Global Supply Chain Control

A Conceptual Framework for the Global Control Centre (GCC)

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Abstract.

The operation of global manufacturing network is challenging due to the complexity in product and information flow, diversity in sites, localization and processes and the information processing needed for control. Thus information technology has to be developed to cope with this complexity and to develop decision support for controlling the network. In this paper the concept of the Global Control Centre for manufacturing activity is developed based on research on a Norwegian supplier of fish hooks. The main elements of the GCC is found to be the global control model, performance measurement system, ICT solutions and the organization and the physical environment. In order to realize the GCC the main challenges are ICT investments and standardization, and the management of change and organizational resistance. The findings presented in this paper are not yet collectively implemented and tested and must therefore only be viewed as conceptual proposals.

Key words:

Operations management, case study, supply chain control, global operations

1. Introduction

Supply chain management (SCM) is the concept of how to orchestrate and operate the broad set of activities, resources and companies in the supply chain (SC) in order to assure competitiveness and efficiency. The complexity most companies faces due to outsourcing, globalization and just-in-time deliveries makes the SC an interwoven

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network, often with a geographical decentralized structure. However, even if there exist knowledge of how to organize the SCM activities, many companies finds it challenging to coordinate the SC. The consequence of poor coordination is a less responsive, cost efficient and service oriented SC (Frost and Sullivan, 2006).

Access to real-time information and development of information and communication technology (ICT) is expected to revolutionize SCM and to build a new fundament for improving productivity and competitive strength (Hansen and Nohria, 2005; Beardsley et al., 2006; European Commission, 2006). The next generation ICT based SC will consist of RFID and track and trace technology, real-time monitoring and visualisation, and control systems which will lead to more intelligent logistical solutions (European Commission op cit.). However this will challenge our traditional SC models. New operation and control models, work processes and integration and collaboration models have to be developed (Beardsley et al., 2006). Successful operation requires that decision making at all levels can be performed in a setting where relevant information is transparent and can be accessed from any place in the SC in real-time (Strandhagen, Alfnes and Dreyer 2006). The challenge is to establish ICT-based concepts where electronic information and signals replace the traditional manual and physical control processes, and to utilise the best available real-time technology in integrated teams independent of localisation.

The aim of this paper is to develop a concept of the Global Control Centre (GCC) for manufacturing. The research question we address is how to control and make decisions in a geographical spread and decentralized manufacturing network? The authors are involved in development of such centres in Norwegian companies with globally distributed SC. Through modern collaborative technology, these centres will enable a holistic insight of global SC control and global, real-time communication.

The paper is a conceptual paper. Based on state-of-the-art theory and empirical data from a Norwegian case company, we discuss and suggest a concept for a GCC. Data is collected and analyzed through traditional methods as observations, interviews and extracts from the company's databases. The theoretical fundament which forms the GCC is SCM and operations management, production planning and control and organisational theory.

2. Theoretical Framework

The trend in manufacturing has moved towards the optimisation of the total SC instead of the single company. Operations of manufacturing networks cause significant complexity both related to the number of actors, processes and information involved, and to the geographical distance (Cooper and Gardner, 2003; Chopra and Meindl, 2007). It is claimed that such networks often suffer from insufficient co-operation and integration (Sanders and Premus, 2005). Inefficient information and communication processes combined with historical and static information often causes limited performance knowledge and reducing the ability to control the network activities.

In global and geographical distributed SC, information sharing and access to real-time information becomes essential. Decision making and control has to be performed in a setting where relevant information is accessible and updated, and can be accessed

from any place in the SC in true time (Holweg et al., 2005). Today a vast majority of the information and numerical demand analysis is based on forecasts, historical information and assumptions rather than *real-time information* and dynamic facts. Real-time information leads to higher predictability and insight into the demand situation which will prevent the "bullwhip" and artificial demand amplification. Several studies have identified the challenges caused by a lack of information and to what extent competitive advantages can be gained from a seamless SC (Forrester, 1961; Lee et al., 1997; Chen et al., 2000). Improved information quality will among other factors lead to a reduction in inventory level and stock-out situation which will increase the service level.

