THE EMERGENCE OF NEW VALUE CHAIN HIERARCHIES: NEW CHALLENGES FOR SOFT COMPUTING IN THE WORLD OF EMERGING COMPLEXITY

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Abstract: *This paper is concerned about phase transition that is currently happening in supply chain managements all over the world, and will bring us to a whole new world of a value perception. "Phase" transition can be seen as the reconfiguration of the system from one state to another, with different quantitative and qualitative characteristics on the beginning of the process as on its end. The key facilitating mechanism in this evolution phase of supply chain management is the change of value chain perception from manufacturer-centric to customer-focused corporate vision. This shift of perception drives the change throughout a firm's internal and external linkages and will lead to new forms of value chain organization and management in future.*

Key words: *Critical mass theory, Complexity, Simplicity, Hierarchy, Supply chain management,*

World is changing. Not only we are experiencing one of the biggest downturns of global economies in recent years, but also stepping with full speed into the 21st century. All the new technologies enabling us the experience of mass-communication, knowledge sharing and information spread in a whole new dimension. Tremendous shifts in population demographics, the "endless" availability of resources. Yes. The world is definitely changing.

This paper is concerned about phase transition that is currently happening in supply chain management, and will bring us to a whole new world of a value perception. The topic is relevant to most of today existing businesses and organization because it is concerned about the value perception critical for any business processes. The supply chain management is still undertaking turbulent changes like in the last few decades in theoretical and practical areas. The main goal of this paper is to grasp the basic ideas that are behind this transition and to define some questions to answer for better recognition of turbulent days that we are heading for in soft computing and other areas of research all together. These ideas can be then used by research society for further development.

In many cases, the changes don't happen stepwise. They are rather started when a critical point is reached and a "phase" transition happens. "Phase" transition can be seen as the reconfiguration of the system from one state to another, with different quantitative and qualitative characteristics on the beginning of the process as on its end. This counterintuitive behavior of systems, sometimes referred to as critical mass building is something else, than we were told in schools, and doesn't cope very well with the action – reaction model, that our minds are set for. This type of "evolution" can be also seen in supply chain management theory and praxis.

Over the past two decades, the purchasing and logistics functions have rapidly evolved. This new evolution step is broader, more complex, and from the point of management view has a much more strategic approach. Broadly it is called the supply chain management. The term by itself and its definition is still a topic for tens of papers, and books to be written. I will therefore define it just in a very brief manner, through the explanation of the evolutionary steps. There is plenty of literature available and I will be pointing to it throughout the text.

The literature by itself is still full of buzzwords. We can read about integrated logistics, supplier networks integration, collaborative partnerships, supply base management, supplier alliances, and supply chain

managements, to further address just the elements or development stages of this new management philosophy (Tan et al., 1998; La Londe and Masters, 1994).

To understand this new phenomenon in organizing of value chains, we should go back and look at the beginnings of supply chain evolution.

The beginning point can be set in the 1950s - 1960s, when mass-production was the main rule for most of the manufacturers. Emphasized minimization of unit production cost as the primary operations strategy, with little product or process flexibility lead to slow or no new product development and relied exclusively on in-house technology and capacity.
So called “bottlenecks” were “eliminated” with the help of huge piles of inventory, therefore balanced line flow could be still maintained. Partnership with customers or suppliers was considered as too risky. Cooperative strategic buyer-supplier partnerships didn’t practically exist. The purchasing function was perceived as a service to production (Farmer, 1997).

In the 1970s a change happened. The spread of electronics, especially computers, introduced Manufacturing Resource Planning. Suddenly managers have realized the impact of huge WIP on manufacturing cost, quality, product development and lead-times. This enlightenment lead to development of new material management concepts.

Next step is closely connected with intensification of global competition in the 1980s. Low cost, high quality, design flexibility, these and other customer requests pushed the focus on just-in-time (JIT) and other management initiatives to improve manufacturing efficiency. In the fast-paced JIT environment, manufacturers began to realize the benefits and importance of strategic and cooperative buyer-supplier relationships (Adair and Heeley, 1988).

