Raising Implementation Effectiveness of Innovations by Considering Structural Aspects of Organizations

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Abstract

The purpose of this study is to analyze the impact of informal communication networks on the implementation process of innovations within organizations. Therefore, a System-Dynamics model is built to simulate and analyze implementation-specific dynamics that influence implementation effectiveness. The findings of this study suggest that senior management of an organization can use its limited resources more effectively by focusing on employee groups that are connected to each other and by isolating excluded groups from other groups that are not influenced by senior management. In addition, managers should only apply pressure on groups until a specific tipping point is reached after which the innovation diffuses by itself within the respective group. Major limitations of the study are that only one network structure was examined and that all groups are considered to be homogeneous.

Keywords: rational and ambiguous innovations, innovation implementation, communication networks, diffusion, network structure, implementation effectiveness, management support

1. Introduction: Communication networks in organizational innovation implementation processes

Due to the intensification of competition as well as the rapid evolution of technology, innovations are vital to most organizations (Choi and Chan, 2009, p. 245). In addition, a growing number of customers are expecting organizations to act ecologically and socially responsible. Those circumstances force enterprises to adopt and implement innovations even beyond their core businesses. Nevertheless, the results of innovations such as improvements in efficiency due to total quality management, statistical process control, and manufacturing resource planning are in many cases not satisfying (Klein, Conn, and Sorra, 2001, p. 811). Several studies have shown that an organization's failure to benefit from an adopted innovation can often be attributed to a deficient implementation process rather than to the innovation itself (Klein and Sorra, 1996, p. 1055; Aiman-Smith and Green 2002, p. 421; Gary, 2005, p. 644; Karimi, Somers, and Bhattacherjee, 2007, p. 123). The implementation process, as the critical interface between the decision to adopt and the routine usage of an innovation (Klein and Sorra, 1996, p. 1057), has received increasing attention by scholars. The degree of implementation success is considered a better indicator for innovation quality than the degree of adoption success due to the fact that not all adopted innovations get ultimately implemented (Karimi et al., 2007, p. 103).

Despite the growing number of studies which identify multiple causes of unsuccessful implementation processes, literature is lacking multidimensional models that explain the difference between successful and unsuccessful implementation efforts. Such models should take into account multiple and to some extent interrelated drivers of implementation success (Dean Jr. and Bowen, 1994, p. 393; Klein and Sorra, 1996, p. 1056; Klein et al., 2001, p. 811; Repenning, 2002, p. 110). In addition, Choi and Chan (2009, p. 245) point out that existing implementation studies tend to focus either on employee-related aspects, mostly on an individual level, or on organizational aspects such as management support, structure, and resources of the implementing organization. By combining these two approaches, Choi and Chan (2009, p. 251) show that management support significantly improves the implementation effectiveness as well as the innovation effectiveness by strengthening the collective innovation confidence and the collective innovation acceptance of employees.

The present study aims to contribute to existing implementation literature by examining the combined and interrelated influence of two organizational aspects (communication structure and management support) on implementation success, which is characterized by the

employee-related aspect innovation acceptance and usage. This is achieved by combining the organizational aspects predominant in diffusion literature and the employee-related aspects mostly discussed in implementation literature by means of an informal social communication network. In contrast to Choi and Chan (2009), this study does not focus on the strength of causal relationships between factors of influence and implementation success. Instead, the dynamics within and between interacting employee and management groups, which are partially caused by the communication structure and which affect implementation success over time, are of particular interest. Building on the derived knowledge of the underlying dynamics, the effectiveness of different management policies is analyzed by means of computer-aided simulation.

The structure of the paper is as follows. In the second section, we review the literature on innovation implementation. We concentrate on the process of innovation implementation within organizations and on the effects of communication networks on the success of innovations. The third section discusses a system dynamics model that we use for subsequent dynamic analyses of communication interactions and their consequences on the implementation of innovations. The results of these analyses are described in the fourth section, in which we investigate the influence of management pressure on innovation success with and without migration between groups in an organization. The paper closes with a discussion of implications for research and practice.

2. Literature Review

2.1. The Process of Organizational Innovation Implementation

Joseph A. Schumpeter (1996, p. 81-86) describes innovation as a process of creative destruction which is continuously revolutionizing macro level markets and structures. The widespread sub-categorization of the innovation process into the consecutive phases of invention, innovation, as well as diffusion and imitation can also be attributed to Schumpeter (1939, p. 84-102; Milling and Maier, 1996, p. 17). The invention phase is characterized by the discovery of a previously unknown solution to a problem. In form of an innovation, the invention is economically used for the first time during the innovation phase. In the subsequent diffusion and imitation phase, the innovation spreads through the market, thereby increasingly realizing the potential technological progress (Milling and Maier, 1996, p. 17-18).

