

# **Resolving Performance Measure Conflicts in a Supply Chain Using Systems Thinking Methodology**

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## **ABSTRACT**

Performance measurement and management have received a great deal of attention in the literature in recent years. However, to date, there is scant attention to dynamics and trade-offs amongst performance indicators in theory and in practice (Santos, Belton et al. 2002). Thus, performance management systems (PMS) have remained static, fragmented, and backward looking (Bourne et al. 2000) leading to adverse outcomes, often unknown to managers and organisations. A systems view of performance, on the other hand, calls for a holistic approach to performance measurement integrating multiple dimensions, functions and time horizons across the enterprise. A systemic performance measurement would take into account the interdependencies of functions and their dynamic influence on the performance of the organisation as a whole. This paper addresses this challenge using the four level thinking (Senge, 1991) and causal loop models to highlight the inter-relationships between the KPIs and their trade-offs within and across different functions. The study reports on an action research within a multinational company where through real case scenarios we demonstrate how KPIs influence, contribute or impede one another in a manufacturing/supply chain setting. The paper reveals how the use of systems thinking concepts and causal loop models by novice users facilitated an open environment for cross-functional communication and collaborations, leading to team and organisational learning and enhanced performance.

**Keywords:** performance measurement, team learning, mental models, systems thinking, cross-functional management

## **INTRODUCTION**

*“Not everything that can be counted counts and not everything that counts can be counted.”* Albert Einstein

Numerous frameworks have been proposed to help organisations define indicators that reflect their objectives and assess their performance. Examples include Performance Pyramid (Lynch and Cross 1991), the Balanced Scorecard (Kaplan and

Norton 1992) and Performance Prism (Neely, Admans et al. 2002). Recent literature indicates a shift from treating financial performance as the foundation for performance measurement to treating them as one among a broader set of indicators. The new performance measurement frameworks aim to connect performance indicators to business strategy and are designed to be multi-dimensional, explicitly balancing both financial and non-financial measures, both leading and lagging indicators to overcome the limitations of the traditional financial measurement systems. However, a key criticism of current performance measurement frameworks is their static nature (Todd 2000).

KPIs are widely used by organisations to track actual performance against targets to assist decision making. Although the use of KPI is prevalent, there remains an underlying complex problem of correctly identifying and addressing trade-offs between a set of KPIs. Maani and Li (2004, 2005) suggest that too many KPIs could lead to over-reactions and over-intervention with adverse unintended consequences for organisations. This is because KPIs are often viewed as 'linear' - without paying due attention to interactions amongst them. In addition, far too many organisations still define their performance measures without understanding the dynamic interdependencies and trade-offs between the individual or groups of indicators (Santos, Belton et al. 2002).

The existing literature on performance measurement and evaluation appears to have overlooked the critical dimension of trade-offs between the performance indicators and strategic objectives. Trade-offs are inherent in complex systems - in particular in a business, social and policy environments. Understanding the dynamic interactions between KPIs allows decision makers to prioritize conflicting interests and objective and to achieve greater enterprise wide result.

## **LITERATURE REVIEW**

The prevailing performance management systems tend to be driven by short term goals and local optimisation (Neely, P et al. 1999; Youngblood 2003), discouraging continuous improvement and learning (Lynch and Cross, 1991) and lack external focus (Kaplan and Norton, 1992).

Catellano, Young et al. (2004) identified seven fatal flaws of performance measurement outlines below:

1. Ignoring the Performance Contributions of Interactive System Elements
2. Misunderstanding Variation
3. Confusing Signals with Noise
4. Misunderstanding Psychology
5. Confusing the Voice of the Customer with the Voice of the Process
6. Failure to Support a Process View
7. Misunderstanding the Real Role of Measurements

Most organisations and managers, by extension, treat different elements of performance as independent and in isolation. This stems from a lack of systemic and integrated view of their organisational units leading to silo mentality and internal competition. "Unless performance management has an enterprise scope, an

organisation cannot synchronise measurement across departments and gain true visibility of business performance” (Bourne, Mills et al. 2000; Castellano, Young et al. 2004).

Furthermore, the real role of performance measurement is often misunderstood. Often managers are so consumed with lengthy data gathering and mindless micro management that they lose sight of broader organisational objectives and strategy. This could lead to proliferation and over-complexity in performance measurement systems (Johnston, Brignall et al., 2002).

### Performance Trade-offs

The concept of trade-offs is not new. However, there is no consensus amongst researchers as whether or not they are avoidable. Skinner (1969) first proposed the trade-off theory and defined that trade offs are unavoidable in the competitive business environment. Organisations are constantly competing along multiple objectives therefore it is argued that higher performance in one objective can only be achieved by compromising the performance of another. Santos, Belton et al. (2002) state that trade-offs between performance indicators are inherent in the business environment. If there are multiple objectives for an organisation, then by definition they must be conflicting, otherwise there would only be one objective (Youngblood 2003). Slack (1991) believes that trade-offs exist only in the short run; they can be eliminated in the long run. However, Silveira and Slack (2001) suggest trade-offs do exist and they can only be lessened but not eliminated.

Collins (2001) on the other hand suggests that organisations should abandon trade-offs and replace them with an approach to complement competitive objectives. He maintains the ultimate aim of organisations should be focusing on satisfying customer needs by achieving *all* competitive objectives.

Ferdows and de Meyer (1990) take a middle ground suggesting that trade-offs do exist but the trade-off theory does not apply in all cases; instead it is a function of progressive development of each performance dimension upon the others. They state that in the short term, it is possible to trade off capabilities against one another, but in order to construct long-term capability, management must develop the four objectives of quality, dependability, speed and cost in a ‘sand cone’ fashion where the lower layers must be extended in order to support any increase in any higher layer.

