

## Comparative analysis of the effect of organizational culture characteristics on telecommuting system strategy through inferential statistics and rough set theory

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**Abstract:** As quick access to computers and information technology and modern media is popularized, not any country can handle the economy of 21<sup>st</sup> century without its electronic infrastructure. Telecommuting as a new form of work arrangement in this era, is a method which lets the employees do their professional tasks and work by relying on information technology and without going to office or conventional work places. Even though tendency towards the establishment of telecommuting system in present work places and space seems to be quite inevitable for all organizations, the role and effect of several factors such as organizational culture on creating such a tendency should be taken into consideration. The present research, based on collected data from a sample population of 447 employees of all administrations in Gilan, aims to investigate the effect of organizational culture characteristics on telecommuting strategy. The findings show that the variables of integration, control, result orientation, and stability have the greatest effect on telecommuting system strategy. Moreover, the findings of Rough Set Theory indicate that the variables of control, management support, risk taking, and result orientation affect telecommuting system strategy. The variable of control has an inverse effect on both parts.

**Key words:** Telecommuting; Organizational culture; Strategy; Rough Set Theory

### 1. Introduction

Telecommuting (telework) is actually considered as a kind of creativity in routine trend of organizational processes. Innovation in an environment essentially leads to changes in usual conditions and can change cultures and traditions which have governed the organization for many years. That is why it is necessary to know the key factors in the success of telecommuting for adopting proper strategy. Moreover, telecommuting development requires cognition and public belief in its positive and effective functions. If legal requirements and also infrastructures and supportive institutions are provided and established but the culture is not realized, telecommuting will not be popularized and will just be exclusive to certain conditions. Telecommuting requires developing culture and an atmosphere of trust and dialogue. Moreover, the development and expansion of social security systems can make organizational culture close and aligned with this domain so that tendency towards telecommuting will appear in individuals as a desire (Sakaran, 2005).

In today's modern word telecommuting is a modern way of arranging work. Telecommuting has been taken into consideration around the world and in our country in order to increase the efficiency of workforce and also the effectiveness and performance of organizations and it seems that the

workforce can improve its performance in doing the work accurately in this way during the float time through better concentration and in better conditions. This term was first used in private sector more frequently and then it became popular in public sector, as well (Khaki, 2003).

As telecommuting is a new phenomenon, there are a lot of resistance and cultural conflicts against it that should be taken into consideration in telecommuting programs. The matter becomes more complicated when we know that the type and intensity of cultural resistance will be different among different nations and even different regions of a country, and separate investigations and studies should be done to deal with them in each country or region and separate prescriptions should be provided for them in accordance with opinions there. Moreover, as telecommuting is not yet socially acceptable and the need to change usual traditional method is not felt, telecommuting system is facing fundamental barriers that indicate the significant role of culture in designing and implementing telecommuting (Robins, 2006).

### 2. Research theories

#### 2.1. Telecommuting

In some cases, application of technology has created some jobs with new features and structure which called telework (ing) generally or

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telecommuting specifically. Telecommuting is the movement of work towards employee rather than the movement of employee towards work. This phrase was stated by Jack Niles. He discussed this point in defining telecommuting which was mainly used in private sector at first and then became common in public sector (Martino and Vitorio, 2003). In another definition, it can be said that telecommuting is defined as a kind of work in which employees do their tasks in another place rather than the usual work place (Moshabaki, 1998).

The proponents of telecommuting believe that it is a "win-win situation". In other words, telecommuting has multiple benefits for both employers and employees (Gholi Poor, 2001). Of course, it seems that in global level, public sector is standing at the end of the line of taking advantages of telecommuting opportunities (Casico, 2000).

Telecommuting advantages can be analyzed in three individual, organizational, economic and social levels:

Researchers have found that as the rate of telecommuting increases, the work-based conflict decreases among family members, but when the work is interrupted the conflict increases among them (Honby, 1974).

According to a research conducted in the U.S., 85% of employers stated that telecommuting had medium to large effect on keeping and maintaining their staff. 68% of "Schering-Plough Corporation" staff that are involved in telecommuting program has stated that the possibility of telecommuting is a factor that has made them continue to work for the company (Information Resource Management Association, 2011). If the organization adapts itself to overall strategy of "flexible work" all costs related to the staff replacement can be decreased.