On a micro level, innovations diffuse between actors of a social system or an organization through an existing or emerging set of relationships (Allen, 1977, p. 234-265; Roger, 2003, p. 5). Everett Rogers (2003, p. 5-6) defines *diffusion* in the standard work *Diffusion of Innovations* as a process by which information is exchanged over certain communication channels between members of a social system. He differentiates between the five stages *knowledge*, *persuasion*, *decision*, *implementation*, and *confirmation*. The *knowledge stage* is initiated by the first encounter with the innovation and ends after a general understanding of the innovation has been acquired. In the following *persuasion stage,* an affirmative or negative attitude towards the innovation emerges. Within the subsequent *decision stage,* the innovation is at least partially tested before it is decided whether the innovation will be adopted or disregarded. In case of a positive adoption decision, the innovation will be used for the first time during the *implementation stage*. Within the final *confirmation stage,* the adoption decision is continuously challenged and where appropriate revoked based on newly acquired information about the innovation (Roger, 2003, p. 168-169).

Within an organizational context, the innovation process is subdivided into two main processes: the *initiation process* and the *implementation process* (Zaltman, Duncan, and Holbeck, 1973, S. 58; Roger, 2003, p. 420), which are similar to the stages mentioned in the previous paragraph (see Figure 1). The *initiation process* comprises the collection of information, the creation of concepts, the planning of the adoption process, and the final decision to adopt or disregard the innovation (Roger, 2003, p. 420-430). It consists of the two sub-processes *agenda-setting* and *matching*. The former starts with the occurrence of an organizational problem, which could lead to distress. This discrepancy between the desired and expected performance of an organization can initiate the innovation process. Thereupon the problem is exactly defined. Within the subsequent process *matching,* an innovation is assigned to the problem in order to solve it.

In contrast to the initiation process, the implementation process comprises all events, activities, and decisions which ideally lead to a routine usage of the innovation. It consists of the sub-processes *Redefining/Restructuring*, *Clarifying*, and *Routinizing*. Within the first sub-process of the *implementation process,* the innovation is adjusted to organizational needs as well as to the organizational structure. During the second sub-process, the innovation is increasingly understood and used by the members of the respective organization. Finally, the innovation loses its autonomous character and becomes fully integrated into the organization in the course of the last sub-process (Roger, 2003, p. 435).

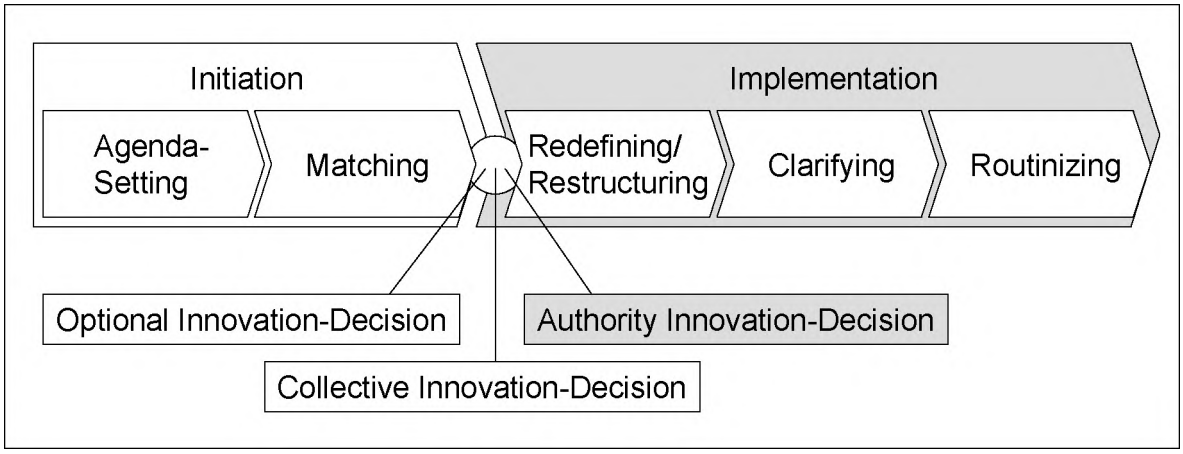

Figure 1: The innovation process on an organizational level

Within the initiation process, Rogers (2003, p. 403) also differentiates between three kinds of adoption decisions on an organizational level (organizational adoption decision). In the case of the *optional innovation-decision,* an individual independent from the members of the respective social system decides over the adoption or disregard of the innovation. If a *collective innovation-decision* is underlying, such a decision is based on the consensus of the members of the social system. In the case of an *authority innovation-decision,* a minority of the social system, which is characterized by high social esteem, expert knowledge or power, decides in favor or against the innovation. This decision must then be accepted by all other members of the organization.

Even though both, the initiation as well as the implementation process, have a substantial influence on the successful utilization of an innovation, this paper focuses on the internal implementation process of an organization as highlighted in Figure 1. It is assumed that this process is initiated by an authority innovation-decision, which was made by senior management of the organization.

