Supply Chain Management

An in depth analysis of the export supply chains of Iris

Bachelor Assignment
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Note of confidentiality

Due to the sensitive nature of the information in this research, names of companies, individuals, customers and locations have been modified. Companies are represented by names of flowers, and locations have been removed from this report. The research methodology and results are not affected. To obtain the original information, please contact BOZ of the faculty MB.

Management Summary

Lotus is the closures division of Hyacinth Inc., the world wide leader in packaging. Currently, one of their production locations for steel drum closures is IRIS, located in India. Besides sales to domestic and export customers in the Middle East, 52% of all products produced by IRIS are exported to Lotus sales centres and warehouses around the world.

Over the last years, the number of complaints regarding the unreliability of supply from IRIS has increased severely. In many cases, these issues had to be resolved by last minute re-allocating demand elsewhere in the Lotus network, which is very expensive in terms of transportation costs and heavily affects business of other production locations. Obviously, the image of Lotus being a reliable supplier is affected as well. These negative effects caused the need for a thorough research in order to *improve the efficiency and reliability of supply from IRIS.*

To achieve this, we used the Supply Chain Operations Reference (or SCOR®) model, developed by the Supply Chain Council in 1996 to standardize description and evaluation of supply chain processes, to acquire of a detailed understanding of the problems causing these inefficiencies and unreliability. Using the same methodology, we also developed solutions for the problems found. A large number of problems ('disconnects' in SCOR®) and potential solutions ('best practices' in SCOR®) were found. The 'disconnects' found were grouped and filtered, resulting in 9 key problems with supply from IRIS (see Figure 1). Similarly, the 'best practices' were grouped and filtered to identify 16 solutions that can solve the 9 key themes (again see Figure 1).

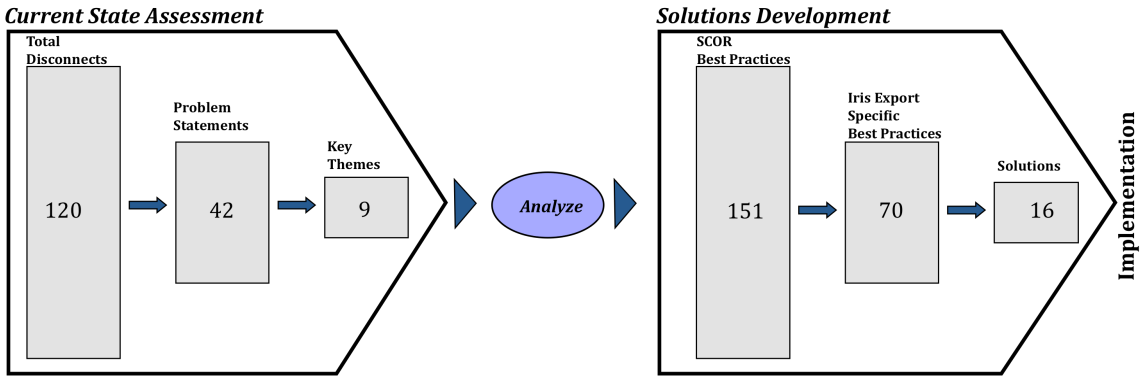


Figure 1 - From disconnect to solution

The key problem themes and solutions for these problems found during this research by using the SCOR® model are depicted in Table 1. All these solutions need to be developed into a detailed implementation schedule in order to solve the identified problems. Due to limitation in time, this research only developed this implementation schedule for the solution with the highest priority. With regards to this, we recommend Lotus® to:

- *Use and configure the new ERP system*. As IRIS's new ERP system is due to go live on April 1st, 2011, all adjustments needed in the ERP system to solve the supply chain issues, mainly related to internal planning and communication, need to be completed before then.
- *Use the developed supply chain dashboard.* In order to quantify supply chain performance in terms of reliability and efficiency and to closely monitor actual

performance when implementing the proposed solutions, the developed supply chain dashboard should be updated on a monthly basis.

- *Develop implementation schedules for the remaining solutions.* The remaining solutions will need to be developed in detailed implementation schedules in order to solve all problems found during this research.

Besides finding the key problems and presenting solutions for supply from IRIS, we like to believe that this research created the awareness needed to thoroughly improve and sustain the supply chain performance.

Key theme	Solutions
Planning (internal)	• *Use and configure new ERP system*, which could potentially solve some supply chain related planning issues. • *Link ERP to SOP for customer communication*. Communication should be a standard, repeatable process, possibly triggered by the ERP system.
Planning (external)	• *Standardize lead-time for supply from IRIS*. Lead-time for all customers should be equal, in order to facilitate production planning. • *Re-evaluated demand allocated to IRIS*. Actual production volume does not meet total demand and production is at maximum capacity, hence some demand should be diverted elsewhere within the Lotus network. • *Separate Customer A orders from Singapore orders*. To facilitate planning and avoid confusion, orders for Singapore and Customer A should be separated. • *Partial shipment of Customer A orders, with top priority.* To prevent capacity issues in the warehouse and increase flexibility in production planning.
Packaging	• *New sticker design including Lotus barcode*. In order to solve issues with labeling, a new, standardized sticker should be designed. • *Container inspection*. To eliminate the use of dirty and leaking containers, implement a thorough inspection of empty containers. • *Upgrade cartons*. To prevent damaging products and packaging, upgrade the cartons to a higher quality.
Communication	• *Develop SOP for customer communication*. Communication should be a repeatable, standard process. • *Appoint/hire supply chain manager*. Key in improving the supply chain performance is dedicating manpower to it.
Quality	• *Repair/reinstall visual check systems*. To minimize delays caused by quality issues
Product Issues	• *Standardize descriptions and codes throughout the Lotus network*. Descriptions and coding of products should be standard.
Shipping/ Receiving	• *Develop proper warehouse management practices*. In order to utilize capacity efficient and prevent in-house product damages.
Manufacturing	• *Salaries and cross training of personnel.* Make factory personnel more flexible and motivated. • *Upgrade production equipment.* To increase production output and reliability, equipment should be upgraded.
Supply	• *Develop new supplier for Buna (square & round) washes.* To decrease supplier dependency and eliminate non-availability of washers.

Table 1 - Key problem themes and solutions

Table of content

1 Introduction

Steel drums are nowadays widely used for a variety of applications, ranging from the oil industry to transportation of chemicals and toxic waste. Hyacinth Inc. has been one of the largest producers of steel drums since the Second World War and almost doubled in size when they purchased Tulip Packaging NV, a Dutch based packaging firm from the 1920's, in 2001 from Crocus-Tulip. After this acquisition, the company is now known as Hyacinth Inc. and is the leading firm in the packaging industry.

At the time of acquisition, part of Tulip Packaging NV was Lotus®, a closures division fulfilling the need for in-house closure production. Currently, Lotus® has 9 sales offices and 7 production locations word wide and produces high quality steel and plastic closures for a wide range of applications.

One of the Lotus® production sites is located in India. In 1994, a joint venture between Daisy & Co. Ltd., a large Indian multi-technology firm, and Tulip Packaging NV formed IRIS. Due to Indian regulations, the name has remained unchanged, even though Tulip is part of Hyacinth Inc. since 2001. The IRIS factory has 2 divisions; a steel closures division and a plastics division that produces plastic containers.

Even though IRIS produces high quality closures, the profit margins are relatively low and entrance barriers to the market are hardly present. Competitive advantage and profitability is therefore highly dependant on the efficiency of processes and the reduction of costs wherever possible. However, current performance of the closures production in terms of volume and reliability is lagging compared to other Lotus® Closures production locations and internal expectations. Therefore, Lotus® has initiated several projects to improve the performance of IRIS and ultimately increase competiveness of Hyacinth Inc. One of these projects is a supply chain improvement project supported by this research.