## **2.2. Organizational culture**

Organizational culture as a set of common beliefs and values affects the behavior and thoughts of organization members and can be considered as a turning point for dynamic movement or a hindrance to progress. It is one of the most essential principles of changes in organization. Since new programs of evolution more concentrate on fundamental changes in organizations, the main purpose of such programs is to change organizational culture as the foundation of changes. In general, organizational culture is the individuals' perception of their organization. It is something which exists neither in an organization nor in an individual. Certain features of an organization represent typical and stable characteristics which distinguish organizations from each other (Information Resource Management Association, 2011).

Many experts believe that cultural organization is a system of common perception of an organization by its members which distinguishes two organizations from each other (Ishaya and Macaulay, 1999). Hofstede (1980) believes that the role of culture in a community or organization is like an

individual's personality. As individuals' personality distinguishes them from each other, the culture of an organization or community distinguishes it from other organizations or communities, as well (Kowalski and Swanson, 2005). He has conducted extensive research in order to identify cultures and their roles in organization management and suggests that culture is a very important factor in management and application of managerial and organizational tools. In addition to the effect of communities' culture on organizations and their work methods, organizations and their new work methods affect communities, as well and many cultural elements of societies are created or changed under their influence.

## **2.3. Telecommuting and Organizational Culture**

Baruch and Yuen (2000) believe that technical limitations, telecommuting drawbacks, and culture are three main barriers to expected growth of telecommuting. They discuss the effects and importance of each one of those barriers and state that in spite of technology, some occupations, professions, and different kinds of industry are not remotely operated easily; however, recent advancements in electronic industry has decreased technological restriction of telecommuting implementation. Therefore, technology cannot be the main barrier. Telecommuting drawbacks are isolation, decrease of work teams, etc. Cultural barriers might play the main role in preventing the development of telecommuting in comparison to previous prediction levels (Lister and Harnish, 2010). Managers, by evaluating the special kind of their own culture, find it necessary to know the appropriate telecommuting methods and also the cultural barriers that must be overcome accordingly. The implementation of telecommuting in a way which opposes organizational norms will lead to failure. This means that there might be various subcultures with opposite values and if working norms of such subcultures are not taken into consideration, telecommuting will be opposed by them. Therefore, it is necessary to pay more attention to the important issue of organizational culture. In fact, trust-based organizational culture is one of the key factors to successful telecommuting (Meadows, 2007). Like support, trust is also necessary in all organizational levels. Managers should be confident that telecommuters can do and will do their tasks quite well. Telecommuters also should be confident that their managers will behave them fairly. Ultimately, if the organization culture is not trust-based, building trust between the staff and managers seems to be far-fetched. Building trust is so vital that without it telecommuting plan won't be successful even if all other things are provided (Mello, 2007). The research conducted in 2001 showed that there is direct relationship between trust and good performance and job satisfaction, but there is an inverse relationship between trust and amount of stress (Office of personnel management,

2008). Trust-based culture needs to think again about the meaning and concept of work and the way of respecting and rewarding it. The main element of trust-based culture is the result-based performance management system, and efficiency should be evaluated based on performance and the ratio of outputs to inputs not based on the consumed time at work place (Ruth and Chaudhry, 2008).

Managers need to trust the telecommuters whom they do not see and are out of their vision. Managers should trust their employees self-control and self-management and the trust should be built through empowering the employees (Overmyer, 2011).

Telecommuting development requires cognition and general belief in its positive and effective functions. If legal requirements and also infrastructures and supportive institutions are provided and established but the culture is not realized, telecommuting will not be popularized and will just be exclusive to certain conditions. Telecommuting requires developing culture and an atmosphere of trust and dialogue. Moreover, the development and expansion of social security systems can make organizational culture close and aligned with this domain so that tendency towards telecommuting will appear in individuals as a desire (Cisco, 2011).

This research is practical and developmental in objective and correlational in description. Conducting descriptive research can contribute to better cognition of current situation or assisting decision-making process. Descriptive research includes data collection for testing the hypothesis or replying the questions related to current situation of studied subject. A descriptive study determines the status quo (Thomas, 1995). A descriptive study determines and describes characteristics of the variables of a situation. Therefore, the aim of every descriptive study is to describe certain aspects of the phenomenon which are considered by the researcher with individual or organizational perspectives, characteristics, and other similar stuffs (Curtin, 1998).

