Chapter 4
The Effects of Disorganization on Goals and Problem Solving

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Abstract This chapter presents an agent-based simulation of the ability of employees to solve problems. The primary aim of the chapter is to discern the difference in problem solving under two structural conditions. One has rigid structural constraints imposed on the agents while the other has very little structural constraints (called "disorganization" in this work). The simulation further utilizes organizational goals as a basis for motivation and studies the effects of disorganization on goals and motivation. Results from the simulation show that, under the condition of a more disorganized environment, the number of problems solved is relatively higher than under the condition of a less disorganized and more structured environment.

Keywords Agent-based modeling • Disorganization • Expectancy theory • Goals • Problem solving • Effectiveness

4.1 Introduction

This chapter presents a model of the occurrence of "disorganization" and its impact on goal setting and problem solving. In this work, we do not attempt to define disorganization per se, because that would be the scope of another article. Instead, we consider it as an umbrella concept to indicate the reduction of structural constraints and rules of interaction employees are subject to so that their work does not seem to follow any clear order or rule. Every organization sets countless goals (Brown, Jones, & Leigh, 2005) and each is perceived as having a given level

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of difficulty, some are relatively trivial, others appear to be very hard (Locke & Latham, 2013). Goals ought to be well defined and measurable (Locke & Latham, 1990) and this, historically, led to the idea that a well-organized structure associated with goals makes them manageable (Shenhav, 2002). This principle goes deep down to the roots of management (e.g., Fayol, 1916; Taylor, 1911) since it reflects the belief that goals (as problems to solve) should be clearly associated with employees and managers such that they become easier to achieve. In other words, it is the clarity of instructions and effective organizational structures that facilitates goal attainment (Chandler, 1932; Simon, 1947). This is what classic or rational management theories claim (Scott, 2001). However, recent debates have questioned the effectiveness of organizational structure and highlighted the seemingly positive effects of disorganized work environments on work outcomes (Amabile, 1996; Deci & Ryan, 1991; Frost, Osterloh, & Antoinette, 2010).

This chapter is a first attempt to investigate the effects of disorganization and goal attainment (framed as problem solving; see below). Even though some argue that disorganization may bring some benefits (Abrahamson & Freedman, 2006), the effect of disorganization on specific organizational processes and procedures has received limited attention. There is some ambiguity in what is meant by "disorganization" (Abrahamson, 2002) and this is why, in this paper, it is used as an umbrella term to encompass multiple concepts (Abrahamson & Freedman, 2006). These can be, among many others, messiness (unwanted aggregation of things), reduction of organizational structure, and low levels of organizational control (Abrahamson & Freedman, 2006; Cohen, 1974; Warglien & Masuch, 1996). This chapter focuses on goal achievement under condition of more or less structure and of formal or informal rules of interaction for workers. Hence, it is apparent that the concept of "disorganization" dealt with in this chapter is built around studies on the effects of increasing control in organizations (Abrahamson & Freedman, 2006; Cohen, 1974; Crozier, 1969).

The research presented in this chapter has two primary objectives. First, the chapter explores the effects of disorganization on goal achievement. In order to do that, we use an agent-based computational simulation model (ABM) that unveils the effects of disorganization and organization on employee's access to problems and solutions in the light of available problem solving opportunities. The primary interest of the research is to compare the efficiency of both organization and disorganization in terms of achieving goals, namely problem solving, assuming that to "solve problems" a goal needs to be set beforehand. This is done considering how motivation fluctuates among employees when problems are solved. The second objective of the chapter is to contribute to building of a theory of disorganization (Abrahamson, 2002; Warglien & Masuch, 1996). Consequently the study aims to broaden the understanding of how disorganization affects organizations.

In the following sections, we first discuss the concept of disorganization, then introduce the components of the model, present some preliminary results, and discuss them in a concluding section.

4.2 Theoretical Framework

4.2.1 Disorganization

Disorganization is a concept which was first introduced and discussed in the 1970s (Cohen, 1972) and it can also be referred to as *organized anarchy*. This is how Cohen and March (1974) discuss it in relation to leadership under conditions of ambiguous power and its responsibilities, a situation that provides advantageous outcomes for leaders. In the 1960s, disorganization was defined as any deviation from the organizational protocol (Crozier, 1969). This definition soon revealed to be inadequate since it does not explain "what" disorganization is, nor does it define its characteristics, causes, and consequences (Abrahamson & Freedman, 2006; Shenhav, 2002; Warglien & Masuch, 1996). For clarification purposes, it should be noted that in the context of this study the word "disorganization" does not automatically imply the antithesis of "organization." This means that for disorganization to occur, it is not required that the organized allocation of a given environment, resources, thoughts ought to be known. To make a simple example, when we see what seems to be a dis-organized desk, it does not mean that we have clear in mind how the same desk would be if organized. Moreover, disorganization can be also seen as an occurrence which takes place within a more organized or structured context.

There is a semantic level in the discussion that needs to be clarified before we can move forward. We may refer to disorganization and organization as ways of distributing, assembling and connecting resources, thoughts, and elements. The word "organization" can also be referred to social structure as a way of pulling resources together in a limited and formal social environment (e.g., a company, the European Union). If the latter meaning is used, it is clear that dis-organization cannot be considered an antonym. The model discussed in this chapter focuses on the former set of meanings, where the mode of using or not using structure is the main focus. The way disorganization occurs in this model is within a given formal social structure. Hence, the two levels are nested.