Currently, about 20% of IRIS's total costs are caused by supply chain related activities (transportation, invoice handling, warehousing, etc) (Daisy - Tulip, 2010). Obviously, handling these activities more efficient will result in considerable cost savings and increased reliability. Within this research, the current supply chain activities and opportunities for improving them will be investigated. Lotus® closures produced by IRIS are manufactured for export markets as well as domestic markets. A large part of the exported closures are dispatched to Lotus sales centres and warehouses, but other export customers (Iran and Saudi Arabia) and domestic customers are served as well (see Figure 2).

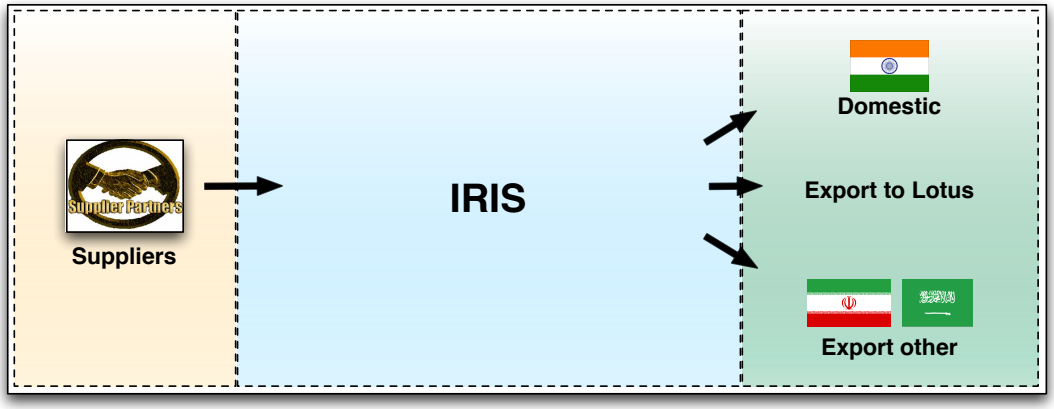


Figure 2 - Lotus supply chains

2 Research Design

To perform this research is a structured way, this chapter outlines the goal and the scope of this research, the research questions and methods used to achieve the research goal and finally outlines to who this research may be of interest.

2.1 Research Goal

The reliability (and thus the competitiveness) of any company is dependent on the delivery performance (in terms of reliability and delivery volumes) of its suppliers. Currently, the delivery of closures is unreliable, as only 55% of the orders are delivered on time (Daisy - Tulip, 2010), causing the delivery of the sales centres and warehouses to be even more unreliable. In order to safeguard customers from this unreliability, the Lotus® sales centres and warehouses will have to dramatically increase safety stock levels and order increasing quantities of closures. As any inventory increase is expensive, Lotus tries to improve supplier reliability wherever possible to prevent this.

As all Lotus® Closures to serve the South East Asia market are produced by IRIS, improving the reliability and efficiency of their processes is of great importance to Lotus. Several projects, as for example the implementation of an Enterprise Resource Planning (ERP) system, are initiated to support this desired increase in reliability and efficiency of IRIS.

This research will contribute to that by focussing on improving the supply chain processes of IRIS. The goal of this research is therefore *to improve reliability and efficiency of supply from IRIS*.

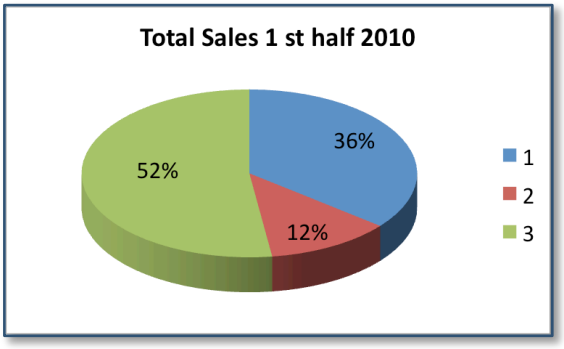
2.2 Scope definition

Due to limitations in time and resources, not all supply chain processes of IRIS will be researched. Some customers, products or processes are more important than others and they should be prioritized accordingly. Within this section, less important (parts of) supply chains will be excluded from further research.

This research will solely focus on export supply chains to customers within the Lotus group, leaving out domestic markets and other export customers. This is done for several reasons:

- Lotus® has encountered some recurring problems with deliveries (incorrect deliveries, delayed deliveries, etc) from IRIS that affected their own business directly as described above. As such, Lotus® decided to initiate this supply chain project to improve upon these problems.
- Second, the export to Lotus® sales centres in Italy and Australia combined with the warehouses in the United States and Singapore constitute for 52 % of IRIS's total sales volumes (Figure 3), which makes it by far the largest (set of) customer(s) of IRIS (and thus the most important one).

One additional customer, that is not part of the Lotus® group, will be added to the scope of this research; a Korean company called Customer A. Customer A is within the top 5 customers of Hyacinth Inc worldwide. They used to be delivered from the Lotus warehouse in Singapore, but since October 2010, products are ordered from the Singapore warehouse, but shipped directly to Korea. This type of shipment will be referred to as drop shipments.



1	Domestic
2	Export Other
3	Export Lotus

Figure 3 - Total Sales IRIS 1st half 2010 (Daisy - Tulip, 2010)

By neglecting the domestic customers and other (non Lotus®) customers, this project will be able to solve some pressing issues for Lotus on a short term.

Another aspect that will be outside the scope of this research is the supply of raw material. As delivery performance of raw material suppliers is up to Hyacinth standards in terms of percentage of deliveries on time and accordance with contract agreements (Iris, 2010), the supplier processes will be considered as static input. This will entail that the link between suppliers and IRIS will be part of this research, but the actual supplier processes are outside the scope of this research.

2.3 Research questions

In order to improve supply chain activities, it is eminent to know what these activities are, how they are currently performed, where problems occur and what improvement opportunities are. A very structured way of assessing supply chain performance is by using the Supply Chain Operations Reference (or SCOR®) model. This model, developed by the Supply Chain Council in 1996, is considered to be the new industry standard for describing supply chain activities and assessing supply chain performance (Wisner, Tan, & Keong Leong, 2009).

First, we need to know what the SCOR® model is, how to use it and what gains can be expected from using it. These topics will be answered in research question 1; *How to use the SCOR® model?* Once this is clear, we will use the SCOR® model to systematically analyse and improve the supply chains by following the SCOR® Project Roadmap (see Appendix A; SCOR® Project Roadmap). The phases as described in the project roadmap are converted into research questions that will guide this research. Per relevant phase of the SCOR® model, the matching research question is mentioned in Table 2.

After getting acquainted with the SCOR® model, we will start by determining which supply chains are within scope of this research (question 2), analyse how activities in these supply chain activities are performed (question 3), what problems with performing these activities cause the unreliability and low efficiency as mentioned earlier (question 4), what solutions the SCOR® model gives for these problems and which of these solutions are useful for Lotus® (question 5). Finally, we will go one step further then the SCOR® model by briefly investigating how the most promising solutions could be implemented in the business environment of IRIS (question 6). Table 2 also lists in which chapter each research question will be answered.

SCOR®	Research question	Ch
-	1. How to use the SCOR® model?	3
Define scope	2. What are the supply chains of IRIS?	4
As-Is analysis	3. What is the current state of the supply chain activities?	5
Disconnects analysis	4. What are particular problems with the current state of the described supply chain activities?	6
Best Practice & Opportunity analysis	5. How can these problems be resolved/improved upon?	7
Implementation	6. How can the solutions be implemented?	8

Table 2 - research questions

2.4 Research method

In order to obtain all the information necessary to perform this research, this section defines the appropriate data sources as well as the research method(s) per research question. Most of the information will come from either employees or data provided by the companies involved. If data is provided by one of the companies involved, Lotus® is listed as data source. An overview of the research methods and the data source per research question is given in Table 3.

