TOWARDS A NEW BOSC PARADIGM FOR MASS CUSTOMISATION BOSC: BUILD-TO-ORDER SUPPLY CHAIN

Alexander Tsigkas
Managing Director, FlexCom AT&P Ltd.
Senior Lecturer, Department of Management and Production Engineering
Democritean University of Thrace Greece
flexcom@hellasnet.gr
www.flexcom.net

Agis Papantoniou
Information Technology Director, Cosmoline, Greece
papantoniou@cosmoline.com
www.cosmoline.com

Vassili Loumos
Professor, Department of Electrical and Computer Engineering
National Technical University of Athens, Greece
loumos@cs.ntua.gr
www.ntua.gr

KEYWORDS
Mass Customisation, Logistics, Distribution, Virtual Enterprise.

Introduction

Build-to-order organisations need a high degree of agility in their supply chains. This becomes imperative in the case of mass customised products and services. There is little information in the literature about an approach in designing and deploying supply chains as virtual enterprises from a systemic perspective. Therefore in this paper an innovative approach is taken for the "a priori" design and development of agile supply chains as single virtual organisations. Agility in this context means flexible demand and supply chains. This approach recognises that such organisations are systems and therefore systems engineering design methodologies can be applied for the organisation design and development.

In contrast to other approaches, the systemic view addresses the intra-enterprise and the inter-enterprise relationships as relationships among components or subsystems, departing from the model of the traditional functional silos per se. In a virtual organisation the inter-enterprise relationships become intra-virtual enterprise relationships. Gal (2003) has introduced a new paradigm that departs from the classical customer-supplier relationship when looking at intra-organisational relationships and talks about

intra-organisational partnerships (IOP). However, Gal is preserving the functional silos. The virtual Build to Order supply chain organisation presented in this paper makes use of the Gal paradigm, attempting to expand above and beyond classical functional silos and to propose instead an alternative BOSC organisation. Build to Order is a way to offer mass customised products and services.

Build-to-order operations should target at the transformation of ‘new‘ knowledge or the exploitation of "old" knowledge into new individual products or services. The speed with which knowledge can be converted into new value-added products or services will provide in the future the competitive advantage. It is the authors' belief that this will be best achieved through the formation of value-added networks (Tsigkas et al 2003). A value-adding network forms a virtual enterprise. The enterprise sees its competitive advantage in the quick adaptation not only to new business environments directed from external market conditions, but also in changes that alone can introduce into the market place in order to create new differentiation factors and capabilities for gaining sustainable competitive advantage. In order to achieve these goals a new partnership and networking paradigm is imperative. This partnership and networking paradigm will encompass also a novice "win-lose-win" situation, how it should be applied and what should be the criteria of allocating profits and losses in the individual network-members. Furthermore the model proposes how a member of the supply chain network can be chosen or replaced and what are the agile principles that govern interfacing and interacting on the network (RRS, reusable, reconfigurable, and scalable).

The role of Internet-based information systems is prevailing in this type of environment. Based upon the organisational structure proposed here, an attempt is been made to define an overall information systems architecture that will support the new business model.

The systemic view of the virtual enterprise calls for special performance metrics that need to be developed. Custom Measures of Effectiveness (CMOE) will be therefore defined to track the build-to-order supply chain performance.

The structure of the paper is as follows. In the first section the motivation for this research work is given. In the second section the systemic organisation of the BOSC is presented. The third section

contains the definition of the new partnership needed in the BOSC virtual enterprise. The fourth section attempts to define performance metrics of the new organisation. The last section includes suggestion for further research.

Section 1: Motivation for the research work

Competition today is often fought on the same ground and as a consequence wealth creation is very slow. The reason is mainly the similarities that exist among the competition forces. Using all sorts of benchmarking techniques organizations achieve to become formidably alike to their competitors. This fact hinders differentiation and therefore makes progressively hard, sustainable competitive advantages to be gained. As a result competition is often played on a single dimension, namely this of the cost. However, for companies that design and manufacture innovative build-to-order products, cost optimisation is a necessary but not sufficient condition to win and prevail in the global markets. As a matter of fact cost may not be the most important factor in winning the competition race, it is rather speed-to-market and sustainable innovation, that are gaining ground in an accelerating fashion. For this purpose there is an eminent need for highly flexible and response able supply chains. It is the authors' belief that this is where competition will be fought and won in the 21st century. Mass Customisation will play an important role in constructing individualised supply and demand chains and therefore bringing into the market the individualised value (eigenvalue) of the products and services delivered by the system.