Real-time information is considered to be point-of-sale (POS) data, updated stock level information, bare code systems and scanners. However, RFID (Radio Frequency Identification) technology will provide much more accurate and real-time information due to the number of data registration points, data capturing frequency, reading quality, etc (Hedgepeth, 2007). Even though such solutions will create formidable amount of information there is still is a challenge related to the absorption, utilisation and grasping of the information. Thus in order to grasp large and complex amount of information there is a need for processing instruments and ways to represent and visualise information (Liff and Posey 2004).

The proliferation of ICT, e-business and internet technology has enabled new ways of working and sharing information, and changed the way organisations communicate. This have significant implications for operation of the SC leading to reduced inventory and cost levels, improved transactions efficiency and planning processes and better performance (Busi & Dreyer, 2004; Silberberger, 2003; Thoben et al., 2002).

A recent strategy for utilising the potential of ICT is Integrated Operations (IO). IO aims to improve integration and interactivity between the different off-shore and on-shore activities in the oil and gas industry. New data transmitting technologies, intelligent sensors, advanced monitoring and visualising technology, and internet based solutions for communication and information sharing, is integrated in advanced control centres that enable efficient collaboration and remote control of off-shore operations (OLF – The Norwegian Oil Industry Association, 2003).

A similar strategy is emerging in the manufacturing industry. Based on recent technology and software, Supply Chain Studios (Jonsson and Lindau, 2002; Strandhagen et al., 2006) are developed that enables close collaboration and effective operations in geographically dispersed SC. The authors are currently involved in several research projects that aim to realise this strategy. One of the projects is performed in collaboration with the company Mustad, which aims to develop a GCC to synchronise the operations in their global manufacturing network.

3. The case company – a global supplier of fish hooks

Mustad is the world leading supplier of fish hooks and fishing tackle. Mustad has facilities for manufacturing, assembly, packing and distribution in eight counties worldwide, including Norway, China, Singapore, Philippines, USA, Dominican Republic, Brazil and Portugal. Mustad is the no. 1 selling hook brand world wide, and products are exported to more than 160 countries. Customer requirements are differing within different geographical regions, application type (recreational, sport, industry, sea) and customer type (wholesalers, retailers, OEMs).

Traditionally, the supply chain has been characterised by fully decentralised control. Decisions regarding inventory levels and product programs are made independently on each site. Production and market forecasts are shared only to a small degree, and there is an overall lack of coordination across the different SC sites. Mustad's fish hooks have a Y-shaped product variant structure, with very few raw materials (mainly steel wires) and a large number of sizes, shapes, surface treatments and packaging, totalling up to about 12.000 finished product variants. Mustad is also offering trading products of complementary fishing equipment, in order meet requirements from retail chains that demand supply of complete range of fishing products. Further, new hooks are introduced to the market frequently, but exclusion of products from product programmes are challenges as customers require full product series of a hook type, even though some variants are seldom sold. Together, this has lead to a situation where Mustad now has about 20.000 stock keeping units. This is adding further complexity Mustad's supply chain management.

The company has been facing major logistics challenges. The total stock turn is low, at about 1.5 years, meaning that a product is kept in stock for about 35 weeks in average. The lead times in their supply chain are large, with an average manufacturing lead time of 8-12 weeks, and transportation lead times between 1 – 7 weeks (depending on whether air or sea transport is used). The material flow in their supply chain is complex. Certain products can be produced only at certain sites, and there is a large degree of internal transportation. A mapping of material flows in their supply chain showed a true "spaghetti" structure (Figure 1).

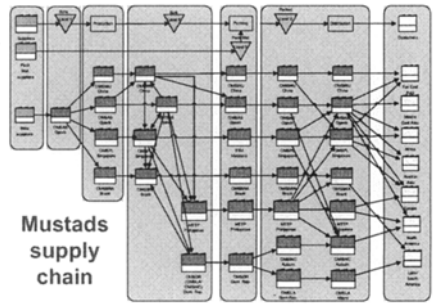

Figure 1: Mustad's material flow

The company therefore wants to build a supply chain studio that utilises modern ICT to integrate and control their global operations. They term this studio the Global Control Centre (GCC). The GCC will become the central information hub in the Mustad supply chain, and is based on a combination of various computer-based systems and information technology tools to capture, process, present, store, and distribute the information needed. The control centre that is being developed is further described in the next chapter.