## **RESEARCH MODEL & METHODOLOGY**

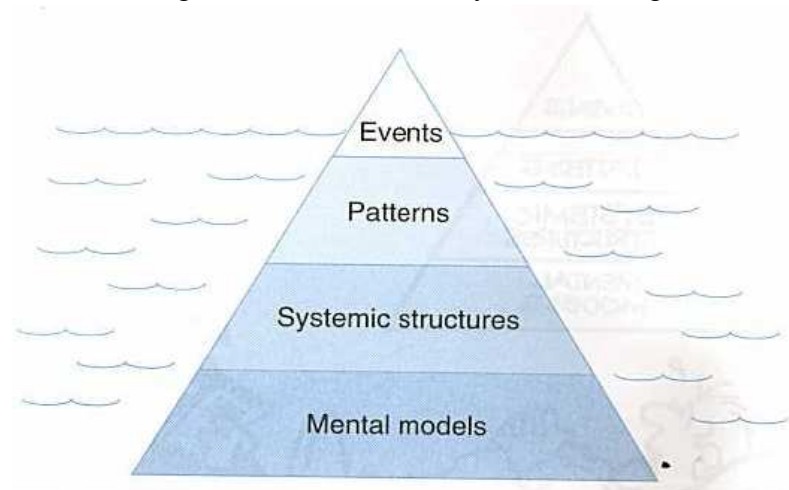
The research approach used here is the Four Level Thinking Model (Senge, 1991, Maani and Cavana 2007). This model consists of four distinct but related levels: events, patterns of behaviour, systemic structures and mental models (Figure 1). It is argued that most management and policy actions unfold in this manner, where events represent the shallowest yet most visible level of reality and mental models reflect deepest and most profound assumptions, norms and motivations (i.e., individual as well as organisational culture).

The research methodology employed was action research within a multi-national food company (referred to here as FoodCom) where one of the authors is employed as the supply chain planner. Six scenarios were studied in detail. For each scenario the researcher began by observing and documenting relevant events and historical patterns over an extended period (several months). Following extensive discussions and focus group meetings with the stakeholders the researcher constructed a causal loop model representing systemic structures - the forces and dynamics that had influenced the patterns of behaviour in the system.

The constructed Causal Loop Diagrams (CLDs) were then validated through follow up interviews with key participants. Following the validation of the CLDs, recommendations were formulated to suggest possible actions for improvements. Company participants were also asked to brainstorm on possible leverage points for interventions.

Finally for each case scenario, the researcher probed deeper into the mental model of the stakeholders (i.e., their assumptions, norms, views). In this paper we present two case scenarios in relation to performance measure conflicts and trade-offs in FoodCom's supply chain. The recommendations derived from the discussions are illustrated at the end of each scenario to improve or overcome the problem situations.

Figure 1: Four levels of system thinking



(Maani and Cavana 2007)

## CASE SCENARIOS

From the field notes taken during interviews, informal discussions and document research, the problem situations and key variables were identified. Stakeholders' views and thoughts were also sought to construct a conceptual model. The problem situations were summarised into different scenarios to demonstrate the interaction between KPIs and the complex issues that FoodCom's management is currently facing. The scenarios identified highlight how functional teams interacted within the supply chain and how KPIs governed by different teams contribute or impede each other.

## Scenario One – Urgent Devanning (Fixes that Fail)

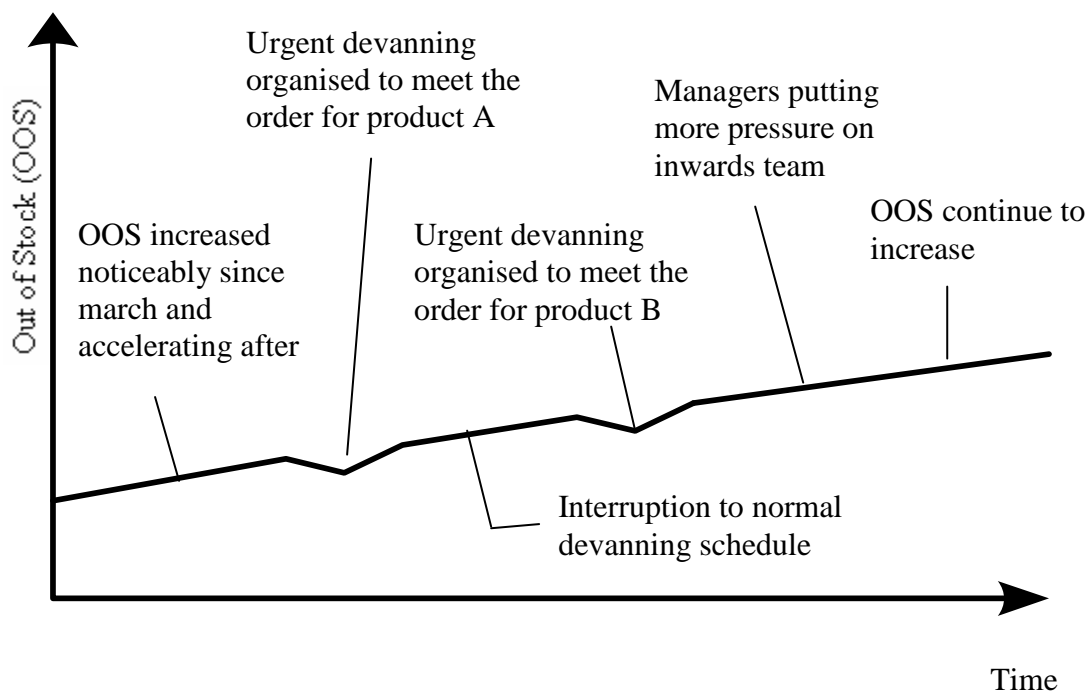
### Events

In mid 2006, FoodCom's Supply Chain (SC) team organised a team meeting to discuss certain events which were of concern to the managers, as follows:

- Goods receiving time had increased from five days turnover to nearly eight days. Goods receiving time can be described as the time it takes for the products to be devanned (moved out of the container), palletised and received into the system.
- Out of stock (OOS) products had noticeably increased since March 2006 and accelerating thereafter.
- Warehouse and distribution staffs frequently complained about the workload and stress -