Mass Customised Build-to-order products exhibit typically high demand uncertainty combined with highly evolving and unstable supply processes (Lee 2002). For this type of products Lee is recommending a strategy that would lead to the development of an agile supply chain through the combination of risk-hedging and responsive strategies. Risk-hedging strategies are based on decoupling demand from supply through inventory, towards enabling stability in the supply (satisfaction) of a highly uncertain demand. Responsive strategies are based upon flexible processes that allow postponement and late implementation of individual customer requirements as close as possible to the end of the manufacturing process (Tsigkas et al. 2003). Although the work of Lee is of high practical importance, it does not address agile supply chains as being an independent type and not a hybrid of two other types

(risk-hedging and responsive) that needs separate and individual attention. The simple reason being, that the problem from our point of view is an inefficient or unsuitable supply chain organisational structure and not the external factors that lead to supply process instabilities. Furthermore demand uncertainties could be smoothed through targeted demand steering strategies, which is a matter of how proficient an organisation is to changes in order to respond to changing and or to direct customer requirements (external factors). Keely et al (2001) propose strategic and operational descriptions as well as illustrations of the interfaces among the supply chain processes and an example of how a process approach can be implemented within an organization with the traditional functional silos.

It is being recognized, (Lambert et al, 1998) that implementation of supply chain management across the network of organizations that comprise the supply chain is quite a complex endeavour. The international literature is rich of such examples. It is the authors' belief that this complexity is arising due to the fact that the development of an "a posteriori" network of sustainable partnerships that would "look and feel" as a single virtual organisation is a very challenging as well as a time- and resource-consuming task with doubtful outcomes and benefits. This effort is also challenged by the traditional functional silo based organizations. Implanting supply chain activities in such a structure is bound to create a large number of interfaces that are difficult to manage and maintain. It is not simply a question of integrating information and material flows in the network. It is a question of developing a "fit" among activities in the network towards achieving a common goal. A further challenging point is that, the generally accepted target of "win-win" in a partnership may have to be abandoned from time to time, and become "win-lose" or "lose-win" in a dynamic manner if this is for the benefit of the virtual organization. Today this is not a widespread belief or practice in the business world, especially when the nodes of the network are individual companies driven by separate P&L (Profit and Loss statements). It is therefore necessary to think about supply chain networks as system needed to be designed "a priori". However, reality dictates that ideal conditions never exist. Nevertheless, designing a virtual Build to Order supply chain organisation from scratch can serve as a reference model for a design approach against which step-by-step reengineering efforts can be planned and implemented. The objective is to offer a design framework that

supports the design of intelligent organisations that can adapt themselves in a timely and controlled manner to new differentiation targets.

Section 2: The systemic organisation of the BOSC

The model adopted in this research is based on the skeleton of ascending levels of systemic organisation according to their mode of behaviour defined by Kenneth Boulding (1956). This model is summarised in the following table:

Level	**Name**	**Description**
0	Framework	Arrangement, structure, maps
1	Clockwork	Simple predetermined dynamic systems
2	Thermostat	Self-regulating systems, closed loop cybernetic system
3	CELL	Self maintaining structure, Self reproducing structure
4	PLANT	Multiplicative ensemble of cells
5	ANIMALS	Teleological open system
6	HUMAN	Self conscious open system
7	SOCIAL	For which the element is the role not the person
8	TRANSCDENTAL SYSTEMS	Knowledge

The added value of this representation is that it prevents from accepting as final a level of theoretical analysis which is below the level of the empirical world which is investigated. The world investigated in this research is that of level 8. The topology of a supply network is defined in this research as non hierarchical with modular configuration. The design of such a network, the system, consists of defining an architecture that accommodates the coexistence and the interaction of chunks (a group of

modules) that are defined in order to perform all the processes of a supply chain. The modules should be designed so that the following characteristics are preserved: Reusability, Reconfigurability and Scalability (Rick Dove). These characteristics are known as RRS principles. RRS principles allow a system to be able to readjust and adapt to new internal and external requirements in order to create a "fit" of activities in the network towards achieving a common goal. If the goal changes the additional or different functions or processes required, can be accommodated through a reorganisation facilitated by initialising appropriate predetermined procedures. As an example, in a BOSC environment demand uncertainties are a common characteristic. Instead of following a common strategy of decoupling demand from supply chain through inventory, one could reorganise its resources in order to reconfigure the system towards relocating work there where the demand changes in almost real time and thus avoiding to keep inventory that is always a high cost but most important a delay factor. This relocation, one can argue, costs also money. That is true in a classical organisation organised in functional silos. Departmentalisation is exactly one of the strong reasons why external factors influencing a company's performance limit strongly its response ability. Companies in order to cope with this problem prefer to keep inventory on an individual basis as opposed to see the benefits from forming a virtual enterprise. To their defend, one might argue, that a lot has been written on virtual enterprises but less has been implemented in the every day life. It is not the purpose of this paper to go in depth in the design of such an organisation, but future research will concentrate on the architecture of such modules that exhibit a self-maintaining and a self-reproducing structure based on RRS principles. The final result of such a structure will be the design of agile supply chains as systems especially suited for the market of Build to Order products. The virtual enterprise will consists of multiple modules that will form virtual enterprises. The organisation of such an enterprise is not based any more on functional silos but on self-adjusted, self-regulated modules, the modules. Modules are here meant to be human cells and enterprises are meant to be places where human constructs are organised in modules in order to accomplish a certain purpose through their interaction (system).

