The model consists of 4 agents which have a set of variables defined under them. Table 2 shows agent types and their attributes (parameters in the simulation) while Table 3 shows parameters, values, and a short description of what they represent.

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 2: Agent and Attributes

As shows in Table 3, 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[1] 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.

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

[1] The *employee* agent is used to refer to any employee within the organization from the lowest level (i.e. mail room) to highest level (i.e. boardroom)

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) of 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.

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 ≈ (0, 1)	Unique to an employee. Represents an employee's capability in solving problems

Ability	N ≈ (0, 1)	Unique to an employee. Represents an employee's level of skill and competency in solving problems
Motivation	N ≈ (0, 1)	Represent an employee's intrinsic and extrinsic motivation.
Problem difficulty	N ≈ (0, 1)	Represents the inherent level of complexity or simplicity of the problem.
Solution Efficiency	N ≈ (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. This reflects the real world range an individual has in searching for resources. This is used to model functional disorganization. For example an individual could be given a small range (i.e. within the department) to find a solution. On the other hand the individual can be given a large range (i.e. inter departmental access).
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.

Table 3: Model Parameters

3.4.2 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. We assume that each problem has set of resources assigned to it. For example the marketing department having marketing personal, processes and procedures, therefore a problem in the marketing department has marketing resources around it at a given moment. The task of the employee then is to determine what resources to use and what to avoid and also determine how to go about solving the problem. The solution agent parallels the resources available in the real world, both physical and non-physical. A given moves towards the maximum valued problem in range mimicking resources being assigned to problems in an organization.
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. Here too, we assume that each problem has an opportunity to be solved. In a real world setting this would be equivalent to time being set aside to engage a given problem. A given opportunity therefore moves toward a problem mimicking a window of time being assigned to a given problem.

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 (structural disorganization) 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 '*structurally 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 structural 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 (Shelling, 1969, 1971). The purpose of the segregation algorithm is to separate agents in a way that agents with similar levels cluster together. The following pseudocode summarizes the functionality of this operation.

```
IF [
    (Similar agents percentage in the surrounding range >= Percentage of similar agents
    wanted) [
        Agent is Happy and remains on the same spot]
ELSE
    Agent finds a new spot
]
```

Pseudocode 1: Segregation Model

The aforementioned operation continues until the desired level (which can be specified by the researcher) of happiness among the agents are achieved. 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.

3.4.3 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. The following pseudocode outlines the operation.

```
IF [

((Collective value of a given employee's attributes + most efficient solution in range) ≥ (The
difficulty of the problem in range)) [
                    Problem is solved;
                    Motivation Increases;
          ]

ELSE
          Agents disperse;
]
```

Pseudocode 2: Decision Making

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 (Equation 1).

$$E(a*m*e) + Sme\ (ef) \geq P(d) \qquad (1)$$

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 Equation 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 (Equation 2). If that is the case then, all agents immediately disperse.

$$E(a*m*e) + Sme\ (ef) < P(d) \qquad (2)$$

3.4.4 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) I assume that the experience of successfully solving a problem has a positive effect on motivation (Deci and Ryan, 1991; Steel and Konig, 2006). An employee can set themselves either a “hard” or an “easy” goal. Depending on the nature of the goal (hard or easy) the employee’s motivation is increased as described in the following pseudocode.

When a Problem is solved:

IF [

```
        ((Problem Complexity)  ≥ (2 * Employee Capability)) [
                Motivation Increases by 2
        ]
ELSE
                Motivation Increases by 1
]
```

Pseudocode 3: Motivation

In formalizing pseudocode above, A hard goal is set if the following condition is satisfied:

$$2*(E\,(a*m*e)) \leq P\,(d) \tag{3}$$

Where ‘E’ is employee, ‘a’ ability, ‘m’ motivation, and ‘e’ efficacy. ‘P denotes problem while “d” denotes the difficulty of the problem. As Equation 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.

$$2(E\,(a*m*e)) > P\,(d) \tag{4}$$

Therefore in a situation where the above condition (Equation 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).