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Edward Sweeney
Dublin Institute of Technology, edward.sweeney@dit.ie

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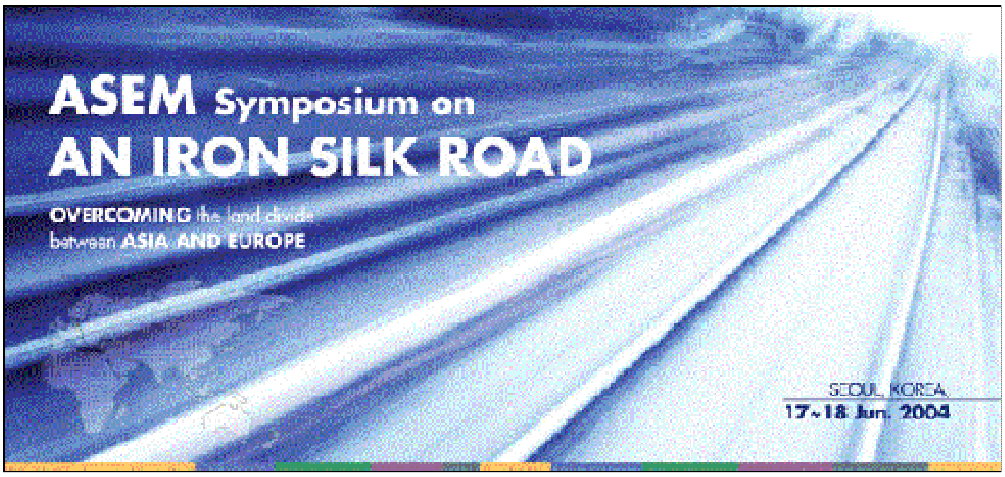

Using a Systems Approach in Logistics Design and Planning

Edward Sweeney
National Institute for Transport and Logistics
DIT Aungier Street
Dublin
Ireland
Email: Edward.Sweeney@nitl.ie
URL: www.nitl.ie

Abstract

Keywords: *transport infrastructure*, *systems*, *re-engineering*, *business processes*, *methodology*.

The international economic and business environment continues to develop at a rapid rate. Increasing interactions between economies, particularly between Europe and Asia, has raised many important issues regarding transport infrastructure, logistics and broader supply chain management. The potential exists to further stimulate trade provided that these issues are addressed in a logical and systematic manner.

However, if this potential is to be realised in practice there is a need to re-evaluate current supply chain configurations. A mismatch currently exists between the technological capability and the supply chain or logistical reality. This mismatch has sharpened the focus on the need for robust approaches to supply chain re-engineering. Traditional approaches to business re-engineering have been based on manufacturing systems engineering and business process management. A recognition that all companies exist as part of bigger supply chains has fundamentally changed the focus of re-engineering. Inefficiencies anywhere in a supply chain result in the chain as a whole being unable to reach its true competitive potential. This reality, combined with the potentially radical impact on business and supply chain architectures of the technologies associated with electronic business, requires organisations to adopt innovative approaches to supply chain analysis and re-design.

This paper introduces a systems approach to supply chain re-engineering which is aimed at addressing the challenges which the evolving business environment brings with it. The approach, which is based on work with a variety of both conventional and electronic supply chains, comprises underpinning principles, a methodology and guidelines on good working practice, as well as a suite of tools and techniques.

The adoption of approaches such as that outlined in this paper helps to ensure that robust supply chains are designed and implemented in practice. This facilitates an integrated approach, with involvement of all key stakeholders throughout the design process.