### 3. Research statistical population

Research population includes all 70000 employees working in 72 administrative organizations in Gilan. This population is used to identify barriers and problems and also the rate of implementing telecommuting system. The stratified random sampling is proportional to the sample size. The sample size of 447 selected to 447 participants will be calculated through Cochran Formula.

Cochran formula for calculating sample size  $n = \frac{\frac{z^2}{4d^2}}{1 + \frac{z^2}{4d^2} - 1}$

$d = 0.04 =$  estimation error due to selecting  $n = 447$   
 $d = \frac{1.96}{2} \sqrt{\frac{N-n}{n(N-1)}}$

In order to test the validity of questionnaire content validity is used. For this purpose, at first a questionnaire was designed and submitted to the elites and after their final confirmation, the main questionnaire was designed. Moreover, in order to calculate the reliability of the questionnaire Cronbach's alpha coefficient is used because the Cronbach's alpha can nearly be used as a good indicator of internal validity and consistency (Curtin, 1998). The Cronbach's alpha coefficient is equal to 0.98 which is a good value.

### 4. Step 1: Results of inferential statistics

In order to analyse data, descriptive statistics (frequency distribution, frequency percentage) and inferential statistics (calculating correlation) were used. The data were analysed by SPSS and ROS2 software.

The general purpose of present research is to investigate the relationship between organizational culture and telecommuting (teleworking) and the research question is answered in this part

Does organizational culture, as an important factor in statistical population of the staff, affect telecommuting system strategy in administrative organizations?

Table 1: ANOVA<sup>b</sup>

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9149.976	9	1016.664	8.672	.000 <sup>a</sup>
	Residual	11371.314	97	117.230		
	Total	20521.290	106			

a. Predictors: (Constant), result orientation, reward, integration, stability, support, team orientation, risk taking, control, innovation

b. Dependent Variable: strategy

Table 2: Variables coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	15.385	4.733		3.251	.002
	control	-.303	.657	-.077	-.460	.003

stability	2.181	.481	.559	4.530	.000
Team orientation	.027	.286	.015	.094	.925
integration	.979	.717	.188	1.366	.000
Reward	-.267	.410	-.084	-.651	.517
Innovation	-.309	.319	-.195	-.968	.335
Risk taking	.464	.415	.210	1.119	.266
Support	-.207	.422	-.067	-.490	.625
Result orientation	.368	.455	.111	.810	.002

a. Dependent Variable: Strategy

With regard to statistical testing it is observed that the variables of integration, control, result orientation, and stability have the highest effect on telecommuting system strategy ( $P < 0.005$ ). Of course, there is an inverse relationship between control and telecommuting strategy. That is the more control, the less implementation of telecommuting strategy will be.

**5. Inferential Statistics Conclusion: (First step)**

According to the results which were obtained through statistical test of the relationship between organizational culture and implementation of telecommuting among the statistical population of employees and managers working in administrative organizations in Gilan Province, it was determined that the variables of integration, control, result orientation, and stability have played an effective role in telecommuting strategy. According to regression equation, the negative coefficients indicate the inverse relationship with dependent variables and as the variable of control changes one unit, the strategy changes in opposite direction as much as 30.3%.

**6. Step two: Rough set theory**

In computer science, Rough Set Theory was established by the Polish scientist professor Zdzislaw Pawlak in the early 1980 for the first time. It is difficult to find an equivalent for the term "Rough Set". Some equivalents such as tough, coarse, approximate, rude, turbulent, and uneven have been considered for the term "Rough" in Dictionary (Thomas, 1995). Among this terms "approximate" is more similar to the concept which was considered by the founder of this theory. This theory is dealing with analysis of data tables which can be obtained through measurement by professional and knowledgeable experts. Rough set theory aims to deal with uncertainty and ambiguity that we face in some issues. Rough set theory suggests a new mathematical approach for imperfect sciences such

as inaccurate and ambiguous topics. In this approach, vague concepts are expressed by a border region of a set. This theory is a generalization of classic set theories based on three-value logic for dealing with imperfect and inconsistent data and reducing them and decreasing additional data not required by databases. In this theory, data tables can be obtained through measurements or through the opinions of experts and specialists. The main purpose of rough set analysis is to achieve approximate concepts of acquired data. As it was stated, this theory is a strong mathematical tool for reasoning in cases of ambiguity and uncertainty.