### Patterns of behavior

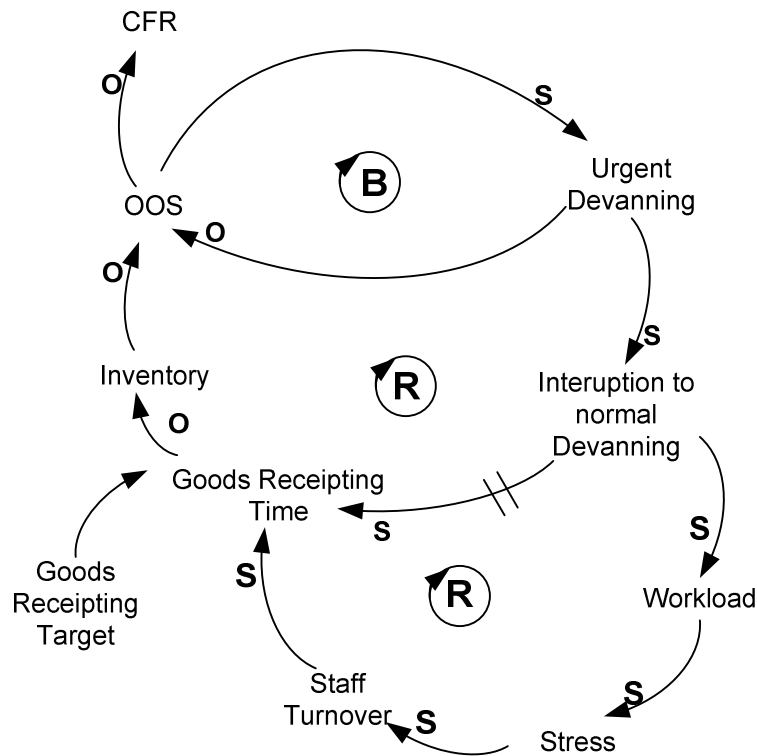
Figure 2 - BOT for Out of Stock in Scenario One



By looking at the trend over time, the OOS situation is increasing continuously and the effort of instructing urgent devann and putting more pressure on inwards team is making the situation worse. More and more products become OOS and inwards team is under a lot of stress.

## Systematic Structure

Figure 3 - CLD for Urgent Devanning Scenario



This scenario is a classic "fixes that fail" archetype (Senge 1990) where well intentioned actions could cause unintended and often harmful consequences.

Historically, FoodCom has several products that routinely face out of stock (OOS) situation and leads to a low Case Fill Rate (CFR) – customer service level. In order to fix this, the supply planners request for warehouse and distribution to organise urgent devanning, so the OOS product lines can prioritised and receipted into stock to meet the customer orders and relieving the problem of OOS. However, this quick fix of urgent devanning results in the side effect of interruption to normal work flow which have the potential to delay normal scheduled devanning and causing more OOS. In addition, the double handing of shifting containers around on site leads to an increase in workload for the inwards team which could have the potential to increase stress and staff turnover to further delay the goods receiving time. So the side effects undermine the impact of the intervention and the OOS reverts back to its original condition after some delay.

## Mental Models

Members of the supply chain team recognise that there is an issue that needs to be addressed immediately, but it is difficult to decide where to start. The supply planners were under pressure to meet customer orders and reduce OOS; therefore they instruct

the inwards team for urgent devanning and busy fire fighting to catch up ensued whenever an OOS occurs.

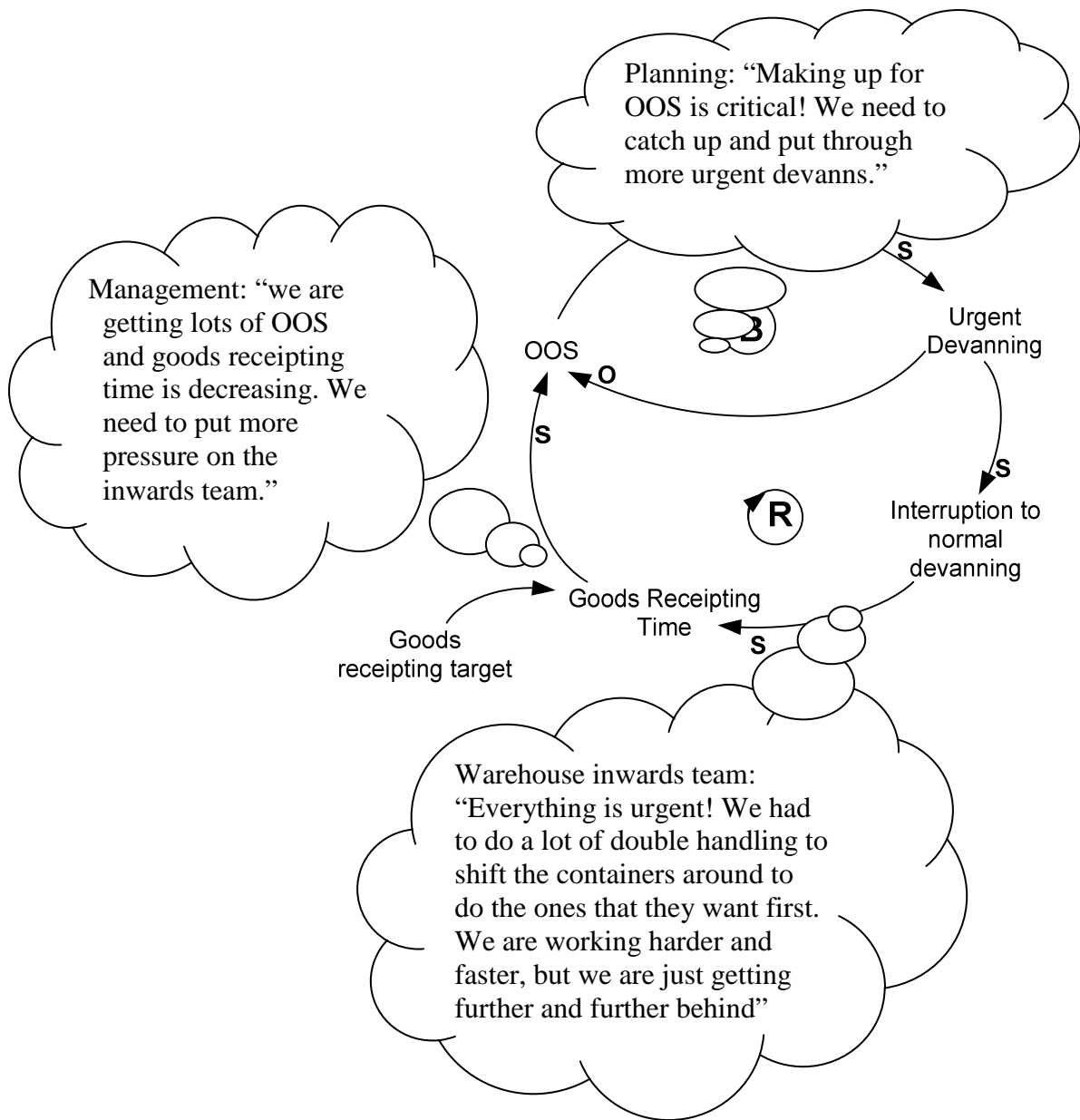
The warehouse inwards team thinks if they just “kept their nose down” and follow the instructions from the head office by working harder and quicker they could help relieve the OOS situation. But the harder they try, the bigger the problem become and the workload just keep increasing. One inwards team leader explained during a phone conversation:

*“On top of further delays in receipting time, the cost associated with this mess is also increasing. Detention charges (similar to a library book overdue fine) are also increasing due to delay in returning the containers back to the freight forwarding companies. Storing a 20 ft refrigerated container could cost up to \$500 extra per day!...We are going out of our way asking for special favours to arrange special container deliveries directly from the port of Auckland instead of going through the usual channel to shorten the lead time. But we are still behind. Do they know what they are doing?”*

This scenario has an impact financially in terms of cost of goods. The management, seeing the decrease in goods receipting time was not performing efficiently, put more pressure on the inwards team. Special projects were also set up to investigate the possibilities of increasing the capacity by adding more people into the inwards team or having double shifts instead of just single 8 hour shift.

Figure 4 below shows some of the key underlying assumptions held by the staff. These are shown as ‘thought balloons’ which represent the mental models of the parties involved.

Figure 4: Mental Model for Scenario One Urgent Devanning



### Scenario Two – Poor Case Fill Rate (CFR)

Following from scenario one, the OOS situation also directly impacted on case fill rate (CFR). This is called 'service level' in inventory management. The CFR target for FoodCom in year 2006 was set at 98%, which means 98% of the time when the customer orders a product, FoodCom will be able to fulfil the order, and fill the customer shelves with the desired products. An increase in OOS results in poor CFR which puts sales and customer services teams under undue pressure to meet sales targets to keep customers happy. During the monthly consensus meeting in June



between supply chain, sales and finance, several events have been identified in relation to the CFR.

### Events

- Pallet count (inventory) in warehouse was down by 2000 pallets
- CFR was performing poorly in 2006, category A was performing at an around 70% on average and a low of 57%
- Number of local truck deliveries increased by 15%
- Cost of failure increased substantially - in the second quarter air freighting cost alone was over fifty thousand dollars.

### Patterns of behavior

As the CFR deteriorates, FoodCom's customers become more and more impatient and unhappy. The sales teams struggle to meet their target because some of the products are either OOS or pass the 4 months shelf life rule. The poor CFR also impacts on their relationship with the customers and some customers even threaten to de-list the particular poor performing product if the CFR do not improve.

In FoodCom, the transit time for sea freight imported goods from northern hemisphere is around 4 to 6 weeks, but due to the poor CFR rate, normally many airfreights are arranged to shorten the lead time in the hope to solve OOS issues and satisfy customer's needs. While meeting customer's needs are important, airfreight charges increase the cost of goods and the cost of failure. Moreover, when the product finally arrives in NZ, urgent local truck deliveries to the customer need to be arranged to further shorten the lead time. Some behavior over time graphs are shown in Figures 5 and 6 below to summarise the situation described:

