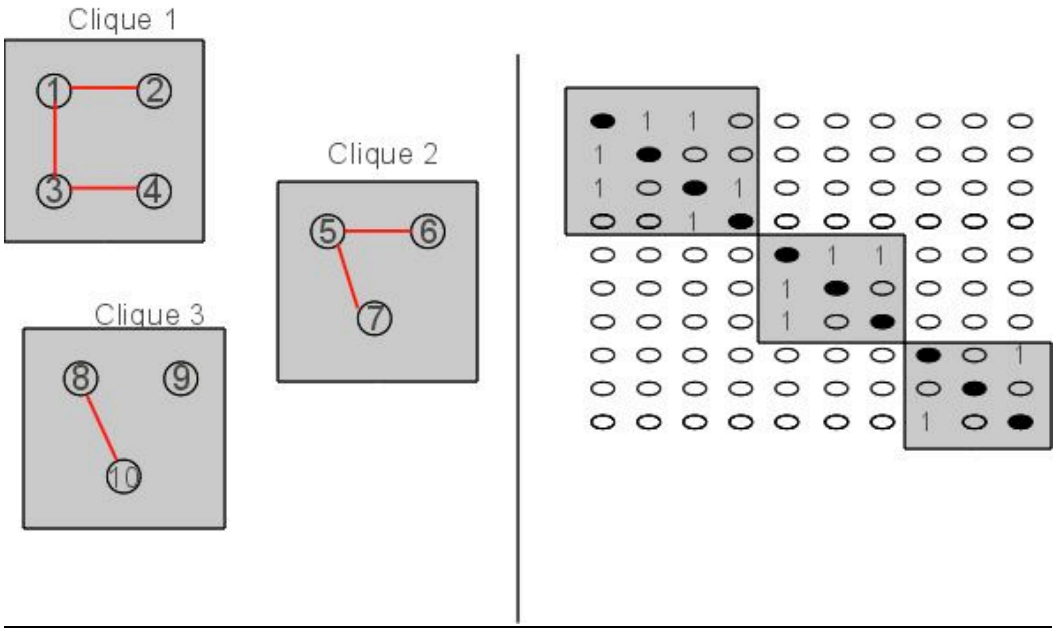


Figure 4. Representation of intra-clique ties with a density of 50%

Figure 5 is a representation of inter-clique ties. We can also set the density of ties between clique ties. In our illustration, 10% of the ties between cliques exist. That means 7 out of 66 possible exists. In a network of any size, the possible links within cliques and between cliques are n^2-n.

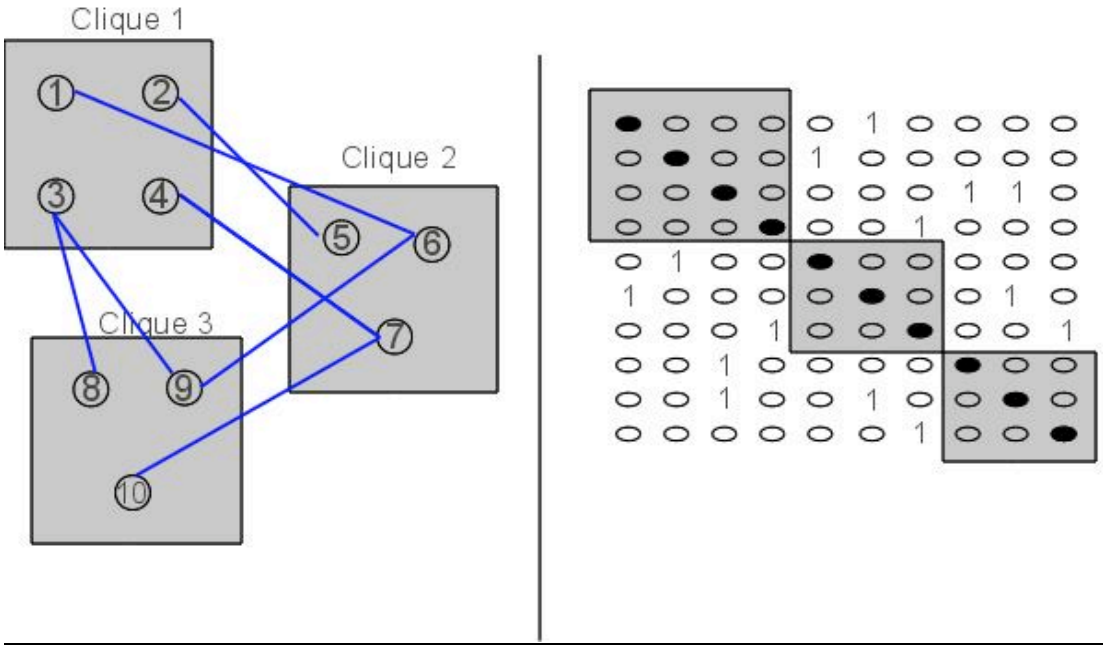


Figure 5. Representation of inter-clique ties with a density of 10%

The initial state simulation parameters are preset at the start of each simulation run and are

randomly assigned for successive simulations. Density of ties within cliques is higher than density of ties between cliques. Three structures with different densities of intra-clique and inter-clique ties will be modeled, namely the 90-10, 65-25 and 50-50 structures, to differentiate mechanistic structures from organic structures (Burns and Stalker, 1961). In line with the social network literature, the 90-10 network structure would represent a mechanistic organizational structure with a high density of intra-clique ties of 90 percent and a low density of inter-clique ties of 10%. On the other side of the continuum, a 50-50 structure represents an organic structure with a density of intra-clique ties of 50% and inter-clique ties density of 50%.

Our second macro-level variable, trust, is operationalized through the strength of ties. The innovation is interpreted within an existing social context. Each acquaintance has an associated tie strength which is a measure of the strength of the relationship from the agent to her/his acquaintance (cf. section 2.2). The stronger the tie, the closer two organizational agents are going to be, and the greater the likelihood the adoption of the innovation. When a tie exists (value≠0) weak ties and strong ties are randomly assigned through a continuum from 1 (weak tie) to 5 (strong tie) according to two densities: one density for the strength of ties within a subunit and one density for the strength of ties between subunits. Density of strong ties is a proportion of strong ties computed as the actual number of strong ties that a unit engages in divided by the total number of possible strong ties that a unit could engage in. The distribution of the tie strength is modeled with two normal distributions. One distribution refers to within-clique ties and the second distribution refers to between-clique ties. The distribution used for within-clique ties tends to be more dense with more strong ties whereas the distribution for between-clique ties tends to give more weak ties. The existence of a tie between two individuals is assumed to be symmetric, however the strength of a tie is not. Along with our three structures, namely the 90-10, 65-25 and 50-50 structures, densities of intra-clique and inter-clique strong ties have been assigned respectively. Mechanistic structures tend to have higher densities of strong ties within cliques and lower densities of strong ties between cliques. On the other hand, more organic structures tend to have lower densities of ties within cliques but higher densities of ties between cliques. Therefore, the 90-10; 65-25 and 50-50 structures are assigned respective densities of 3,8-1,5; 3,2-2,1 and 2,8-2,8 for intra-clique and inter-clique strong ties.