The traditional view of how an organization should work vouched for isolating the organization and its functions from external disturbances, or for trying to focus on a limited set of external influences only (Thompson, 1967). Over the years this approach has fallen out of favor given that every organization is heavily influenced by external factors such as market fluctuations. Furthermore, due to geographical barriers and technological advancements traditional hierarchical control over employees seems to be ineffective and more flexibility is required (De Vulpain, 2005). The reasons for different forms of organizing are largely due to globalization (Featherstone, 1990). Additionally, the workforce has also undergone substantial change since the 1960s and, for example, employee turnover has increased over the years (Mobley & Fisk, 1982). This means that a constant inflow and outflow of employees is commonplace in most modern organizations. Another factor which heavily influences organizations is the technological development and the tendencies towards globalization (Jarvenpaa & Leidner, 1998). In adapting to the changes in the environment, new forms of organizing have emerged. These new forms of organizing are increasingly driven by advancements in technology that are sometimes managed via globally distributed virtual teams or via so-called network organizations (Nohria, 1994). Network organizations contain small and agile self-directed teams; these organizations usually utilize multiple forms of organizing where some teams can be highly organized while other teams can be self-governing and disorganized (De Vulpain, 2005). Network mediation ensures interoperability of these heterogeneously organized teams (De Vulpain, 2005; Nohria, 1994). These flexible forms of organizing with large elements of disorganization (lack of structure) are also known as hybrid enterprise sensible organization, and organizing through social technologies—constructive learning approaches and are driven by the exponential leaps in technological capabilities (Black & Edwards, 2000).

Disorganization has earlier been considered a detrimental factor for organizational performance (Shenhav, 1995, 2002). However starting in the 1970s (Cohen, 1972) this view has started to be challenged. Abrahamson (2002) points out that there are disadvantages to order such as inattentiveness towards emergence, decreased employee motivation, and deviation from primary goals and objectives. In light of new evidence (Abrahamson & Freedman, 2006; Warglien & Masuch, 1996), some scholars (Freeland, 2002; Warglien & Masuch, 1996) now agree that there are advantages of minimally structured organizational environments (disorganized environments). The primary benefits of disorganization can be traced in decision making, problem solving (Cohen, 1972), innovation (Freeland, 2002), and motivation (Warglien & Masuch, 1996). Some key benefits of disorganization highlighted by Abrahamson (2002) and Abrahamson and Freedman (2006) are efficiency advantages, enhancing creativity, political advantages—indispensability, less use of resources, allowance for nonstandard agents/processes.

Given the hypothesized benefits of disorganization, some scholars conceive of disorganization as something that can be managed (Abrahamson & Freedman, 2006; Freeland, 2002; Warglien & Masuch, 1996). In this context, management does not imply "structuring." Instead, it implies direction and optimization of disorganization (Abrahamson & Freedman, 2006). The utilization of an amount of disorganized components, relationships, and procedures when needed (in decision making, in innovating, etc.) can be seen as disorganization management. Given the hypothesized ability of disorganization to be managed to achieve better outcomes for an organization, understanding the levels of disorganization at which effective goals can be set is an important task.

Currently, research (e.g., Abrahamson, 2002; Muller, 2000; Stacey, 1993) aims to provide a theoretical clarification of the concept of disorganization. Disorganization itself has not received attention from mainstream management given that the field has been concerned with the organized, the rational, and the structured for quite a long time (e.g., the so-called rational systems theories; Scott, 2001). The current lack of consensus on what disorganization really is can also be seen as one such cause. Nevertheless, some authors (Muller, 2000; Nonaka, 1988; Stacey, 1993) directly or indirectly present the concept of disorganization from various vantage points (individual, group, and organizational level). Over the years the concept of disorganization has been addressed by researchers under different terminologies (Muller, 2000; Nonaka, 1988; Stacey, 1993). Nevertheless, currently there is no established definition of "disorganization" which has achieved consensus (Abrahamson, 2002; Eisenberg, 1984). Thus, "disorganization" is used interchangeably with other words such as "disorder" and "messiness."

In this study, we start from the basic working definition of disorganization as introduced by Abrahamson (2002). This can be seen as the only attempt to define disorganization as an independent concept. This particular definition was chosen because it provides significant detail and makes the concept easier to operationalize in a simulation. He posits that "[d]isorganization is the disorderly accumulation of varied entities in hierarchically ordered complex human structures" (p. 4).

According to the aforementioned definition, disorderly accumulation refers to unintended aggregation of both non-physical and physical components within an organization (varied entities in the definition). These entities are also hierarchically ordered, pointing at how an organization is conventionally structured. Even though this definition roughly encompasses the concept of disorganization it still does not provide much of an explanation of what "disorganization" is. Abrahamson (2002) further posits that disorganization as defined above is an unavoidable condition within an organization and should be embraced. The rate at which a disorderly accumulation of varied entities happens is dependent on the structure of an organization. The structure can be rigid (organized, hierarchy) or flexible (disorganized, anarchy). These features can be re-phrased to indicate a reduction of structural constraints (hierarchy) and rules of interaction that employees are subjected to (anarchy). The implication is that work does not seem to follow any clear pattern or rule.

4.2.2 Operationalizing the Concept

In developing the simulation discussed in this chapter, the so-called garbage can model by Cohen (1972) was taken as a starting point. The garbage can was the first attempt to model disorganization and organization and it defines a solution space in which participants, problems, solutions, and opportunities are put together in a minimally structured environment. However, the technology used in the garbage can model is obsolete by today's standards as shown in the modern agent-based simulation as updated by Fioretti and Lomi (2008) who defined a mechanism to implement disorganization (anarchy) within the simulation.

