

The alignment of collaboration and the importance of integrated performance measurement

M. Sarana and R. J. Mason

Cardiff University – Innovative Manufacturing Research Centre, Cardiff CF10 3EU, UK

Abstract

The notion that supply chains compete with supply chains is encouraging companies to manage their entire supply chain so that optimum levels of efficiency and effectiveness can be realized for the successful running of business operations. In line with this concept, all the players within the supply chain must work together to ensure the achievement of this. Therefore, supply chain efficiency and collaborative working appear to be positively correlated. However, whilst this may be the case, companies need to be able to measure the performance of collaboration in the supply chain. Collaboration between companies may occur in many forms such as integrated manufacturing processes, integrated distribution processes and information sharing processes. Do we measure the performance based on these processes or the supply chain as a whole? This paper presents a literature review of research in this area focusing on the alignment of collaboration and the importance of integrated performance measurement, supported by case study examples. It argues that where there is a misalignment of measures, even in a minor way, this can undermine trust and mutual understanding vital to the sustainability of an integrated collaborative approach.

Keywords: Collaboration, Performance Measurement, Alignment, Supply Chain Management

1. Introduction

Collaboration can be defined as, “two or more independent companies, who work jointly to plan and execute supply chain operations with greater success than when acting in isolation” [1]. Research has shown that while technologies (e.g. information communication technology and automated manufacturing) provide benefits to an organization, these processes can not work in isolation. Collaboration is required across the supply chain as a pre-requisite for enabling it to function with co-ordination [2]. However, not only is collaboration important, we also need to be able to measure what companies are gaining from it. This paper uses current literature to discuss what the characteristics of collaborative metrics are, and why the alignment of

collaborative performance measures is important in supporting an integrated supply chain strategy. It argues that inappropriate performance measures are a key reason for collaboration strategy misalignment between supply chain members. In addition, examples of companies which illustrate the importance of alignment to support collaborative business relationships are provided.

2. Motivation to Collaborate

There are a range of reasons why firms chose to collaborate. Our focus will be on collaboration which is motivated by the desire to improve the coordination of the business of product and service supply. Traditionally, companies and functions within companies have incentivised

performance in a myopic and self-focused way. Consequently, it is perhaps not surprising that members have tended to focus on their internal logistics performance measuring systems rather than a holistic measure for the entire supply chain [3].

In supply chain management literature it is argued that there is tremendous potential to prodigiously improve a value chain's effectiveness and efficiency through adopting a more integrated approach [4]. This seeks to better optimise performance by tackling areas such as the duplication of activities, hedging and risk aversion strategies, lack of coordinated partnering flexibility, demand disconnected from supply leading to uncertainty, poor forecasting, amplified demand, large stockpiles of inventory as well as many other sub-optimising issues which are all symptoms of uncoordinated inter-company processes. Holweg et al. [5] assert that to optimise performance synchronisation as well as collaboration is important, which is illustrated in a table stating the benefits of supply chain collaboration and synchronization (Table 1).

Holweg et al. [5] go on to present factors that need to be considered in choosing a supply chain collaboration strategy (Table 2). Depending which factors a company perceives to be important will result in a certain type of collaborative relationship (for the different types of relationships see [6]). This relationship will need to be planned to fit into the participating companies' strategies and then measured to see how well the different strategies have been aligned and operationalised in the supply chain. In order to do this, companies need to have collaboration performance metrics in place so they are able to evaluate their performance and assess the true value that collaborative activities are having on their supply chains.