Our third construct, uncertainty, depends on the controversy of the innovation. The controversy of the innovation is modeled with a transmission threshold (an arbitrary value). The controversy threshold represents the difficulty that the innovation will be transmitted from an adopter, an organizational agent that is in favor of the proposed innovation, to a non-adopter, a person that has not adopted the innovation. It is the minimal tie strength needed for the innovation to be implemented. For instance, an agent will proselytize other agents in favor of the innovation only if a certain level of tie strength exists. The success of the adoption is a function of whether a tie exists and whether the strength of the extant tie exists exceeds the transmission threshold.

The above assumptions captured the macro-level assumptions of the diffusion process, namely, differentiating mechanistic versus organic structures, trusted network ties versus acquaintances and the degree of controversy of the innovation. The following helps to capture the micro-level dynamics of the diffusion process (cf. section 2.3). In the initial stage of the simulation, each organizational actor seeks out other organizational actors within the organization and exchange with them on their beliefs about the innovation. All organizational actors can take on one of the three possible states depending on their perception of the innovation: initial adopter (those that currently believe in the innovation), detractors (those who are currently opposed to the innovation) or nonadopter (status-quo oriented organizational actors). After successive iterations, the initial adopters and initial detractors

will intend to convince non-adopters about the benefits or the drawbacks of the innovation. If the strength of a tie is above the controversy threshold, the innovation is accepted (rejected) and the non-adopter becomes an adopter (detractor) (cf. section 2.3 case 1, cases 2a and 2b). We performed successive iterations and when each run converges towards stable values –in terms of intra-clique and inter-clique densities and controversy parameter values, we count the number of adopters and calculate the mean of adopters at the end of each iteration. The simulation is run 20 times with the same initial parameters. Then we capture the speed and effectiveness of the diffusion process, represented by the maximum number of adopters, with diffusion curves.

4. RESULTS

We postulated that structure, tie strength, transmission threshold and perception of the innovation will determine the success or failure of the implementation process. This section presents the results of our simulation. We have varied the values of our parameters, uncertainty, structure, trust and the number of initial adopters and detractors in order to fully explore the effects of the constructs on outcomes. The following results represent diffusion patterns with a) controversy rates ranging from 2.5 (incremental innovation) to 3.9 (radical innovation) and b) number of initial adopters ranging from 1 to 10 and number of initial detractors ranging from 0 to 5. Each curve depicts a different organizational structure. The S-curve indicates the output of the simulation, namely the average cumulative number of adopters that have adopted the innovation at every period during 15 successive time periods. The innovation has successfully diffused if the 150 organizational members have adopted it. The following most intriguing results are proposed.

Optimal structure, incremental innovations and no resistance to change. Figures 6a depicts the diffusion curves of a low degree of controversy innovation with 1 initial adopter and 0 detractors. The results show that all organizational actors have adopted the innovation, regardless of the organizational structure. After the third iteration, the innovation diffused within the ten organizational units. In this particular case, the innovation diffuses effectively under the three organizational structures and independently of the strength of the ties. Therefore, when management accounting systems are perceived with a low degree of uncertainty and consequently with relatively low levels of resistance to change, both weak ties and strong ties provide efficient conduits and propagate management accounting systems because they provide bridges to distant organizational units. The strength of weak ties argument holds. Individuals transmit information over weak ties. Under these conditions, information circulates among the dense network of strong ties within a clique and can freely make the jump over weak tie bridges to adjacent cliques. This renders weak ties "strong" because they can serve as vital inter-island links. Therefore, varying the amount of structure and the level of trust are not significantly associated with the success or failure of the diffusion process.

Proposition 1: Management accounting innovations with low degrees of controversy successfully diffuse within organizations regardless the organizational structure and the trust level of the individual relationship. Weak ties as well as strong ties provide efficient communication channels.

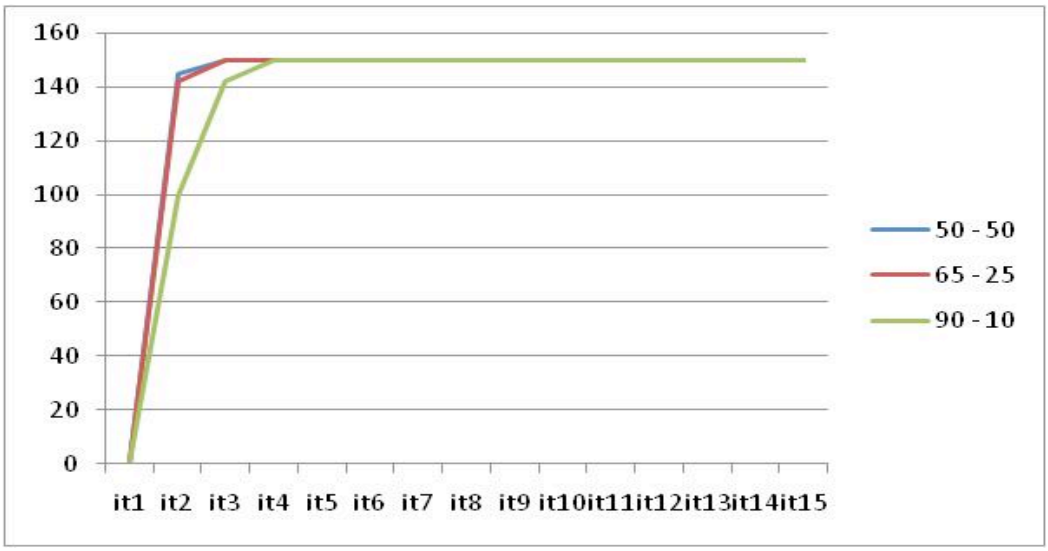


Figure 6a. Diffusion curves of non-controversial innovations and no resistance to change.

Optimal structure, radical innovations and no resistance to change. Figures 6b-6e depict the diffusion patterns of a radical innovation. In this case, the degree of controversy has been increased from 2,5 to 3,9. As the degree of controversy increases, the importance of the amount of structure and the social context become increasingly important. The diffusion patterns provide support for the importance of structural arrangement and trust in the diffusion process. On one hand, the results suggest that mechanistic structures (structures 90-10 and 65-25) are ineffective in the implementation of controversial management accounting systems. This inverse relationship between the amount of structure and the success of the diffusion process occurs because, when the degree of controversy is high, individuals are reluctant to transmit the innovation through weak ties. The innovation can no longer jump over weak tie bridges to adjacent cliques and instead, becomes trapped within the clique: innovation flow through the network may then cease. Under these conditions, innovation diffusion will be observed only in the relatively rare instance where strong (rather than weak) ties link together the members of different cliques. Such strong ties are more frequently encountered in more organic types of structures (i.e. 50-50 structure). Therefore, more organic organizational structures are more effective at diffusing controversial management accounting innovations. The increasing amount of connectedness between organizational units is beneficial for the diffusion of the innovation. Organizational agents spend more time with other agents from different sub-units and develop trusted relationships. Stronger ties rather than weaker ties are more suitable conduits to implement controversial management accounting systems because the trust component that has been developed through frequent interactions helps to overcome resistance to change. Therefore, varying the amount of structure and the level of trust are significantly associated with the success or failure of the diffusion process.

Proposition 2: Management accounting innovations with high degree of controversy diffuse more successfully within an organic structure. The trust content of the tie allows the diffusion of the innovation throughout the whole organization. A mechanistic structure is not effective at diffusing a radical innovation as it remains trapped into an organizational unit and spread with difficulty to other organizational units.