2.2. Influence of communication networks on implementation success

Before analyzing the implementation process, it is necessary to select at least one significant measure of implementation success in order to distinguish between successful and unsuccessful implementation efforts. Karimi et al. (2007, p. 108) evaluate implementation success by measuring the effectiveness, efficiency, and flexibility of business processes, arguing that the first-order effects of an implemented innovation occur at the operational level of an organization. Since this study is not actually measuring the implementation success within organizations, it is directly evaluating the performance of the implementation process

by using *implementation effectiveness* as a measure of implementation success. With respect to existing studies, this measure is consonantly implying that there is a strong correlation between implementation effectiveness and implementation success, the later being, among others, characterized by visible benefits from the innovation as well as by the routinization of the innovation among employees (Choi and Chan, 2009, p. 249-251).

After selecting implementation effectiveness as a measure of implementation success, the question of how implementation effectiveness itself is characterized needs to be answered. Aiman-Smith and Green (2002, p. 422) evaluate organizational implementation effectiveness by means of *user speed to competence* and *user satisfaction*. The sooner the innovation can be productively used and the more satisfied its users are the higher implementation effectiveness is. According to Klein and Sorra (1996), implementation effectiveness describes "the quality and consistency of the use of a specific innovation within an organization as a whole" (p. 1059). In a study among US-hospitals, Douglas and Judge Jr. (2001) found a positive correlation "between the degree of implementation of TQM practices and overall organizational performance" (p. 165). Based on these three approaches, implementation effectiveness in the present study is described by the intra-organizational diffusion speed, the reached degree of overall adoption, and its sustainability. It is assumed that the innovation is only used by the members of an organization if they are completely convinced that the innovation is beneficial. Thereby, the proportion of adopters within an organization also resembles the quality of use of an innovation, as mentioned by Klein and Sorra (1996, p. 1059). Hence, implementation effectiveness can be interpreted as the extent of intra-organizational acceptance and usage of an innovation over time.

The question remains how implementation effectiveness and thereby implementation success can be positively influenced. In this context, many factors are discussed within the literature. Certainly, innovation-related characteristics are among them. However, those factors are already considered within the initiation phase. If the benefit of the respective innovation is doubted within the initiation phase, the organizational adoption decision will often be negative so that the innovation will not even reach the implementation phase. Apart from this, several studies have shown that an organizations failure to benefit from an adopted innovation can often be attributed to a deficient implementation process rather than to the innovation itself (Klein and Sorra, 1996, p. 1055; Green 2002, p.421; Gary, 2005, S. 644; Karimi, Somers, and Bhattacherjee, 2007, p. 123). Therefore, this study focuses on factors, which are largely independent of innovation specific characteristics.

A large number of factors being discussed in implementation literature is concerned with the acceptance and usage of the innovation by the members of an organization (Klein and Sorra, 1996). Thereby, structural and institutional aspects are often not taken into account at all or only in a very simplified manner. Damanpour (1996, p. 695), for example, examines by means of a meta-analytic procedure the influence of organizational complexity on the innovation process. However, only the extent of horizontal complexity, characterized by the degree of functional departmentation and the extent of role specialization, is used as an indicator for organizational complexity. Dynamics between the horizontal elements of an organization are not considered. Similarly, Repenning (2002, p. 122) excludes interactions between organizational groups in his analysis of implementation-specific dynamics.

While the connections and interactions between different groups of an organization have been largely neglected in implementation literature, they are considered essential in diffusion literature. Hence, Abrahamson and Rosenkopf (1997, p. 307) investigate the effects of randomly generated network structures on the diffusion process of innovations within social networks. Thereby, they focus on the bandwagon effect, which is based on the restrictive assumption that members of an organization never change their opinion about an innovation once they adopted it. The same assumption is made by Bohlmann, Calantone, and Zhao (2010, p. 749) whose market-level study examines the diffusion process with respect to different topologies of social networks. Gibbons (2004) analyzes the impact of innovation networks, which change over time, distinguishing between clearly beneficial and ambiguous innovations. However, the focus is on networks between organizations and not on social networks within them. In contrast, Krackhardt (2001) examines the dynamics between adopters and nonadopters of an innovation on an organizational level by *not* making the restrictive assumption, that adopters never change their opinion about the innovation. Still, Krackhardt (2001) focuses only on the diffusion process, neglecting characteristic factors of the implementation process.