As already stated above, how disorganization impacts problem solving is the primary focus of the agent-based simulation presented in this chapter. This simulation attempts to compare disorganization and organization in terms of access to problems by employees under both hierarchy-based interactions and non-hierarchy-based interactions, matched with opportunities and solutions. These comparisons are needed in order to properly define the concept of disorganization. It further allows for an operationalization helping to understand what its imminent effects on the daily operations of a company are. In particular, this study focuses on the process of problem solving, involving individual abilities, motivations, available solutions, and problems.

Given that the primary aim of the model is to study the effects of disorganization on problem solving, it explores the impact of disorganization (interpreted as absence of hierarchical distribution of problem solving) on decision efficiency using several elements that characterize problem solving, including the decision maker's motivation, defined through goal setting theory. By modeling the effects of disorganization (as defined) on goal setting and task performance, an understanding of why disorganization occurs, and how it materializes can be gained. Ultimately, the ABM approach allows for an investigation of what emerges once disorganization happens.

4.2.3 Goal Setting

One of the ways to better understand and study disorganization is that of associating it with a tangible and pervasive element of organizing (Warglien & Masuch, 1996). In this study, we claim that one such element is "goal setting" (Locke & Latham, 1990, 2013). In order for a goal to be achieved, workers need to make decisions and solve problems. In this paper, we are not interested in how goals are actually "set" or in the individual or social decision making process leading to a shared understanding of prioritizing goals and identifying what they should look like. It is worth noting that some of these goals are ambiguous (Cohen & March, 1974), thus making it difficult to deal with them. Not all goals are straightforward and easily measurable, as the theory seems to recommend (Locke & Latham, 1990). If we consider elements of goal ambiguity, we may realize the more individuals dealing with the same goal may help defining the shared meaning it has for the organization, employees, and management (Cannon-Bowers & Salas, 2001). Moreover, the dynamic of advice giving and taking between members of a team and/or hierarchical levels (Bonaccio & Dalal, 2006) affects how people think and act on particular goals and tasks. These broader processes can also be described cognitively, providing an externally and socially distributed version of the goal setting process (Cowley & Vallee-Tourangeau, 2013; Hutchins, 1995). This is why it is useful to approach solving problems related to goals using a less-organized (or disorganized) perspective.

Additionally, disorganization and goal setting share some common attributes. Both disorganization and goal setting occur at every hierarchical level of an organization (be it the mailroom or the boardroom). Furthermore, both disorganization and goal setting can be observed regardless of the reference point from which the observation is conducted (individual perspective, group perspective, organizational perspective). Additionally, goal setting and disorganization are inevitable attributes of any organization (Seijts & Latham, 2001). Moreover, setting goals acts as a platform for increasing employee motivation. Finally, the effects of disorganization on goal setting have not been studied before and this provides an added incentive to explore how the two variables interact together (Abrahamson & Freedman, 2006).

Goal setting theory (Locke & Latham, 1990) was developed over a 25-year period based on 400 laboratory and field studies (Locke & Latham, 2013). More recent studies have looked at components of goal setting theory as learning goals and individual efficacy (Donovan & Williams, 2003; Drach-zahavy & Erez, 2002; Seijts & Latham, 2001; Wiese & Freund, 2005). The basic premises of the theory state that hard and clearly defined goals lead to better task performance than vague (less defined) or easy goals if the individual has the efficacy, commitment, and does not have other conflicting goals (Locke & Latham, 1990).

The aforementioned relationship between goal difficulty and task performance has been well established both conceptually (Locke & Latham, 1990, 2013) and empirically (Donovan & Williams, 2003; Seijts & Latham, 2001). Furthermore, Bandura (1997) and Brown et al. (2005) found that self-efficacy, past performance, and various external influences affect the way goals are set. Even though the relationship between goal difficulty and performance is well understood, the external environmental or social effects of disorganized work environments on goal setting have not garnered the same attention (Locke & Latham, 2013). In the simulation model discussed in this chapter a goal is considered a prerequisite for a problem to be solved. This means that when a problem is solved a goal has been achieved.

Nevertheless, as already stated above, one of the impacts of disorganization on goals is that they can become ambiguous (Cohen & March, 1974). Of course, there are many ways goals can be perceived that way. For example, a goal can be perceived differently from employee to employee, be defined independent of the hierarchical level(s) in which it is first defined, and its achievement may be judged differently due to the goal being ill-defined (i.e., ambiguous) in the first place.

4.3 The Model

We explore the effects of disorganization on goal setting and task performance using agent-based modeling. ABMs can be seen as a direct solution for understanding complexities involved in an organizational environment (Miller & Lin, 2010). ABM can be used to simulate various organizational dynamics in a simple yet detailed manner (Lomi & Harrison, 2012; Secchi, 2013). The primary advantage ABM has over its alternatives is the ability to be more flexible and adaptable (Gilbert & Terna, 2000), characteristics that have increased its use among contemporary scholars (Gilbert, 2008).

