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## **The Frigero on-line simulation: experiencing supply chain strategy and management in a virtual team**

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### **Abstract**

This paper reports the design, development, implementation and success of an on-line simulation, one component of postgraduate course on Supply Chain Innovation, Strategy and Management (T882) at the UK Open University. Students learn through participation in virtual teams managing a five year supply chain improvement programme (SCIP) for 'Frigero', a company manufacturing refrigerators.

### **Introduction**

In the period 2001-2003, a course team in the Faculty of Technology at the UK Open University developed a 30 point course in the Technology Management Masters programme entitled: Supply Chain Innovation, Strategy and Management (T882). The primary target population is students working towards a Masters degree who are practitioners in the supply chain arena, or those whose work brings them into contact with the expanding areas of supply chain functioning. The course emphasizes a holistic approach to supply chains, identifying them as complex, highly interactive systems, which require strategic management in the companies involved. It also takes account of the fact that most organizations operate in more than one supply chain. Most significantly, it draws in the environmental, regulatory, ethical and other external factors that increasingly impinge on supply chain performance.

Although some students have experience of management in a supply context, many are working in relatively junior positions and do not take strategic decisions. How then can the course deliver a practical 'feel' for the experience of strategic supply chain management alongside the case studies and the more theoretical content of the course? The course team explored various options for teaching and learning in this area and eventually focused on an on-line simulation of a supply chain improvement programme (SCIP) in a fictitious company that manufactures and supplies refrigerators: 'Frigero'. The simulation aims to:

- 1) Complement other course components by providing a valuable (and enjoyable) supply chain learning experience for participants, irrespective of their previous experience of supply chain management.
- 2) Develop a 'hands-on' appreciation of the complexity of supply chain functioning and the need to take a holistic, strategic perspective on the management of total product systems.

- 3) Demonstrate the value of working across the traditional management functional boundaries.
- 4) Offer a positive experience of virtual teamworking.
- 5) Emphasize decision making within long term, strategically oriented time horizons.

What follows is an account of the successful design, development, testing, implementation and evaluation of Frigero as an innovative vehicle for group centred distance learning at postgraduate level. We begin with a brief description of the supply chain imperatives which drive the course.

### **The supply chain context**

The evolution of supply chain management (SCM) and practice over the past 25 years has a central role in contemporary global economic and socio-political change. The implications of this development were neatly summarized in Christopher's suggestion that competition was becoming: "not company against company but rather supply chain against supply chain" (Christopher, 1992). The impacts of advanced supply chain practice include driving fundamental changes in approaches to the concept of 'product', product design, production methods, distribution and marketing. The course reflects current leading practice by emphasizing the need for SCM to encompass the total 'cradle-to-grave' product life cycle, embracing aftermarket support and end-of-life (EOL) reprocessing. Supply chains dominated by very large retailers and end manufacturers have major influences on societal functioning and economic development at global, national and local levels. Even the supply chains for simple products can involve several different industries and link many manufacturing and service companies, large and small. Those for complex products may span several technological domains and economic sectors, linking hundreds or, sometimes, thousands of companies.

This complexity is evident, for instance, in the scale and scope of supply chain operation in capital and consumer goods sectors (such as aircraft, cars and apparel), and in services (such as hotel chains, fast-food franchises and financial services). In such cases, various parts of the design, production and distribution processes associated with an end-product, together with the associated management and support services, may be carried out in many countries in all continents. This provides the context in which "a very small firm in one country may be directly linked into a global production network" (Dicken, 2004: 253). "Geographic dispersion has occurred on a massive scale" (Ernst, 2002: 504), and supply chain organization has provided the channels through which much of this has occurred. At the individual level, it seems probable that those whose lives are not profoundly shaped, directly or indirectly, by developing supply chain practice are now a dwindling minority of the world's population. The effects of integrated SCM extend, for example, to workers (in all categories), subsistence farmers, consumers and owners of small retail and other businesses.

In different academic disciplines a varied terminology is applied to what, broadly, are the same sets of phenomena. For instance, usage includes 'supply networks', 'value chains', 'global commodity chains' and 'product systems'. There are some important differences in the definitions attributed to these terms but 'supply chain' seems to be an increasingly inadequate descriptor of the dynamic changes that are under way.

‘Network’ and ‘system’ are more appropriate terms than ‘chain’, while the emphasis of activity has shifted from supply towards demand as the driver of production linkages. It has also moved towards a product focus, as is evident in co-ordinated approaches to product development between actors in a supply chain and in the extension of producer commitments into the ‘aftermarket’ and end-of-life product reprocessing.