For this research, a project team is established, consisting of the author, the factory manager and the senior manager Quality Assurance. Whenever necessary, the author consulted the other members of the project team will be during this research. Most research questions will be answered by performing a literature study. Research question 2, 3 and 4 however will be answered by extensively interviewing all staff involved, including the staff at the Lotus® sales centres, and critically reviewing procedures, documents and systems used.

Research question	Research method	Data source
1. SCOR® methodology	Literature research	Scientific literature
2. Supply chains of IRIS	Interview	Lotus
3. As-Is Analysis of supply chains	Interview/data collection	Lotus
4. Problems in the supply chain	Interview	Lotus
5. Solving/improving problems	Literature research/brainstorm	SCOR® Best Practices
6. Usefulness of solutions	Brainstorm	Lotus
7. Solutions implementation	Literature research/brainstorm	Scientific literature

Table 3 - Research methods

2.5 Research Interest

The outcomes of this research will be useful for several organizations and individuals. First and foremost this research will contribute to the business capabilities of Lotus. As this project will result in improvement opportunities for multiple companies within the researched supply chains, Lotus® will benefit in terms of supply chain efficiency and reliability.

Second, experiences acquired by the involved staff at IRIS can be used to perform similar studies for the supply chains that are outside the scope of this research; i.e. the domestic and other (non-Lotus®) export customers.

Third, the results from this research can be used as an example for similar studies within the Hyacinth network. Although this research focuses on Lotus®, the methodology used can achieve similar results within other supply chains of Hyacinth Inc.

3 SCOR® methodology

This chapter will provide an introduction into the basics of the SCOR® Methodology, as it's understanding is vital for the rest of this research. First, the model itself will be discussed. Second, the relevant phases of the SCOR® Project Roadmap (see Appendix A; SCOR® Project Roadmap) will be discussed, as they provide a guide on how to use the SCOR® model in a SCOR® project. Finally, we will briefly elaborate on results from a previous SCOR® project.

3.1 Introduction to the SCOR® model

The Supply Chain Operations Reference (SCOR®) model was developed by the Supply Chain Council in 1996 in an attempt to standardize description and evaluation of supply chain processes. The model is nowadays widely used to describe and assess activities within a supply chain, benchmark performance against internal or industry standards and achieve improvements in delivery performance, sourcing cycle time and supply chain management cost (Wisner, Tan, & Keong Leong, 2009). The SCOR® model does not attempt to describe every business process or activity. More specific, the model does not address sales and marketing, product development, human resource, training, research and development and post delivery customer support.

3.1.1 Outline of the SCOR® model & level 1 categories

The SCOR® model is organised around five core management processes; Plan, Source, Make, Deliver and Return, linking these activities for each company within the supply chain, from your supplier's supplier to your customer's customer (see Figure 4). By describing supply chains using these standard building blocks, the model can describe any supply chain using a common set of definitions, regardless of its complexity.

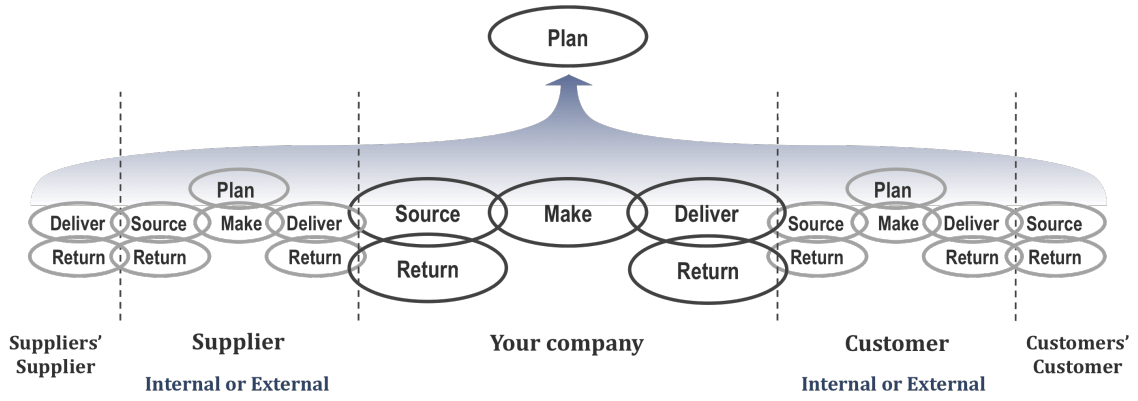


Figure 4 - SCOR® outline (Supply Chain Council, 2008)

Within the SCOR® model, there are three levels of process detail, each describing activities more detailed than the previous one. For each company or business entity within scope, the first level of the SCOR® model defines 5 categories of processes, matching the 5 management processes mentioned earlier (see again Figure 4). Depending on the scope of a project, level 1 can describe multiple independent companies in a supply chain, but also interacting business units within the same company or any other combination of business entities that perform supply chain activities.

Level 2 describes for each (level 1) category how that specific management process is configured; companies implement their operations strategy through the configuration they choose for their supply chain (Supply Chain Council, 2008). We will describe the level 2 processes in more detail in section 3.1.2.

Finally, level 3 defines for each (level 2) configuration the actual (operational) processes (or process elements as SCOR® calls them). See section 3.1.3 for a more detailed description. Figure 5 shows the hierarchy and the interaction between the different levels of the SCOR® model. As the level 2 configurations and the level 3 processes are key elements of describing a supply chain, they will be discussed further in detail.

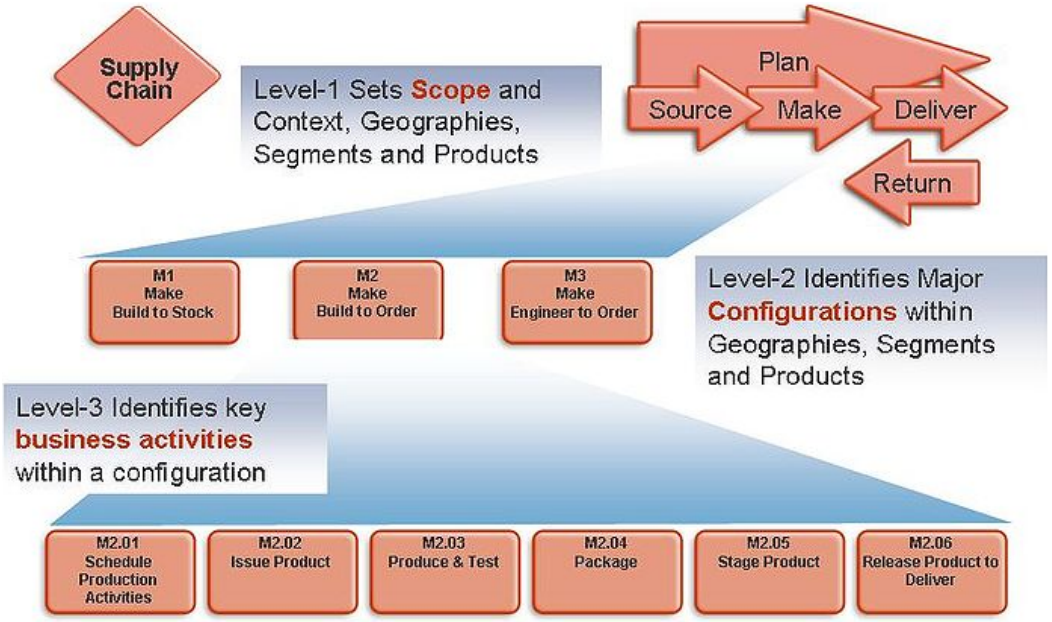


Figure 5 - Relations between different levels of SCOR® (Supply Chain Council, 2008)

Besides the different *levels*, the SCOR® model also established three process *types*; *planning, execution* and *enable* processes. A *planning* process aligns resources to meet expected demand on a strategic, long-term level. These strategic, long-term *planning* processes are present in all 5 management processes (see Plan in Figure 4). *Execution* processes are performed on a tactical level. They include (short-term) scheduling and sequencing, transforming materials and services and moving products. All 3 levels of the management categories Source, Make, Deliver and Return are *execution* processes (see Figure 4). Finally, *enable* processes prepare, maintain and manage information or relations between business entities upon which *planning* and *execution* rely. The relation between the different levels and process types of the SCOR® model is clarified in Figure 6.