Complementing the flexibility of ABM to study disorganization is the fact that this tool has already been used to model effects of disorganization in decision making. Fioretti and Lomi (2008) used an ABM to simulate the garbage can model (Cohen, 1972) of decision making. In developing the model for studying effects of disorganization on goal setting and task performance, a similar approach to that of Lomi and Harrison (2012) is adopted. In fact, a set of rules is derived from the underlying theory which can then be modeled into parameters. Thus the work of Fioretti and Lomi (2008) and Lomi and Harrison (2012) can be used as a foundation for the research proposed here. These rules were modeled using conditional statements.

The two main scenarios are modeled as "organization" and "disorganization." Hierarchy (organization) represents the structured working environment with rigid rules, regulations, and operational procedures where agents can only move based on sufficient conditions. Anarchy (disorganization) represents the loosely structured work environment where agents are fully autonomous and free to move.

The intention of this exploratory work is to assess whether some theoretical assumptions hold and to assess under what circumstances they do hold. ABM allows conducting more accurate theoretical refinements before getting to the testing phase. Moreover, this class of models is particularly well suited to represent complex adaptive systems, such as organizational problem solving dynamics.

4.3.1 Space and Agents

The world in which the agents reside is three dimensional. The dimensionality of the simulation space allows each agent to move along the x, y, and z axes. A three dimensional simulation space is used instead of a two dimensional simulation space in order to give more variability to agent movements.

The model consists of four agents which have a set of variables defined under them. Table 4.1 shows agent types and their attributes (parameters in the simulation) while Table 4.2 shows parameters, values, and a short description of what they represent.

Independent of its type, each agent is associated with a level that is used to specify where each agent is situated within the organizational hierarchy. These levels are defined by numbers from 0 to 4. The number '0' represents the lowest tier of the hierarchy (e.g., mailroom) while the number '4' represents the highest level (i.e. boardroom).

The agent employee represents the typical worker within a given organization. Efficacy, ability, and motivation are characteristics of each employee and are attributed through a random normal distribution with a mean of 0 and standard deviation of 1.

Table 4.1 Agent and attributes

Agent	Attributes
Employee (E)	Efficacy (e), ability (a), motivation (m), level (l)
Problem (P)	Difficulty (d), level (l)
Solution (S)	Efficiency, level (l)
Opportunity (O)	Level (l)

Table 4.2 Model parameters

Parameters	Values	Description
Levels	0, 1, 2, 3, 4	Each agent is assigned a hierarchical level randomly. This parameter allows the creation of a hierarchy with the model.
Efficacy	$N \approx (0, 1)$	Unique to an employee. Represents an employee's capability in solving problems.
Ability	$N \approx (0, 1)$	Unique to an employee. Represents an employee's level of skill and competency in solving problems.
Motivation	$N \approx (0, 1)$	Represents an employee's intrinsic and extrinsic motivation.
Problem difficulty	$N \approx (0, 1)$	Represents the inherent level of complexity or simplicity of the problem.
Solution efficiency	$N \approx (0, 1)$	Represents the suitability of available resources to be used for problem solving.
Range	1–10	The range determines the amount of patches an agent will scan. i.e., if the range is set at 5 an agent will scan 5 patches around itself at every step.
Similar wanted	0.00–1.00	Under the organization condition, the similar wanted parameter determines the percentage of agents of the same hierarchical level that a given agent is satisfied with. I.e., when similar wanted is set to 70 % an agent will be satisfied if agents in range were of similar level 70 % of the time.

The problem agent represents both physical and non-physical problems which arise within an organization (e.g., unruly employees, broken computers, delayed projects, low sales, and angry customers). This agent in the context of the model is used as a placeholder to represent all the multitude of problems an organization faces. Each problem has a difficulty assigned to it through a random normal distribution with a mean of 0 and standard deviation of 1. The difficulty of a problem represents the inherent complexity (or simplicity) or any given problem and is used in the decision making process. A problem is perceived more or less difficult depending on how this inherent complexity matches with an employee's abilities, efficacy, motivation, solutions, and opportunities. Such matching reflects problem difficulty relative to each agent-employee.

The solution agent represents both physical and non-physical options available (e.g., repairman, various tools, will power, collective action, political capital) which can be used to solve problems. The solution agent acts as a placeholder to represent all the various solutions available within a given organization. Each solution has an efficiency assigned to it through a random normal distribution with a mean of 0 and standard deviation of 1.

The opportunity agent is used to represent the occasion when a problem can be solved and when solutions are available. This variable takes into account the fact that in any given organization the opportunity to solve problems arise and cease to exists, thus the opportunities need to be grabbed once presented. A given opportunity does not have any attribute which is unique to it but shares the level attribute with all the other agent types.

4.3.2 Movement

Movement in the model represents the real world movement of agents within an organization. The orientation of a given agent (the direction which they are moving towards) depends on its type. Once an agent turns to a random direction it scans its surroundings and moves toward other agents within its range or randomly, depending on the following rules:

1. Problems move freely (i.e., randomly) within the solution space. Upon every step a given problem turns to a random angle and moves a patch before repeating the procedure ad infinitum until the simulation is stopped or the problem is solved in which case it exits the solution space.
2. Solutions tend to move around problems. In this context a solution represents resources available for solving a problem. The solution agent parallels the resources available in the real world, both physical and non-physical. A given solution scans its surroundings and moves towards the maximum valued problem in range.
3. Opportunities represent the window of time and circumstance where a given problem can be solved. In the real world some problems can only be solved at an opportune time or place thus this agent represents the reality of the window of opportunity. A given opportunity scans its surroundings and moves towards the maximum valued problem in range.
4. Employees within the model are fully mobile and move randomly in the simulation space. This represents an organization where employees tend to move around and are not stationary. Even if an employee is stationed to a physical location they have the opportunity to handle multiple problems and move around their designated physical location. Employees move towards problems at any given time. A given employee scans its surroundings and moves towards the maximum valued problem in range.