The main features of this theory are:

1. Providing optimal algorithm for finding hidden patterns in data
2. Discovering the relationships that are not found through statistical methods.
3. Ability to use quantitative and qualitative data
4. Finding the minimal set of data that is useful for classification (such as reducing the size and number of data).
5. Data evaluation
6. Generating decision making rules through the data

In implementing rough set method, collected data are inserted into a specific form of data table which is usually displayed as a flat table and is called "information system" or "decision system".

Rough set theory is based on the concepts of lower approximate set, upper approximate set, and boundary region which will be defined in the following parts of the article.

The tool of the research is a questionnaire. The research question is as before.

A part of primary data, 447 subjects, along with nine predicting features and three arbitrator features are shown in Table 3;  $a_1$ : team orientation,  $a_2$ : integration,  $a_3$ : control,  $a_4$ : result orientation,  $a_5$ : reward,  $a_6$ : innovation,  $a_7$ : risk taking,  $a_8$ : support,  $a_9$ : stability and  $b_1$ : age,  $b_2$ : education,  $b_3$ : gender. These features are known as conditional mediator properties.

**Table 3:** Part of primary data (information system)

447	...	3	2	1	Staff Feature	Type of variable Predicting Variables
3	...	1	2	2	Team orientation	
3	...	1	3	2	Integration	
3	...	2	1	2	Control	

3	...	3	2	2	Result orientation
3	...	2	3	2	Reward
3	...	2	1	2	Innovation
3	...	2	1	2	Risk taking
3	...	2	1	2	Support
3	...	2	1	2	Stability
1	...	2	2	1	Establishment of telecommuting system strategy
1	...	1	1	2	Gender
2	...	4	2	3	Education
3	...	2	2	1	Age

Decision making variable

In the appendix of the research questionnaire it is written:

The features of strategic decision of telecommuting system in administrative organizations:

- Questions related to team orientation,
- Questions 1-9 related to
- Questions 10-12 related to integration,
- Questions 13-16 related to control,
- Questions 17- 21 related to result orientation,
- Questions 22-27 related to reward
- Questions 28-36 related to innovation,
- Questions 37-43 related to risk taking,
- Questions 44-48 related to support,
- Questions 49-52 related to stability,

5-point Likert scale was used in order to answer the questionnaire (1: completely disagree to 5: completely agree).

Also, intermediate variables are defined as the following:

b<sub>1</sub> = gender: 1= woman, 2 = man

b<sub>2</sub> = education: 1 = diploma, 2 = associate degree, 3= B.A. 4 = M.A. or more

b<sub>3</sub> = age: 1 = 25-35, 2 = 36-45, 3 = 46-55, 4 = 56 or more

Therefore, qualitative and quantitative items used in the questionnaire include:

{a<sub>1</sub>,a<sub>2</sub>,a<sub>3</sub>,a<sub>4</sub>,a<sub>5</sub>,a<sub>6</sub>,a<sub>7</sub>,a<sub>8</sub>,a<sub>9</sub>}

That is, team orientation, integration, control, result orientation, reward, innovation, risk taking, support and stability.

### 7. Information systems and rough sets:

In implementing rough sets method, collected data are inserted into a specific form of data table which is usually displayed as a flat table and is called "information system" or "decision system". Information system (IS) is an ordered couple (U,A). U is a non-empty set of objects and A is a non-empty set of attributes and V<sub>a</sub> set is usually called the values of each attributes of a in A.

$$\forall a \in A [a: U \rightarrow V_a]$$

Decision system (DS) is an ordered couple ((U, A ∪ {d}). d ∉ A is a decision feature but A and B are conditional features.

Columns

{a<sub>1</sub>, a<sub>2</sub>, a<sub>3</sub>, a<sub>4</sub>, a<sub>5</sub>, a<sub>6</sub>, a<sub>7</sub>, a<sub>8</sub>, a<sub>9</sub>, b<sub>1</sub>, b<sub>2</sub>, b<sub>3</sub>, d} display features and lines display inputs and objects. Cells contain features values of each object. As mentioned before, there are two kinds of features including conditional feature {a<sub>1</sub>,a<sub>2</sub>,a<sub>3</sub>,a<sub>4</sub>,a<sub>5</sub>,a<sub>6</sub>,a<sub>7</sub>,a<sub>8</sub>,a<sub>9</sub>, b<sub>1</sub>,b<sub>2</sub>,b<sub>3</sub>} and decision feature {d}. In rough set glossary, such a table is called information system.