		Process type				
		Planning	**Execution**			
Process level	Level 1	*Plan*	*Source*	*Make*	*Deliver*	*Return*
	Level 2					
	Level 3	Enable Plan	Enable Source	Enable Make	Enable Deliver	Enable Return

Figure 6 - SCOR® levels and process types

3.1.2 SCOR® level 2 configurations

Level 2 of the SCOR® model describes how each level 1 category is configured; it describes how companies implement the operations strategy they choose for their supply chain. The difference in configurations is strongly dependent on the influence of customer requirements (internal or external) on the process and is comparable with 'conventional' Customer Order Decoupling Points (CODP).
According to the SCOR® model, each of the level 1 *execution* processes (Source, Make, Deliver and Return) can be described using the level 2 configurations. For the Return processes, the SCOR® model distinguishes between two types of returns; Source Returns, describing the return process of sourced materials or products to the supplier and Deliver Returns, describing the return process of finished products from customers. Table 4 lists for each level 1 *execution* process the possible level 2 configurations and the process ID, which is used to facilitate modelling at a later stage.

As mentioned earlier, strategic, long-term *planning* processes are present in all 5 management processes. The level 2 configurations of the management process 'Plan' are therefore different from the level 2 configurations of the *execution* processes, as they are not related to the CODP (the term 'configuration' is therefore somewhat inapplicable, but is used anyway for the sake of unity within the SCOR® terminology). The level 2 configurations of 'Plan' relate to the *execution* process they provide the strategic and long term planning for (see Table 4). The only level 2 configuration of 'Plan' not directly related to an *execution* process is Plan Supply Chain; this configuration describes balancing resources and expected demand at the highest hierarchical level of the supply chain under consideration.

As said, the level 2 configurations are used to describe how companies have implemented their operations strategy. This implies that companies producing to stock (configuration M1) will also deliver products from stock (configuration D1). In general; the configurations of Make and Deliver processes are related. Source processes however can be configured differently; a company producing products according to customer specification (M2) can use standard materials (S1), possibly combined with customer specific materials (S2). A similar analogy as with Make and Deliver processes holds for Deliver and Source processes of different companies in the supply chain; if a company sources stocked products (S1), its supplier will obviously deliver stocked products (D1). Combining multiple configurations is also possible, as a company may produce stocked products as well as customer specific products (M1 and M2).

After establishing the correct configuration(s) for each of the *execution* and *plan* processes, a thread diagram is constructed, depicting the flow of information and material between Plan, Source, Make, Deliver and Return process configurations throughout the entire supply chain (see Appendix B; Example of a thread diagram).

Level 1 Category	Level 2 configurations	Process ID
Source	Source Stocked Products	S1
	Source Make-to-Order Products	S2
	Source Engineer-to-Order Products	S3
Make	Make-to-Stock	M1
	Make-to-Order	M2
	Engineer-to-Order	M3
Deliver	Deliver Stocked Products	D1
	Deliver Make-to-Order Products	D2
	Deliver Engineer-to-Order Products	D3
	Deliver Retail Product	D4
Return (Source & Deliver)	Return Defective Products	SR1 & DR1
	Return Maintenance, Repair & Overhaul	SR2 & DR2
	Return Excess Products	SR3 & DR3
Plan	Plan Supply Chain	P1
	Plan Source	P2
	Plan Make	P3
	Plan Deliver	P4
	Plan Return	P5

Table 4 - Level 2 configurations (Supply Chain Council, 2008)

3.1.3 SCOR® Level 3 processes

At this stage, all the processes (of the supplier(s), the company and the customer(s)) in the supply chain are described using the level 2 configurations and the relations and flows are modelled in a thread diagram. For each of the configurations listed in Table 4, the SCOR® model has defined specific level 3 process elements that are executed on an operational level. These level 3 process elements describe step by step what actual tasks are (or can be) executed within a certain configuration. For each of the level 2 configurations in Table 4, the corresponding level 3 process elements are listed in Appendix C; SCOR® level 3 . We see that for example Sourcing Stocked-Products (S1) consists of the elements Schedule Product Deliveries (S1.1), Receive Products (S1.2), Verify Product (S1.3), Transfer Product (S1.4) and Authorize Supplier Payment (S1.5).

At this point, it is up the user to model the level 3 process elements of the supply chain under consideration in a flow chart. This flowchart depicts the flow of information and/or materials between different level 3 process elements within a certain company or business entity. Each company or other business entity in the supply chain is modelled in a separate flow chart. To keep the flowchart clear, it is convenient to keep the process elements performed by the same department/person on the same horizontal level. To construct a flowchart that best reflects the actual situation, some processes elements can be executed by multiple departments/persons whereas others may not be used at all.

While modelling the level 3 process elements, the user will discover that some *execution* and *plan* processes are supported by *enable* processes. Remember that *enable* processes prepare, maintain and manage information or relations between business entities upon which *planning* and *execution* processes rely. A complete list of all *enable* processes is

given in Appendix D; SCOR® Enable processes. Looking again at sourcing products, it may very well be that the performance of suppliers is measured during the sourcing activities. This process is described by SCOR® as Assessing supplier performance (Process ID ES.2). The *enable* processes are put into the flow chart as well, as there presence (or absence) is key in understanding the supply chain performance. An example of a complete flow chart is given in Appendix E; Example flow chart.

3.1.4 Staple Yourself Interview

When arriving at this phase of SCOR®, we will have several flowcharts describing the flow of products and information within the different business entities in the supply chain. These flow chart will be the basis for the 'Staple Yourself Interviews". These extensive interviews are performed with every department (of every company) involved in the supply chain and are used to elaborate even further on daily operational tasks. The level 3 process elements as they were assigned to a specific department in the flow charts will guide this interview, as it tells the interviewer on what elements to focus.

The goal of these interviews is to find the 'disconnects' that occur with executing daily activities. SCOR® defines 'disconnects' as the generation, misinterpretation, usage or absence of information, plans, schedules, personal capabilities and/or products that negatively affect supply chain efficiency and reliability (Supply Chain Council, 2008). These disconnects can occur in processes within a company (for example between department) as well as between different companies.

In order to identify the disconnects present within or between specific departments/ companies, the interviewer uses the Staple Yourself Worksheet, listing the name and accountable function of the interviewee, the relevant SCOR® process elements, the process steps, the technology used to execute the process, the business rules in place, a description of the disconnects found and ideas to improve the process. Each of these subjects will be briefly discussed.

- *Name and accountable function;* list the name and accountable function of the interviewee.
- *SCOR elements*; list the SCOR® level 3 process elements executed by the interviewee. This list is used to check whether all activities have been discussed during the interview.
- *Process steps*; all steps in executing the level 3 processes as listed above are discussed, starting with where input (of information as well as material) comes from, how the process is executed and where output (of information as well as material) goes to.
- *Technology used*; describes the technology used for executing the processes. This can be as simple as using a telephone to as complex as the support of an advanced IT-solution as for example an ERP system.
- *Business rules*; lists corporate policies or special (standard operating) procedures that apply to the activities of the interviewee.
- *Disconnect description*; lists all disconnects that were found during the interview. As stated before, a 'disconnect' can be anything; from order numbers that do not match between companies till untimely communications on delays.
- *Ideas to improve;* lists ideas suggested by the interviewee to improve their daily activities. The interviewer can also list some own improvement suggestions here.