Section 3: The definition of the new partnerships

A new concept of partnership is necessary to be evolved and prevail in this environment. The today's highly praised "win-win" in a partnership incorporates implicitly the status of a compromise. The new partnership is based on the systemic view of the supply chains which drives into transient forms of status that can be not only acceptable but above all desirable in win-loose and loose-win situations for the benefit of the supply chain as a system. The current model in cooperation is based on compromises and this not where the competition will fought in the future. Maximising rather optimising gains on the Supply Chain level and on the individual company level that make up the supply chain should be the target. Looking it from the Mass Customisation perspective, individualisation of Supply Chains in the sense of offering something different, quicker and of top quality will be the competitive advantage of the future competition ground. In order to achieve this objective it is imperative that formal agreements (contracts etc.) must be defined not to the final detail as today is the case, but there should defined at the level of a framework that let the individual members that come to implement the cooperation high flexibility and agility in operating efficiency. Speed and efficiency in responding to market requirements are the key measurements for the supply chains of the future. These are the independent variables. Cost is a dependent variable that is a result of how quickly and efficiently virtual enterprises will not only react but also act on markets. The pull principle that is widely acceptable in the markets today will be replaced by a push-pull model. It is not always the market that wants a product, it is also the product r service producers that offer new solutions or products to the market. In the Mass Customisation era, the customer becomes procumer, a combination of producer and consumer for the self benefit. This is not a pure pull model and only a pure push model. A procumer will be the one that will define the individual needs and act in order to design the product or the service best suits these needs. The procumer then becomes the motivator for the demand and supply chain and therefore he or she becomes part of it. New partnership frameworks will have to account for this individuality that the procumer introduces in to the new concept.

Section 4: Performance metrics

One of the keys to improving supply chain operations is having a solid set of measures in place to monitor

performance. The challenge here is making good choices among the dozen of measures available. Some companies try to measure too much, overwhelming themselves with data that never quite form a coherent picture. Others measure too little, relying on one or two indicators that don't reflect the full spectrum of performance. This tendency to focus too narrowly is exacerbated by management fads such as cycle-time reduction in the 1990's and the current obsession with inventory velocity. Just as there is no easy answer to all supply chain problems, there is no magic measure for improving performance. The selection of measures should be based on four broad categories: measures of time, measures of efficiency and measures of effectiveness. All these categories should have a dependent variable: cost. We will need at least one and probably several measures from each category if we want to get the best performance out of the chain and in general out of the virtual enterprise. Efficiency is a measure of flexibility and agility. Effectiveness is a measure of the quality of being flexible and agile.

Section 5: Further Research

It is desirable to be able to describe mathematically the system matrix and drive it to new steady states that are defined by its eigenvalues as these are known from the system control theory. New individual steady states are in this case new individual states of the supply and demand chain offering simultaneously new value to the customers as well as to the partners in the supply chain itself. Advanced simulation techniques will have to be used in order to back up the mathematical forlmulae and suggestions. From the authors' side a series of future publications is planned that will follow this first design framework paper in order to further detail the design approach introduced with this present submission.

References

Gal, D., 2002. Intra-Organizational Partnership: changing the intra-organizational service paradigm. Israeli HR Magazine (in Hebrew with english translation)

Lambert, D., Cooper, M., Pach, J., 1998. Supply Chain Management: Implementation issues and research opportunities. The international journal of Logistics Management, Volume 9, No 2, 1-19

Lee, H., 2002. Aligning Supply Chain Strategies with Product Uncertainties. California Management

Review Vol. 44, No. 3, 105-119

Tsigkas, A., Papantoniou, A., Loumos, V., 2003. Towards Knowledge-Based Mass Customization: A Framework for on Demand Design (ODD). 2nd Interdisciplinary World Congress on Mass Customisation and Personalization, Munich

Tsigkas, A., de Jongh, E., Papantoniou, A., Loumos, V., 2003. Distributed Demand Flow Customization, in: Mitchell M. Tseng, Frank T. Piller (eds.), The Customer Centric Enterprise, Springer, pp. 361-378

Taylor A. David, 2004. Supply Chains, a Manager's Guide, Addison-Wesley, 2004