Figure 5 -BOT for Scenario Two

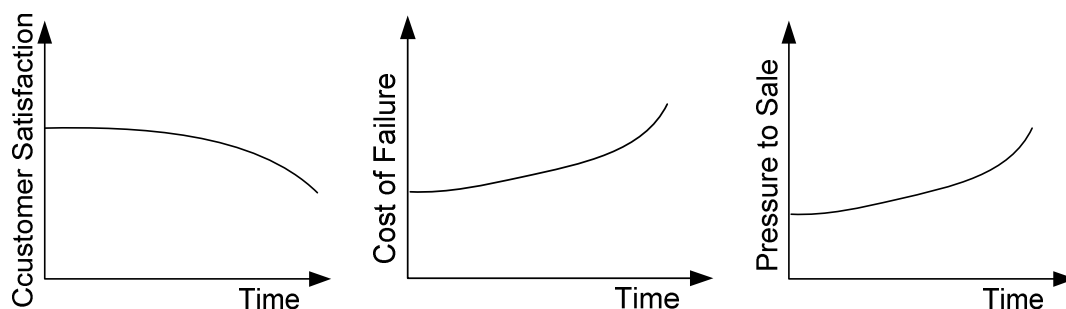
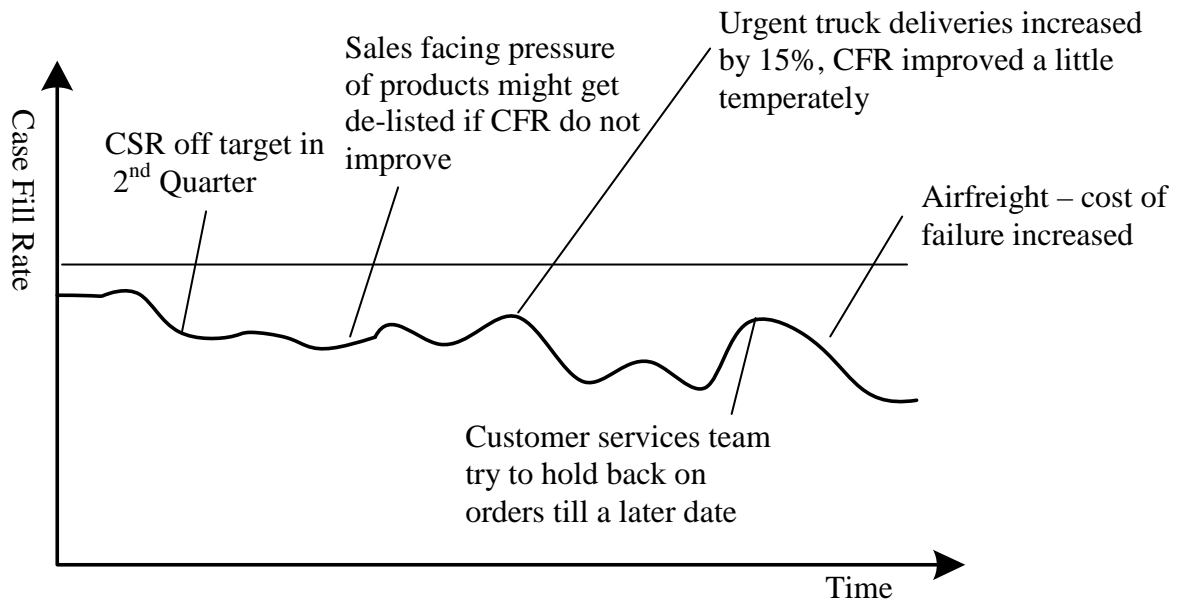


Figure 6: BOT for Case Fill Rate

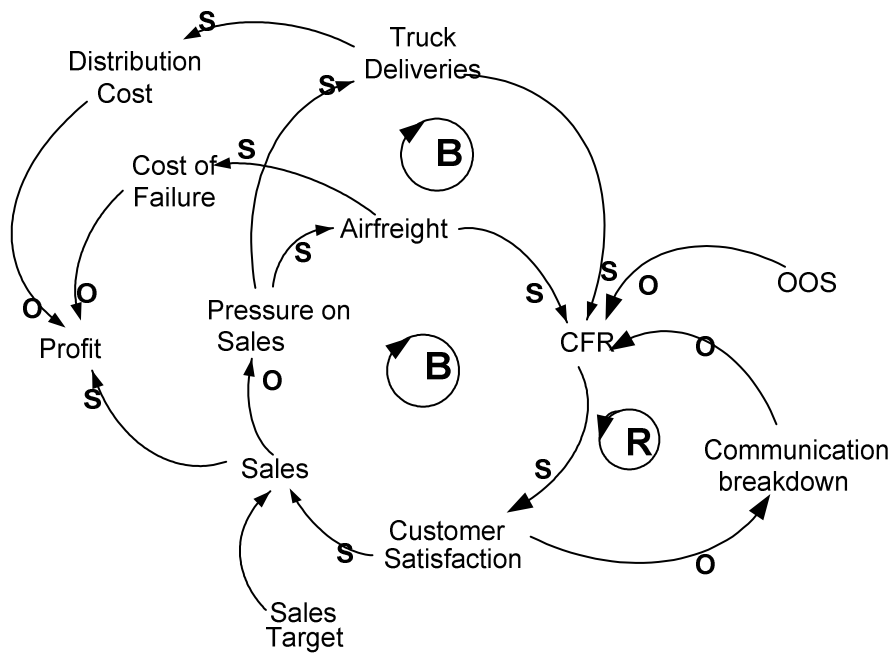


### Systemic Structure

The CLD shown in Figure 7 below highlights the impact of CFR on some key financial KPIs such as cost of failure, distribution cost and profit. By doing more airfreights and truck deliveries instead of sea freighting, the product transit time is shortened in the hope to increase CFR and to satisfy the customers. But the transit time is shortened at the expense of cost. CFR is only relieved temporarily and customers are still frustrated which reflects in the low customer satisfactions.

Low customer satisfaction reinforces the communication breakdown between FoodCom and its customers. As the communication breakdown increases, FoodCom's knowledge about their customer plan for promotional activities further decreases the CFR – hence was forming a reinforcing loop. This is expressed by one territory manager: *“It would be nice if they (customers) have told us about what they were doing. But low CFR is frustrating our customers, and unhappy customers are less likely to have open conversations with us.”* Moreover, sales team is finding it a lot harder to negotiate with customers in terms of shelf spacing. *“Every time when we try to negotiate to increase ranging or shelf spacing, customers are hesitant to do so due to the low CFR. Some even ask us to get CFR back to target before going back to talk to them.”*

Figure 7 - CLD for Scenario Two



### Mental Models

This scenario represented a messy situation that could not be resolved with a quick fix of airfreight or truck deliveries. The tension between the teams overtime has also created some blaming culture with undesirable consequences for the organisation. Sales believe the planning team was not doing an adequate job to ensure there are enough inventories to meet the customer demand. Finance was also pointing at the planning team for the same reason which resulted in the increase in cost of failure and transport costs. The following quotes extracted from a telephone conference involving all key managers: sales, planning, finance and off-site customer services shed light on the stakeholders’ mental models:

*“We are way off our target CFR of 98%, category A is currently averaging around 70%! I’m constantly getting pondered by unhappy customers about the miss orders and we got to do something!”* Customer services manager

*“What happened this quarter? Our airfreight cost has gone through the roof! In addition, our local delivery charges between North Island and South island have also increased due to more urgent truck deliveries instead of rail. What’s happening in the planning team?”* Financial controller Supply Chain

*“We have over sold in the last quarter and customer A was doing a big promotion on category A which we did not know about... they didn’t give us enough notice to respond to the change and depleted all of our south island stock. I understand our CFR looks horrible but I can only work on what information I have on hand...”* said the supply planner for Category A.