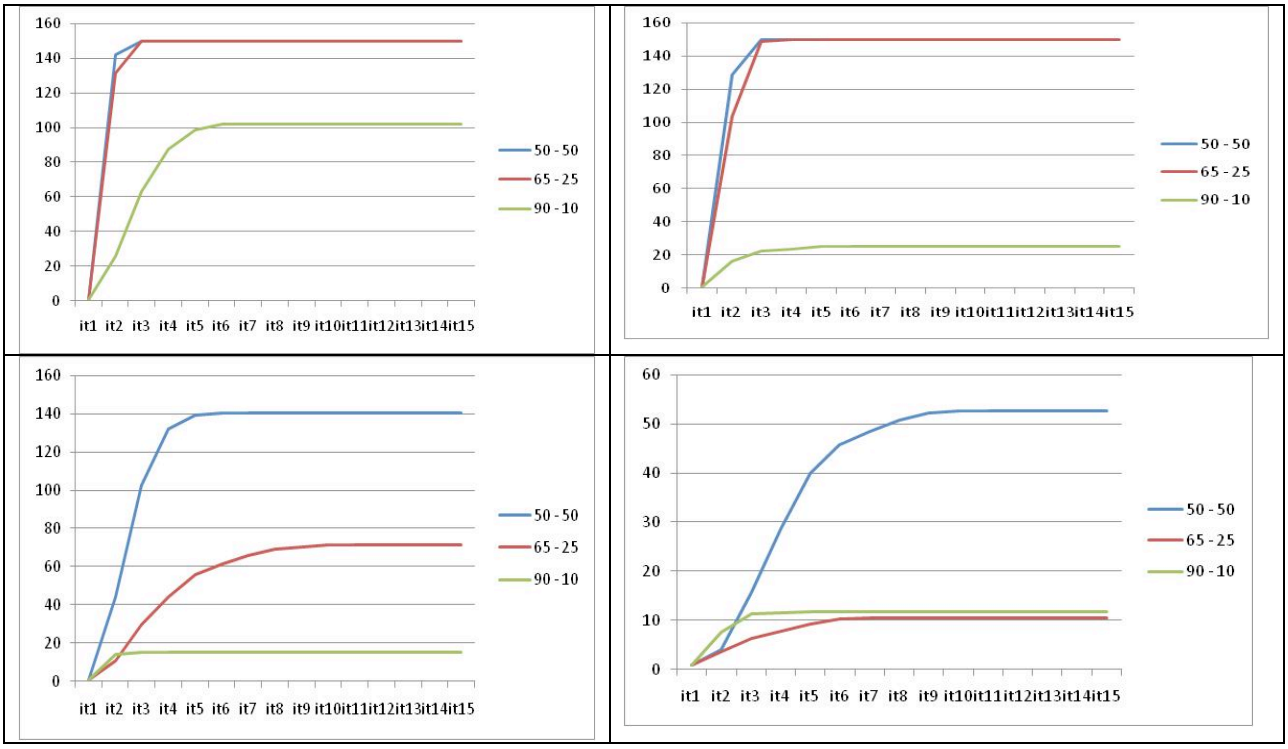


Figure 6b-6e. Diffusion curves of controversial innovations and no resistance to change.

Optimal structure, radical innovation, increasing number of adopters and no resistance to change. Figures 7a-7d depict the diffusion curves for an innovation with a high degree of controversy. The degree of controversy parameter was set at 3,9 and the number of initial adopters was increased respectively with values of 1, 3, 8 and 10 while the number of detractors remained 0. The results highlight the importance of increasing the number of initial adopters to increase the effectiveness of the diffusion process for radical innovations. The more an innovation tends to be radical, the more the long-term survival of the innovation depends on the number of initial adopters. Interestingly, when the number of adopters increases, the best performing structure becomes the more mechanistic one. The difference in the number of final adopters between organic and mechanistic structures reduces itself as we increase the number of initial adopters. This diffusion pattern is also visible with setting up the initial conditions with lower degrees of controversy although the effect is more visible as the degree of controversy increases[5]. Increasing the number of adopters increases the likelihood that at least one of the initial adopter will be part of one respective organizational unit. Therefore, the initial adopter can foster the diffusion process within the group. Therefore, the following proposition can be offered:

Proposition 3: Management accounting innovations with high degree of controversy diffuse more successfully with a mechanistic structure rather than an organic structure when the number of initial adopters increases. The likelihood of an initial adopter being part of the in-group facilitates the adoption process of a radical innovation within mechanistic structures.

[5] The "degree of controversy" parameter was varied to examine how sensitive the behavior of the system is to the choices of parameter settings and initial conditions. Since the behavior does not change much with small variations in conditions, then the system's behavior is robust, increasing confidence in the results of the simulation.

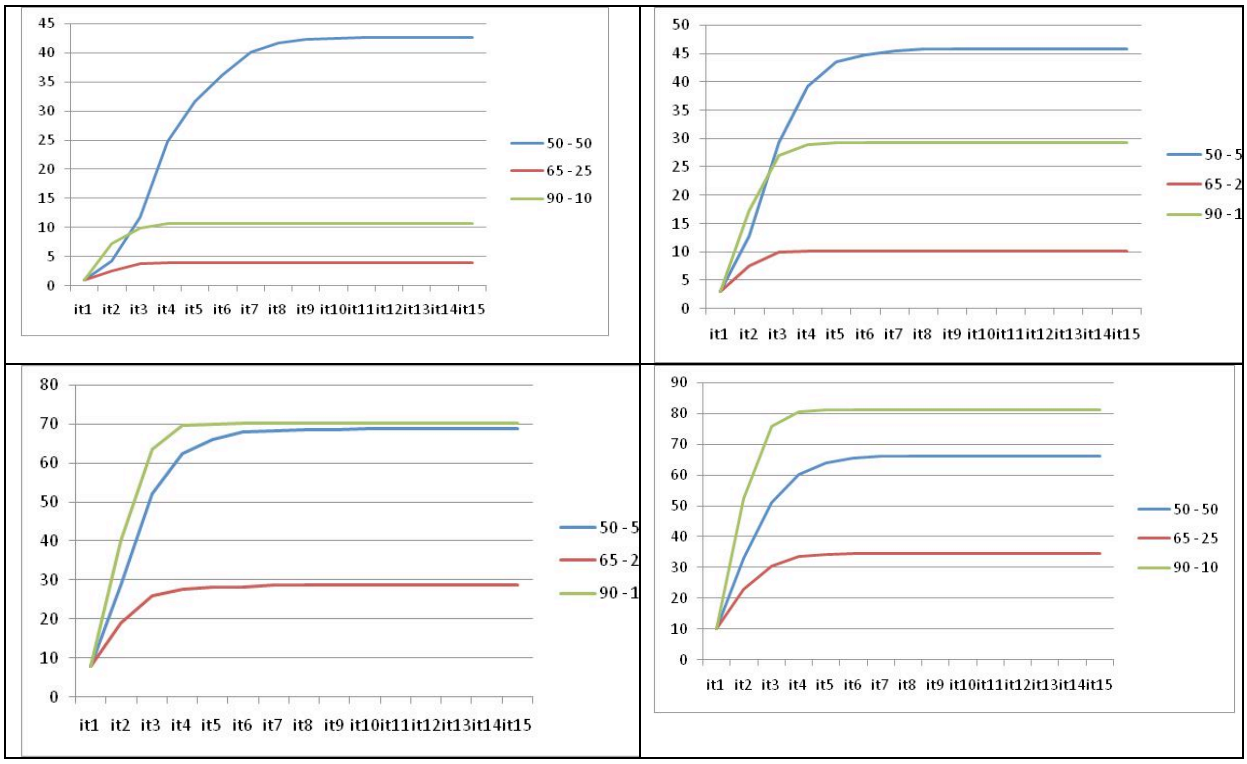


Figure 7a-7d. Diffusion curves for controversial innovations with an increasing number of initial adopters and no resistance to change.