In order to impose the conditions of both “organization” and “disorganization” within the solution space, various movements based on a set of rules have been developed. First, once “disorganization” is switched-on all the agents within the solution space move with complete autonomy and each agent turns to a random direction and moves forward freely. Under this condition agents are free to interact with one another without any restrictions. This form of movement represents a “disorganized organization” where employees, solutions, opportunities, and problems move freely within the organization and interact without any restrictions. All the single agent movement conditions are applied under this setting. The distance a given agent travels under the disorganization setting is determined by the "range" parameter which is an initial condition.

In contrast, when the "organization" is switched on the agents are only allowed to move to a certain set of other agents within the solution space. The condition of "organization" is designed to represent the hierarchical nature of a real world organization where, for example, a problem in the mail room tends to be handled by an employee from the mailroom rather than an executive from the boardroom. This hierarchical restriction is implemented through the use of the "level" variable of each agent. The algorithm for hierarchical movement is as follows:

$$E_l \neq P_l \;\; \text{OR} \;\; E_l \neq S_l \;\; \text{OR} \;\; E_l \neq O_l$$

In the above algorithm let "E" be employee, "P" be problem, "S" be solution, and "O" be opportunity that are available at a given "level," "l." The employee's hierarchical level is checked against the hierarchical level of the solution, problem, and the opportunity so that the agents are dispersed without any interaction if the levels are not equal. In order to implement the aforementioned algorithm fitting a real world scenario some inter-level interactions were allowed. The extent to which the inter-level employees interact is dependent on the randomly defined position they find themselves in. In a real world scenario employees on a higher level might solve problems appearing in lower levels, eventually.

Therefore, in order to implement a more practical hierarchical rule, the so-called segregation algorithm is used (Wilensky, 1997), based on Schelling's racial segregation model (Schelling, 1969, 1971). The purpose of the segregation algorithm is to separate agents in a way that agents with similar levels cluster together. This clustering allows agents with different hierarchical levels to interact to a small extent. For example, if the segregation is set to 70 %, this implies that 70 % of the times agents will only interact with other agents who have the same level and they tend to interact with agents from other levels 30 % of the times.

4.3.3 Decision Rules

The same decision making logic is used both when movement is disorganized and organized. A problem is solved when a participant has sufficient ability (a), efficacy (e), motivation (m), and a sufficiently efficient (Sme) solution such that their product is greater or equal to the difficulty of the problem. This is called a "completed solution" in the model. Completed solutions take place when at least one participant, one opportunity, one solution, one problem are on the same simulated place (the so-called patch). The sum of the abilities (including motivation) of the participants on the patch, multiplied by the efficiency of the most efficient solution on the patch, is greater or equal to the sum of the difficulties of the problems on the patch (Eq. 4.1).

$$E\left(a^{*}m^{*}e\right) + \text{Sme}\,(\text{ef}) \geq P\,(d) \tag{4.1}$$

Most often, completed solutions occur when just one participant, one goal opportunity, one solution, and one problem happen to be on the same patch and the ability of the participant, multiplied by the efficiency of the solution, is greater or equal to the difficulty of the problem as shown succinctly in Eq. (4.1).

When the difficulty of a given problem is greater than the product of the employee efficacy, ability, motivation and the efficiency of the solution in range no decision is made (Eq. 4.2). If that is the case then, all agents immediately disperse.

$$\mathrm{E}\left(\mathrm{a}^{*}\mathrm{m}^{*}\mathrm{e}\right) + \mathrm{Sme}\,(\mathrm{ef}) < \mathrm{P}\,(\mathrm{d}) \tag{4.2}$$

4.3.4 Motivation

For the purpose of the simulation it is assumed that in order for a problem to be solved a goal has to be set by an employee. It is assumed that setting a goal is only possible if an employee is sufficiently motivated. It is assumed as a precondition that the external rewards and incentives are present within the model which provides the necessary extrinsic motivation. It is also assumed that employees are intrinsically motivated by the interest and the enjoyment of the tasks at hand to some extent. The levels of motivation among employees are randomly assigned among the employee population within the simulation.

In line with motivation theories (e.g., self-determination theory) we assume that the experience of successfully solving a problem has a positive effect on motivation (Deci & Ryan, 1991; Steel & Konig, 2006). An employee can set themselves either a "hard" or an "easy" goal. A hard goal is set if the following condition is satisfied:

$$2^{*}\left(\mathrm{E}\left(\mathrm{a}^{*}\mathrm{m}^{*}\mathrm{e}\right)\right) \leq \mathrm{P}\,(\mathrm{d}) \tag{4.3}$$

where "E" is employee, "a" ability, "m" motivation, and "e" efficacy. "P" denotes problem while "d" denotes the difficulty of the problem. As Eq. (4.3) depicts, if a problem's difficulty is greater than or equal to two times the product of an employee's ability, motivation and efficacy then the problem can be seen as a difficult problem to be solved. Thus an employee in such a predicament has to complete a hard goal. The term "hard" here implies that the problem a given employee is trying to solve is a very difficult one (i.e., 2 times one's own capabilities). Even though the problem might be hard it can still be solved using a highly efficient solution, where the combined value of both the employee's attributes and the solution's efficiency will be adequate to solve the problem at hand. In such a case where a "hard" problem is solved, the employee's motivation increases by a predefined value (i.e., 2).