If the scores are as follows, in order to observe hidden continuum system in Likert 5-item system with the features value range of V<sub>a</sub> = {1, 2, 3, 4, 5}, for i = 1, 2, 3, 4, 5, 6, 7, 8, 9 the values of conditional features and their cells are classified into the following continuum categories. In order to simplify coding, the element x<sub>i</sub> in U is shown by the symbol of i.

It is natural that the value range of feature can be classified and divided into minor scopes and instances in proportion to the size, scope, and number of available values for these features (|V<sub>a</sub>|). For instance, a three-point scale can be used instead of Likert's 5-point scale. Obviously, this division corresponds to a partition of the domain (0.5, 5.5) to the following sections:

$$[0/5, 2/17], [2/17, 3/83], [3.83, 5/5]$$

$$(a, 2/17), (a, 3/83), (a, 5/5)$$

$$\text{Class 1} = [0/5, 2/17] = 1 = \text{Low}$$

$$\text{Medium} = [2/17, 3/83] = 2 = \text{Class 2}$$

$$\text{High} = [3.83, 5/5] = 3 = \text{Class 3}$$

The values of decision feature equal to:

$$V_d = \{Y, N\} = \{\text{yes, No}\}$$

$$X_1 = \{x \in U \mid d(x) = y\} \quad X_2 = \{$$

$$x \in U \mid d(x) = N\}$$

Therefore:

$$= \{3, 4, 6, 7, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24\}_X$$

$$X_2 = \{1, 2, 5, 8, 9, 10, 15, 23\}$$

Therefore, with regard to analysis model and number of indices for measurement and evaluation of each feature, 24 rules were obtained through 447 samples which are displayed in Table 4.

Table 4: Extracted rules

N	a <sub>1</sub>	a <sub>2</sub>	a <sub>3</sub>	a <sub>4</sub>	a <sub>5</sub>	a <sub>6</sub>	a <sub>7</sub>	a <sub>8</sub>	a <sub>9</sub>	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	D	N
1	1	1	3	1	2	1	1	1	1	1	1	1	2	19
2	2	2	3	1	3	2	1	1	1	1	2	2	2	19
3	3	2	1	3	1	1	3	3	3	1	3	2	1	14
4	1	3	1	3	2	1	3	3	3	2	3	2	1	17
5	1	1	3	3	2	1	1	1	1	1	3	2	2	11

6	2	3	1	3	2	1	2	2	3	1	3	2	1	19
7	2	3	1	3	2	1	3	3	2	2	4	1	1	18
8	2	1	1	1	2	1	2	1	2	1	1	1	2	21
9	2	1	2	2	2	1	2	1	1	1	2	1	2	19
10	1	1	3	3	2	1	1	1	1	1	3	2	1	15
11	3	2	1	2	3	3	2	3	3	1	3	2	1	18
12	2	2	1	2	3	2	3	3	3	2	3	2	1	12
13	3	2	2	2	3	3	2	3	3	2	3	3	1	19
14	1	2	1	3	2	3	3	3	3	2	3	2	1	18
15	3	1	3	2	2	2	1	2	1	1	2	4	2	15
16	1	2	2	3	3	3	3	3	3	2	4	2	1	22
17	3	3	1	2	1	2	3	2	3	3	3	2	1	11
18	3	2	1	2	3	3	3	3	2	1	3	2	1	19
19	2	2	2	3	3	3	3	3	3	1	3	2	1	18
20	2	1	2	3	2	1	2	1	1	1	2	1	1	21
21	2	3	1	3	2	2	3	3	3	1	3	2	1	12
22	3	2	1	3	1	1	3	3	2	2	2	2	1	17
23	2	2	3	2	3	3	1	1	2	2	2	2	2	19
24	3	1	1	3	2	2	3	3	3	1	2	2	1	20
TOTAL														413

Estimation error of n= 413 responses equals to:

$$d = \frac{1.96}{2} \sqrt{\frac{N-n}{n(N-1)}} = 0.0133$$

In fact, the conceptual set of  $x_x$  consists of the staff that believes organizational culture influences telecommuting system implementation.

And conceptual set of  $x_o$  consists of the staff that believes organizational culture does not influence telecommuting system implementation.

Note that Table 1 contains contradictory and inconsistent data. For instance, data 5 and 10 have similar conditional features without considering intermediate conditional features, but decision values are different for them.