Optimal structure, resistance to change and increasing number of initial detractors. The abovementioned results were obtained with varying the number of initial adopter, the degree of controversy of the innovation and the structural arrangements[6]. Notwithstanding, the effects of different individual perceptions towards the innovation have not been considered. Therefore, resistance to change is introduced by manipulating the initial conditions of the simulation. The following simulation results show the effects of increasing the number of initial detractors on the diffusion process of a radical innovation. First of all, figures 8a-8c depict the drop in effectiveness of all structures when an increasing number of initial detractors is introduced while maintaining one initial adopter. The results show that organic structures tend to be more effective at diffusing radical innovations. However, the increasing number of detractors decreases significantly the number of final adopters impeding the adoption of the innovation. Similarly, a decreasing number of final adopters were also observed for less controversial innovations although the number of final adopters increases as the innovation is less controversial.

[6] Proposition 1, proposition 2 and proposition 3 are also robust with the introduction of the "number of detractors" parameter. The diffusion effectiveness of the organizational structures shows similar diffusion patterns (although the overall effectiveness decreases when the number of detractors increases) when varying the initial number of detractors, therefore, increasing confidence in the simulation process (cf. proposition 4 and proposition 5 below).

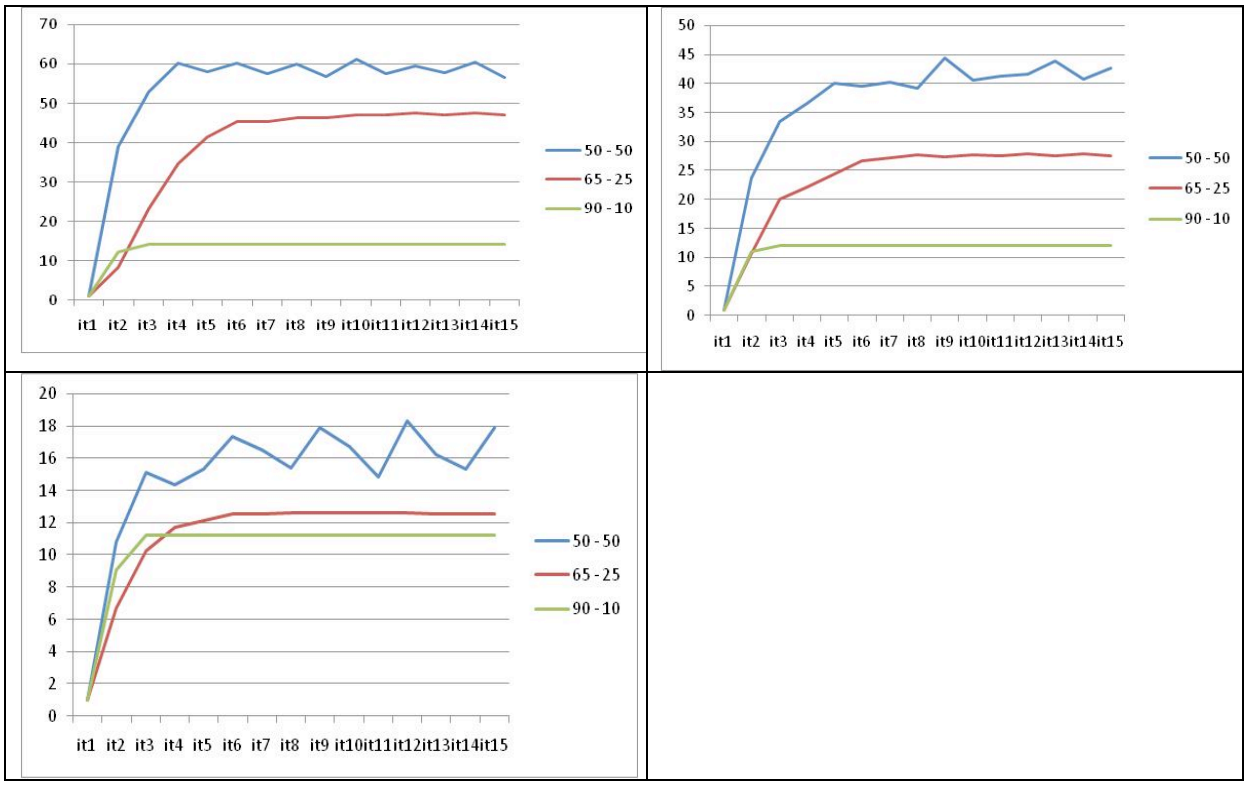
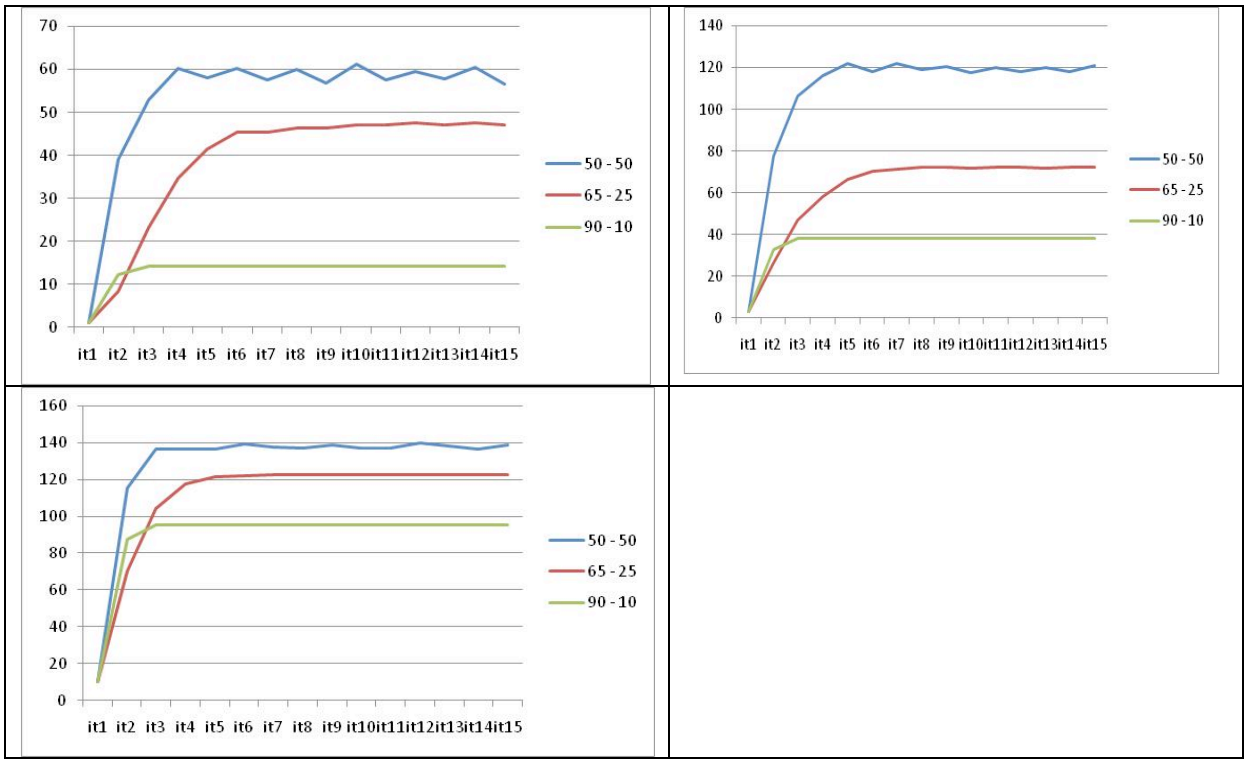


Figure 8a-8c. Diffusion curves for controversial innovations with an increasing number of initial detractors.