The present study aims to overcome the mentioned limitations of previous studies by introducing a social communication model, which comprises employee-related mediators of implementation literature as well as structural and institutional mediators of diffusion literature in order to analyze the effects of those mediators on implementation effectiveness. Thereby, this study coincides with Ford and Ford (1995, p. 561), who argue that organizational change processes should always be placed within a context of communication in order to understand them better. Kraatz (1998, p. 638), for example, states that communication within social networks results in an adjustment of behavior among its

members. As an example he discusses that colleges organized in a network tend to implement a particular bachelor degree if a network partner successfully implemented it beforehand (Kraatz, 1998, p. 632). Kraatz (1998, p. 634) calls this effect *social learning through networks*. Those indirect learning processes are not just taking place between organizations but also within them (Wood and Bandura, 1989, p. 362). Consequently, communication networks also influence the organizational opinion-forming process with regard to the perceived advantageousness of an innovation (Abrahamson and Rosenkopf, 1997, p. 293). Assuming that the members of an organization are free to come to their own decision whether they adopt an innovation or continue to use the status quo instead (individual adoption decision), the opinion-forming process also influences the proportion of adopters and thereby the organizational implementation effectiveness. Building on a mathematical model of Krackhardt (2001), the following chapter describes a dynamic model to analyze the opinion-forming process within organizational communication networks.

3. A dynamic model of communication networks within the implementation process

In a first step, the underlying model of this study will differentiate between adopters and nonadopters of an innovation within several homogeneous and equally large groups (Krackhardt, 2001, p. 250-251). Those groups can for example represent homogeneous departments of an organization that are interconnected over an informal communication network. This communication network thereby represents the communication structure of the underlying theoretical framework. Within this network, an innovation diffuses on two levels. On the first level, an opinion-forming process is taking place between the adopter camp and the innovator camp within each group (Krackhardt, 2001, p. 251). The proportion of adopters, represented by the variable C, will determine the degree of diffusion within one group. In course of the opinion-forming process, a certain fraction of adopters and nonadopters gets convinced by the opponent camp. In the following, this process will be called *conversion*. On the second level, an opinion-forming process is taking place between groups. This process is represented by the exchange of members of the same party between connected groups.

Assuming that five groups are interconnected in a row, a fraction of adopters of group 2, for example, is migrating to the connected groups 1 and 3 in order to influence the opponent camp in this group. In return, a certain fraction of adopters of these neighboring groups is migrating to group 2. The same process is taking place between the nonadopter camps of connected groups. In the following, this process will be called *migration* (Krackhardt, 2001,

p. 252-254). The migration difference between incoming and outgoing adopters of a group over a certain period will be referred to as *net migration rate*. Figure 2 is illustrating the interrelation between the two processes *conversion* and *migration* underlying a communication network of five groups being interconnected in a row. In contrast to Krackhardt (2001), who is assuming that conversion and migration are taking place in an iterative sequence, in the *system dynamics* model of this study we make the more realistic assumption that both processes are taking place simultaneously.

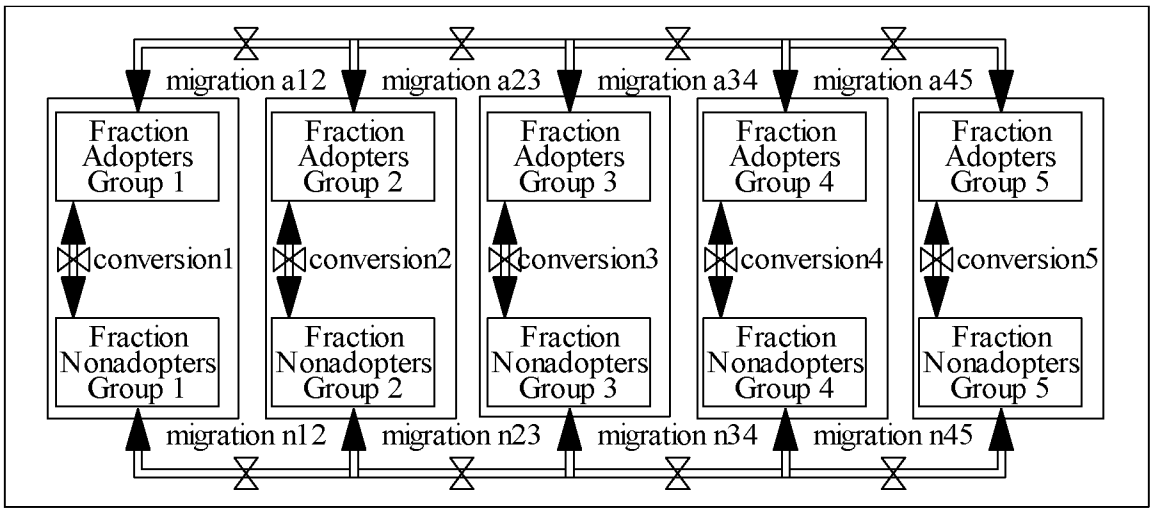

Figure 2: Process of innovation diffusion within an organization using the example of five groups organized in a serial structure