We suggest elsewhere (Rhodes, 2005) that this conceptual diversity needs further extension. The combination of evolving supply chain strategy and practice among lead actors with changes in regulatory and other external influences is interpreted as a major shift towards holistic approaches in both analysis and in management at a strategic level. Hence, ‘supply chain’ emerges more appropriately as the concept of ‘total product systems’. This perspective forms the conceptual framework of T882.

### **Frigero – how the simulation works for the student**

Decisions made at any level within an organization, whether for the manufacture of products, such as cars or clothes, or for the provision of a service, as in healthcare, can impact not only on the surrounding areas, departments or individuals, but also on the organization itself. These decisions can have “knock on” effects on the relationships within the associated supply chain and the markets in which the organization operates. The Frigero simulation was devised to demonstrate the inter-dependence of these relationships. It also establishes potential approaches to improving organizational performance and survival prospects, since all organizations operate – and survive – within supply chains. Role play in the simulation takes place within a five year timescale, and has the objective of transforming the supply chain in which Frigero operates so that it is better able to meet pressing market, innovatory, regulatory and other forces.

The learning outcomes specified for the students are to be able to

- explain a wide range of policies which could be applied to improve supply system performance;
- understand the importance of each policy and how policies interact to benefit (or disadvantage) various stakeholders within the supply system;
- demonstrate improved communication skills both within online environments and in other written communication;
- explain some of the principal issues raised by teamworking within a virtual peer group, and how these might be addressed;
- demonstrate enhanced conceptual thinking in professional and commercial contexts;
- contrast the possible objectives and perspectives of various roles within supply chains and explain contrasting role behaviour.

A creative design ice-breaker exercise, conducted in an asynchronous First Class conference, gives the group tutor some insight into each student’s behaviour in an on-line environment. Participants are then allocated to one of seven roles within a SCIP management team: Marketing, Production, Human Resources, Finance, Marketing, Logistics and Purchasing. Familiarization with each role is supported by full on-line descriptive and explanatory documentation. Each manager is presented with a series of options which enables her/him to develop an understanding of her/his role and on

which s/he makes decisions. As many of these options depend on action and agreement from other roles and, in some cases, on initiating prior, preparatory steps, the simulation creates an arena rich in inter-departmental and inter-personal dynamics. Dialogue informed by evidence is the basis for recommendations to colleagues; their amendment by negotiation and re-negotiation is a central part of the simulation. This process is conducted in a dedicated e-conference.

The team is facilitated or chaired by the person taking the Marketing role. The participants must reach a team consensus on the actions to be taken in each stage or 'year' of the simulation. The impact of the team's decisions on many aspects of the operational supply chain and market performance of Frigero and also on the workforce, the suppliers and the customers in the marketplace, is assessed by the model and fed back to participants as a series of comprehensive reports.

Although the major theme is the drive towards more flexible and environmentally sensitive lean organization, it is recognised that there may be many ways to achieve this aim, and that change takes time. There are therefore "decision windows" for the first four 'years' of the simulation, but the model runs for a further 'year' before the final outcomes are revealed.

Frigero is tied into the course as a whole through assessment components in each of the three course assignments. Students are encouraged to become reflective practitioners by discussing and evaluating their own performance and that of their team in different ways as the simulation progresses. This has the added advantage that they have additional motivation for engaging with the activity throughout the whole course. They are also encouraged to provide their comments on their experience of, and participation in, the simulation to their tutor and the course team. These are considered seriously and contribute to continuing development of the simulation model.

### **Key aspects of the model**

An important decision for the course team at the beginning of Frigero development was how to create a realistic model without generating either (i) an impossibly heavy (expensive and time-consuming) software programming workload or (ii) a learning path that was too complicated to implement on-line. Simplicity in both respects, however, had to be balanced against providing a rich learning environment. For example, the original concept for the model incorporated teams representing a lead manufacturer, some supplier companies and some customers, but it quickly became clear that this approach to the complexity of supply chain improvement would be difficult to realise both technically and pedagogically. Modelling a single company and its supply chain seemed much more achievable from every point of view, and design of the model evolved from this basis. Students operate within interactive customer, supplier and shopfloor environments that are established in the model and are shaped by participants' discussion and decisions, but their own decisions still determine the outcomes. Outcomes are conveyed through a comprehensive set of performance measures at company and operational levels.

Built in to the Frigero scenario are elements of real life situations:

- The company has not invested sufficiently in the development of new models or kept its manufacturing techniques up-to-date.
- The staff have not been developed and motivated to reach their full potential.
- There is pressure to import refrigerators from low cost manufacturing countries.
- There is growing competition from other manufacturers.
- There are increasing demands from major retailers and their customers for improved product features, more rapid delivery and improved after-sales services – all combined, of course, with lower refrigerator prices.
- New environmental regulations affecting model design and end-of-life disposal increase the cost of operations and necessitate a re-think of product development.