Table 1: Benefits of collaboration [5]

Benefits typically achieved through supply chain collaboration:	Additional benefits, typically not achieved without supply chain synchronization:
<p>1. Collaborative forecasting enables better customer service levels, or a reduction in inventory (but generally not both), In fact in many cases these are traded off against each other, or service levels are traded.</p> <p>2. Reduce the rationing gaming by giving the supplier responsibility for replenishment. However, if there is a general shortage this collaboration can quickly break down.</p>	<p>1. Elimination of the bullwhip effect by linking the inventory and replenishment decisions.</p> <p>2. A reduction of inventory levels by up to 50% without compromising customer service levels (Disney & Towill, 2003), and better utilization of production capacity as the extended visibility of the supply chain provides a certain additional flexibility to prioritize or delay customer replenishment without compromising service levels, thereby reducing the need for capacity buffers (Waller et al., 1999)</p> <p>3. Better utilization of transport resources, because shared information allows for better load consolidation.</p> <p>4. Controlling the risk for constrained components or materials. For example, monitoring key items with long-lead times can create an early warning system of future supply constraints.</p>

Table 2: Factors that need to be considered in choosing a supply chain collaboration strategy [5]

Factors	Why Important?
Geographical dispersion of customers and supplier plants	The closer, and more dedicated supply is, the easier it is to implement synchronized production and inventory control of other members of the supply chain

Demand pattern of the product	The more stable the product's consumer demand, the greater the dynamic benefits of eliminating bullwhip and synchronizing demand and supply in the supply chain
Product characteristics, in particular selling periods and shelf life, as well as value	The longer the shelf life or selling period of the product, the more sensible it is to consider collaborative practices. Equally the more valuable the product, the more impact tighter inventory control yields

3. Importance of Performance Measurement

The basic principle of collaboration is for all companies that have engaged in a collaborative activity to improve their operations individually but also as a supply chain. Collaboration may not come naturally to some companies and therefore, they need to understand the true benefits and need to see some kind of feedback measure that has been derived from their hard work and effort.

The supply chain management discipline is underpinned by systems theory [7]. Developed in physics and biology [8], systems theory can be summarised as envisioning that the whole may be greater than the sum of its parts. Supply chain management is theoretically rooted in this concept with the aim of better optimizing the end to end supply chain. Fawcett et al. [9] state that effective performance measurement should be characterised by:

- providing the insight for understanding the system;
- influencing the behaviour of the system and;
- providing information regarding the results of the system.

Stainer [in 10] state that: "A performance measure system, or a set of performance measures, is used to determine the efficiency and/or effectiveness of an existing system, or to compare competing alternative systems". Simatupang & Sridharan [1] support this, adding that the performance measurement system should focus on continual improvement for supply chain members, end customers and outside stakeholders.

Thompson & Sanders [11] show the benefits of collaboration in Figure 1. They suggest a positive correlation could be expected between the strength of

the relationship of companies and the benefits of the partnering to achieve specific business objectives. However, whilst the relationship between two companies may be of a low degree of objective alignment (e.g. co-operation), time may prove to demonstrate the benefits of a stronger relationship. Table 3 shows the benefits of collaboration for the short-term – long term. This may suggest different performance metrics depending on the length of the relationship.

Table 3: Time Benefits of Collaboration [1]

Short-term
Increased planning capability, improved customer service, shorter order cycles, reliable delivery, assets utilised, reduced inventory, cash flow increased
Medium-term
Increased product variety, effective product life cycles, time to market, reduced overhead cost, flexibility increased
Long-term
Increased market share, increased human resource capability, increased customer service, reduced overhead costs

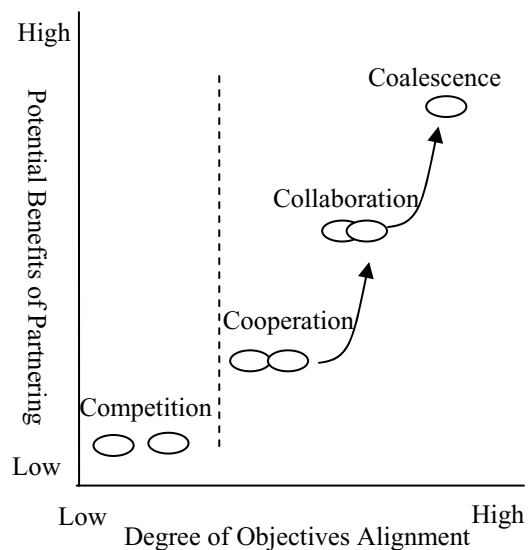


Figure 1: Types and collaboration and benefits [11]

