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Agent-Based Model Developed to Assess Supply Chain Agility (Case Study: Institute of Higher Education, Science and Research Branch of Tehran)

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Abstract. Agility of the supply chain is one of the main challenges in organizations which acting in a dynamic and complex environment, which they have to be able to answer to customers quickly. But the agility of supply chain is influenced by different agents. Using the model based on agent, this study has tried to simulate the agility of supply chain in an institute of higher education. There are three impressive elements are used in this model called as: smooth, offender and fault case, which those are

also categorized in two groups impressive and impressible. There is a model is designed by using NETLOGO software which examines the impression and impressibility on each other. After executing the model at the case studied university at point of Time-769, the organization's improvement will be possible in the best estate. All offender elements are reduced at this point.

Keywords: Agents, Agility, Educational Organizations, Model of Agent Base, NETLOGO, Supply Chain.

1. Introduction

Entering to 21st century, organizations and individuals are experiencing new phenomena and events which their roots may were growing since many years ago. By entering of IT element in each domain, there is necessity for promptitude and answering to customers and increasing changes at market and consumer's needs, more flexibility in organizations and production, moving toward agile term within the organization. This concept which is aroused from new organization's need is considered as one the most important evolutions and new approaches at management filed and organization by creating a network in physical, figurative domain and eliminating wastages in organizations.

2. Literature review

One of the concepts or paradigms by less than two decades of ages is agile term which is derived from need of new organization seeking to accomplish the previous approaches such as manual production, mass production and pure production. On the other hand, during the recent two decades, the supply chain management is discussed as one of the most important agents in competition and success of organizations and considered by many researches and experts in field of production and operation management (Chopra and Meindl, 2013). Today, following agile term in supply chain as a synthetic concept is attracted by many managers and experts and researches are trying to represent new aspects of this new-fangled concept.In the competitive market, there is an urgent need to develop and improve flexibility as well as organizational accountability. Today, many organizations and companies are faced by

increasingly uncertain competition that has intensified through technological innovations, changing market environments, and changing customer needs. This critical situation has led to major reforms in the strategic vision of the organization. So that past approaches and solutions have lost their capability to face organizational challenges and external environment, and strategic plans of the organization are replaced with new approaches and perspectives. One of the ways to respond to these factors is organizational agility. In fact, agility is a new paradigm for engineering firms and companies (Chan et al., 2017).Agility, before being a technique or method, is a state of acceptance and psychological vigilance for dealing dynamically with unpredictable issues for organizations and individuals that, by becoming an organizational culture through the training and support of the leader of the firm, it provides an equilibrium balance between flexibility and stability. And finally, agility leads to the benefits of lowering costs, especially in the service sector, increasing market share, customer satisfaction, preparation for introducing new services, evaluating and evaluating activities with no added value, increasing intra-organizational and outsourcing competition and employee satisfaction. Competitive organization will be organized (Rajabzadeh Qotri et al., 2012).Of course, it should be noticed that most experts believe that the realization of agility in service organizations requires the support of agents (employees) from the agile organization as a value (Martinez-Sanchez, & Lahoz-Leo, 2018). Leadership support in this area can also be emphasized on the agility culture in the organization and the creation of a learning organization by allocating appropriate rewards for prediction, acceptance of change and rapid adaptation to it. Senior managers can also aggravate the agility factors by motivating them to enrich their jobs, delegate more power and also own work by working teams. This agility can be found at the levels of collaboration such as collaboration and interaction between stakeholders in evolution: (continuous delivery of services), effectiveness (increased service quality), adaptability (increasing the speed of responding to changes and rapid feedback), and enveloping (preparing the organization's environment for the acceptance of the principles and agility culture) is achieved for the organization (Mansouri et al., 2017).Today's capability to respond the complexity of the environment is