*“There is no such a thing as over sold - sales have basically under forecast and there is a communication breakdown.”* said the demand planner for Category A.

In response, sales manger defended themselves: *“What about the other categories that are not on promotion? The CFR for those are still off the target. It makes our job a lot harder out in the trade; some of the customers are even threatening to de-list our products if our CFR doesn’t improve soon... Our years of relationship with the customers have been significantly impaired by the poor CFR, planning is making our job very difficult.”* *“As for category A, we did not know about the promotion, customer A has just put the price of the whole range down to treat them as a lost leader. It will be nice if they have told us about what they were doing. But unhappy customers are less likely to have open conversations with us.”*

*“It’s just not good enough, you guys at the front line need to keep us informed, we can’t keep on doing this. We are spending thousands of dollars rushing around in the hope to raise our CFR, but our performance seems to be going down even more.”* said the supply planner for Category A.

Following a recommendation to the supply chain manager, the SC team embarked a daily monitoring of the CFRs. This led to the discovery that a large proportion of poor performance was the result of customers ordering either deleted items or old product numbers (run-out lines). When a customer orders a deleted line or an incorrect old line number, it is also considered as a miss in the CFR report and hence exaggerating the true CFR figures. To resolve this requires customer services and sales teams to communicate and collaborate closely.

## **VALIDATION OF MODELS**

After initial data collection and one-on-one interviews, conceptual models qualitative system dynamics were constructed to develop a picture of the reality. Follow up meetings with participants were also conducted at this stage to clarify any ambiguous concepts and problem issues.

The links and relationships between the KPI's were presented visually through the use of CLDs and the four levels of thinking model. Once the scenarios and CLDs were validated and finalised, the next step was to bring the participants together to develop a common vision for taking significant actions on the issues investigated. This helped to uncover multiple mental models held by the participants.

Next section discusses group sessions where the participants were able to reflect on and discuss their existing processes and experiences to derive areas requiring change.

### **Group Discussion Sessions**

Several group discussion sessions took place to enable the researcher to present findings and recommendations back to the organisation. In contrast to initial data collection interviews, where the participants focused on describing their experience of

the issue and the context, this session was to ensure they understand the bigger picture and explore possible interventions. Group discussion sessions covered three areas:

- Introducing the system thinking concepts
- Discussion of Scenarios and CLDs identified
- Recommendations for action (intervention strategies)

Overall, all the participants had a positive attitude towards system thinking concepts. This was demonstrated by their level of enthusiasm and engagement towards the scenario problems. Some participants were even interested in looking into further readings about system thinking which was a surprise.

By incorporating multiple stakeholders, participants' understanding could be extended and different perspectives could be integrated into a holistic interpretation that satisfies the different participants. The group discussion happened in several sessions, each involving the participants that were relevant to the problem scenario.

The group discussions then moved on to discuss the recommendation and to give the participants a platform for formulating action plans and identifying priority areas for improvements. Original recommendations of the researcher were validated and if necessary modified with the rest of the participants in a collaborative approach.

## **Reflection**

At the end of the group discussion session, participants were asked to reflect on what they had achieved and learnt. The reflections by participants were also taken during and after the implementation of proposed recommendation.

Participants were asked to evaluate the processes of this research. This information was valuable to assess the value of system dynamics in enhancing understanding of the trade-offs between performance measures. and in supporting performance management decisions.

The focus group like discussion sessions turned out better than expected. Overall, the results confirmed that qualitative system dynamics modelling enhanced participant understanding of the causal relationship between KPIs. Moreover, the process clarified complex issues involving multiple objectives enabling decision makers to understand the strength and weaknesses of each approach to make an educated trade-off decision.

This approach illustrated that KPIs could exhibit contradictory behaviour between one another, typically across different functional teams, as was the case of increase in sales which impacted the distribution cost negatively.

some extent demonstrating the Hawthorne effect. However, it is believed the scale and magnitude of the improvement cannot be simply explained by the extra time and resource devoted to performance measurement. The performance improvement observed during the course of this research is the largest increase in FoodCom's

performance as far as the staff can recall. This adds further confidence to the integrity of this finding.

The debate between marketing and technical and production departments over strategic product ranging and factory complexity illustrates the trade-off concept perfectly. On one hand, product ranging is the main drive for sustainable growth and market share. On the other hand, the increase in factory complexity impacts short term financial results severely. The performance manager in the factory cynically referred to as “*success is measured by how much we lost, because we are losing money on every packet we sell.*”

Nevertheless, the performance in cost of production improved as soon as the ‘unnecessary’ packet configurations were deleted. At the same time, the market share was unaffected as customers simply trade up or down to the next packet configuration available. This result surprised marketing and changed their stance towards the strategic ranging aspects.

## **TEAM LEARNING AND COMMITMENT**

Decision making in FoodCom has always been complex and involves several strategic objectives that are sometimes contradictory. Each function team has different views of the situation and defines problems differently. The research showed that by sharing the underlying assumptions and mental models in the personal world, the participants were able to learn from each other and collaboratively construct a shared perspective in the social world. The shared perspective in the social world then can be derived into the technical world to modify system policies, to engage the behaviour of participants socially and hence change the mindset of people personally. As a result, conflicts can be minimized between different teams with different objectives and different KPIs.