4. Conceptual framework for the Global Control Centre

GCC is a concept for integrated operations and synchronized SC control. The main aim is to enable holistic and integrated control in the decentralized and global network of the entire Mustad supply network. In this case The GCC constitutes a central information and communication node that enables integrated operations and remote control in the network (see Figure 2).

The GCC enables decisions makers at each node to collaborate virtually and make decisions based on updated information. The GCC also constitutes a single-point of control where a team takes overall decisions regarding Mustad's global operations. Most decisions regarding operations are still performed locally at each node. However, some overall control tasks are allocated to a GCC team that are co-located and collaborate virtually with other decisions makers in the network.

The GCC consists of four core elements, the global control model and decision support, ICT, organization and the physical environment. In addition, potential benefits of the GCC are described.

Figure 2: GCC position in the SC

4.1 Global control model and decisions support

The primary role of the GCC is to provide global control and decision support for a set of defined areas at Mustad. These areas are typically related to the operational activities for control of materials and information flows in the SC, including forecasting, planning and replenishment, inventory management, product management, sales and operations planning and transportation management. Furthermore, more tactical and strategic decisions regarding for instance SC structure, design and internal pricing will be supported by the GCC.

Decision support will be provided to support the following tasks: centralized forecasting, planning and replenishment; global stock program coordination; global product program management; sales and operations planning; global transport tracking and costing; and performance management.

4.2 Information and communication technology

The technology that will be used are business intelligence applications, ERP-systems, production and inventory management systems, CRM systems, forecasting and planning tools, etc. Additional equipment and tools includes PCs, large projected displays, interactive whiteboards, wireless technologies, portable devices, video conference systems, chat, SMS, etc. In addition, a performance dashboard will be developed to represent all the collected information in an intuitive and visual manner. The performance dashboard is a key element in the decision support involving the performance parameters for control. This computer-based solution ensures that control decisions are based on indicators related to performance objectives of the SC. Combined, these technologies facilitate the flow of information across different control situations. The team will be able to communicate and share information with managers at the other Mustad sites through virtual meeting rooms.

4.3 Organization

The organization of the GCC activities will primarily be team oriented. A team oriented structure ensures an efficient decision process and flexibility in allocation of tasks and responsibilities and limits vulnerability and dependence on key personnel Kristensen et al., 2005; Teasley et al., 2000). This structure will further help to support the SC in meeting defined customer service requirements such as improved responsiveness and delivery precision. The GCC will not only serve as a single-point-of-contact for internal communication but also as an important interface towards customers and suppliers of Mustad. The following are examples of tasks that will be performed in the centre: SC design and analysis; coordination of production and packing activities; coordination of a global stock program; establishment of plans and forecasts, adjustments of control parameters; central coordination of purchasing from suppliers; and coordination of deliveries. The GCC will provide high level of service to all parts of Mustad's supply chain.

4.4 The physical environment

The GCC will be located at Mustad Groups headquarters in Gjøvik, and will be a management centre with physical, virtual and visual elements. The Mustad SC control team is physically located at the centre, in an open office environment ensuring efficient communication among team members. The team is in direct contact with people at the various SC sites through virtual workspaces/interfaces. The decision support solution ensures the visual display of all information regarding the supply chain that is necessary for the team to make right decisions. If needed, the team can also use wireless and portable tools for remote access to the centre.

4.5 Realisation - potential benefits

On a general level, the realization of the GCC is expected to contribute to the overall aims of SC orientation. Some central areas for performance improvements are specified in Table 1.

Table 1: Potential benefits of the GCC (excerpts)

Supply chain measure	Reduced costs/ increased efficiency	Improved service/quality
Supply chain coordination and integration between sites	- Increased utilization of production and planning resources (economies of scale) - Increased efficiency in delivery and shorter lead times - Improved efficiency in inventories and transportation	- Opportunities for developing additional services such as transportation tracking, track-& trace - Opportunities to centralize common functions e.g. sourcing of products - Redesign of SC structure - reduced complexity
Forming a GCC team – combination of competences	- Reduced need for moving tasks between multiple functions - Increased efficiency in decision-making processes - Increased logistics support to	- Higher level of responsiveness, better positioned for dealing with deviations - Single-point-of contact: One interface towards external partners - Combination of competences give

	internal sites	better/ more informed decisions
Focus on market needs - integration of functions	- Shorter time for decision-making - Reduced administrative/ transaction costs	- Increased focus on customer needs - Quicker response to market demand and improved customer service levels - Timely orders and delivery
A common platform for decision support	- Increased efficiency in decision-making processes - Increased coordination of IT, information and communication structures	- Information gathered at one single place - Improved data quality - Improved coherence - common understanding