4. Performance Measurement System Procedure

The system for performance measurement should aim to align the incentives of each of the members in the supply chain, so that members are considering the penalties and rewards for the whole

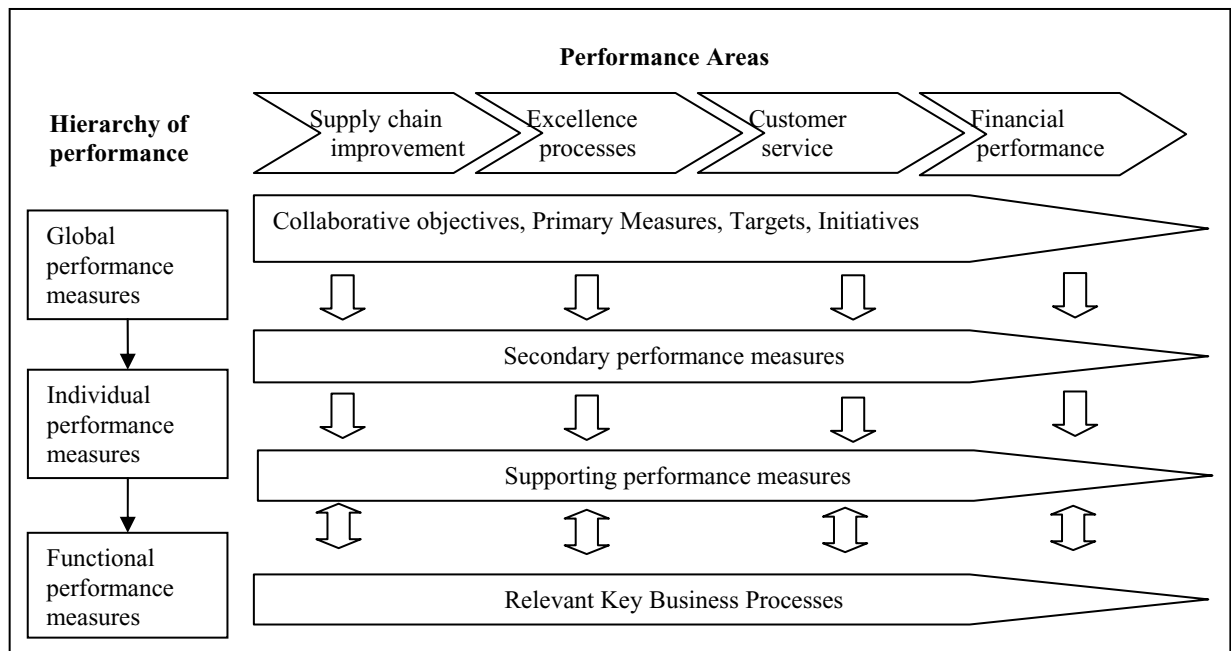


Figure 2: A Performance Map [1]

supply chain rather than themselves [1]. Simatupang and Sridharan [1] advise certain steps when devising a performance:

a. Design Performance – this refers to devising a system that allows supply chain members to monitor and improve performance and involves three processes:

- **Performance model** – choosing a framework which will link supply chain performance with the different levels of decision hierarchy in meeting supply chain objections of each supply chain member. For example Supply Chain Operations Reference (SCOR);
- **Performance metrics** – choosing measures that indicate the degree to which mutual objectives of the chain members have been achieved e.g. inventory across the whole supply chain at a particular point in time;
- **Secondary measures** – measures developed for individual members of the chain.

When implemented across the supply chain, these measures must be collected, analysed for individual performance and how this affects the holistic supply chain performance. It is important that the performance measures are communicated across the supply chain and an effective way of doing this could

be through the performance map (Figure 2).