Introduction

Companies have long realised the need for company-wide approaches to organisation design and redesign. The development of systems engineering approaches to manufacturing system redesign in the 1970s and 1980s (Hitomi, 1996) was followed by the focus on organisational re-engineering, often based on business processes, in the 1980s and 1990s (Macdonald, 1995). A common feature of all of these approaches is a recognition that "the whole is greater than the sum of the parts". In other words, optimising subsystems (whether those subsystems are functional departments, production sites or individual processes in the manufacturing cycle) can result in a sub-optimised total system. Lack of efficiency and/or effectiveness is often a result of the poorly designed interfaces between subsystems rather than any inherent subsystem weaknesses. There are numerous examples of companies who have generated significant improvements in competitive advantage as a result of the application of this "total systems" thinking.

It must be recognised that a product is delivered to the ultimate customer through a complex interaction of several companies on the way. The manufacturer's ability to give the customer what they want, when they want it, at the price and quality that they want, is not just determined by the efficiency and effectiveness of the manufacturer's own operation. Inefficiencies anywhere in the supply chain will reduce the chances of the manufacturer successfully competing against other suppliers. Without a proper focus on total supply chain management, therefore, a company will never achieve true competitive advantage (Christopher, 1999). The increasingly international nature of markets and companies has resulted in many companies becoming part of large and complex global supply chains. In addition, the potential benefits associated with emerging electronic commerce technologies provide the potential to simultaneously improve customer service levels and to reduce supply chain costs. These factors have sharpened the focus on the need for improvements in all aspects of supply chain performance.

Elements of The Systems Approach

The systems approach to analysing supply chains and improving their performance recognises that the process of re-engineering supply chains needs to be carried out in a logical and systematic manner. The approach has been developed based on the experiences of a range of companies in a range of different business sectors. This paper describes the four distinct constituent elements of the systems approach. The ***principles*** summarise the underlying thinking and concepts. The ***methodology*** is the series of steps to be followed in analysing and improving a typical supply chain. The ***guidelines on good practice*** summarise the main relevant elements of world class operating practice. Finally, the ***tools and techniques*** support the implementation of the methodology.

Principles

The Oxford English dictionary describes a *system* as, 'a set of *connected* things or parts; an *organised* group of things; *orderliness*'. The italics are those of the author because they highlight those aspects of the definition which provide some pointers to problems which exist in supply chains and, hence, to the type of change which might

be required. Any finite system will have a boundary and anything outside that boundary can be regarded as the environment. An important aspect of the study of systems involves examining the interaction between systems and their environments. Indeed, the way in which a system interacts with its environment will largely determine the usefulness or degree of success of the system. If the supply chain under consideration is regarded as the system then the environment is the business environment in which that supply chain operates. The business strategy of firms is concerned with the interaction between supply chain companies and their business environment (Porter, 1980). Essentially, the strategy formulation process defines the nature of this interaction.

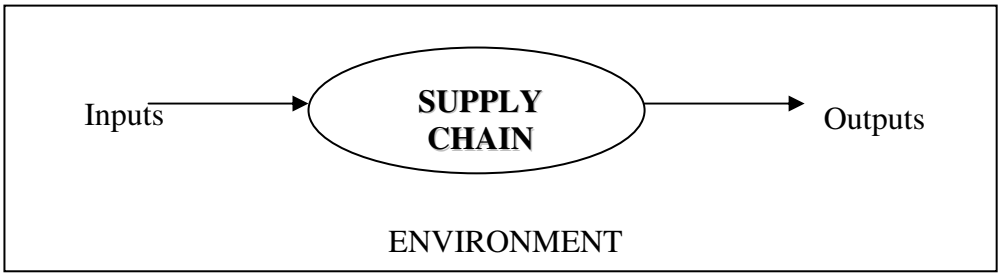

Figure 1 - The supply chain as a system

The supply chain system could be regarded as shown in Figure 1. The interaction of the system with its environment is represented by the system inputs and outputs. In practice, supply chain systems can be broken down into subsystems. This aids understanding of the operation of the system and facilitates systems analysis. Each of the subsystems should display the characteristics of a system; each subsystem will have inputs, outputs and a boundary. When considering a company's internal supply chain the subsystems can be regarded as the company's business processes (e.g. designing, buying, making, moving, selling). These business processes are multidisciplinary activities that cross traditional functional department boundaries. When considering a supply chain which comprises several companies the subsystems can be regarded as the individual companies or the business processes which cross company boundaries. Traditionally, efforts at improving supply chain or organisational effectiveness have focussed on making changes within the subsystems. This often resulted in optimal subsystems but sub-optimal total systems.