The Causal Loop Diagram (CLD) illustrated several key advantages in investigating the interdependencies amongst KPIs. This provided a clear picture of different attributes of the problem variables and the interconnectedness amongst them. Cause and effect, time delays and feedback loops can be illustrated via CLDs and demonstrate the dynamic behaviour of the system. For example, in Scenario Two, the KPI case fill rate (CFR) is an important measure for customers. Lower values of CFR reflect a poor performance of meeting customer deliveries and hence reflecting a lower customer satisfaction. The CLD constructed showed how this KPI interacts with the other variables. An increase in delivery costs will lead to an increase in the CFR and conversely, an increase in communication breakdown resulting from a poor customer satisfaction which in turn decreases the CFR. Therefore the system thinking techniques, in particular developing CLDs enhanced participants understanding of the interdependencies through a holistic view of the system.

Overall, this research created a learning atmosphere to foster shared understanding, as a result, commitment and direction of the staff in the FoodCom changed. People no longer cling to “dearly held views” but instead are open to make compromises and to

help out other colleagues in different teams. A classic example of this is demonstrated by Scenario Four – Sales trade spending vs. supply chain contract to clear.

*“The key take-home for me from this discussion session will be regarding to understanding of ‘working as a whole’ concept, that write offs are not SC’s responsibility alone. Our sales trade spend budget and SC’s write off are really from the same bucket of funding.”* said one key account manager.

Sales team started to change their mindset regarding the balance between trades spend funding and write off. Through discussion sessions, sales team demonstrated a sympathetic view towards supply chain by beginning to consider the funding as one pool of money.

Many participants described organisational learning was the most valuable payoff of this research. The benefits of system dynamics to explore inter-relationships of KPI for supporting decision making derived as much from the process as the outcomes of analysis. To staff members, in particular the research participants of FoodCom, this research study has influenced the way they think and act. This research is believed to have improved their shared understanding of the complex issues in particular the performance trade-offs of the organisation. The participants have also gained more appreciation of each other’s responsible areas and formed a stronger bond with each others. Some quotes identified from the discussion session have been listed below regarding to this area:

*“I never thought about the problem this way, now I see! I guess I was a little selfish... I was probably the one that caused all the ciaos in supply chain. I shall arrange more meetings with supply chain to find out more about what they do.”* Key account manager.

*“It’s amazing how I have actually created these problems for myself!”* supply planner

*“I have got more exposure to other parts of the business especially marketing’s view on market share and product ranging. Being away from the head office makes it a lot harder to know what’s going on in other parts of the business. This session is beneficial, we should get more people involve in similar cross-functional discussions. It could add a lot of value.”* Factory performance manager

## **GROUP DYNAMICS – ORGANISATIONAL CHANGE**

As the researcher gained the trust of the participants and cross functional teams became more involved both in formal and social settings, closer goal alignment was achieved both vertically and horizontally.

Although the research disrupted some practices which have been institutionalised at FoodCom’s for a long time, it is expected that it will result in several positive influences on the participants and team dynamics. Two interrelated aspects arose from the action research cycles and were perceived to have contributed to the following learning and behavioral changes:

- Developing and sharing knowledge
- Valuing the big picture

### **Developing and sharing knowledge**

*"You cannot have a learning organisation without a shared vision...A shared vision provides a compass to keep learning on course when stress develops." — Peter Senge*

From the beginning of this research, the behaviour of the participants notably changed gradually throughout the 18 months of this research. As a direct consequence of a shared vision, the level of communication between functional groups also increased. For example, supply chain department has now a stronger involvement with sales and marketing in product promotions. Sales team begun to take the proactive approach to check with SC and discuss possible stock level impacts before committing to special activities in the trade. Sales also developed a trade activity report so SC could have more visibility in trade activities and adjust demand and forecast accordingly.

By increasing the visibility of functional KPIs, some new opportunities has opened up for FoodCom. Rather than reinventing the wheel, the teams are now learning from each other, sharing information cross functionally using the same report. The development of a new monthly operations review (MOR) reports had a notable contribution to the increase in performance of some KPIs particularly in the last quarter of 2006.

The MOR report contains KPI figures which are used by all functions and each team is now more aware of what is going on in other areas of the business. For example, the report has enhanced communication between sales and demand planners and increased demand plan accuracy. This resulted in Case fill rate to increase to an average of 94% from around 70%. More importantly, the teams now understand *how* their KPIs could affect each others. The systems perspective and successful collaboration has proven to be gradually helping participants to aim towards feeling as one team with one common goal.

### **Valuing the big picture to prevent Sub-optimisation**

This research has brought FoodCom one step further by exposing and changing their underlying mental models to reduce, if not eliminate, destructive competitions amongst functional teams.

A cross-functional view of performance measurement consolidating several functional aspects into one holistic picture tends to have greater effectiveness. At the beginning of the research, sales person A during one informal discussion viewed supply chain people as whistle blowers:

*"SC team is the whistle blower, because they are usually the one that says NO to marketing's new product launch ideas, NO to the promotion date that we have organised with the trade, they are the one that stop all the fun!"*



But towards the end of the research, when asked to comment on the supply chain department again the same individual said:

*“I never thought about an issue this way, now it seems so simple and it is all common sense. Why didn’t we look [at] the situation this way before? I now understand why they [supply chain team] are always challenging our ideas. To be honest we never actually think about whether it is cost effective or whether the inventory level is enough to go ahead with promotion...[before] it wasn’t really my problem. My only concern was how we can increase sales from particular activity. I missed the whole idea of the big picture and was only achieving local optimisation.”*

The practice of personal reflection demonstrated a valuable and positive impact that this research had on staff attitudes. The combined power of action research and system thinking also contributed to this key success.

### **Language and Gesture**

In addition to the change in mindset, the terminology/language used by the participants has also changed over the duration of the case study. As the participants became more familiar with the concepts of system thinking, they have started using its terminologies and phrases such as: ‘fire fighting; feedback; root cause; goes around in a loop; and the big picture.’ Several of the participants also use hand gestures to draw a loop in air while explaining their interpretation of scenarios.