In the following, the mathematical structure of those two processes is outlined. According to Krackhardt (2001, p. 250), the active search of organizational members for innovation-related information and opinions drives the conversion process within groups. However, taking into account the *satisficing* concept of March and Simon (1958, p. 140-141), those members do not consider the opinions of all members of the group. Instead, they stop searching after finding one other group member who is fortifying their own beliefs. Thereby, the random search for members of the same camp is limited to a special part of the group. Members of a group will only convert to the opponent camp if they do not find at least one like-minded person in this part of the group (Krackhardt, 2001, p. 250-251). Based on Asch's (2003, p. 295-303) work, Krackhardt (2001, p. 250) assumes that adopters advocate the innovation more ambitiously than nonadopters do with regard to the status quo. That means that adopters scan a greater part of the group than nonadopters do (Asch, 2003; Krackhardt,

2001, p. 250). Hence, the search intensity of adopters (*Search Intensity A*) is greater than the search intensity of nonadopters (*Search Intensity N*).

Equation (1) describes the proportion of adopters (C) in a group i that is converted by the nonadopters of that group over a certain time period, because they were unable to find other like-minded adopters in the part of the group they scanned:

$$\frac{dC_{iN}}{dt} = \frac{C_i \cdot (1 - C_i)^{Search\ Intensity\ A}}{Time\ To\ Convert}. \tag{1}$$

The term $(1 - C_i)^{Search\ Intensity\ A}$ represents the probability that an adopter only finds nonadopters in the part of the group he or she scanned (Krackhardt, 2001, p. 253). The proportion of adopters that does not find any like-minded group members and converts to the nonadopter camp within a certain time period (*Time To Convert*) equals $C \cdot (1 - C_i)^{Search\ Intensity\ A}$. Following the same logic, equation (2) calculates the positive change of the adopter proportion within a group i due to the conversion of nonadopters:

$$\frac{dC_{iA}}{dt} = \frac{(1 - C_i) \cdot C_i^{\,Search\ Intensity\ N}}{Time\ To\ Convert}. \tag{2}$$

As assumed in section 1, the decision to adopt the innovation was made by senior management. In line with Repenning (2002, p. 113) this study also assumes that senior managers exert pressure on the employee groups in order to convert initial nonadopters to adopters of the innovation. This third influence on the conversion process of a group i is described in equation (3):

$$\frac{dC_{iM}}{dt} = \left(C_G - \frac{\sum_i C_i}{n} \right) \cdot \frac{1}{T}. \tag{3}$$

The variable C_G represents the externally given goal of senior management concerning the average proportion of adopters within the organization as whole. Hence, the first term on the right hand side describes the discrepancy between this goal and the perceived average proportion of adopters within the groups. This difference is divided by the variable T, which describes the time needed, until senior management develops and implements suitable actions, until employees react to those actions, and until employees finally modify their behavior (Repenning, 2002, p. 115). Therefore, the result of equation (3) represents the proportion of nonadopters that convert to the adopter camp within a certain period due to the pressure

managers exerts on them. The total change in the proportion of adopters over time within a group *i* is represented by equation (4):

$$\frac{dC_i}{dt} = \frac{dC_{iA}}{dt} - \frac{dC_{iN}}{dt} + \frac{dC_{iM}}{dt}. \tag{4}$$

The migration process, which is taking place *between* groups, depends on the structure of the communication network. In the following, that structure will be described by an adjacency matrix that maps the migration ties between groups (Krackhardt, 2001, p. 252). The so-called *migration fraction* represents the proportion of adopters or nonadopters of a group *i* that migrates to each congenial camp of all connected groups within one period (Krackhardt, 2001, p. 252). The multiplication of the migration fraction with the proportion of adopters or nonadopters and the subsequent division by migration time result in a periodical migration rate of the group *i*. The multiplication of that migration rate with the total number of connected groups describes the proportion of adopters and nonadopters respectively that leaves the group *i*. The proportion of adopters and nonadopters respectively that immigrates from each connected group into group *i* is calculated analogously. The adding of those migration rates equals the total proportion of adopters and nonadopters respectively that immigrate into group *i* within one period.

4. Analysis: Management-caused dynamics of the diffusion process

4.1. Dynamics of the conversion process within groups

The preceding chapter introduced Krackhardt's (2001) social communication network and extended it by taking into account senior management's influence in an organization. In contrast to Krackhardt (2001, p. 254), the main question of this study is not how a minority of innovators can overcome a majority of nonadopters. Instead, the dynamics between and within communicating groups being influenced by senior management are of main interest. Thereby, management is initiating the implementation process by exerting pressure on employee groups to adopt the respective innovation, assuming that the innovation-related commitment of each group, and hence the proportion of adopters, is zero beforehand ($C = 0$).