On the other hand, if the product of the employee's attributes is greater than the problem's difficulty, then the problem can be easily solved once a solution is utilized.

$$2\left(E\left(a^{*}m^{*}e\right)\right) > P(d) \tag{4.4}$$

Therefore in a situation where the above condition (Eq. 4.4) is satisfied, where two times the product of an employee's attributes are greater than a given problems difficulty a problem is classified as an "easy" problem. This implies that the employee does not have to set a "hard" goal. In this case the employee's motivation does not increase as much compared to a "hard problem" but does increase slightly (i.e., 1).

4.3.5 Testing

Upon completion, the model was subjected to tests in order to determine whether the simulation was working as expected and if the results produced were consistent over multiple runs. The tests were divided into two categories. The organized movement test and the disorganized movement test.

In order to test the organized movement within the model both the segregation algorithm which enforces the hierarchical dynamics to the simulation and the decision making of the overall model had to be considered. A time limit of 5,000 steps was imposed on each test and 10 runs were carried out to check the consistency of the results obtained. The runs of the simulation were used to check if the simulation did not halt, segregation among agents happened according to specified percentages, if the problems were solved and were terminated and if the overall motivation increased.

In the disorganized movement test only the decision making capability of the model had to be considered. In order to compare results between disorganized movement and organized movement these tests were also given a time limit of 5,000 steps. A total of 10 runs were carried out. The runs under the "disorganization" condition was used to check if the simulation did not halt, if the random movement conditions worked, if the problems were solved and were terminated and if the overall motivation increased.

4.4 Findings

At any given instance the employees are divided into five employee types (levels) with a default distribution which is: low level workers (50 %), supervisors (25 %), managers (10 %), middle management (10 %), and top management (5 %). The default percentages tend to reflect the most common composition of employees within a standard organization.

Table 4.3 "Disorganization" results

Test number	Number completed	Completed percentage	MMAS	MMAE	Range
1	34/100	34	0.730702	14.04572	5
2	42/100	42	0.804362	20.79112	5
3	51/100	51	0.792403	58.61872	5
4	47/100	47	0.643094	42.64631	5
5	48/100	48	0.729849	33.67737	5
6	53/100	53	0.757948	89.20042	5
7	42/100	42	0.74192	36.94125	5
8	42/100	42	0.74043	25.70379	5
9	45/100	45	0.898174	59.5295	5
10	55/100	55	0.752668	107.3486	5
Total			7.59155	488.5028	5
Average	45.9 %		0.759155	48.85028	5

MMAS mean motivation at start, *MMAE* mean motivation at end

The range parameter determines the number of patches a given agent will scan during a single step. The scanning allows an agent to acquire some knowledge about its soundings namely if any other agent is present in the vicinity. Using this knowledge the agent can either move towards an agent or move away from an agent accordingly. It was initially set to 5.

Upon conducting 20 runs (10 runs per condition) we can draw some tentative and preliminary results. The following table presents the findings obtained through running the simulation in the "disorganized" movement condition under a specific set of initial conditions. The initial number of problems, employees, solutions, and opportunities were set to 100 at the start of the simulation.

Through the results obtained (Table 4.3) it can be observed that under the "disorganization" movement condition i.e., where all agents interact freely—46 % of problems are solved when the model is run for 5,000 steps. On average, it takes around 10,000 steps for 95 % of the problems to be solved under this condition. However, the number of problems solved decreases significantly when running the simulation under "organization" movement condition (Table 4.4).

Under the "organization" condition, the percent of similarity is set to 70 % which means that a given agent will only interact with other agents from the same level as itself 70 % percent of the time while engaging with agents with other hierarchical levels 30 % of the time.

Table 4.4 shows that, on average, under the "organization" condition 17 % of problems are solved when the simulation model runs for 5,000 steps. This is a 29 %-points drop in efficiency compared to the disorganized movement condition. This drop in efficiency is anticipated given the fact that under the "organization" condition agents are mostly expected to only interact with other agents on the same level. Furthermore the range and SW (similar wanted) parameters also affect the overall efficiency of the model. The tests conducted above were used to check the

Table 4.4 "Organization" results

Test number	Number completed	Completed percentage	MMAS	MMAE	SW (%)	Range
1	7/100	7	0.8126	1.4396	70	5
2	11/100	11	0.9057	2.3621	70	5
3	12/100	12	2.0156	0.7709	70	5
4	12/100	12	0.7044	2.0109	70	5
5	2/100	2	0.8099	0.8166	70	5
6	17/100	17	0.6664	2.3183	70	5
7	29/100	29	0.8166	7.3511	70	5
8	38/100	38	0.8229	15.9551	70	5
9	8/100	8	0.7945	1.7031	70	5
10	36/100	36	0.7320	12.7969	70	5
Total			9.0805	47.5246	70	5
Average	17.2 %		0.9081	4.7525	70	5

MMAS mean motivation at start, *MMAE* mean motivation at end

accuracy of the simulation. Given the vast number permutations and combinations which can be set through the simulation further testing will be conducted in order to gauge an understanding of the models behavior under a range of initial conditions.