*“I didn’t really see how I could help the SC department in terms of reducing bad goods and distribution cost, because after all, my job is demand planning and concentrating on the DPA and making sure that we meet our target of 75%. But now through identifying these causal relationships I understand! If the forecasted volume is too high, inventory goes through the roof; cost of working capital increases. Moreover, stocks become aged and will need to be written off when the expiry date hits us. Alternatively, if the forecasted volume is too conservative, we will be out of stock (started using his hand gesture to draw a loop in the air while explaining) which hits our CFR. In order to counter attack OOS, we need to arrange urgent devanning, urgent deliveries by truck to SI, which again increases more OOS. The loop just keeps on going!”*

Research participants are starting to step away from the linear thinking and move towards closed loop thinking. Hence, systems thinking principles and language can trigger behavioural change and enhance team learning in complex organisations.

## **ORGANISATION LEARNING**

The purpose of this research was to use system thinking concepts and tools to investigate the interdependencies amongst KPIs and the causes and consequences of performance trade-offs in a multinational organisation. The word that most appropriately describes the broad context for contemporary performance measurement is uncertainty (Milgate 2004). Organisations are constantly facing an uncertain

dynamic world in which they must balance multiple stakeholders, multiple time horizons and multiple KPIs. In such an environment, performance measurement and management need to focus on identifying the root causes of performance problems and understanding the reasons for performance laps. However, even when a comprehensive analysis of the problems is carried out, the identification of suitable corrective actions is still considered challenging (Santos, Belton et al. 2002). While one KPI would indicate high levels of performance, it might have adverse effect on one or more other areas of performance. Often, the success in one area can only be achieved at the expense of another, which suggests trade-offs between performance indicators may be inevitable in complex dynamic systems.

The outcomes of this research can be presented on two levels. First, introducing the concepts of system thinking and system dynamics modeling (in particularly the CLD) captured a holistic view of the KPIs and their interdependencies. Understanding of the cause and effect relationships between indicators and actual performance was enhanced through the process of identifying events, patterns, systemic structure and mental models. The case scenarios provided evidence that the system thinking approach had a substantial impact on improving FoodCom's KPI performance. Most research participants agreed that there had been several improvements in the KPI results in the last quarter of 2006. By combining shared vision and the profound knowledge derived from personal mental models (identified from interviews) and collective team learning (through the discussion sessions), system thinking process enhanced cross functional understanding and cooperation. This research also raised awareness of the dynamic nature of the performance indicators.

Secondly, by giving the participants the opportunity to engage in the process of inquiry they increased their knowledge of cross-functional dynamics and changed their mindset and behaviour - showing more appreciation for the needs and concerns of other teams which were previously overlooked. This allowed the employees the opportunity to contribute and create a shared vision. As a result the decisions were made by consensus and represented balanced perspectives, leading to greater buy-in and commitments to actions.

Overall, this research had a positive impact on FoodCom's culture and performance. It allowed the staff to engage and take ownership of the process and to achieve higher performance. Although the resultant decision making process might have been considered as tedious and initially time consuming, the teams realised greater payoffs down the track. This 'collective wisdom' had further flow on effect organisational behaviour and relationships.

## **RESEARCH CONTRIBUTION**

Although exploratory in nature, this study has important theoretical and practical implications.

From a theoretical perspective, the study provides empirical evidence that the systems thinking approach can help managers and staff to gain a holistic view of their organisations and to understand dynamic interdependencies and trade-offs amongst

the performance indicators. The use of the four-level model to frame the research problem and explain the results made a significant contribution to this research. As the events were identified and behaviour over time graphs were constructed, significant insights into the underlying patterns of variables were gained. Together with the causal loop diagrams, inter-linkages between cause and effect of different KPI variables were mapped and integrated to demonstrate the systemic structures underlying performance measurement. The results, insights and proposed interventions were then communicated back to the stakeholders, which helped them revise their mental model and facilitated group and organisational learning.

From the managerial practice perspective, this study demonstrated an effective process to create an open environment for cross-functional communication and organisational learning. By constructing the CLD models, decision makers could enhance their understanding of how actions today can affect future performance. Therefore, decisions could be made proactively and systemically, enabling decision makers to initiate changes without adverse and unintended consequences. The proactive rather than reactive management of performance was evident at the case study organisation.

From the above theoretical and practical outcomes, it is concluded that the use of system dynamics can catalyse and enhance team dynamics and organisational learning. It also overcomes the silo mindset and reduces the risk of making erroneous inferences of dynamic processes imbedded in complex systems.

### **FoodCom – 16 months on**

We revisited the case company 16 months after the initial research and asked three questions as follow:

Q1: whether the collaboration between the teams had continued?

A: Yes, particularly in the Supply Chain team. There is a strong consensus amongst the entire SC division that communication and cross-functional collaboration had become the key area of focus for business success. The CEO commented that SC (and in particular the planners) is no longer just the service provider as they are now actively involved in the commercial part of the business (sales). The more SC understands the sales promotional plans, shelf strategy, pricing strategy...etc, the more they can accommodate and even challenge the commercial part of the business.

Q2: whether the SC performance improvements have been sustained?

A: The main SC KPI results (DPA, CFR, Stock Cover, bad goods, etc) have all shown consistent improvement. CFR, for example reached 97.5% in 2007. The improvements are in large part due to enhanced dialogue, awareness of potential KPI trade-offs and a deeper understanding of what other departments do and how their actions affect each other.

Q3: whether the employees have continued to utilise systems thinking concepts to maintain a culture of continuous improvement and learning?

A: Since the introduction of Systems Thinking, FoodCom has initiated a “One Number principle” - a holistic view of business where cross functional stakeholders collaborate together and share responsibility to achieve a single company target. This is in sharp contrast to the previous mode of operations whereby sales set its own target, SC forecast another figure, and finance would budget for another number which resulted in endemic dysfunctional behavior. Although this is still work in progress, it is believed that the benefits from adopting a systemic performance management is profound and enduring.

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