one of the biggest efforts of each organization, due to the shorter duration of product and technology usage for various reasons. In a way that even competitive pressures have inevitably led to more changes in products, and consumers have wider needs. The organization has to use agility to deal with a complex and competitive environment in such a way that it can respond in a shorter time period both in terms of volume variations and under changing conditions (Kalantari, Khoshhalan, 2018). Organizational agility refers to the ability to respond and to respond quickly and successfully to environmental changes. Like producers, other organizations and institutions have to look for agility to compete in the 21st century, as modern organizations are increasingly struggling to enter the global dynamic market to find new ways to compete. Agility enhances the organization's ability to deliver high-quality products and services, resulting in an important factor for organizational productivity (Mirghafoori, 2017).Agile supply chain is usually considered as a structure to meet the needs of customers and employees, given the speed of accountability and the diversity of services or products. This structure is supported by four principles: mastery of change and uncertainty; creative management structures and virtual organization; collaborative and coordinated communications; and smart and flexible technology. These four principles are supported by various factors in the organization, which can create a coherent, coherent and disturbed system, which determines how the supply chain will be agile and how these factors interact and conflict (Blome et al., 2013).In spite of many people have introduced components and indexes of supply chain evaluation within less than one decade, but in general, one group have centered the main phases of supply chain means supplies, manufacturing and distribution (such as Giannakis & Louis, 2016) and another group have centered the elements effected on agile means motives, capability and enablers and tried to represent the index of these elements in supply chain (Hogenboom and et al., 2015). In the present study, the researcher is looking to introduce the elements and indexes of evaluating supply chain agile as impressive and impressible agents. In the other words, evaluation indexes of per agile elements within main procedures of supply chain will be determined and validated based on agents because organizational agents have important role in increase or decrease that

organization's agile at supply chain of each organization. Since the subject of supply chain agility is considered so important by key responsible among service companies especially universities and High institutes and on the other hand, there is no serious study in this regard, therefore, the Science & Research University of Tehran as one of the biggest and best High Education Institutions in Iran is chosen for this reason. The present study has a glancing review over subject literature of supply chain agile based on agents as well as has evaluated and represented impressive and impressible agents in agile supply chain and also existing relations and differences between different service processes among agents. Indeed the necessity and importance of supply chain is obvious considering to promptitude, answering to customers, increasing changes of market, consumers' needs and etc either scientifically or experimentally in many industries, still universities and High Institutions who are producing mentioned researches have not much attention to these issues and design and development of their own supply chain's agile. Same as other organizations, the universities are founded and programmed based on particular agents. The particular agents used in universities are such as: human force, equipments, buildings, software, etc. but all these agents are under influenced by three general agents means smooth, offender and fault case agents (This will be reviewed briefly at Model Simulation section). The contrast and relation among three above motioned agents determine the agile in the organizations (Tizro, 2011).There is need to many random data with different domain in order to modeling the supply chain agile as well as evaluating the relations of brisk organization considering to impressive and impressible agents on that organization, full of calculations, figures and mathematical formulas are controlling and calculating by different algorithms. According above requirements, NETLOGO and MATLAB software can be used. MATLAB software is more powerful comparing to NETLOGO at algorithmic estimations but it is not able to produce different spans of random data, creating dynamic and graphic environment, management and guiding the modeling and etc, so, this study is used NETLOGO programming language. Considering to above discussion, the main reason of this study can be defined as evaluating

and modeling the agile supply chain based on agents using NETLOGO software in high education institute.

3. Method

The first agility studies conducted by Kid (1994) in the field of agility of production were provided by agility generators of production. Subsequently, Identity (1996) presented the agility model of the organization with an emphasis on the existence of an environmental perception system and multi-tasking staff. Sharifi and Zhang (1999) also, by studying the organization's agility among automotive companies, provided an agility model that included stimuli, empowerment, capabilities, and agility results. Researchers such as Gannaskaran (1998) studied the role of information technology in creating an integrated and agile system for agility for agility (Ahmadi et al., 2016). According to Charlene (2011), in a study titled Measuring Agility in Manufacturing Companies in Taiwan, given the many pressures that environmental factors bring to the organization, how organizations react to this uncertainty, a measure of size Their performance is theirs (Charlene, 2011).