Optimal structure, resistance to change and increasing number of initial adopters. Similarly, initial conditions were manipulated to observe the impact of an increasing number of initial adopters while maintaining one initial detractor for a moderate level of controversy. Figures 9a-9c depict the jump in effectiveness of all structures when an increasing number of initial adopters is introduced while maintaining one initial detractor. However, the results tend to show that organic structures provide a more efficient diffusion curve. As the number of initial adopters increases, the number of final adopters increases significantly facilitating the adoption of the innovation. The increase in effectiveness was also observed with incremental innovations although the number of final adopters was increasingly important as the innovation is less controversial.

Proposition 4a: Management accounting innovations that are moderately controversial diffuse more successfully with more organic organizational structures when resistance to change emerges.

Proposition 4b. The success of implementing management accounting innovations with organizational resistance to change tends to be extremely sensitive to the initial number of initial adopters and detractors.



Figures 9a-9c. Diffusion curves of a moderately controversial innovation with an increasing number of initial adopters.

Optimal structure, radical innovations, high number of initial adopters and increasing number of detractors. Figures 10a-10d depict the diffusion patterns obtained with 10 initial adopters and respectively 0, 1, 3 and 5 initial detractors with a highly controversial innovation (degree of controversy = 3,9). As noted in Proposition 3, interestingly, when both the number of adopters and detractors increase, the mechanistic structure tends to be more effective at diffusing a radical innovation than the organic structure. Therefore, in a context of a radical innovation and a high level of resistance to change, proposition 3 can be extended:

Proposition 5: Management accounting innovations with high degree of controversy and strong resistance to change diffuse more successfully within a mechanistic structure rather than an organic structure when the number of initial adopters is high.

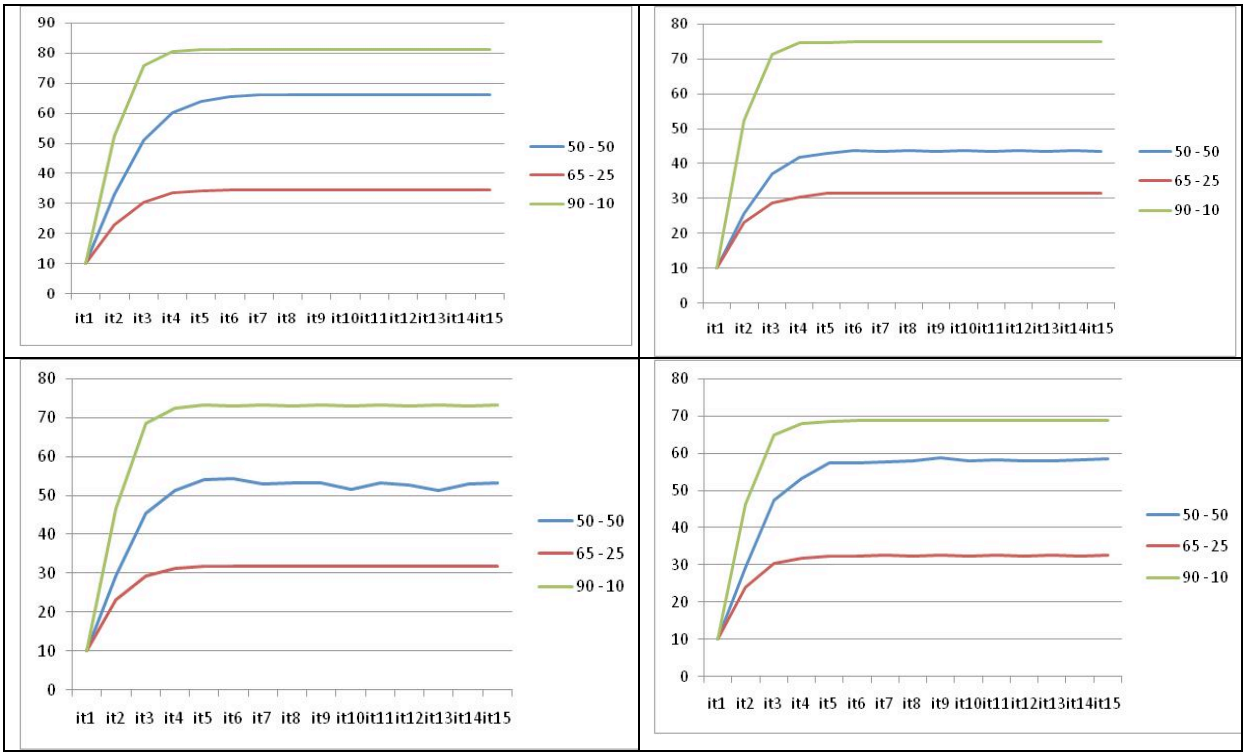


Figure 10a-10d. Diffusion curves of a controversial innovation with a high number of initial adopters and an increasing number of initial detractors.

Stability/instability of structural arrangement. Several figures (i.e. figure 8a-8c) show the existence of an oscillatory pattern during the diffusion process of the organic structure. The oscillatory pattern is observed when both the number of detractors and the degree of controversy increase[7]. The pattern contributes to think that the diffusion process of a more radical innovation within a more organic structure faces higher unpredictability and instability. The oppeness of the organic network structure with a higher density of network ties between organizational units opens up a persuasion process to all organizational members while the persuasion process tends to be confined within organizational units with mechanistic structures. On one hand, the number of final adopters decreases significantly with an increasing initial number of detractors in organic structures. On the other hand, the mechanistic structure tends to be more stable and the number of final adopters decreases slightly with the increasing number of detractors. Therefore, in the process of diffusing a management accounting innovation:

Proposition 6a: The outcome of the diffusion process within an organic structure tends to be increasingly unpredictable as the innovation becomes more radical. Moreover, the organic structure is highly sensitive to initial conditions, i.e. the diffusion success decreases significantly with increasing levels of resistance to change.

Proposition 6b. The outcome of the diffusion within a mechanistic structure tends to be more stable as the innovation becomes more radical. Moreover, the mechanistic structure is less sensitive to initial conditions, i.e. the diffusion success decreases only marginally with increasing levels of resistance to change.

[7] Also, the simulation run have taken an extended period of time to obtain the results for the organic structure. This reinforces the fact of the instability of the organic structure.