4.5 Discussion and Conclusions

Results show that the "disorganization" condition provides a better structural environment for employees to solve problems rather than under the "organization" condition. Disorganization provides faster access to problems, opportunities, and solutions. This result must be further substantiated with more testing, with wider parameter ranges and additional conditions. Nevertheless, these findings seem to indicate that disorganization is not completely detrimental for an organization, contrary to what posited by rational management theorists (Scott, 2001). Although these are only tentative findings, they can be discussed as follows.

First, results from the model indicate that there seems to be a good chance that some disorganization is helpful to an organization. This confirms the findings of Cohen (1972) and Fioretti and Lomi (2008) who, under different circumstances, established that disorganization is a more efficient condition than organization in decision making. Results further provide support to the claims by Abrahamson and Freedman (2006) that disorganization is beneficial to problem solving. However, this is a starting point and further analysis is needed to circumstantiate these claims on a more robust and consistent basis.

Second, current findings indicate that a rigid organizational structure may be detrimental to problem solving due to constraints on how agents interact and solve problems. The model shows that sometimes solutions are available to people that are not directly related to a particular problem, thus disorganizing the rigid organizational structure to allow such indirect associations is advisable for organizations.

Third, making agents freely move on the organizational ground with minimal constraints means that abilities are more likely to be matched with the "right" problem or solution. The employee that is "stuck" to one hierarchical level may see his/her own abilities go to waste because they do not match any problem to be solved.

Fourth, there is an issue with scope in employees allocating themselves to problems. Through the reduction of structural constraints and rules of interaction, the disorganization condition increases the personal discretion available to employees. Personal discretion is defined as the degree to which a task provides substantial freedom, independence, and choice to individuals in determining the procedures to be used in carrying the task out (Hackman & Oldham, 1980). These preliminary results show that under the condition of disorganization the employees have increased individual discretion in the problem solving process. This also means that different agents/employees "see" and apply different solutions to problems, enhancing the probability that it gets solved. This also adds to the level of motivation among employees. A given employees will be able to self-determine the best problem to solve.

Fifth, modern organizations consist of teams; some teams often compete to accomplish same or similar tasks. An out-group looking at another team might underestimate or overestimate the capabilities of its rival team which leads to false perceptions and expectations (Cohen & March, 1974). In order to avoid unnecessary and unfair judgment based on subjective reasoning, a disorganized decision making process which involves actors from various groups can be used. The preliminary results of the simulation show that decreasing rules of interaction does contribute to a larger number of problems being solved. This decreasing of the rules of interaction ensures that the employee who previously was unable to interact with others due to rigid structures can now do so with relative ease. Agents in the model can be interpreted as teams of individuals, if one gives that interpretation to it. From our findings, we are not able to define whether individual and team problem solving is affected by organization or disorganization. However, this is clearly an interesting area to move this research further.

Sixth, organizational issues are always linked to other issues (Cohen & March, 1974). Once one issue is about to be tackled other linked issues come into the decision making process (e.g., construction of a new building brings in environmental issues). Trying to isolate and deal with a single issue is not always a sustainable approach. In instances where issues are isolated only stakeholders on that issues will play a part in the decision making process. In only focusing on one issue without any consideration for the linked issues can have drastic consequences for organizations (i.e., constructing a building without considering any linked environmental issues can have severe legal ramifications). Therefore integration of stakeholders representing the major issues and its sub-issues is essential. The findings of the simulation show that providing a low structured environment actors addressing multiple problems can come together in order to solve problem.

Seventh, the preliminary results show that when employees are given more freedom in interacting with problems, solutions, and opportunities there is a greater level of productivity (Table 4.3). These results feed in as a solution for a more general problem which is stakeholder involvement in decision making. In order to make the organizational mission work top management and everyone else down the hierarchy has to believe in its promise. Such a decision cannot be made in isolation as it will not consider the viewpoints of other key stakeholders. Therefore as the results show decreasing hierarchical structures will provide a faster channel for information to trickle down the hierarchy unhindered. Such an issue is an ideal locus for a disorganized decision making process (garbage can Cohen 1972).

Eighth, the advent and the increase of network organizations is a clear indicator that totally rigid management approaches do not provide viable results any more (De Vulpain, 2005; Nohria, 1994). The results obtained suggest that rigid hierarchical structure does not perform well compared to disorganized structure in terms of problem solving. Results show that the ideas which propose rigid hierarchical structure and tight control are not necessarily effective in relation to problem solving. Instead, the results are more in line with research (Hackman & Oldham, 1980) which claims that increasing productivity through rigid structure are outdated and which propose that teams should be autonomous and fluid in structure. Through the introduction of disorganization into management the organizations will be able to take a flexible approach to external influences using fluid structures which allow better cooperation among employees and adaptable rules of interaction.

Ninth, the preliminary findings of the simulation show that increasing disorganization increases productivity. Increasing disorganization in the context of the simulation involves giving employees more autonomy in engaging with problems. There is a link between increased autonomy and creativity (Hackman & Oldham, 1980). Shalley (1995) posits increased individual discretion leads to higher creativity. Creativity is the key ingredient in innovation (Amabile, 1983; Blumenthal, Inouye, & William, 2003; Terhurne, 2010). For an organization, adaptation is a necessity; adaption requires innovation and creativity. There is no guarantee that all efforts to innovate will yield positive results. However it is a necessary task in order to survive (Amabile, 1983). A key ingredient in innovation is creative autonomy and flexibility in planning and thinking. This flexibility can be facilitated by disorganizing certain structures within the organization. The results of the simulation show that the process of disorganizing can be started and stopped as and when required. It should be mentioned that in a real world scenario this change from organization to disorganization or vice versa can take substantial amount of time and is dependent on the scale and the contexts of the organization. In an organization currently innovating, disorganizing certain processes within the organization can incubate creativity. Once the necessary level of innovation is achieved the disorganized components can be re-organized as needed. Therefore, disorganizing the control structures within an organization will provide more chances of innovation.