3.1.5 From disconnect to best practice

The most important information subtracted from the staple yourself interviews are the 'disconnects'. The user should indicate for each disconnect to what level 3 process element it applies. After this is done, the 'disconnects' will be grouped according to the field of problems it belongs to. For example, all disconnects relating to communicational issues will be grouped under 'communication'. These categories are developed by the user; if a specific disconnect does not fit within one of the existing categories, create a new category until all disconnects are listed. These brainstorm categories are then used to group similar disconnects in a 'problem statement'; a short description of the problems caused by the 'disconnects'. By doing this, the total number of disconnects is reduced. After this, the problem statements are again grouped by defining certain key problem themes; areas that comprise many disconnects (and thus several problem statements). These key problem themes can be similar to the categories developed earlier, but that does not necessarily have to be the case.

After defining the key problem themes, the user should convert his attention towards the best practices database of the SCOR® model, which is accessible for all members of the Supply Chain Council. This database lists for each level 2 configuration proven best practices. This database is used to list the best practices for each problem area, by listing the best practices of each level 2 configuration per problem area. What we end up with is a list of problem areas, the SCOR® processes these specific problems relate to and potential solution to solve these problems and improve the processes. This is the output of the SCOR® model.

3.2 Using the SCOR® model

As we gained some understanding of the SCOR® model itself in the previous section, this section will focus on performing a project using the SCOR® model. This is done following the different phases of the SCOR® project roadmap (see again Appendix A; SCOR® Project Roadmap). Not all phases listed in the roadmap will be discussed, as some of them are left out of this research in accordance with the project description as given by Lotus®. This mainly comprises phase II; Metrics. This phase is normally used to assess the current performance of the supply chains. Given the large number of customer complaints with supply from IRIS, Lotus® has decided at this time to start a research for solutions rather than endlessly evaluate current performance. As metrics are important for any performance assessment, we will come back to this in section 8.3. The relevant phases of the project roadmap are briefly discussed.

3.2.1 Phase 0; Support

Gaining the right support for the project is of key importance for success. In this phase the project team is assembled, together with the hierarchical structure by which it will operate, whom it reports to and what other departments and/or persons are involved.

3.2.2 Phase I; Scope

Defining the scope of the project comprises defining the different supply chains, making a prioritisation and developing a project charter that will list the project scope, business need & benefits, the project approach, the project team & governance, deliverables, project timeline, assumptions, risks and constraints on the project.

3.2.3 Phase II; Metrics
Developing a scorecard and measuring supply chain performance, benchmarking the performance to internal or industry standards and defining the competitive requirements for you company; what measures need most improvement from a strategic point of view. Again, this phase will be excluded from this research.

3.2.4 Phase III; Analyze
This phase consists of a) creating a geographical map of the identified supply chain, graphically showing how products and information flows, b) developing a thread diagram that graphically shows the flow of information and products between the companies of the supply chain and c) starting with analysing the disconnects.

3.2.5 Phase IV; Work
Describing and analysing the activities related to the identified supply chains using the SCOR® model. Specifically assess transactions between subsequent level 3 process elements and analyse the best practices given by the SCOR® model.

3.2.6 Phase V; Implement
Analyse the improvement opportunities provided by the best practices of the SCOR® model on implementation effort, improvement potential and feasibility. Select the most promising one(s), based on the appropriateness and improvement potential and roughly define the project requirements for implementing the solutions, together with a plan for organizational deployment of that solution.

At this point, the SCOR® model and project stops. Developing any improvement opportunities into full proof implementation plans is a logical next step, but this is outside the scope of the SCOR® methodology.

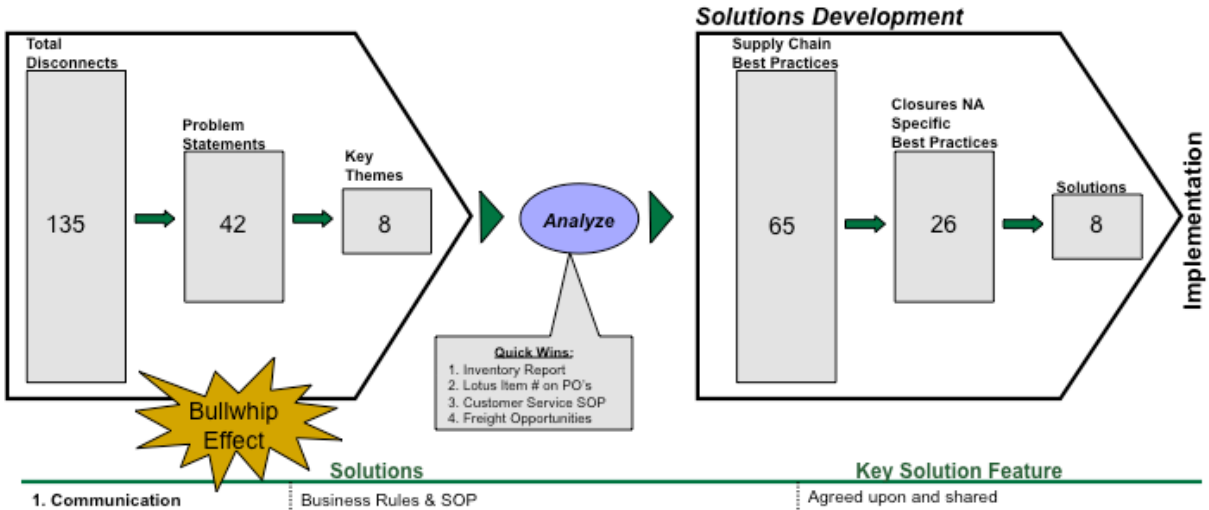
3.3 SCOR® results in practice; the North America Project
This chapter will briefly discuss some results of a previous SCOR® project, to gain some insight in the expected results. In general, improving supply chain management by using the SCOR® model is expected to yield one or more of the following results (The Performance Measurement Group, 2011):

- 25 – 50% reduction in total supply chain costs
- 25 – 60% reduction in inventory holding costs
- 25 – 80% increase in forecast accuracy
- 30 – 50 % improvement in order-fulfilment cycle

To see some of these results in practice, we will discuss a previous SCOR® study that was executed within Hyacinth Inc. In 2009, a SCOR® study was executed at Aster & Mfg, a company within the Lotus® group, in order to improve performance of supply chains leading to and going from Aster & Mfg. The project team followed the steps of the SCOR® project as described above, and came up with a total of 135 disconnects, grouped in 43 problem areas and leading to 8 key themes for improvement. Using the SCOR® best practices, they found 65 supply chain best practices, of which 26 were useful for the supply chain under consideration. After careful analysis, they found 8 solutions best solving the key problem themes, and 4 quick wins which could be implemented immediately in order to improve performance. These results are depicted in Figure 7. In order to visualize this process a bit more, consider the following; amongst the 135 disconnects found were the disconnects “Lack of proactive

communication to plant from Aster for changes in the purchase order or late shipment", "Time zone variation" and "Phone call and/or emails not returned". These disconnect were grouped together in the problem statement "Lacking proactive, timely and consistent feedback loop between Hyacinth and Aster". This problem statement was then considered part of the key theme "Communication".
Similar grouping exercises were performed for all solutions presented by the SCOR® best practices that could solve communicational issues, eventually leading to "Business Rules & Standard Operating Procedures (SOP)". The best fitting solution to solve the communicational issues was to agree on business rules and SOP on how communication should be executed, complemented with pre-defined input and output channels and an accountable person for each step in the procedure. For the other 7 key themes, solutions were found in a similar way. The entire project yielded the following results (Hyacinth, 2009):

- 20% improvement on perceived performance by Aster
- Backordered line items improved from 6.08% in 2009 to 2.82 % in 2010
- 94.96% On-time delivery to Hyacinth plants
- 96.74% Fill Rate on Hyacinth orders
- 94.58% Hyacinth compliance to agreed upon ordering lead times