The SCIP strategy has to be carefully selected in the light of the resources available to the team as a whole. These are expressed as units of *financial resource* and *human resource*, without denominations attached. The course team considered it important to avoid the competitive features of many business gaming simulations which focus principally on maximizing profit. They also sought to highlight one of the most critical factors shaping organizational achievement - the availability of people with the necessary experience, skills and commitment to complete a given project; hence the emphasis on *human resource* as a focal constraint. This links to the underlying aim of 'Frigero': achieving a successful strategy of improvement over the five year life of the programme. Similarly, the different Frigero teams functioning during any one presentation of the course are not set up to compete with each other – they are simply trying to improve their own Frigero company position.

## **Implementation**

Following testing of the simulation in its various stages of development with face to face groups comprising interested colleagues, the activity went live with the first presentation of the course in November 2003. Tutors attended a staff development briefing on the simulation and its role in the course.

Allocation of students to roles within Frigero teams went smoothly, reflecting high levels of engagement with the creative design ice breaker exercise. Both tutors and students quickly found their way around the scenario, role briefs and options. Work submitted for the assignments showed that students had engaged intensively with the issues raised by a SCIP. Their feedback on the simulation as a learning experience was positive, warm and enthusiastic. For example:

I found it very interesting and stimulating to have a different viewpoint to the course. I enjoyed its practical aspect and it made you think of the whole organization rather than one department. The simulation also brought the team together [...]. This was both stimulating to hear different view points and difficult to manage due to the time constraint set on the course and the availability of other team members. The simulation is a very important part of the course in developing an understanding of the supply system and I have enjoyed it thoroughly. [Student 1]

The holistic appreciation of decision making and the effect provided brought a realization that for the supply chain to be effective it needed all components and their interaction to work together. It went further, showing the need to consider factors external to the supply chain such as the EU regulations. [...] I believe the number of participants could be reviewed. We ended with fewer than planned and this limited the amount of discussion, which did mean we missed points and struggled for a consensus but it did force individuals, us, to cross boundaries [Student 2]

Frigero was a useful learning experience from the point of view that it was a practical exercise in supply chain management. Not all changes proved to be good; some choices that were good for one area were bad for others. [...] The model taught me that you have to get a long-term/short-term balance in your strategic thinking [Student 3]

A highlight of the course was the high levels of interaction between students, clearly aided by Frigero. I guess this brings students as close as possible to a normal university course in terms of interaction. “ [Student 4]

Inevitably, in a virtual environment as in real life management, individual contributions to teams vary enormously. Some students commented on the problem of uneven participation, but this did not seem to have detracted unduly from their positive reaction to the exercise as a whole. On the contrary, there is a strong element of peer learning within the team. Students bring diverse experience to the course and they use it to contribute to the learning process. This is a positive driver of commitment to their team and to the performance of Frigero which, in almost every case, develops very early in the first ‘year’.

The benefits for the participants include:

- A recognition of the value of support from, and co-ordination across the whole supply system in the achievement of minimum cost, high quality and socially acceptable goods and services;
- The need to differentiate between immediate short term fixes and the longer term strategic objectives;
- An awareness of the “ripple effect” on the supply chain of decisions taken by a lead manufacturer or core service supplier;
- The development of inter-personal skills necessary to reach a consensus opinion;
- An insight into real world management of a total product system;
- A substantially expanded awareness of what is involved in supply chain management and of trends that are currently developing.

### **Further developments**

Initially, the simulation ran for four ‘years’ but feedback was also provided for a fifth year on the basis of trends that had been established in years one to four. Because students are just beginning to settle down by year three and to understand the effect of their decisions, the model is currently being modified to include a fifth decision year.

New methods of using Frigero have been developed. The challenges of adapting the on-line version of the simulation used with students over a period of several months, to one-day workshops for SME managers, have been interesting. Some face-to-face workshops have been run with MBA students using a CD based version of the simulation as an intermediate method of delivery, and with managers from SMEs. These require differences in approach, including the need to sustain engagement with the activity throughout the day. Ongoing improvement also includes extending the indices associated with the options for each role to give greater definition of outcomes, and the creation of additional options. Overall, a more realistic, more complex model is gradually emerging.

This simulation can be used with many different groups, regardless of their supply chain experience or position. Even though it concerns consumer durable

manufacturing, its lessons are transferable across most manufacturing sectors and into service sectors too. It is a vibrant, innovative tool for learning in virtual teams and measured against its five aims (see Introduction), it can be judged to have been extremely successful.

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