5. Discussion – major challenges

The realization of the GCC requires that a number of essential elements are in place. In addition, the most critical conditions for success should be targeted. The most critical obstacles to the realization and success of the GCC are:

- ICT investments and standardization
- Change management and organizational resistance

These critical areas for success are discussed below.

5.1 ICT investments and standardization

As the GCC decision support primarily depends on information, issues regarding information and data management need to be dealt with. Data quality, trust and willingness to share information, confidentiality, data security, availability of data and the increase in data volume are all issues that need to be considered in order to be a reliable decision support system. The selection and implementation of technology is critical. The IT platform must have enough capacity to deal with the extensive amounts of data gathered from various sources. The system must permit easy integration with other systems and interfaces and there must be an overall coherence in information and IT support throughout the SC. Existing systems may need to be substituted entirely or can be integrated with new applications.

The standardization element is considered to be critical for SC integration. It is not until Mustad has reached a common understanding of processes, systems, roles, KPIs etc. on a global scale that the major achievements from the SC orientation will be achieved. However, the GCC can serve as a central support for this standardization process.

A major task is to develop a performance measurement system for the entire SC with uniform indicators that will constitute an essential input to the decision support solution at the GCC. Indicators must be valid and unambiguous for the SC to permit aggregation and facilitate comparison of measures across the SC. Indicators must be linked to vision, strategies and performance objectives defined for the entire system.

5.2 Change management and organizational resistance

For Mustad, it is important to establish an organizational structure that truly supports the process towards becoming a SC oriented company. The organisational model will have to clearly define the relationships between the individual sites, the GCC team, the headquarters, etc. It is important that the sites are organised to support the work towards optimisation of the performance of the whole system and do not seek to optimise their own individual performance on the expense of the SC. The organisational structure will therefore be based upon the global vision, strategies and objectives for all parts of the SC. All employees at each site must be aware of their specific role in the system.

A major challenge may be the potential reorganisation of individual sites from business/production units into supply units. When management responsibility is transferred to the GCC team and the frame of operations is defined centrally, the individual sites may be turned into demand-oriented supply units. This change needs to be done in a setting where the individual site gets incentives for carrying out their core business which will be the daily operations.

An assessment of the current SC structure will detect potential inefficiencies and propose necessary measures for redesign of the structure. This work also involves reconsideration of site location, links between sites and specific details regarding material and information flows.

6. Conclusion

In today's global economy, manufacturing enterprises must be viewed in the context of their contribution to the total SC. Collaboration in the SC has a wide range of forms with one common goal: to gain information and to create a transparent, visible demand pattern that paces the entire SC. Even though formidable amount of information is created there is still is a challenge related to the absorption, utilisation and grasping of the information in such a complex network.

As a contribution to close this gap a concept for a GCC that supports the monitoring, analysis and management of the SC performance has been developed. It supports control and decision making by visually displaying in true time leading and lagging indicators in a SC process perspective. The GCC will help to decrease the level of complexity and improve control of operating environment and the main benefits are:

- The access to true-time monitoring facilities at a high level
- A true SC perspective (different from a single actor perspective)
- Speeding up recognition and decision making
- Integrated decision making (for instance purchasing and production control)

The findings presented in this paper are not yet collectively implemented and tested in a SC context. Therefore, the findings can only be viewed as conceptual proposals. Thus, further research is needed within the following areas to realise this strategy:

- Development of Supply Chain Studios in other companies and industries.

- Development of ICT infrastructures supporting integrated global operations
- Development of a performance measurement system for the entire SC with uniform indicators. Indicators must be valid and unambiguous.
- Development of an organisational model that defines the relationships between, the GCC team, individual sites and HQ. The organisational structure should be based upon common vision and for all parts.

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