The basis of the supply chain concept emerged as companies started to experiment with partnerships with their immediate suppliers. The evolution continued into the 1990s, as the spread of the best practices in managing corporate resources and inclusion of strategic suppliers into the company networks began to drive the strategic thinking of corporate managers. Manufacturers started to exploit supplier strengths and technology in support of new product lines (Ragatz et al., 1997).

Also the retailers pushed further the integration of their distribution with transportation partners to achieve direct store delivery or cross-docking without the need for receiving and outgoing inspection (St. Onge, 1996).

The key facilitating mechanism in this evolution phase of supply chain management is the change of value chain perception from manufacturer-centric to customer-focused corporate vision. This shift of perception drives the change throughout a firm's internal and external linkages even in these days and will lead to new forms of value chain organization and management in future. The phase transitions so far in the field of supply chain management and its predecessors weren’t fully evolutionary, but rather copied the critical mass effect, when a critical mass of changes, inventions and ideas triggered, rather fast change of perception and system transformation. The main idea behind this article is to communicate the basic directions that the shift can lead in future. According to these, new thesis can be set in future, examined, simulated and experimented with.

For the rest of this article it will be helpful that we consider the supply chain as a complex adaptive system. By this we mean a system with a large number of components which can interact simultaneously in a sufficiently rich number of parallel ways. The system than shows spontaneous self-organization into a hierarchic structure that is arranged in new way, that cannot be predicted on the basis of data or information obtained from its parts.
For better understanding we can see the similarity with, for example language. As a system, language can be also considered as a complex adaptive system. The outcome of a poem perceived emotionally by a listener cannot be predicted by the quantitative analysis of the words, that are the core building blocks, nor upon the syntax of sentences that are upper hierarchy level of the poem organization to them. Only as a whole, the poem with the receiver as one system, can be analyzed, derived and structured back to its

building blocks with significant information content for the researcher. The poem in the combination with the receiver inherits in its structure, or better said, hierarchy, qualitative functions that are not parts of the building blocks. According to Herbert A. Simon in his article *The architecture of complexity* (Simon, 1962), hierarchy can be seen as *a composition of interrelated subsystems, each of the later being, in turn, hierarchic structure until we reach some lowest level of elementary subsystem.* On different stages of evolution the hierarchy is developing a different set of qualitative characteristics.

This hierarchical decomposition of newly established complex structures is necessary for knowledge base development. Especially in supply chain management, these new structures of value perception can emerge in different forms and intensities. It is therefore critical when identifying, analyzing and optimizing the supply chain we know the building blocks that are affecting the value perception.

For building block analysis inside of the supply chain we need to generalize any observer and observed subject to Key Performance Indicators. At this moment the QCD terminology comes very helpful. Quality, Cost and Delivery (QCD) are nothing new. They originated in the manufacturing sector, during the "TQM" times at Toyota, and are an important element of the lean improvement movement. These Key Performance Indicators can be an excellent start point when developing measures of value perception. QCD measures are sufficiently flexible to be tailored to most organizations and can be very well used also in Supply Chain.

Quality can be best defined as measuring the errors or failures within a process or activity, sometimes referred to as efficiency. Cost by itself is one of the most important measures that are used in business live on a daily basis. Everyone is counting costs in the first place. Delivery can be referred to as the overall effectiveness of processes.

If the supply chain is a complex and hierarchical system, thanks to the critical mass theory, the emergence of new structures inherited in the subsystems is based on the specific circumstances that need to take place inside the system. These are not so easy to foresee, because their significance in our current models can be sometimes derived in to constants, mostly not incorporated at all.
This is the cause that many times even robust methods and models are not sufficient for organized complex problems solution. With rising complexity of the system, the quantitative methods and models lose their ability for proper analysis. More complex systems cannot be examined solely with quantitative approach. If done, they are failing to deliver long-term solutions. Therefore a qualitative analysis of the supply chain needs to be taken into consideration when building the optimization or analytical construct. This is just the authors perception and experience and should be examined by further research separately.