Solutions		Key Solution Feature
1. Communication	Business Rules & SOP	Agreed upon and shared
2. Distribution	Pull System, Lead Times & Order Cycles	Leveled unjustified demand orders
3. Inventory	Pull System & Consumption Report	Controls and limits of product on floor
4. Lead Times	Pull System, Order Cycles & Postponement	Ability to plan with confidence
5. Planning	Pull System, Order Cycles, Consumption Report & Lead Times	
6. Business Process	Pull System, Lead Times & Order Cycles	Consistent process across all functional areas
7. Systems Integration	Pull System & Visual Management	Processes will be developed in ERP LN
8. Product/Manufacturing	Postponement & Order Cycles	Improved capabilities

Figure 7 - Results of the North America project (Hyacinth, 2009)

3.4 Getting started

After gaining understanding of the SCOR® model and a SCOR® project, the methodology will now be used to perform the actual research. The rest of this report comprises a description of the SCOR® study performed at IRIS. All relevant steps of the project roadmap are performed and discussed in order to find improvement opportunities. After all the steps of the SCOR® project have been performed, the most promising solutions will be worked out into a preliminary implementation plan. This last phase of the research is outside the scope of the SCOR® methodology, but is performed anyway in order to provide Lotus with a guide to improve supply chain efficiency and reliability.

4 Export supply chains

To answer the second research question and to determine which supply chains will be further researched, it is important to obtain some knowledge on products and (Lotus®) customers of IRIS, as any combination of these is a potential supply chain. After these topics are discussed, the final supply chains will be defined. As stated, the suppliers are outside the scope of this research and will not be discussed.

4.1 Products

Lotus® Closures are produced in a wide variety, ranging from small plastic plugs to large steel closure rings. IRIS only produces Steel Drum Closures (S.D.C.), Light Closures (L.C.) and light metal closures. The focus of this research will be on the S.D.C.'s, as the other products are not exported to Lotus® customers.

4.1.1 Flanges & Plugs

Steel closures consist of a flange and a plug and both come in 2 types; G2 (50mm in diameter) and G¾ (20mm in diameter). Flanges and plugs can be plated with a variety of coatings to protect them against different types of corrosion. Export flanges and plugs produced by IRIS are all zinc plated. For pictures of the different flanges and plugs see Appendix F; Lotus® Steel Closures.

4.1.2 Washers

In order to provide a reliable seal, the flanges and plugs can be fitted with a washer. Washers fitted on a flange ensure a reliable seal between the closure and the drum when the flange is fitted into the drum, whereas washers fitted on a plug ensure a reliable seal when the drum is closed off. Washers can only be fitted to plated flanges and plugs. Washer used for flanges are Black Nitrile (BN), Ethylene-Propylene-Diene-Monomer (EPDM), Poly Ethylene (PE) and the Dual washer (a combination of an EPDM washer and a smaller BN washer). For plugs, only BN, EPDM and PE washer are used. Normal washers have a square cross-section. Round ones however are also used upon customer request. See Appendix F; Lotus® Steel Closures for examples of different washers.

4.2 Export customers

As explained earlier, the focus of this research is on customers of IRIS within the Lotus® group. Four major customers can be identified within this scope. The fifth customer under consideration is Customer A, for reasons stated earlier. The customers and their locations are listed in Table 5.

Customer	Location
Sales centre Lotus® Italy	Italy
Sales centre Lotus® Singapore	Singapore
Sales centre Lotus® Australia	Australia
Aster & Mfg. Co., Inc	United States
Customer A Co., Ltd	Korea

Table 5 – Export customers of IRIS

4.3 Supply chains

In order to determine the export supply chains within scope, the products are grouped into flanges and plugs, each with a specific destination/customer. The washer type used puts specific demands on the supply chain, as some washer are imported, whereas others are sourced locally. As suppliers are outside the scope of this research, this sourcing difference can be left out and the washer type no longer puts specific demands on the supply chain. For that reason they are considered to be a product family for a specific flange or plug. The various washer-types exported to a specific destination are put between brackets. Besides these combinations, IRIS also exports unplated flanges and plugs to the United States. As the production of these products differs somewhat from the plated closures, they are considered separately. All the above results in the supply chains listed in Table 6. Each of these supply chains will be analysed in detail in this research.

SC number	Description
# 1	Flanges (Dual) to Italy
# 2	Plugs (BN, EPDM) to Italy
# 3	Flanges (Dual, EPDM, w/o) to United States
# 4	Plugs (BN, EPDM, PE, w/o) to United States
# 5	Unplated flanges to United States
# 6	Unplated plugs to United States
# 7	Flanges (w/o, BN, EPDM, Dual) to Singapore
# 8	Plugs (w/o, BN, EPDM, BN(round), PE(round), PA) to Singapore
# 9	Flanges (BN, Dual, w/o) drop shipment to Korea
# 10	Plugs (BN, PE(round), BN(round)) drop shipment to Korea
# 11	Flanges (Dual) to Australia
# 12	Plugs (PE) to Australia

Table 6 – Export Supply Chains in scope

5 As-Is analysis of supply chains

The SCOR® model will be used to review the current state of activities for the supply chains defined in research question 3. Through extensive interviews (see Appendix G; Reference of interviews) with staff members and assessing day-to-day activities, procedures, documents and systems, this chapter will eventually provide the flowcharts, consisting of level 3 process elements, for all companies involved. Imported to keep in mind is that by defining the supply chains as we did in Chapter 4, we also defined across what business entities level 1 spans; IRIS as the centre company, the Lotus sales centres/warehouses as its customers and Customer A as the customer's customer (see again Figure 4). The actual processes at the suppliers are still considered as static input.
We will analyze the level 2 configurations for each of the identified supply chains in section 5.1 and discuss the appropriate level 3 process elements in section 5.2, resulting in the level 3 flowcharts.

5.1 Level 2 configurations of the Lotus export supply chains

For each company in the supply chain, the level 2 configurations will be determined, starting with the supplier and ending at the customers.

Suppliers

As supplier processes are considered as static input (see section 2.2), we will only have to consider how and when products are delivered to IRIS in order to determine the configuration of the supplier delivery process. Again, the possible SCOR® level 2 configurations are listed in Table 4. After consulting with the purchasing department of IRIS, the delivery configuration turned out to be Deliver Stocked Products (D1), as agreements on delivery requirements and prices are already in place and suppliers deliver standard materials to IRIS from stock. Plan Deliver (P4) supports planning these deliveries.

IRIS

In order to find the level 2 configurations for IRIS, the project team was brought together to assess the Plan, Source, Make, Deliver and Return processes. The challenge was to translate 'business as usual' into the SCOR® configurations. After careful consideration, we established for each of the 5 management processes the following configurations:

Source; Obviously, as materials are delivered from stock (D1 with the supplier), the sourcing process at IRIS should have the same configuration. Hence, sourcing is done for all supply chains (#1-12) according to the Source Stocked Products (S1) configuration.

Make; The production at IRIS can be divided into two parts; the first part is driven by a forecast and produces plated flanges and plugs to stock; a clear-cut case of Make-to-Stock (M1). From there, specific customer orders define what type of washer needs to be fitted and what type of packaging should be used. According to SCOR®, this process has a Make-to-Order (M2) configuration. This description suggests that plated flanges and plugs are kept in stock, waiting to be finished with a washer. This however is not the case, as current demand is much higher than supply and all plated products are directly fitted with the requested washer. So even though the operational planning is to produce to stock (the M1 part of production), there is no *physical* inventory of plated products. The second part of the production process is not performed for unplated products (supply chains #5-6); they are packed after all shaping operations have been completed.