The performance map allows us to see the links between mutual objectives, global performance, individual chain member's performance and functional performance in each member of the chain. In addition, the map may assist in highlighting problem areas within the supply chain and what the causes of those are. This performance map can be viewed similarly to the process of policy deployment.

b. Facilitate Performance – developing an effective performance information sharing system. This would allow the communication, monitoring and control of how actual performance compares to target performance. For example; to see the inventory level at different locations in the supply chain via the internet.

c. Encourage Consistent Performance – providing supply chain members with timely incentives that they value and which increase value in the supply chain.

d. Intensify the Performance Measurement System – comparing and modifying performance measures. This may be done internally or by external auditors.

5. Empirical Discussion

The paper has explored the importance of having the correct performance measurement system for collaboration alignment between companies. The successful operation of a good collaborative performance system will also support other key ingredients for supply chain collaboration such as the cultural elements of collaboration [14], partnering trust and openness to freely exchanging information, as well as the continual development of the right support systems (e.g. technology).

Research undertaken by us indicates that although there may be support for a collaborative relationship, in practice alignment of measuring may be inappropriate or poorly drawn up. This is illustrated by two mini-case study examples taken from the steel and grocery sectors. The approach adopted in conducting these two cases is the 'Quick Scan' method, which has been developed and employed to audit supply chains [2]. The cases form part of a three year active research project within the Cardiff University Innovative Manufacturing Research Centre.

In the steel supply chain our research has shown that each member involved uses an individual performance measure. Figure 3 shows the physical flow of materials in the chain. The supplier provides rolled coils which are delivered by the contracted transport provider to the tube manufacturer. In this case the three members used the following delivery metrics:

- Materials supplier – ready on time/tonnes
- Transport provider – percentage of loads delivered in time
- Tube manufacturer – percentage of loads delivered on time.

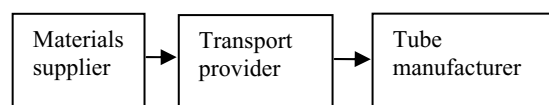


Figure 3: Steel Supply Chain

Whilst the performance measures used by the transport provider and tube manufacturer appear to be the same the values at both companies were typically found to have a 20% difference. This indicates that the companies are using slightly different ways of measuring delivery. This scenario not only creates confusion in the supply chain but also provides a lack of trust between the players. This supply chain needs to develop some joint

performance measures and examine how these jointly developed performance measures fit into the overall performance strategy of each of the companies.

In a separate example in the steel sector we observed that the supplying steel producer whilst recognizing the importance of on time and in full delivery was actually measuring under this name departed on time in full. This again meant that confusion could exist between receiving and supplying partners especially in leaner supply chains where on time in full delivery was more critical.

Similarly in the grocery sector we found that great importance was placed on suppliers delivering on time in full. This requirement has become even more exacting as retailers' have progressively lowered inventory levels in their distribution centres thus reducing their buffer of stock which may have protected them from sell outs if deliveries were received late or below the ordered level. Therefore, this measure was agreed by both parties as a fundamental measure of service success. However, the measure was derived essentially by two different measuring systems, one driven by the retailer and one driven by the supplier. The possibility that the supplier may believe that their on time in full measure was above target whilst the retailer's equivalent failure to arrive (FTA) measure was below target was clearly a possibility. Our discussions exposed that indeed that this scenario did occur and could lead to an undermining of relationship trust and status.

The examples highlight the importance of supply chain members developing a performance measurement system jointly. Such measures could be developed using the guidelines suggested by Simatupang and Sridharan [1] in Section 4. Their top down approach ensures players are measuring the same thing throughout the entire supply chain. This not only encourages the supply chain to operate more efficiently but also strengthens relationships.

6. Conclusions

Although the literature on collaborative performance measurement is fairly developed a number of questions arise from it and our empirical examples, which point to avenues of potential future research. In order to motivate collaborative behaviour do we need a supply chain performance measurement team (a group of individuals who promote and monitor the collaboration)? In theory this seems like a good idea but which member of the supply chain is responsible for this? Which member bears the cost of

this? Companies operate in networks (multiple suppliers and customers) rather than a chain. Therefore, how do we measure collaboration given the complexity of over-lapping supply chains? The network structure of supply chains requires companies to trust each other explicitly and requires the collaborating company to share information with some customers and supplier and not others. Lambert & Pohlen [3] assert that “there is no evidence that meaningful performance measures that span the supply chain exist”. In addition to this, there appears to be no empirical research showing a holistic (end-to-end) measure of supply chain collaboration. Even simulation studies measuring collaboration in the supply chain tend to focus on inventory costs [13]. Finally, whilst most studies tend to focus on a single measure for collaboration the measure is not related back to the strategic orientation or global performance measure of the collaborating companies.