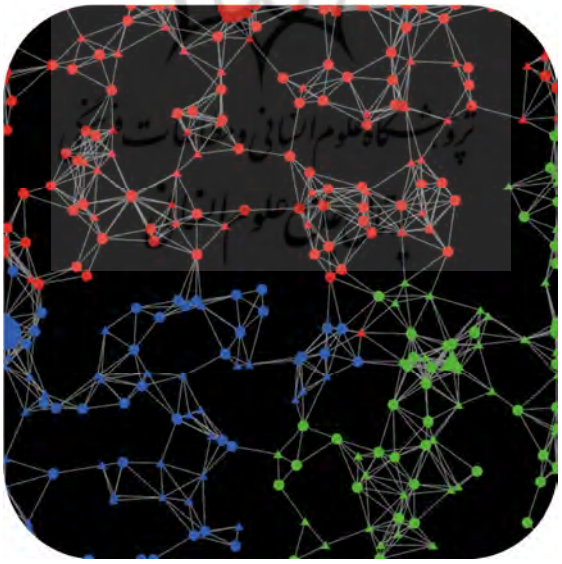

Figure 1: Combination of smooth, offender and fault case elements together

In order to simulate the supply chain, first, there is a need to express the elements that have a direct impact on agility in the organization (whether negative or positive). These elements in the organization have a special reaction. But in simulation, they first need to have a random function to send the random number to the main body of the simulation at any time, and each time the randomization function is repeated, it determines the number of three elements of intent (deliberately or inadvertently), soft, and bleak. Which constitutes the group's devious elements that prevent learning and attempts to advance change but are present in the organization. Smooth are a group that is well adapted to changes in the working environment and corrective laws. Fault elements also form a group that not only resists but also resigns. For example, the element that has the greatest impact on making changes in an organization is employees. In this issue, employees are divided into three categories: soft employees, recruited employees, and employees of the purveyor. The soft and distorted elements of the two elements are completely distant and different, which helps us to conclude accurately about the agility of the organization. In the third row, there are bleached employees who have half of the traits of the tragic and soft elements and draw the conclusion carefully to the point of weakness. The figure shows the elements that are trace elements, red blue elements, and green elements. In simulation world, there are not only impressive (staffs) but also impressible ones too. The impressible ones are divided to two large and small categories. Large impressible include small universities and sub-categories which have to be evaluated in which time period they adapt themselves with changes and this time period must to be simulated which each needs a different algorithm. Small impressible ones include students and clients in organizations who have to show flexibility toward changes, not only their traits are important and necessary but also their number and population playing important role. Obviously the more above mentioned parameters and their affect on population are considered more general, they more they are closer to reality and show better behavior of population.

This model in NETLOGO software is formed by four switches which evaluate the probable management change, simulation speed, simulation duration, simulation relativity sensor of agents compared to each other,

society volume, groups counter. By these switches, user is able to manage three main agents. It should be mentioned that as software program writing is not important in this how know, so its reported are avoided and only the theoretic principles will be discussed. All above switches are modeled according the scenarios categorized into two optimistic and pessimistic scenarios in NETLOGO modeling language. In order to suppose optimistic estate for supply chain agile of organization, at first step, it depends in elements of organization and impressible obligatory. In optimistic scenario introduced to software, the offender elements will be changed to smooth elements by special trainings and intestinally or unintentionally heedless encourages, and impressible improve mentally and psychologically. In simple terms, there remain only fault case and smooth elements and gradually, organizational protocols release from disturbance to increase the agile to higher degrees. Therefore, the impressible have to choose another way to decrease their sensitivity and being more resistant. After training for not a much long time, the organization improves agile with a little doubt and confusion and only smooths and fault case elements are survived. Therefore, the elements which cause the improvement to decay are declined to 60%; this shows a climax in agile progress. In pessimistic scenario, if organization continues the past procedure continuously for many years and does not think about training or eliminating its own elements in the way that are main base of organization, then it will be ruined gradually. The disturbance will be appeared among elements and impressible reach to dualism and collapse. No action will be performed in the right way. Impressible resist against changes. Not only changing regulation will affect them positively but also this will itself cause convulsion between elements and impressive. More clearly, in this stage, impressible begin to make negative effect on impressive and this is the point in which ruination will be started. When impressive feels cannot have any effect so they force to give up to the management mistakes. Now if the elements, impressive and impressible get together more precisely, their impressiveness on improvement will be perceived considering to the discussed outlines that the best condition of agile improvement is time taking and costly.