What does it mean, more complex systems for supply chain in general at all? We can distinguish three basic types of problems from the point of complexity (Weaver, 1948): problems of simplicity, problems of disorganized complexity and problems of organized complexity.

Problems of simplicity can be simulated and solved by easy to establish mathematical equations and algorithms. This is because most of the methods rely on two or few variables varying simultaneously. All the other aspects are taken as constants. Computers and computer science opened doors to more sophisticated models, but still too many constants are taken into consideration when solving problems. This incorporates the mistake directly into the solution when used for complex system analysis and complex problem solving.

On the opposite site we have problems of disorganized complexity, where statistics plays a central role. All random occurrences show a single probability distribution: the Gauss curve. When taken individually, there are unique characteristics, but taken in large numbers, there is nothing unique. It is all a question of scale. Statistics can be presented as recognition for processes or objects that seem to be nothing a like individually, but may behave exactly alike en masse. The only limitation for this kind of problem solution is the randomness of the processes. Hierarchic processes aren't fully randomized. There also the statistics can be applied only with limited success.

The biggest challenge for science and soft computing alike lies in the problems of organized complexity. The essential characteristic against simplicity and disorganized complexity is the hierarchy. Hierarchy as

mentioned before inherits qualitative characteristics of the subject, that cannot be solved by means of pure quantitative analysis, because their new behavior cannot be derived from the subcomponents. Hierarchy provides the system with ability to act as a disorganized complexity, the many are acting in average in common ways, but still inherit and do use of synergies between the unique characteristics of the building blocks, and so prevents to use just statistical tools for analysis.

Back to the Supply chain management topic. As for the supply chain, we can say that it is a complex adaptive system. The system consists of thousands interrelated and interactive unique connections/relations between hundreds to thousands of unique building blocks.

These relations can be characterized qualitatively through the QCD KPIs as a matrix, where each of the three perceived indicators can have low or high state and are triggering with their combination a unique significance to the observer.

Quality	Cost	Delivery
Low	Low	Low
Low	Low	High
Low	High	Low
Low	High	High
High	Low	Low
High	Low	High
High	High	Low
High	High	High

Table 1: Indicators matrix

Upon this construct of perception angles we can define the value perception of the observer perceived to the observed subject. It is to the further research that we define the real split of companies to behavioral patterns. In general spoken from author experience the prime term is the Cost. Whenever the cost is Low, there is a bigger perception of value to the observer. This counts even for the first state in Indicators matrix, the (L, L, L) state.

Every different state is triggering a different perception and therefore behavior of the observer and observed subject. We need to stop for a moment. This kind of analysis would be good from manufacturing point of view, but in supply chain we need to take into consideration even one another factor. That is Volume.
Even High quality product with really low costs and superb delivery can be overseen by supply chains when counting only for 0.0001% of the total volume.
As to this paper we are at the point of decision. Because of limited space we will not continue in the construct of further qualitative model, this will be leaved for further papers, but rather we leave open questions that should be taken into consideration for future research.

The questions can be set therefore:

How behavioral clusters of different sub-sets affect average value perception and the strategy deployment of the supply chain hierarchy?

Are these clusters also affecting the optimization constructs and the best available solution?

Can shifts in the behavioral clusters and new initiatives radically affect the relationships and redefine the whole supply chain construct?

Can we use solutions that work for one type of supply chain hierarchy for another one, and what will be the negative impact of this?

Conclusion

There are more questions opened at the end of this article, as were in the beginning. The theme of behavior clusters and new value chain perception in supply chain management is still a new area, and research should be taken into consideration when developing solutions for general supply chain managements in future.

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