Collaboration aims to improve value for the customers and stakeholders of the supply chain. The vital question this literature review poses is whether we need a universal measure for supply chain collaboration? If so, what should it be? In light of this, should we be looking at input compared to output in the supply chain, suggesting we measure the benefit of collaboration against the time and money a supply chain spends on it.

Our empirical work exposes that even at the most basic level of a single combined measure which partnering firms both identify as critically important a functional, myopic approach is still under-pinning the measurement calculation which can lead to conflicting calculation of the same performance, such as the percentage of deliveries, made on time and in full. This can undermine the partnering relationship rather than supporting the constructive alignment of process activity that would further motivate collaborative engagement.

References

- [1] Simatupang, T. M. & Sridharan, R. The Collaborative Supply Chain, *International Journal of Logistics Management*, (2002) Vol. 13 (1) pp. 15-30.
- [2] Naim, M. M., Childerhouse, P., Disney, S. M. & Towill, D. R. A supply chain diagnostic methodology: determining the vector of change, *Computers & Industrial Engineering: An International Journal* (2002) Vol. 43, No. 1-2, pp.135-157
- [3] Lambert, D. M. & Pohlen, T. L. Supply Chain Metrics, *International Journal of Logistics Management*, (2001) Vol. 12 (1) pp. 1-19.
- [4] Ellram, L. M. Supply Chain Management. The Industrial Organisation Perspective. *International Journal of Physical Distribution and Logistics Management*, (1991) Volume 21, No. 1, pp. 13-22
- [5] Holweg, M. Disney, S. Holstrum, J. and Smaros, J. Supply chain collaboration: making sense of the strategy continuum, *European Management Journal* (2005) Vol. 23, No. 2, pp.170-181
- [6] Mason, R Synthesising the way various ways business relationships are categorized. Submitted to the IPROMS conference, 2006
- [7] Giannakis, M., Croom, S. and Slack, N. Supply Chain Paradigms, in S. New and R. Westbrook, (eds.), *Understanding Supply Chains*, Oxford: Oxford University Press, (2004) pp. 1-21
- [8] Von Bertalanffy, L. Theory of Open Systems in Physics and Biology. *Science*, III: (1950) pp. 23-29
- [9] Fawcett, S. E. & Clinton, S. R. Enhancing Logistics Performance to Improve the Competitiveness of Manufacturing Organizations, *Production and Inventory Management Journal*, (1996) Vol. 37 (1) pp. 40-46.
- [10] Chan, F. T. S., Qi, H. J., Chan, H. K., Lau, H. C. W. & Ip, R. W. L. A Conceptual Model of Performance Measurement for Supply Chains, *Management Decision*, (2003) Vol. 41 (7) pp. 635-642.
- [11] Thompson, P. J. & Sanders, S. R. Partnering Continuum, *Journal of Management in Engineering – American Society of Civil Engineers/ Engineering Management Division*, (1998) Vol. 14 (5) pp. 73-78.
- [12] Naim, M., Disney, S. & Towill, D. Supply Chain Dynamics, Ed New, S. & Westbrook, *Understanding Supply Chains: Concepts, Critiques & Futures*, Oxford University Press: Oxford, (2005) pp. 109-132.
- [13] Huang, Z. & Gangopadhyay, A. A Simulation study of Supply Chain Management to Measure the Impact of Information Sharing, *Information Resources Management Journal*, (2004) Vol. 17 (3)

pp. 20-31.

[14] Barratt, M. Understanding the meaning of Collaboration in the supply chain, *Supply Chain Management: An International Journal*, (2004) Vol. 9 (1) pp. 30-42