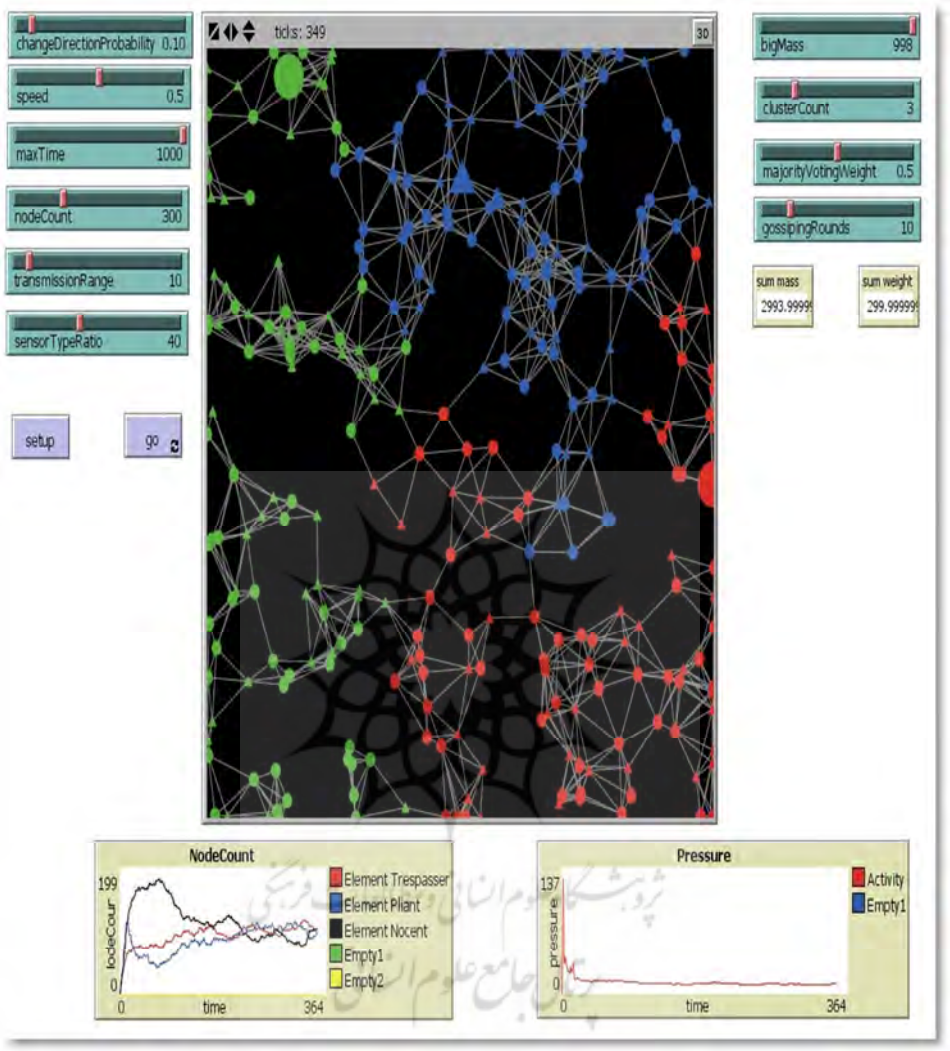

Figure 2: PSO algorithm to create agility in software NETLOGO

Oppositely, in worst possible estate (elements inflexibility) all the components disrupt agile during longer time period but concordant. This approves the impressibility of all the raw problem's variables. Means agile reduction influenced by impressive and offender people create deflation among smooth and fault case elements due to created divergent atmosphere. In order to make this scenario practical, there is need to use an algorithm leads other elements those are doing well their

responsibilities to deflation in case other elements' deflation and this is completely logical which without it, our simulation will be far way real world. This study is used artificial intelligence model algorithm PSO considering to presented scenario to simulation of above matters in NETLOGO software.