Reversibility of the diffusion process: The simulation results show that a reverse process occurs when the degree of controversy is very high and when the number of initial detractors outnumber the number of initial adopters. Figure 11 depicts the reverse process of the organic structure. In this particular case, the innovation is highly controversial (degree of controverse = 3,9) and the number of initial detractors is 5 whereas the number of initial adopters egual 1. The present results also confirm the instability of the 50-50 structure. The diffusion patterns of the mechanistic structure is more stable as no reversing process has been observed.

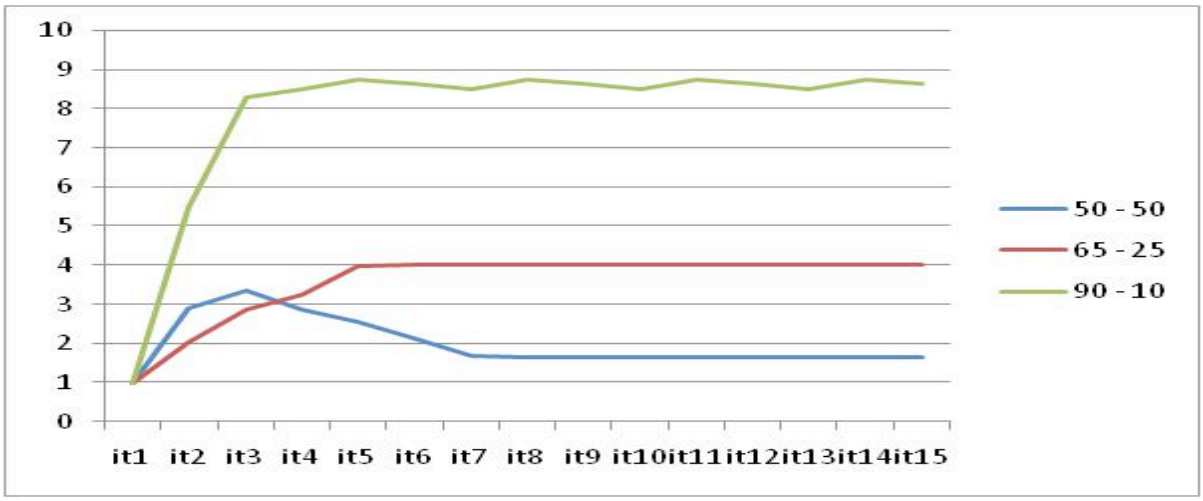


Figure 10. Diffusion curves for a controversial innovation with an increasing number of detractors

Optimal number of initial adopters. Figures 11a-11d depict the diffusion patterns of a low to moderate controversial innovation with initial conditions of 3, 5, 8 and 10 initial adopters and 1 detractor. The results point to the fact that organizational structures behave differently with an increase in the number of initial adopters[8]. The diffusion patterns of an organic structure indicate that an increase in the number of initial adopters is not proportional to an increase in the effective diffusion of a management accounting innovation. The figures indicate that 3 initial adopters provide the same diffusion effectiveness as 5, 8 or 10 initial adopters. However, the mechanistic structure behaves differently when the number of initial adopters increases. Actually, the effectiveness of the diffusion process is proportionately related to the number of initial adopters. Therefore, the following propositions can be offered:

Proposition 7a. The effectiveness of the diffusion process of an innovation within an organic structure depends on a minimum number of initial adopters. When the minimum number is attained, the marginal effectiveness is null. Moreover, the minimum number of initial adopters increases as the radicalness of the innovation increases.

Proposition 7b. The effectiveness of the diffusion process of an innovation within a mechanistic structure is directly related to the number of initial adopters. The effectiveness is proportional to the number of initial adopters.

[8] Similar diffusion patterns were observed for radical innovations. However, the number of initial adopters was found to be between 5 and 8 to have an effective diffusion process for a radical innovation within an organic structure.

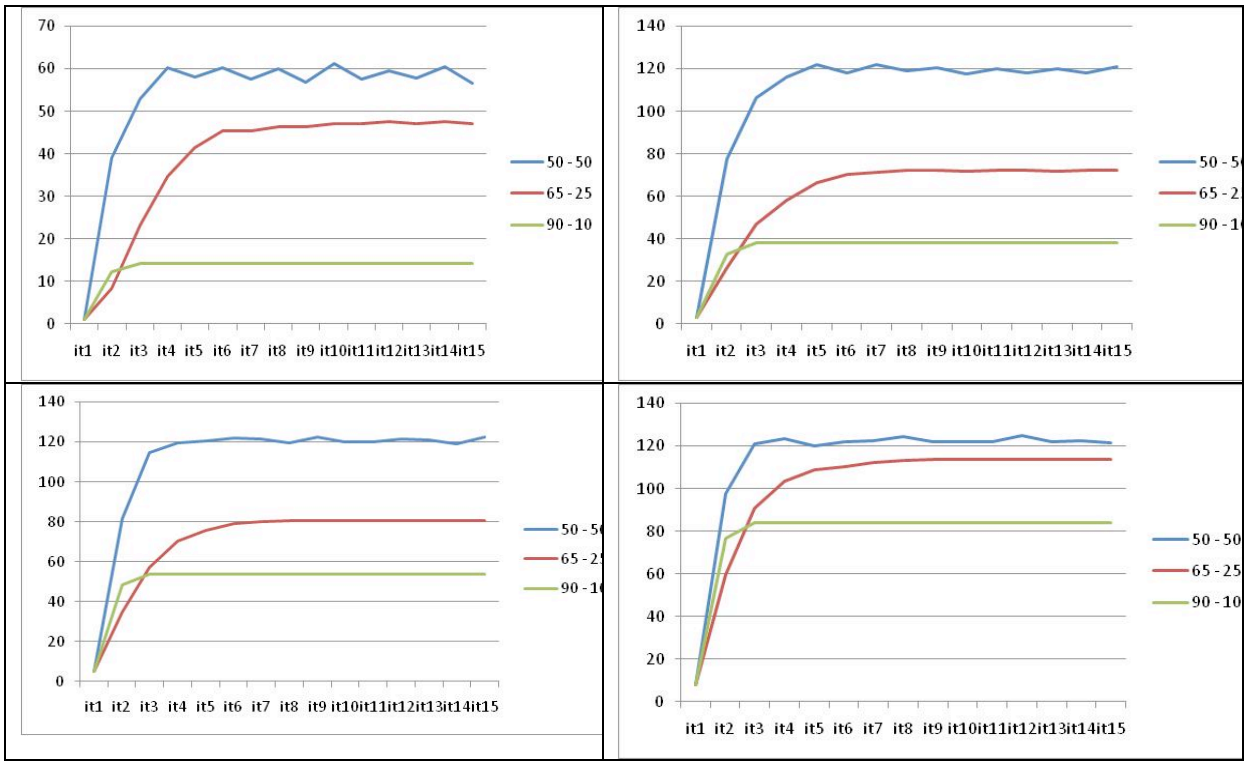


Figure 11a-11d. Effects on diffusion curves with an increase in the number of adopters.