In such condition, rough set theory suggests a simple and easy solution for the measurement and distribution of contradictory data so that from the two contradictory sets, the one which is more definable and more believable is calculated and estimated. Therefore, the set which is more believable is considered as the lower approximate set and the other set is considered as the higher approximate set.

As it is observed, individuals have similar values and are indiscernible with such features. In general, if  $A = \{a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9\}$  is the set of features and  $\emptyset \neq B \subseteq A$  is a favorite and non-empty set, then the following equation is called indiscernible equation of objects in relation to B:

$$I_B = \{(x,y) \in U^2 \mid \forall a \in B, a(x) = a(y)\}$$

In other words, if x and y are objects and the value of each feature in the set of B is similar in these two objects, then (x,y) is in  $I_B$  equation and -B is indiscernible.

In many classification issues, the output is already clear. Output classes label is called decision attribute. Information system which contains decision attribute is called decision system.

Number of non-empty subsets of conditional attributes

$$N = |Sub(A) - 1| = 2^{|A|} - 1 = 2^{12} - 1 = 4095$$

A categorization (classification) can be derived from the set of objects through an equivalence

relation. To do so, the subsets which have the same values in terms of decision attribute are considered.

Suppose an information system  $S = (U, A)$  in which U is the set of objects and A is the set of features. For  $\emptyset \neq X \subseteq U$  and  $\emptyset \neq B \subseteq A$  two sets are defined as the following:

$$BX = \{x \mid [x]_B \subseteq X\}$$

$$\overline{BX} = \{x \mid [x]_B \cap X \neq \emptyset\}$$

Which are respectively called B-lower approximation and B-upper approximation.

$\overline{BX}$  and  $BX$  sets possibly owns objects belonging to X with regard to B definition.

The set of  $BN_B(X) = \overline{BX} - BX$  is called B-boundary region of X and contains objects that might not definitely belong to X. If  $BN_B(X) \neq \emptyset$  then X is a rough set in relation to B.

In this research,  $X_x = \{x \mid d(x) = y = \text{yes}\}$  that is  $X_1 = \{3,4,6,7,11,12,13,14,16,17,18,19,20,21,22, 24\}$

This means that the staffs with numbers 3,4,6,7,11,12,13,14,16,17,18,19,20,21,22,24 believe that organizational culture affects telecommuting system strategy.

The reducts and the core of above table can be obtained by means of Rose 2 software as the following:

- 1- {a1, a2, a4, a6}
- 2- {a1, a3, a4}
- 3- {a2, a3, a4}
- 4- {a3, a4, a5}
- 5- {a3, a4, a6}
- 6- {a1, a2, a4, a8}
- 7- {a1, a4, a5, a8}
- 8- {a3, a4, a8}
- 9- {a1, a4, a7}
- 10- {a2, a4, a7}
- 11- {a4, a5, a7}
- 12- {a4, a6, a7}
- 13- {a1, a4, a6, b1}
- 14- {a2, a4, a6, b1, b3}
- 15- {a3, a4, a9}
- 16- {a1, a4, b1, b2}

- 17- {a2, a4, b2}
- 18- {a1, a4, a8, b1}
- 19- {a4, a7, a8}
- 20- {a3, a4, b2}
- 21- {a4, a7, b2}
- 22- {a4, a8, b2}
- 23- {a3, a4, b1}
- 24- {a4, a7, a9}
- 25- {a1, a4, a9}
- 26- {a3, a4, b3}
- 27- {a4, a7, b3}
- 28- {a4, a9, b1, b3}
- 29- {a4, a8, b3}
- 30- {a4, a9, b2}

The resulting feed of all above reduces is the core and the set of attribute is {a4}.

If B = {a1, a2, a4, a6} then

U/B

= {{1},{2},{3,22},{4},{5,10},{6,7},{8},{9},{10},{11,13,18}, {12}, {14,16}, {15}, {17}, {19,23}, {20}, {21}, {24}}

External area includes all those objects that do not definitely belong to X<sub>1</sub>. In fact, rough set is a set whose boundary region is not empty; otherwise, it is called a normal set. Therefore the decision class of X<sub>x</sub> = {x | d(x) = y = yes} is a rough set because its boundary region is non-empty.