4. Findings

As already said, the elements are divided into three categories those are simulated based on introduced scenarios. After model simulation, the model conclusions will be analyzed and evaluated at different spans and periods to evaluate the effect of elements on each other considering to the figure given to different elements. Studying impressibilities of output variables from input variables, a method can be designed to change model input organizationally by which effects of these changes can be forecasted. Below figure shows Venchrall algorithm performance. The more this schema quantity develops, the more elements taking apart from each other and this distance can be seen clearly in Node count schema.

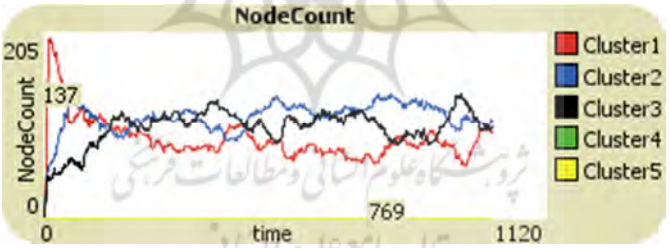

Figure 3: The elements act schema

As you can see in above figure, three modeling elements are taking apart from each other. In this schema, the more offender elements (red diagram) reduce and smooth elements (blue diagram) increase, the more agile of organization improves vice versa. The distance between diagrams is not physical distance but only their common traits taking apart from each other and finally, all the common traits will be eliminated. Elimination of similar traits is normal in modeling and shows particular and exemplar differences between destructive and improvement elements. Generally, the graph introduces the behavior of elements and

effect of each of them on improvement, either positive or negative. In above graph at pint Time=769, organization improvement in best estate is possible. Also, the amount of total agile in Pressure schema, graph, is shown. If there be the oscillations through constancies to this schema, it causes a more precise result after a long function.

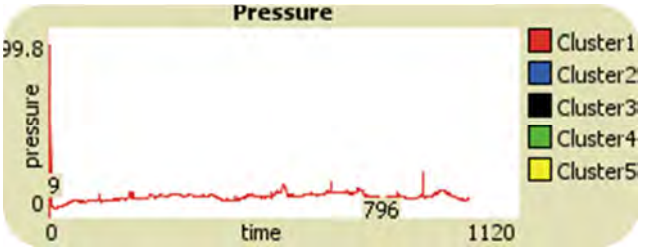

Figure 4: Total agile schema

If negative jump occurs in Pressure schema, referring to Node account schema it can be well perceived that which element causes agile deflation. Mostly seeing that there is a downfall in triple elements but total schema does not change. No need to attention to this downfall and it called unreal downfall because it is emerged only due to decrease in node level. Moreover, if improvement decreases significantly in Pressure schema, Sensor Type Ratio can increase improvement in the way defined for it.

Both two above schemas show the relative level of agile position and elements behavior. To determining the agile level in an organization, two Sum weight and Sum mass monitors are used which indicate numerical quantity of agile improvement; in such a way that both indicate improvement related to 300 and 3000 and this amount can be managed by Node count switch. At point Time=769, two mentioned monitors show below numerical amount.

Figure 5: The results of two monitors at point TIME: 769

Also, Node count switch not only increase the congestion of nodes but also the amount of Sum weight and society weight. The supposed

amount of this switch is 300 and amount of Sum weight monitor will change only by increase or decrease of this switch. Moreover, it increases precision amount of improvement measurement by increase of decimal part. When these monitors are zero, then it accelerates amount of node's motion and move more while, when switch amount increases, it has less move, therefore, the precision of measurement increase higher. Mostly it is needed to increase or decrease the quantity of sub-faculties of a university that this will increase or decrease nodes amount by using this switch.

In case at the first place, it is assumed that all the elements have a steady effect on model, it can be seen that model's output will be different in per training and this is due the risk existed in relation among elements because all the elements don't stultify each other with impressive even when impressible are similar. The more time passing, our risk will be smaller. While the risk amount of model is very small, it absolutely cannot be ignored. The amount of element impression with an algebra constant will be calculated in used model in the way that times being unequal. This is an action to avoid error occurrence related to different abilities of people in different work shifts. The model standards are the same figures and numbers which are prepared by which the group categories are including elements being determined. Table 1 shows amount of elements effect considering to model risk ability and achieved output.