In a similar vein, the results also point to the fact that a significant drop in the number of final adopters is observed in more organic structures when the number of initial detractors increases from 1 and 3 (see figures 12a-12c). Above this threshold, the drop in effectiveness is marginal. The effectiveness of the mechanistic structure does not seem to be affected by the increase of the number of initial detractors. However, the effectiveness of the mechanistic structure is extremelly low. Therefore, the following propositions can be offered when the number of initial detractors increases during the diffusion process of a moderate to highly radical innovation:

Proposition 8a. The effectiveness of the diffusion process of an innovation within an organic structure is extremely sensitive to the number of initial detractors. When a minimum number of initial detractors is attained, the marginal effectiveness is null. However, the number of final adopters is too low for the innovation to diffuse to all organizational units.

Proposition 8b. The effectiveness of the diffusion process of an innovation within a mechanistic is insensitive to the number of initial detractors. However, the number of final adopters is extremelly low for the innovation to diffuse within the organisation.

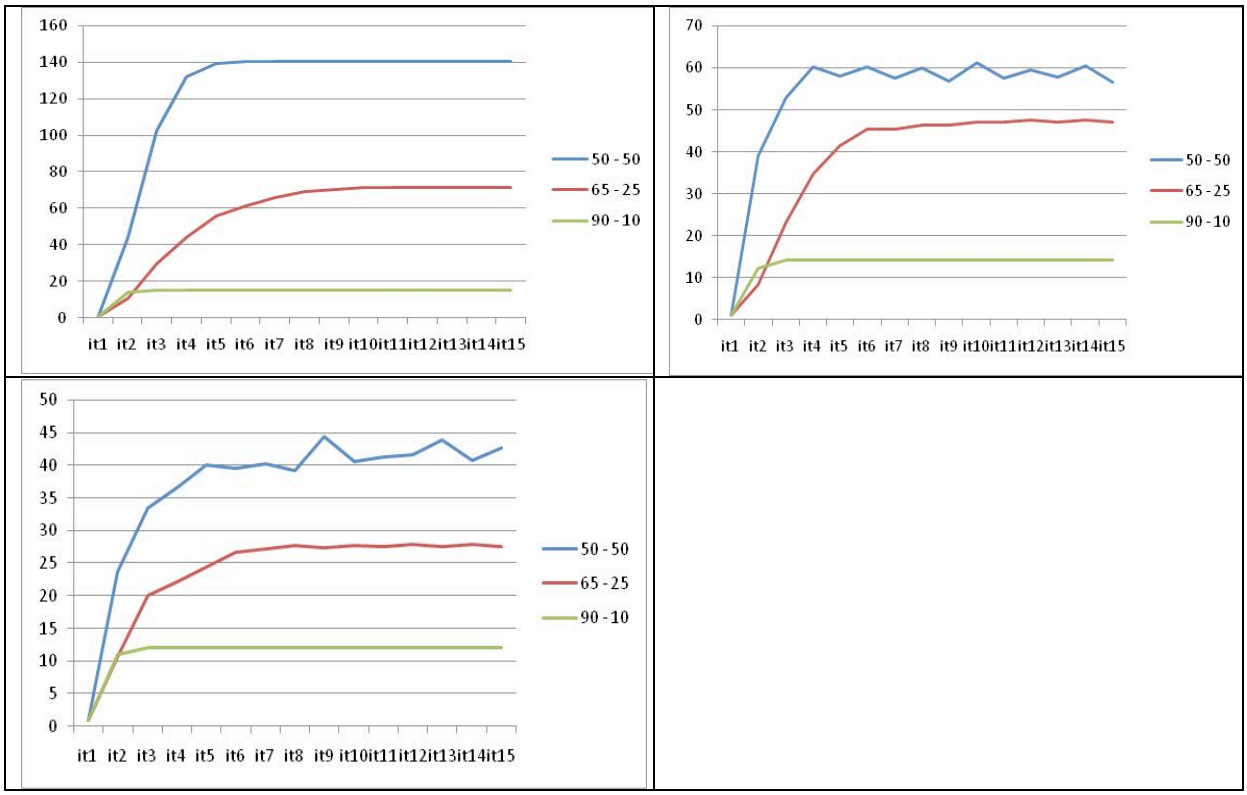


Figure 12a-12c. Effects on diffusion curves with an increase in the number of detractors.

5. DISCUSSION AND CONCLUSION

This article was an attempt to explore the interplay of uncertainty, structure, trust and perception of an innovation on the diffusion of management accounting systems. The results suggest that the effectiveness of implementing a management accounting system is contingent upon a number of variables, namely the type of innovation (incremental versus radical), the structural arrangement (organic versus mechanistic organizational structures), the communication channel through which the innovation diffuses (trusted ties versus acquaintances) and the degree of resistance to change (detractors versus adopters).

The study suggests that management accounting innovations that are not radical are effectively and efficiently implemented independently of the organizational structure (cf. proposition 1). Sulaiman and Mitchell (2005) found that non-radical or incremental innovations, i.e. modification of information outputs or operational modification have a relatively high likelihood of success of being implemented. As non-radical innovations encompass changes to existing management accounting techniques or practices that are characterized by a desire to 'do things better' (for example, making improvements to an already established system of variance analysis), their implementation do not raise much uncertainty and resistance. Therefore, the innovation is diffused through any communication channels, namely weak ties as well as strong ties (cf. proposition 1). Organic and mechanistic structures are conducive of non-controversial management accounting systems.

As management accounting innovations become moderately radical, the likelihood of success in the diffusion process is different whether the organization has adopted an organic or a mechanistic structure. The management accounting literature suggests the importance of the relationship between trust and structure. The study points to the fact that overall the organic structure tends to be more effective at diffusing moderately controversial management

accounting system (cf. proposition 4). Gosselin (1997) observed that technical innovations were more likely to be implemented within organic structures. According to Gosselin (1997), technical innovations focus mainly on processes and activities and have an impact on how products are manufactured and services are rendered as opposed to administrative innovations that entail new administrative procedures and organizational structures (i.e. activity based costing). The scope of technical innovations implementation tends to be narrower thus reducing considerably resistance to change from other organizational units. Therefore, technical innovation that are moderately radical, thus with moderate resistance, diffuse better within organic structures. Organic structures tend to be conducive to innovativeness as freedom to communicate foster the diffusion of innovations as employees can freely interact with other organizational units and develop trust. The importance of strong inter-unit ties in implementing management accounting innovations is conducive to develop strategies to obtain organizational support. Structural arrangements such as the horizontal organization could foster the implementation of such innovations. Horizontal organizations tend to have flatter structures conducive of increasing interaction among organizational units and therefore the development of trust. These recent development the implementation process within truly decentralized and organic structures lack empirical evidences. Mechanistic structures seem to be less effective in the implementation of moderate controversial management accounting systems. When the degree of controversy increases, individuals begins to be reluctant to transmit the innovation through weak ties and therefore rely on stronger ties. Such strong ties are less frequently encountered in mechanistic structures thus decreasing the likelihood of the diffusion success.

The simulation results suggest that when the management accounting innovation becomes radical, that is when the innovation is highly controversial, different results have emerged. At first glance, organic structures seem to provide a better ground for radical innovations diffusion, especially when there are a few initial adopters (cf. proposition 2 and proposition 4a). However, implementing a highly controversial management accounting innovation within an organic structure has also some drawbacks. The results point out that the outcome of the diffusion process within an organic structure tends to be increasingly unpredictable (cf. proposition 6a). As the innovation becomes more radical the diffusion success decreases significantly with increasing levels of resistance to change. Radical innovations tend to be diffused not efficiently when the company has adopted an organic structure because the multiple strong ties through which the radical innovation circulates across organizational units foster exchange of opinions about the innovation, both initial adopters and detractors intend to convince nonadopters through their network of strong ties, creating a climate of uncertainty rendering increasingly unpredictable the outcome of the diffusion process (i.e. illustrated by the oscillatory pattern).