The following analysis is based on a communication network consisting of five groups organized in a row as depicted in Figure 2. Equation (5) shows an adjacency matrix, which represents this structure:

$$M_{R5} = \begin{pmatrix} 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \end{pmatrix}. \quad (5)$$

The matrix shows that the first group (first line of the matrix) and the fifth group (fifth line of the matrix) only have one communication partner, whereas all other groups are influenced by two communication partners. During the following simulation of the diffusion process, it is assumed that the search intensity of adopters equals six while the search intensity of nonadopters is four (Krackhardt, 2001, p. 255). Krackhardt (2001, p. 256) shows that only the ratio between (not the nominal values of) the search intensities plays an important role. At the beginning of the simulation the groups only consist of nonadopters. The migration time and the time to convert are one week each. The migration fraction is assumed to be 12.5 percent. In the following the influence of management pressure on the average commitment of groups is analyzed. The time needed until senior management's actions are implemented and show an impact on innovation usage is assumed to be 12 weeks (T = 12). For now, it is assumed that managers apply the same pressure to all groups.

Figure 3 illustrates the interrelation between the duration of management pressure and the fraction of adopters within groups assuming that management starts to take action in week twelve, which is represented in the model by the management goal being raised from zero to one (C_G = 1). The left part of Figure 3 shows the well-known logistic S-curve of the diffusion process (Abrahamson and Rosenkopf, 1997, p. 295; Repenning, 2002, p. 116). If senior management continues to exert pressure for 20 weeks until week 32, enough nonadopters will be converted to adopters within all five groups so that they are able to convince the remaining nonadopters in their groups from week 32 on, even without managements support. The right part of Figure 3 illustrates what happens to the proportion of adopters in group 1 when senior management stops exerting pressure earlier. Since all groups have the same proportion of adopters before the start of the simulation and since managers are exerting the same pressure on all five groups, those groups exchange exactly the same fraction of adopters and nonadopters at each point of time during the simulation. Therefore, the net migration rate of all groups is constantly zero. Hence, migration does not have an impact on implementation effectiveness in this scenario. That means that the behavior of group 1 (right part of Figure 3) is exactly equal to the behavior of all other groups.

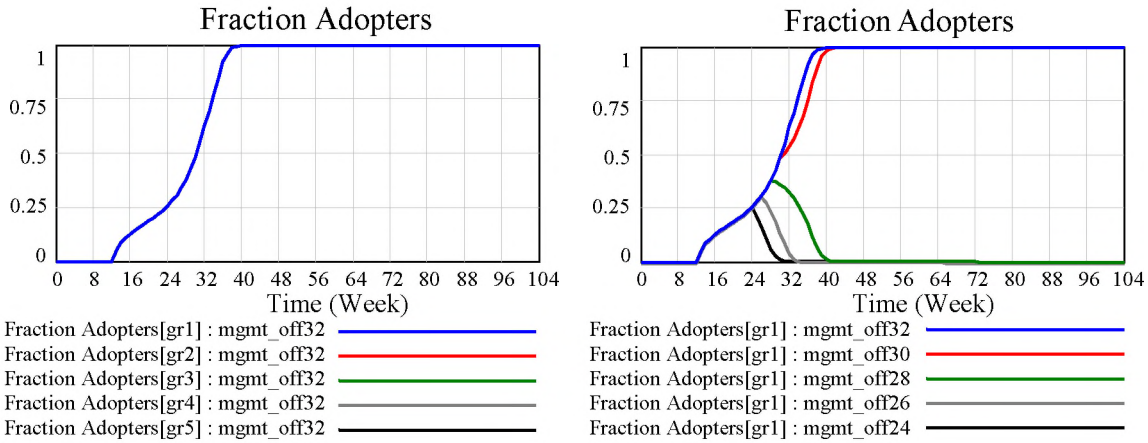

Figure 3: Influence of the duration of management pressure on the fraction of adopters

If senior management only applies pressure until month 30, the innovation still reaches a permanent degree of adoption of one (red graph in right part of Figure 3). Even though the diffusion degree and its sustainability are the same as in the case when senior management pushes the innovation two weeks longer (blue graph in Figure 3), the third dimension of implementation effectiveness, namely the diffusion speed, is slower. If senior management stops influencing the groups at week 28 (green graph in Figure 3), the diffusion only reaches a temporary diffusion degree of 38 percent within group one. Afterwards, the remaining nonadopters are still strong enough to convince more adopters of the superiority of the status quo than adopters are able to convince nonadopters of the superiority of the innovation. This initiates a self-reinforcing process that causes the nonadopter camp in group 1 to get stronger and stronger until all adopters have been converted to nonadopters. An even shorter duration of senior management's influence further reduces implementation effectiveness with regard to all three dimensions (grey and black graph in Figure 3).