Finally, the results indicate that the average motivation among employees is higher under disorganization compared to motivation levels under organization.

This difference in motivations levels can be attributed to the higher number of problems solved under disorganization compared to organization. Under a rigid organizational structure with multiple constraints employees are limited and lack flexibility to solve problems that suit their abilities. This limitation was observed while running the simulation and the results confirm that lack of “elbow room” decreases an employee’s efficiency as posited by Crozier (1969). However, under disorganization employees are more autonomous and have more freedom of choice both in the problems and the solutions available to solve those problems.

This chapter presents the first version of this model to study disorganization. Increasing the granularity of details within the model will enable the model to be more and more accurate with each addition. Some of these additions are the implementation of multi-type agents. In a multi-type environment each agent type will be further divided into smaller sub-agents. For example, the agent “problem” can be divided into stationary problems (i.e., broken air conditioner on 3rd floor) and mobile problems (i.e., unruly employee). This division can also be done to solutions and opportunities. Splitting the agents into sub-types makes the simulation to closer to the real world environment. Furthermore, another addition can be the constant arrival and departure of employees, problems, opportunities, and solutions. Another dynamic which can be added is “training” where when an employee fails to solve a given number of problems (i.e., 5) they will be either fired or sent for training depending on the importance of the employee to the organization. This importance can be derived from the hierarchical position a given employee resides in. At training an employee will get its variables incremented thus enhancing its survivability.

In further developing the simulation, more variables can be added. These variables can either be other essential components in an organization. Ideally in further developing the model, the ability to select the organization type, the management type, and other parameters would provide an even more accurate representation of the real world.

4.5.1 Limitations and Prospects for Further Research

The main limitation of the simulation as it stands now is the granularity of the simulation itself. Granularity refers to the fineness of details considered. Even though the simulation does mimic real world conditions at a crude rather abstract level, in order for the accuracy of the results to be more applicable to a real world setting the level of details need to be upgraded. This can be accomplished by increasing its functionality by introducing team problem solving, prioritization of goals, clear preferences, skills, and multiple attempts to solve the same problem by the same individual or team of individuals, for example. Furthermore, conducting empirical studies will also enable the simulation to be more directly validated using real world data.

Another limitation of the simulation is the assumptions underlying the decision making of the simulation. The primary assumption of the simulation is “for a problem to be solved, an employee has to set goals; for goals to be set an employee has to have some motivation.” This assumption is used in order to imply that when a problem is solved a goal was set prior to solving it. This assumption is directly derived from goal setting theory. This implication can be more explicitly modeled in the simulation in the future. Doing so will also increase the autonomy and granularity of the simulation.

Finally, considering employees’ “ability × efficacy” may lead to distortions in the model, given that the agent is left with a low impact of the two parameters and that it makes it impossible to distinguish between the impact of either ability or efficacy. Tests conducted on the model so far did not raise any particular concern although further checks may be carried on in the future.

Building on the limitations discussed above, it is apparent that the simulation developed can be improved in multiple areas. A first area of improvement is that of collective forms of goal setting. Currently the model only deals with individual problem solving and goal setting. However, some of its processes may be thought of as sequential team work, where one employee engages on a problem, cannot solve it, and another employee starts being on the problem at a second time. A logical next step would be to simulate collective goal setting and team-based problem solving. Adding collective aspects to the simulation will provide a greater range of data which is even more closely related to the real world.

Another interesting direction can be that of considering multiple types of goals. The model presented in this chapter does not distinguish between types of goals and considers only basic view of goal setting. A future expansion would be to take into account the various types of goals such as productivity goal, compliance goals, stretch goals, and creativity goals. Each of these types of goals has nuances that need to be modeled separately to accurately mirror the real world.

Moreover, the introduction of concepts such as training, promotion/demotion, and other employee-related concepts may also increase the appealing of the model.

Developing the simulation further to encapsulate the points discussed above will increase the fineness of detail within the simulation, thus mirroring the real world in a greater manner. Furthermore the improvements will also generate valuable new data which upon analysis might provide some interesting insights into disorganization.

4.5.2 Conclusions

The purpose of the simulation was to utilize the unique functional capabilities offered by agent-based modeling to represent a real world organizational environment. The simulation is used to develop an understanding on how disorganization affects organizational problem solving (goal achievement) and motivation. The model is designed to simulate two contrasting environments one in which a clear hierarchy is present while in the other rules of interaction are minimal. Upon developing and running the simulation it was found that neither complete disorganization nor complete organization was conducive for efficient problem solving within an organization. It was further uncovered that in an environment where 70 % of organization and 30 % disorganization were present provided the most efficient performance in tests conducted. These results were consistent in all the tests conducted. Furthermore, we were able to unveil that, in some instances, shifting from a highly organized operation to a slightly more disorganized environment mid-simulation provides an increase in the number of problems solved 60 % of the time. It should be noted that the results currently uncovered cannot be considered conclusive yet clearly provides preliminary evidence for disorganization as a conducive condition for increasing problem solving efficiency.

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