Table 1: General risk ability amount

Elements impressive amount	Time	Model standards	Concentration time	Impressive	Risk amount in percent	Model output
0.13	0	-1.59	0	0	0	0
0.13	0.5	-1.42	0.09	0.17	0.09	48.3
0.13	1	-1.24	0.15	0.17	0.06	33.87
0.13	1.5	-1.06	0.20	0.17	0.05	30.01
0.13	2	-0.88	0.25	0.17	0.05	27.75
0.13	2.5	-0.71	0.29	0.17	0.05	26.18
0.13	3	-0.53	0.34	0.17	0.04	25.00
0.13	3.5	-0.35	0.38	0.17	0.04	24.05
0.13	4	-0.17	0.42	0.17	0.04	23.27

Elements impressive amount	Time	Model standards	Concentration time	Impressive	Risk amount in percent	Model output
0.13	4.5	0	0.46	0.17	0.04	22.61
0.13	5	0.17	0.50	0.17	0.04	22.04
0.13	5.5	0.35	0.54	0.17	0.04	21.54
0.13	6	0.53	0.58	0.17	0.04	21.09

If concentration time is more than 20, sum mass output is more, but in case mode standards are more than -1. As it can be seen in above table, if numbers are less than 1, model output is descending and as a result, it puts agile into risk. If risk increases, output will start increasing and ascendant path. While, focus changes considering to Venchrall algorithm and affect final result of sum mass and sum weight. If ten inputs are assumed same as table 2, then model output indicates the effect amount on elements as below.

Table 2: Comparison of inputs and outputs

	1	2	3	4	5	6	7	8	9	10
X input	2	3	6	7	8	6	8	9	10	8
Y output	1	2	4	4.25	4.5	1	2	3	4.4	4

Table 3: Sensitivity schema

Single agile amount	Characteristic interference	Non-presence risk amount	Presence risk amount	Impressionability amount	Impression amount	elements
1.415	0.147	0.614	0.190	0.249	0.677	offender
1.283	0.141	0.391	0.115	0.098	0.414	smooth
0.525	0.141	0.713	0.207	0.263	0.844	Fault case

In table 3, risk ability amount is calculated based on random numbers, output and determination of improvement risk during eliminating two offender and fault case elements. The impressiveness of above table is completely random and agile amount of each element is shown individually. The best estate is when characteristic interference is in its possible least amount to increase and decrease risk ability. It should be mentioned that for each elements, its worst not presented in system that being presented and this increase risk amount because impressionability

and impressiveness of each element is different and have to be modeled according to that element's role dynamically at the model. Risk ability amount of elements are presented in table 4.

Table 4: Risk ability according to elements

Low impressiveness	High impressiveness	
0.249	0.677	Offender
0.098	0.414	Smooth
0.263	0.844	Fault case

If impressiveness reaches to 1 at first level, we will not have a good result because there is an increase in impressibility at other two rows taking similar behavior from offender elements and this is completely understandable in real world. At the present, these elements have same impressibility but according to model offender elements are 1.5 more than impressiveness of smooth elements and if this example of agile number span don't control and manage rightly, then organization will lead to ruin.

5. Discussion and Conclusions

At the present essay, the agile model of supply chain was modeled based on agent. In this model, three different elements analyzed and evaluated. Considering to analysis and evaluation of schemas and tables, it can be observed that even if model avoids the elements which lead improvement to ruin, there is no guarantee to increase agile amount and only impressive elements can control organization from created risks by offender elements. Because the impressible are fix in each stage of model but their parameters are continuously changing. In this parametric change, not only their amount changes but also the estates change according to functions that this is a characteristics of impressible inconstancy and help to create the organization's view and elements. By using random numbers span table 5 shows the results on smooth and impressive elements according to organization, population and standards and evaluates the smooth elements by ignoring other elements. Of course, it has to be noted that impressive domains are not completely

random and its 50% adds to random figures according to population crowd.