The systems approach to analysing supply chains and improving their performance is based on the need to consider the whole system rather than confining improvement efforts to particular subsystems. Developing the best solution requires the analysis, planning and implementation work to be carried out *systematically* (i.e. methodically, thoroughly and with proper attention to detail). This involves a far reaching investigation and radical reappraisal of the whole supply chain and often results in a complete redesign of supply chain organisation and operations.

Methodology

The systems approach to analysing supply chains and improving their performance involves the application of logical, structured methods rather than relying on making limited improvements in particular areas of the system. The methodology provides

guidance on how to address this process in an organised manner, proceeding in logical stages to develop a solution. Figure 2 shows an outline of the methodology.

STAGE	STEP
INITIATION	- Set project scope, objectives and time plan - Create project team or task force
DATA COLLECTION	- Determine structure of supply chain - Supply chain audit: detailed data collection concerning the companies and their competitors, markets, currently available resources and future resource requirements
ANALYSIS	- Preliminary analysis of supply chain - Identification of key supply chain business processes
PLANNING / DESIGN	- Realignment of organisation and operations in line with key business processes - Detailed design of organisational structures - Detailed design of operational procedures - Develop business plans
IMPLEMENTATION	- Development implementation plans - Implementation of change - Performance measurement - Continuous improvement

Figure 2 - Methodology for supply chain re-engineering

There are a number of features of this methodology which are worth highlighting. The data collection, analysis and planning stages are carried out by a project team or task force. Such a team is multi-company (multidisciplinary in the case of internal company supply chains) and possesses the knowledge and skills necessary to carry out the tasks required. It should have the commitment of management and be dedicated to its task for the duration of the project. Once the overall structure of the supply chain has been determined and the strategic objectives of each element identified, the task force carries out a supply chain audit. This audit involves collection of detailed data concerning all aspects of the supply chain. The general classifications of data to be collected are: general company and competitor data; market and customer data; data concerning currently available supply chain resources; and, data concerning future resource requirements. The supply chain audit is one of the most important parts of the methodology and it results in a considerable volume of data. The next stage of the methodology involves analysing this data with a view to identifying the key supply chain business processes. The planning / design stage involves (top-down) realignment, and (bottom-up) detailed design of supply chain organisational structures and operational procedures. Business plans for each element in the realigned organisational structures are also required. Detailed implementation plans define how the required change will be put into place. An effective performance measurement system forms the basis of the continuous improvement process.

Guidelines On Good Practice

Every supply chain is unique. It has unique products, processes, people and a lot more besides. Hence, there is no universal solution which can be applied which will

automatically result in a supply chain achieving its optimum competitive potential. The methodology helps to identify the most suitable solution for a particular supply chain but there are approaches which appear to exist in the majority of world-class companies (Schonberger, 1986).

These approaches include employee involvement, total quality management, JIT, (total) preventive maintenance and a philosophy of continuous improvement. The key is not to blindly copy the approaches used by successful companies but to learn from their experiences. Education and training of project team members plays an important role in this.

Tools and Techniques

A potential problem when analysing supply chain organisation and operations is that there are few (if any) established analytical tools which can be employed. The lack of such tools can result in practitioners failing to apply a methodical, scientific approach and instead relying purely on experience, intuition and iteration. However, there are many techniques in use in other fields which are relevant to supply chain analysis. Such approaches include financial analysis, strategic planning techniques (e.g. SWOT analysis, the Porter model), Pareto analysis, systems analysis techniques (e.g. input/output analysis, flowcharting), IDEF0 and process mapping. These techniques can be used to support various stages of the methodology with many being particularly useful at the analysis stage.