These dynamics suggests that there is a system-immanent tipping point or threshold level of the proportion of adopters (Morrison, 2008). After reaching this tipping point, the negative influence of the communication process, which is driving out the innovation, turns into a positive one, which causes a complete diffusion of the innovation. That means that managers only need to apply pressure on groups until a certain fraction of adopters is converted. With regard to the discussed scenario, this threshold is reached after 28.7 weeks when 41 percent of the nonadopters have been convinced to use the innovation. The threshold is lower than 50% due to the assumption that adopters are more committed to finding like-minded group members than nonadopters are. That is, the search intensity of adopters is greater than the search intensity of nonadopters.

4.2. Dynamics of the migration process between groups

After analyzing the dynamics of the conversion process within groups, the focus will now be on the migration process, which is characterizing the dynamics between groups. Therefore, it is examined how the implementation effectiveness is influenced if senior management omits to exert pressure on one of the five groups. Thereby, the adopter-nonadopter ratio of the omitted group will differ from that of the other groups. Due to the communication between groups, which is represented by the migration of adopters and nonadopters, the proportion of adopters will also rise in the excluded group. It is assumed that senior management influences the addressed groups over the whole simulation period. All other parameter values stay the same. Figure 4 is illustrating how the exclusion of group 1 (left part of Figure 4), of group 2 (middle part of Figure 4), and of group 3 (right part of Figure 4) is influencing the fraction of adopters over time. Due to the symmetrical structure of the communication network, the exclusion of group 4 has the same effect as the exclusion of group 2. The same applies to group 5 and group 1.

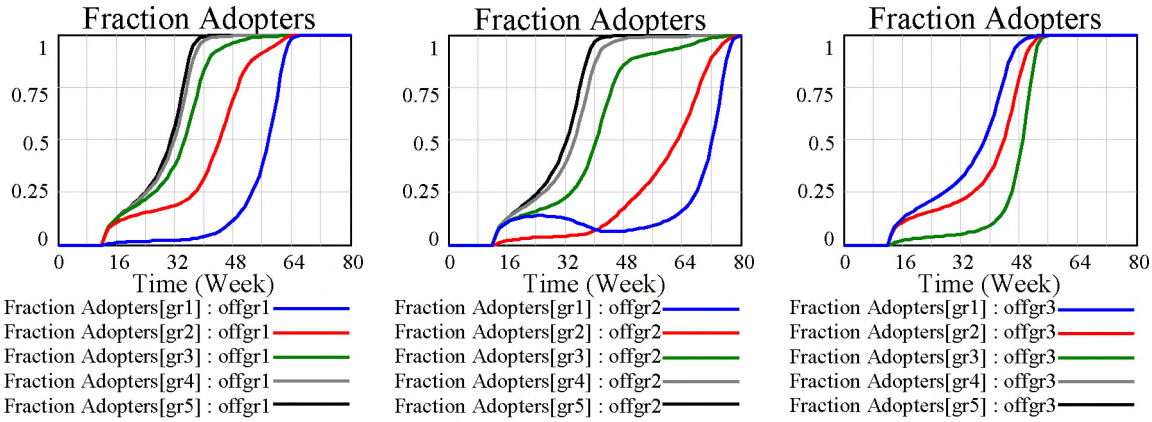

Figure 4: Influence of selectively applied management pressure

Figure 4 illustrates that the exclusion of group 3 (right part of Figure 4) leads to the smallest reduction of implementation effectiveness. From a management perspective, it would hence be most effective to influence the peripherally situated groups 1, 2, 4, and 5. This result is line with Krackhardt's (2001, p. 260-261) principle of peripheral dominance, which is stating that adopters are more likely to prevail against a majority of nonadopters the more peripherally located the former are. However, the exclusion of group 2 or 4 (middle part of Figure 4) has a bigger negative impact on implementation effectiveness than the exclusion of the more peripherally located group 1 or 5 (left part of Figure 4). The dynamics that cause the behavior depicted in Figure 4 will be examined in the following.

After introducing the innovation in week twelve, senior management is exerting pressure on groups 2 to 5, which leads to a growing fraction of adopters in those groups (left part of Figure 4). As a result, the adopter-nonadopter ratio of group 2 (red graph) differs from the adopter-nonadopter ratio of group 1 (blue graph), which consists only of nonadopters due to the lack of management pressure. The bigger this difference is, the lower (higher) is the net migration rate of group 2 (1). This in turn hampers the increase of the fraction of adopters of group 2, which is therefore smaller than the increase of group 3. Hence, the net migration rate of group 3 is also different from zero. Due to the management-caused conversion of nonadopters within group 2, the net migration rate of group 3 is less negative than the net migration rate of group 2. The damping effect of the conversion process results in a less strong impediment of the adopter-nonadopter ratio of group 3 (green graph in left part of Figure 4). This effect is even stronger in group 4 and group 5 (grey and black graph in left part of Figure 4). In general, the more influenced groups are between a group *i* and the excluded group 1, the higher the implementation effectiveness of group *i*.