Deliver; Once the flanges and/or plugs are fitted with the right washer, they are directly shipped to the customer. As the second part of the production process is based on a specific customer order, the delivery process should be configured accordingly. Therefore, delivery in all supply chains is configured according to the Deliver-Make-to-Order-Products (D2) configuration.
For supply chains #5 and #6, this appears to be incorrect, as they only require the production operations up till plating (part of the Make-to-Stock process) and hence delivery should be configured as Deliver-Make-to-Stock Products (D1). However, as unplated products are only produced upon specific customer request, the delivery is configured similar as with plated (and washered) products; Deliver-Make-to-Order Products (D2).

Return; Occasionally, IRIS receives complaints that products that are not in accordance with customer requirements on product type and/or quality. At this point, the non-conform products are scrapped on customer site and IRIS is requested to replace them with new products. The same goes for raw material; some deliveries from suppliers are rejected and discarded at the IRIS factory. Suppliers are requested to replace the defective materials. As there is no physical return flow of products, *Return* processes will be excluded from further research.

Plan; The Source, Make and Deliver activities mentioned above are supported by Plan-activities. After carefully analyzing the different planning activities, we found that Plan Supply Chain (P1), Plan Source (P2), Plan Make (P3) and Plan Deliver (P4) are accounted for at IRIS.

Customers
For each of the five customers that are part of this research, we have determined the level 2 configurations as well. As the different customers are geographically dispersed, this was done conducting several conference calls with the involved staff at the customer's locations (see again Appendix G; Reference of interviews). As quantities ordered by the sales centre in Singapore constitute over 70% of the export orders within the Lotus group (Daisy - Tulip, 2010), we conducted a short visit to the Singapore sales centre and warehouse to elaborate on their pending issues with supply from IRIS. A short description of the activities performed at each customer will be given, as it is important in order to understand the level 2 configurations. First, we will briefly explain the general activities that are performed by all customers. Second, we will discuss some customer specific aspects that might influence their level 2 configuration.

Source; As explained earlier, the configuration of Source is directly dependent on the configuration of the Deliver process of the supplier (in this case the supplier is IRIS). This means that the souring activities of all customers are configured according to Source-Make-to-Order-Products (S2).

Make; As all customers are sales centres (some with a warehouse), no production activities are performed. Products are either stored for some time or directly shipped to their customer. There are two exceptions to this.
First of all Customer A, as they actually use the closures in their drum making process. As Customer A is not part of Hyacinth Inc., it was not possible to obtain information needed to determine the level 2 configuration of the Make activities. This would have been outside the scope of this research anyway, as we cannot influence these activities because the company is not part of Hyacinth Inc.

Secondly, the unplated products delivered to the USA are used for lacquering; another process to protect the products from corrosion. As this lacquering is only done upon specific customer request, these production activities have a Make-to-Order configuration (M2).

Deliver; Without the presence of any production activities at the sales centres, the configuration of the Deliver activities will be similar to the Source activities; Deliver-make-to-Order Products (D2). With other words, the sales centres mainly take care of orders placed by their customers without changing the actual state of the product.

There are two exceptions. First, as the sales centre in Singapore has a warehouse, they can also deliver from stock (D1). Items not kept in stock are ordered from IRIS upon customer request. In that case the deliver activities are again configured according to the Deliver-make-to-Order Products (D2).
Second, the unplated products delivered to the USA. As lacquering is only performed upon customer request, delivery is done accordingly; Deliver-make-to-Order Products (D2).

Return; As explained earlier, there are no physical return flow of products, and *Return* activities are no longer part of this research.

Plan; All five customers account in some way for Plan Source (P2) and Plan Deliver (P4). Again, there are two exceptions; for unplated products delivered to the USA Plan Make (P3) is present as well and we are only aware of Plan Source (P2) at Customer A.

An overview of all the level 2 configurations for each supply chain is given in Table 7.

	Suppliers		IRIS				Customer			
Supply Chain Reference #	*Deliver*	*Plan*	*Source*	*Make*	*Deliver*	*Plan*	*Source*	*Make*	*Deliver*	*Plan*
Supply chains #1-4 & #11-12	D1	P4	S1	M1, M2	D2	P1, P2, P3, P4	S2	-	D2	P2, P4
Supply chains #5-6	D1	P4	S1	M1	D2	P1, P2, P3, P4	S2	M2	D2	P2, P3, P4
Supply chains #7-8	D1	P4	S1	M1, M2	D2	P1, P2, P3, P4	S2	-	D1, D2	P2, P4
Supply chains # 9-10	D1	P4	S1	M1, M2	D2	P1, P2, P3, P4	S2	-	-	P2

Table 7 - Level 2 configurations of the supply chains

Perhaps even more important than the actual level 2 configurations is the way information and products flow within and between the different companies. Some of these relations are straightforward, whereas others are somewhat more complicated. For further analysis it is very important that these relations (or the lack of them) are clear before we go into more detail. For this reason, we constructed a thread diagram (see Figure 8) modelling the flow of products and information for all the companies in the supply chains. The dotted lines indicate a flow (or rather an exchange) of information, whereas the filled lines indicate a flow of products (or materials).