In addition, computer-based tools, which assist in the application of the techniques, are also available. Many of these tools are useful in managing the data collected during the supply chain audit. Useful tools include spreadsheets, databases, visual interactive simulation and project planning software.

Conclusions

The systems approach (to analysing supply chains and improving their performance) provides a basis for achieving world class standards for supply chains operating in all types of industry. The approach involves considering the whole supply chain and avoiding a situation where subsystems are optimised but the whole supply chain is sub-optimal. To apply the approach requires a methodology, a recognition of what constitutes good working practice and the use of tools and techniques to perform the required analysis. The process of supply chain analysis and improvement is complex – it requires total management commitment and dedicated resources. With this commitment and the necessary resources, the use of the systems approach can result in significant improvements in logistics and supply chain performance. It is only in this way that the pitfall of designing transport infrastructure in a fragmented and piecemeal manner can be avoided.

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Using A Systems Approach in Logistics Design and Planning

Edward Sweeney
Director of Learning
National Institute for Transport and Logistics
(NITL), Ireland

Re-engineering Logistics

- Re-engineering = analysing + planning improvement + implementing improvement
- There is no "magic" solution
- Beware of copying inappropriate solutions
- BUT!
- There is a logical and systematic way of addressing the issue

The Iron Silk Road

- Potential for improvement in Europe/Asia logistics
- Need for effective integration of transport with other supply chain links
- Streamlining of internal and external business processes
- *Improved customer service levels and reduced supply chain (including transport) costs*

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The Systems Approach
(in logistics design and planning)

- Principles
- Methodology
- Guidelines on good practice
- Tools and techniques

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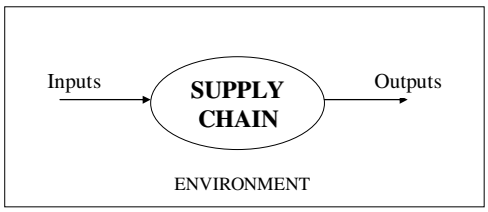
Principles

- System: "a set of *connected* things or parts; an *organised* group of things; *orderliness*"
- The definition provides some clues as to what an effective and efficient supply chain should be like

Principles



- the system is defined by the inputs, the outputs and and boundary
- the interaction of the system with its environment is what business strategy is concerned with
- the system (i.e. the supply chain) can be divided into subsystems

Principles

- A supply chain can be considered as a system
- A supply chain can be analysed as a system (with constituent subsystems)
- A supply chain system (and its subsystems) should display the characteristics of a systems (*connected*, *organised*, *orderliness*)
- Optimising the subsystems often results in a sub-optimal total system

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Methodology

- Developing the best solution requires the analysis, planning and implementation be carried out systematically (i.e. methodically, thoroughly and with proper attention to detail)
- The methodology is the series of steps which need to be carried out in a typical project

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Methodology

STAGE	STEP
INITIATION	- Set project scope, objectives and time plan - Create project team or task force
DATA COLLECTION	- Determine structure of supply chain and objectives of each element - Supply chain audit: detailed data collection concerning the companies and their competitors, markets, currently available resources and future resource requirements
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Guidelines on Good Practice

- Many examples at this symposium of good practice in rail freight transport
- Need to learn from (but not blindly copy) these examples
- Integrating "appropriate" practice into design and planning methodologies

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Tools and Techniques

- Tools and techniques help to ensure that a methodical, scientific approach is used.
- Financial analysis, strategic planning techniques, Pareto analysis, systems analysis techniques, IDEF0, process mapping

Conclusions

- Fragmentation to integration
- Need for a logical and systematic way of analysing and improving existing infrastructure
- The process is complex - it requires total management commitment and dedicated resources
  - **YOU NEED TO THINK SUPPLY CHAIN MANAGEMENT!**