Interestingly, when the innovation becomes radical and highly controversial, the results suggest that the diffusion process within mechanistic structures is more effective (cf. proposition 3 and proposition 5). This argument holds only when there are a significant number of initial adopters. There are several references in the management accounting literature illustrating these results. Gosselin (1997) noted that administrative innovations (i.e. activity based costing) would be easier to implement in mechanistic organizations. He argued that in mechanistic organizations, top managers commit themselves and put forth all the resources available to ensure that the implementation will be a success and exert control on the implementation process. Gosselin's findings are representative of one type of diffusion process, namely organization wide, top-down administrative innovation mandated at the business unit level by senior managers or top managers. In this respect, the innovation diffusion can be facilitated within a mechanistic structure when top managers are trusted by their middle managers and when the latter have are trusted within their own organizational

units. The increasing number of initial adopters within a mechanistic structure would significantly increase the likelihood of success of radical innovations. On the other hand, the likelihood of success of the diffusion process within mechanistic structures would significantly decrease if top managers or senior managers have low density of network strong ties in their lower hierarchical level, thus triggering resistance to change, especially in the face of radical innovations. In this regards, Scapens and Roberts (1993) accounted for the failure to implement a management accounting system mandated by top managers within a decentralized organization still functioning as a mechanistic organization. They argued that the project team, i.e. the financial controllers, lacked a detailed knowledge of the company's operations and the network of contacts within operating units. The limited amount of interactions between operational managers and financial controllers created propitious ground for a hostile environment to develop and to compromise the implementation of the control system. Roberts and Scapens (1985) also noted that distanced relations can cause subordinates to have considerable anxiety about the use of accounting systems by distanced superiors. Departing from Gosselin's top-down approach to innovation diffusion, emergent or bottom-up processes of innovation diffusion are more serendipitous. If the innovation diffusion process is initiated by accountants, the likelihood of success depends on the "role-involvement" of accountants. Mechanistic structures are clustered in network of strong ties within organizational subunits with very few strong ties between organizational units rendering difficult the diffusion process when accountants have a traditional role. When accountants are involved in a more traditionally oriented role – i.e. when they interact mainly among themselves in dense networks of strong ties (e.g. the finance division) – they remain isolated from the rest of the organization, resulting in a climate of mistrust with other organizational members/units. Therefore, the implementation of a management accounting innovation would more likely lead to failure. To illustrate this point, Scapens and Roberts (1993) noted the resentment from a responsible of the organizational unit in which the management accounting system was to be implemented, regarding the project leader: *'Why? Because he was imposed rather than requested; he was a non-Omega man as well; he was an accountant (so the other accountant don't welcome him because they could have done the job instead of him anyway, it was an accountant's job; the other people don't like him because they don't like accountants full stop). Each site will say "we could do this job just as well as having this lot imposed on us; it's another overhead*"'. In this particular case, to increase the likelihood of success in diffusing administrative innovations, management accountants would have to develop strategies to develop strong ties between organizational units. Therefore, when the number of initial adopters is low, the likelihood of success with a mechanistic structure is extremely low.

On the other hand, locally driven innovations initiated by accountants within mechanistic structures have a higher likelihood of success if accountants have a more proactive role in operational units. Emsley (2005) found that controllers with a business unit orientation are closer to their operational units and are more likely to implement radical innovation. As the results of the present findings suggest, increasing the number of initial adopters within mechanistic structures increases the likelihood of success of radical innovations. The trusted ties developed by financial controllers within their operational units increases the likelihood of the implementation process within the operational unit. A similar account was found in Masquefa (2008). The coalition between accountants and engineers greatly reduced resistance to change within organizational units when operational members were reluctant to the change. The coalition with engineers who were close to operational members reduced uncertainty and enabled the change to be implemented. The results of our study suggest that within a mechanistic structure, the absence of trusted ties of accountants within operational units would have jeopardized the implementation of the radical innovation.

Whether mandated by top managers or emerging locally from lower hierarchical levels, the study indicates that a certain climate of trust must exist among organizational agents for the radical innovation to diffuse successfully. Therefore, the results provide a complementary approach to explore the processes of diffusion in light of the recent findings in the management accounting literature.

Finally, the study points to the fact (cf. proposition 6 and proposition 7) that independently the organizational structure (although the marginal effectiveness of increasing the number of adopters differs from organic versus mechanistic structures) a critical number of initial adopters is necessary to significantly increase the likelihood of success of the innovation, and the number of initial adopters will tend to increase as the innovation becomes more radical. Similarly, the study indicates (i.e. proposition 8) that the impact of the number of initial detractors has an important effect on the long-term survival of the innovation. Therefore, project leaders willing to implement radical management accounting innovations should develop strategies to avoid the actions of detractors in an early stage of the diffusion process. Masquefa (2008) has suggested to initially diffuse the innovation slowly through a string of strong ties. In a similar vein Krackhardt (1997) introduced the concepts of peripheral dominance and optimal viscosity. The first principal suggests that when the innovation is controversial, the change agent is better off focusing on a relatively secluded island or cluster to begin the change process. This peripheral location is less likely to attract a backlash from the nonadopters who could overwhelm the adopters. The second concept points out that it exists a narrow window of opportunity wherein the adopters can focus their efforts on a few adjacent clusters, can slowly convert them, and then once they build a base, can carefully move forward through the rest of the organization.

In relation of the above findings, accountants need to study the context in which the innovation ought to be implemented. Knowledge of the organizational structure, i.e. the inwards and outwards network ties (i.e. embeddedness) of the accounting organization within the organizational structure, is relevant to evaluate the most effective implementation strategies as a prerequisite to any implementation process.

The methodology used in this study is novel in the field of management accounting. Among the many benefits and limitations of simulation methods, one of the often cited limitations is its lack of external validity. The results presented here converge with prior studies in management accounting and provide explanatory power of why management accounting innovations may have difficulty to be implemented. The fact that our model is based on empirical propositions reinforce the validity of our findings. A second limitation concerns the inferences drawn from simulation findings (Harrison et al., 2007). Harrison et al. (2007) note that “the simulation findings are only demonstrated for the region of parameter space examined experimentally; generalizations beyond this space can at best be considered conjectures (while inferences based on the parameter values studied can be considered hypotheses of the model)”. To avoid the inference limitations, we have attempted to provide a wide range of parameters to increase the validity of our results. Harrison et al. (2007) note that simulation is a legitimate, disciplined, and powerful approach to scientific investigation, with the potential to make significant contributions to management theory. Properly used and kept in appropriate perspective, computer simulation constitutes a useful theoretical tool that opens up new research avenues. The agent based modeling approach computer simulations discussed in this article provide a sample of a future direction in management research. In example, agent based modeling can be fruitful in a number of areas of management accounting. Potential areas of research are diffusion of innovations, organizational change, control and trust within organizations and between organizations (IOR), the dialectic of innovation and control in management accounting and control.

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