Table 5: Random spans

Sum weight	**input**		
output	impressive	Smooth elements	**Random numbers span**
79.04	1331599	146186	0-1500000
59.75	1867047	922424	0-1900000
99.35	612125	2185179	0-2100000
73.76	1529151	1262867	0-1600000
81.33	1173220	1622509	0-1700000
77.76	1363347	1429748	0-2000000
80.36	1285183	1509619	0-4000000

If the numbers of 8548 and 7548 are replaced into 0 till 9000 instead of impressive, the agile result will be favorable but we will face impressible reduction in agile improvement that, this procedure converts the result due to impressive effects during organization growth period. The figures of above table indicate the favorable output based on spans. Looking the first table it can be observed that indeed there are similar random figures entered into per row but output amount is completely different and as a result total quality remains still the same. Only time and place parameters are changed and have caused change into output. According table 5, it can be concluded that the more input quantities; there is no reason for increase of model output efficiency as elimination of these elements cannot emerges such reason. It can be observed at table that many outputs had no positive change by increasing agile amounts. In 3rd row, though quantities amount is descending in extent of medial span, improvement amount is increased to more than 99% and here the quality and role of impressive and different elements can be observed.

References

Ahmadi, Mahdi; Fekri, Roxana; Babayanpour, Marzieh and Fathiyan, Mohammad. (2016). Agility of supply chain after- sales service of heavy vehicles in Iran. Scientific Journal of Management Improvement, 10(31), 101-122.

Blome, C., Schoenherr, T., & Rexhausen, D. (2013). Antecedents and enablers of supply chain agility and its effect on performance: a dynamic capabilities perspective. International Journal of Production Research, 51(4), 1295-1318.

Chan, A. T., Ngai, E. W., & Moon, K. K. (2017). The effects of strategic and manufacturing flexibilities and supply chain agility on firm performance in the fashion industry. European Journal of Operational Research, 259(2), 86-499.

Charlene A. Y. (2011). Measuring agility as a performance outcome. Journal of Manufacturing Technology Management, 22(3), 384-404.

Chopra, S., & Meindl, P. (2013). Supply Chain Management: Strategy, Planning, and Operation. (5th ed.) Pearson Education.

Giannakis, M., & Louis, M. (2016). A multi-agent based system with big data processing for enhanced supply chain agility. Journal of Enterprise Information Management, 29(5), 706-727.

Hogenboom, A., Ketter, W., Dalen, J., Kaymak, U., Collins, J., & Gupta, A. (2015). Adaptive Tactical Pricing in Multi-Agent Supply Chain Markets Using Economic Regimes. Decision Sciences, 46(4), 791-818.

Kalantari Taher; Khoshalhan Farid, (2018) "Readiness assessment of leagility supply chain based on fuzzy cognitive maps and interpretive structural modeling: a case study", Journal of Business & Industrial Marketing, Vol. 33 Issue: 4, pp.442-456.

Mansouri, Farzaneh; Abbas Nejad, Tayebeh and Askarpour, Hamid Reza. (2017). Agile supply chain design in terms of dependency on demand. Journal of New Research in Decision Making, 2(1), 179-206.

Martinez-Sanchez, A., & Lahoz-Leo, F. (2018). Supply chain agility: a mediator for absorptive capacity. Baltic Journal of Management, 13(10), 20-28.

Mirghafoori, S. H., Andalib, D., & Keshavarz, P. (2017). Developing green performance through supply chain agility in manufacturing industry: A case study approach. Corporate Social Responsibility and Environmental Management, 24(5), 368-381.

Rajabzadeh Qotri, Ali; Seyed Hosseini, Seyed Mohammad; Alborzi, Mahmoud; Razavi and Mustafa; Ramezani Ali. (2012). Designing a dynamic model of

business agility in manufacturing organizations with dynamic systems approach.Case study: commercial automotive companies. Human Resources Management Research, 2(1), 42-60.

Sharifi H., Zhang Z. (1999). A methodology for achieving agility in manufacturing organizations: An introduction"; International Journal of Production Economics, 62, 1999.

Tizro, Ali; Azar, Adel; Ahmadi, Reza and Rafiei, Majid. (2011). Supply chain agility modeling: (Case study: Zob Ahan Co). Journal of Industrial Management, 3(7), 17-36.