U/D = {X<sub>1</sub>, X<sub>2</sub>}

According to the definition, the sets of  $\overline{B}X_1$  and  $\underline{B}X_1$  include:

$\underline{B}X_1 = \{3,4,6,7,11,12,13,14,16,17,18,20,21,22,24\}$

$\overline{B}X_1 =$

$\{3,4,6,7,11,12,13,14,16,17,18,19,20,21,22,23,24\}$

$BN_B X = \{19, 23\}$

$U - \overline{B}X_1 = \{1, 2, 5, 8, 9, 10, 15, 19, 23\}$

### 8. Dependency of attributes

In analyzing data, it is important to find the relationship between conditional and decision attributes. Through dependency of attributes it is possible to eliminate those which are not important. If T<sub>d</sub> is total set of decision attributes and T<sub>c</sub> is total set of conditional attributes, the dependency between them is displayed as: T<sub>c</sub> = > T<sub>d</sub> which means that all decision values are obtained from conditional values. Of course, there might be a slight dependency, too. The formal definition of this property is:

If C is a non-empty subset of A and if D is the set of decision attribute, then D depends on C with degree of k (0 < k < 1) (symbolic form:  $C \Rightarrow_k D$ ) if:

$$K = \gamma(C, D) = \frac{|\underline{C}X|}{|U|} = \frac{1}{|U|} \sum_{x \in U/D} |\underline{C}X|$$

k =  $\frac{|\{3,4,6,7,11,12,13,14,16,17,18,19,20,21,22,24\} \cap \{1,2,\dots,24\}|}{|\{1,2,\dots,24\}|} = \frac{16}{24} + \frac{8}{24} = \frac{24}{24} = 1$

If k = 1, it means that D completely depends on C.

Through the use of Rose 2 software, reduces are obtained and decision rules are deduced. However, instead of the long and perhaps boring method, a

$$\alpha_B(X) = \frac{|BX|}{|U|}$$

$$\alpha_B(X) = 15/17 = 0/8$$

If  $\alpha_B(X) = 1$ , the set of X is usual and if  $0 < \alpha_B(X) < 1$  the set of X is rough.

Decision attribute values are equal to:

$V_d = \{Y, N\} = \{ \text{yes, No} \}$

$C_1 = \{x \in U | d(x) = y\}$   $C_2 = \{x \in U | d(x) = N\}$

$$K = \gamma(B, D) = \frac{Cord(Pos_B D)}{Cord(U)}$$

In which:

$$Pos_B D = \bigcup_{x \in U} \underline{B}X$$

Therefore,

$$Pos_B D = \underline{B}X_0 - \underline{B}X_1$$

And

$X_0 = \{x \in U | d(x) = NO\} = \{1, 2, 5, 8, 9, 15, 23\}$

$X_1 = \{x \in U | d(x) = YES\} = \{3, 4, 6, 7, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 24\}$

$\underline{B}X_0 = \{1, 2, 8, 9, 15\}$

$\underline{B}X_1 = \{3, 22, 4, 6, 7, 11, 13, 18, 12, 14, 16, 17, 20, 21, 24\}$

If B = {a1, a2, a4, a6}, then U/B = {{1},{2},{3,22},{4},{5,10},{6,7},{8},{9},{10},{11,13,18}, {12}, {14,16}, {15}, {17}, {19,23}, {20}, {21}, {24}}

Therefore, for the true implication of  $B \Rightarrow_D$  we

have:

$Pos_B D = \{1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 22, 24\}$

$$\gamma(B, D) = K = \frac{20}{24} = 0.83$$

second method can be used in calculating discernibility matrix and Boolean algebra, and reduce and discernible matrix can be set out of it as follows.

### 9. Rough conclusion

#### 9.1. Definite Rules

Rule 1. (a8 = 3) => (d = 1)

{}, {24, 22, 21, 19, 18, 16, 14, 13, 12, 11, 7, 4, 3}

Rule 2. (a2 = 3) => (d = 1)

{}, {21, 17, 7, 6, 4}

Rule 3. (a1 = 2) & (a4 = 3) => (d = 1)

{}, {21, 20, 19, 7, 6}

Rule 4. (a3 = 3) & (b2 = 2) => (d = 2)

{23, 15, 2}, {}

Rule 5. (b2 = 1) => (d = 2)

{8, 1}, {}

Rule 6. (a4 = 2) & (b2 = 2) => (d = 2)

{23, 15, 9}, {}

#### 9.2. Possible Rules

Rule 7. (a4 = 3) & (a7 = 1) => (d = 1) OR (d = 2)

{5}, {10}

The Findings of the first rule of the research indicate that if a<sub>5</sub> component (management support) is high, decision variable is yes, i.e. it has a positive effect on implementation of telecommuting system strategy.