However, in case the excluded group is located in the centre of the row (right part of Figure 4), its low adopter-nonadopter ratio is influencing two groups (red and grey graph), which leads to a negative net migration rates in both groups. Compared to the exclusion of group 1, the implementation effectiveness of the organization is therefore lower during the first weeks in case group 3 is excluded. Due to the conversion process, the proportion of adopters in group 2 and group 4 is still rising. As a result, a greater proportion of adopters migrates from those two groups into group 3 leading to a growing fraction of adopters also in the excluded group (green graph in the right part of Figure 4). The rising adopter-nonadopter ratio of group 3 causes a lower negative impact of the net migration rate on the proportion of adopters in group 2 and group 4. This in turn has an increasing positive impact on the net migration rate of group 3, which results in an increasing fraction of adopters also of group 3. The implementation effectiveness in case of excluding group 3 is higher than in case of excluding group 1 because the greater negative influence of group 3 due to migration is more than outweighed by the positive influence of the immigrating adopters of group 2 and group 4. Thereby, the damper effect of the conversion process plays a vital role. Therefore, it can be reasoned that the excluded group should be situated as centrally as possible so that the damper effect of the conversion process is maximized and adopters from several groups immigrate into the excluded group.

However, there is no linear increase in implementation effectiveness the closer the excluded group moves to the center of the network. In case group 2 is excluded from

management pressure, the implementation effectiveness is even worse than in case senior management disregards group 1 (Figure 4). The difference to the previous scenario is that the excluded group 2 influences the peripheral group 1, which is not communicating with any other group but group 2. In this case, the positive influence of the conversion process can only dominate the negative influence of the migration process until week 25. After week 25, the fraction of adopters of group 1 decreases (blue graph in middle part of Figure 4). This is the case because the positive influence of the conversion process is decreasing before the tipping point is reached (compare to left part of Figure 3). During that period, the negative impact of the migration process is greater than the positive impact of the conversion process and therefore leads to a decreasing proportion of adopters of group 1 (blue graph in middle part of Figure 4). Since group 3 (green graph in middle part of Figure 4) benefits from a less negative net migration rate because group 4 (grey graph in middle part of Figure 4) is also influencing it, the migration process is not able to dominate the conversion process in group 3. Due to an even smaller negative impact of group 2 on groups 4 and 5 (black graph in middle part of Figure 4), those groups reach the tipping point most quickly. After doing so, the even greater fraction of adopters immigrating from group 4 into group 3 is able to support the conversion process of group 3 to an extent that also this group reaches the threshold level. This in turn enables the adopter camp of group 2 to reach the tipping point and reverse the negative impact on group 1.

5. Management implications and directions for future research

This study has analyzed implementation processes assuming that employees of an organization decide whether they implement an innovation or stick with the status quo based on the information and opinions they are exposed to as members of an informal social communication network within an organization. In contrast to most studies, the present study does not only focus on the diffusion of rational innovations, which show the typical bandwagon-like behavior, but also on ambiguous innovations. Therefore, the underlying communication model of Krackhardt (2001) was modified by making the more realistic assumption that conversion and migration processes within communication networks happen simultaneously instead of sequentially. While Krackhardt (2001) was focusing on the outcome of diffusion processes characterized by the fraction of adopters, the purpose of this study was to analyze the process itself also taking into account the diffusion speed and the sustainability of the reached diffusion degree. Following Choi and Chan (2009) structural aspects, predominant in diffusion literature, and employee-oriented aspects, mainly discussed

in implementation literature, have been combined in order to understand better why so many implementation efforts fail. Hence, the structural aspects of a network have been combined with employee-related aspects by considering the role of senior management as well as different search intensities of adopters and nonadopters.

Assuming that senior management of an organization pushes the adoption of an innovation, the simulation results of this study show that managers can use their limited resources more effectively by considering the conversion dynamics within groups and the migration dynamics between groups. First, senior management only needs to apply on a group until the proportion of adopters of that group reaches a certain tipping point. When this happens, the adopter camp of the group is strong enough to convert all remaining nonadopters by itself. Therefore, management can save resources by stopping to push the innovation in a group when this threshold level is reached. Second, senior management is able to save additional resources while still ensuring high implementation effectiveness by not exerting pressure on less vital groups based on their position in the network. Thereby, senior management should ensure to influence peripheral groups because they are less likely to adopt an innovation due to their relatively few migration ties to other groups. However, a central position of an excluded group does not always a result in higher implementation effectiveness than a less central position. Due to the greater number of migration ties of central groups, these groups initially hamper the diffusion to a larger extent than peripheral groups if they get excluded. Therefore, senior management should consider the damper effect of the conversion process by applying pressure on connected groups and by not excluding several connected groups.

Future research in this area can focus on the limitations of this study. Therefore, the behavior of the presented communication network can be analyzed by considering other network structures than the proposed one. In addition, further insights can be generated by relaxing the assumption that all groups are homogeneous and that the ties between groups are equally strong.

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