Therefore, telecommuting success as a phase of changing traditional work arrangement process into information era depends on management ability to lead this transition. Manager's cognition of staffs abilities, information technology capabilities, and his accompanying and high understanding of telecommuting process will play an important role in designing new routes of telecommuters' and organization's success.

Telecommuting acceptance and implementation mean applying organizational work changes in work place into various places using information systems and information and communication technology which requires the perception of its benefits and the rate of its effects on individuals and organizations. By explaining and informing describing the benefits and advantages of telecommuting and arranging supportive and encouraging rules and regulations and senior executive supports a suitable and successful ground will be provided for implementation of telecommuting.

a set of barriers and disincentives might disturb the establishment trend of telecommuting program as a new method of doing work that through identification and managerial and professional measures such factors should be eliminated, changed, modified, and in some cases prevented. Therefore, in order to have a successful telecommuting program, managers should arrange information technology strategy and telecommuting policy of the organization and should minimize possible risks by training the staff, increasing their abilities, improving telecommuting security and its implementation programs along with providing checklists for telecommuting implementation. They should also help the staff make a relative balance between work and life at home.

The rules 2 and 3 indicate that if integration (a<sub>2</sub>) and team orientation (a<sub>1</sub>) are high, they will have positive effects on implementation of telecommuting system. Good situation, good staff, and staff attitude towards telecommuting are among the work force issues which should be taken into considerations by organizations while implementing telecommuting programs. Even though technology can facilitate cooperation, Tremblay (2002) showed that telecommuting is more appropriate for individual participation works. According to Meadows (2007) telecommuters must be able to work independently and they should be self-motivated and result oriented and they should completely understand functions and procedures (Cisco, 2011).

Krandal and Gao (2005) have predicted that telecommuters are afraid to lose the opportunity to participate in good projects and to lose advertising chance. Mello (2007) has shown that loss of communication with managers and colleagues

makes the employee feel insecure about their position in organization (Overmyer, 2011).

The rules 3 and 6 show the importance of result orientation (a<sub>4</sub>), i.e. the rate of management attention to the results or consequences, not methods and processes that should be used to achieve those results.

The subsequent rules also show that as control increases (a<sub>3</sub>) telecommuting strategies will actually respond later. The managers have to trust the telecommuters that they don't see and that are away from their vision. Managers should first trust self-controlling and self-management of their own staff and the trust must be build up by enabling the employees. Taylor believes that confidence is important since it causes a strong tendency towards understanding how to participate effectively within the organizations. Confidence in virtual organization is more important than that of traditional organization since it plays a special role in alteration and instability conditions. When traditional rules, regulations, policies, criteria, and principles are not governing anymore, people turn to individual relationships for guidance and the quality of such relationships is largely determined by the level of confidence.

Ishaya and Macaulay (1999) investigated confidence in electronic teams working in electronic organizations in three levels of technology, media, and society in a general division. Since information and communication technology is the background for implementation of telecommuting, in order to build up trust in this background we should make the factors related to information and communication technology reliable on one hand, and we should make a common understanding among managers and employees in their relationships with each other on the other hand, so that diversity and rate of changes will not extend unreliability (Office of personnel management, 2008).

Kowalski and Swanson (2005) believe that confidence is the most vital factor in the success of teleworking. Managers should trust their employees' self-control and self-management by enabling them (Ruth and Chaudhry, 2008).

The rules 4, 5, and 6 shows that if people have low level of education (b<sub>2</sub>), that is diploma or associate degree, it will have a negative effect on strategic implementation of telecommuting.

a set of barriers and disincentives might disturb the establishment trend of telecommuting program as a new method of doing work, so through identification and managerial and professional measures such factors should be eliminated, changed, modified, and in some cases prevented. Therefore, in order to have a successful telecommuting program, managers should arrange information technology strategy and telecommuting policy of the organization and should minimize possible risks by training the staff, increasing their abilities, improving telecommuting security and its implementation programs and providing checklists for telecommuting implementation. They should also

help the staff make a relative balance between work and life at home.

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