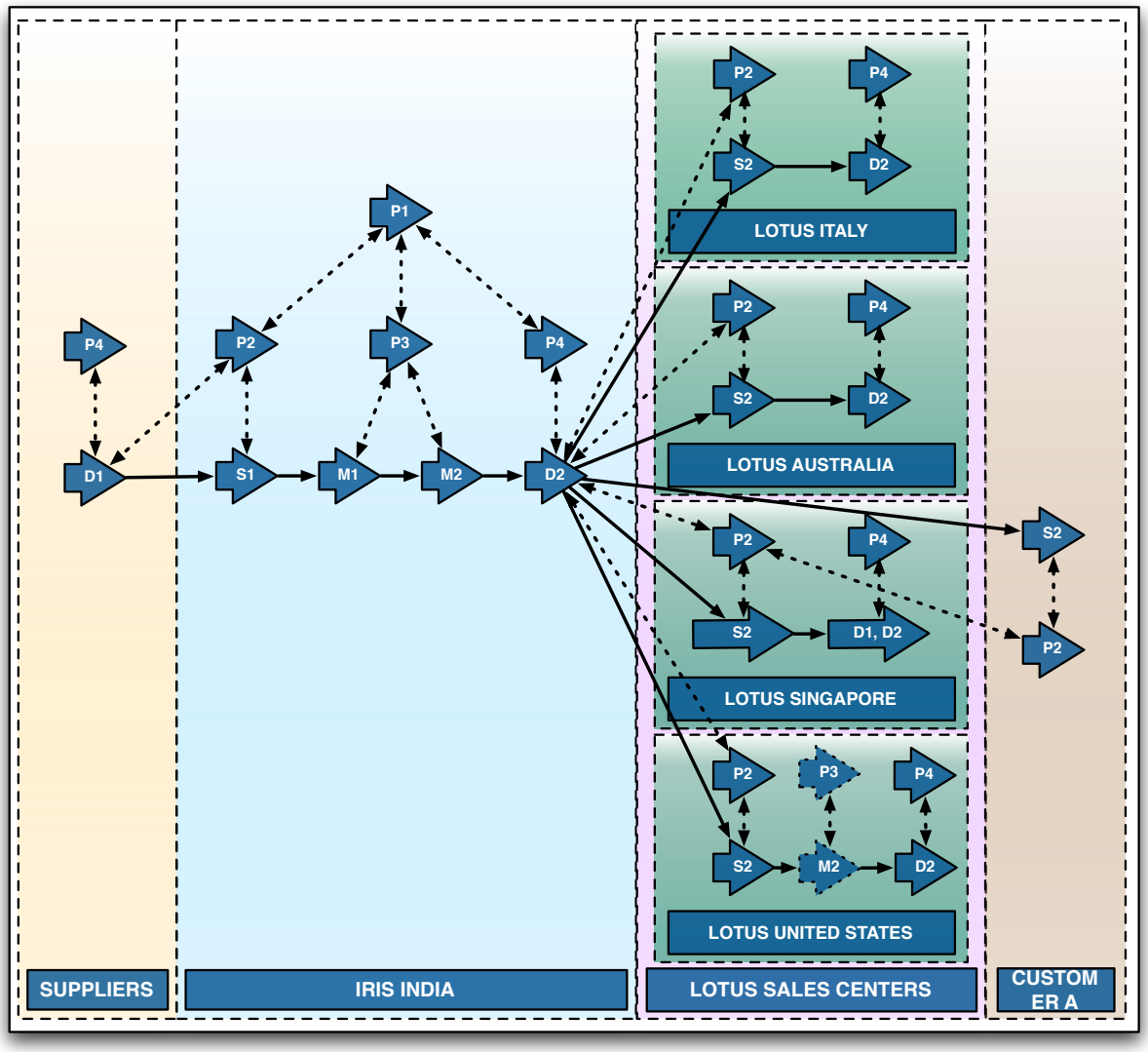


Figure 8 - Thread diagram of IRIS supply chains

5.2 Level 3 processes of export supply chains

In this section we will construct the level 3 flow charts, with the level 2 configurations and the thread diagram from section 5.1 as input. Each level 2 configuration contains several level 3 process elements that can be used to model the actual day-to-day activities (see again section 3.1.3 and Appendix C; SCOR® level 3 process elements). In order to clearly understand whiat level 3 process elements are present at the different companies and what the relations between the different level 3 process elements are,

we conducted extensive interviews with all the involved staff at IRIS (see again Appendix G; Reference of interviews). For the customers, the involved staff was consulted again during a conference call. After the interviews and conference calls, an initial flow chart was constructed for each company. These flow charts were then verified by consulting the involved staff and any errors or missing flows brought up were adjusted. This resulted in 7 flow charts, one for each company in the supply chain and two extra for the production of unplated products for Aster. The flow charts of the suppliers and Customer A are left out; as only modelling the Deliver or Source activities does not provide a better insight in the process then we already have, it is a waste of time.

Table 8 defines for each flowchart which supply chains and business entities are included and the reference to the figure depicting the actual flowchart. Each flowchart shows what level 3 process elements specific departments perform and how information and/or products (SCOR® does not make a distinction at this point) flows between the different department and activities. Furthermore, they show which *Plan* and *Enable* processes are used with each department to plan or support the actual activities. The *Plan* and *Enable* processes in the flowcharts relate to the department they are placed next to (see again Appendix D; SCOR® Enable processes). These flow charts will form the basis for the next phase of the SCOR® project, the "Staple Yourself Interviews", where we will analyse the operational activities and start our search for the disconnects.

Supply chains	Business entity	Reference
#1-4, #7-12	IRIS	Figure 9
#5-6	IRIS	Figure 10
#5-6	USA	Figure 11
#1-2	Italy	Figure 12
#3-4	USA	Figure 13
#7-8	Singapore	Figure 14
#9-10	Customer A	n.a.
#11-12	Australia	Figure 15

Table 8 - Flow charts

To conclude the construction of the flowcharts, consider the following example of activities performed at IRIS that relates to Figure 9. At the beginning of each month, staff from the Import-Export department, the Purchasing department and the Warehouse come together to discuss what orders will be produced the coming month. At this point, they will determine what the material requirements for these orders are and when the materials should be delivered. This matches the flowchart, which shows that Import/Export, Purchasing and Warehouse all three perform S1.1 (which is to Schedule Product Deliveries). The next steps are to receive the products (S1.2) and verify the products (S1.3). Here, both the Warehouse and Quality department come into action, as the Warehouse checks if the materials are delivered in the right quantity and according to the delivery terms (packaged correctly, on time etc), whereas Quality will check if the materials are according to the technical specifications (required thickness, strength etc). Again, this is depicted in the flowchart, which shows that both Warehouse and Quality perform S1.3 (Verify Product). Similarly, all the (supply chain related) activities performed by all departments at all business entities are depicted in the flowcharts below. The legend for all flowcharts is given in Table 9.

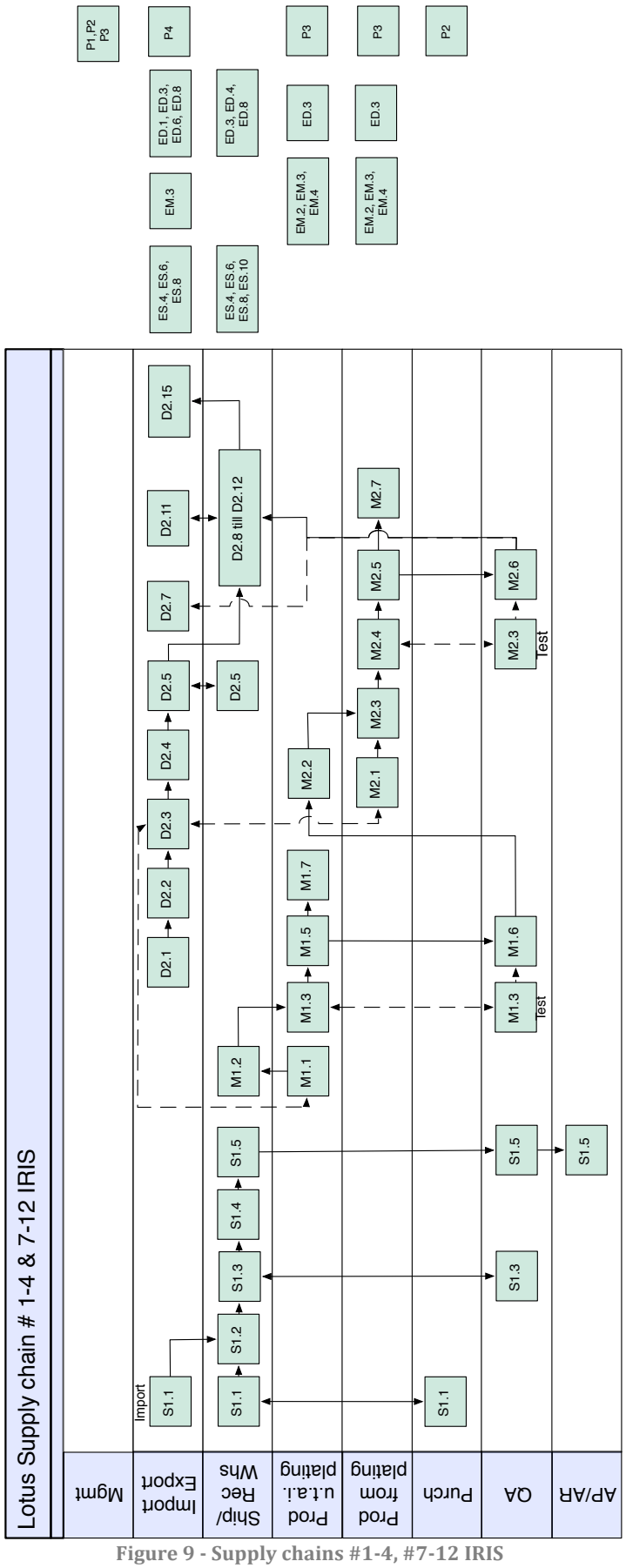


Figure 9 - Supply chains #1-4, #7-12 IRIS

Flowchart	Department
Mgmt	Management
Import/Export	Import/Export
Ship/Rec Whs	Shipping and Receiving Warehouse
Prod u.t.a.i. plating	Production up till and including plating
Prod from plating	Production from plating
Purch.	Purchasing
AP/AR	Account Payable/Account Receivable
QA	Quality Assurance
Lacq.	Lacquering
Logis.	Logistics

Table 9 - Legend for flowcharts

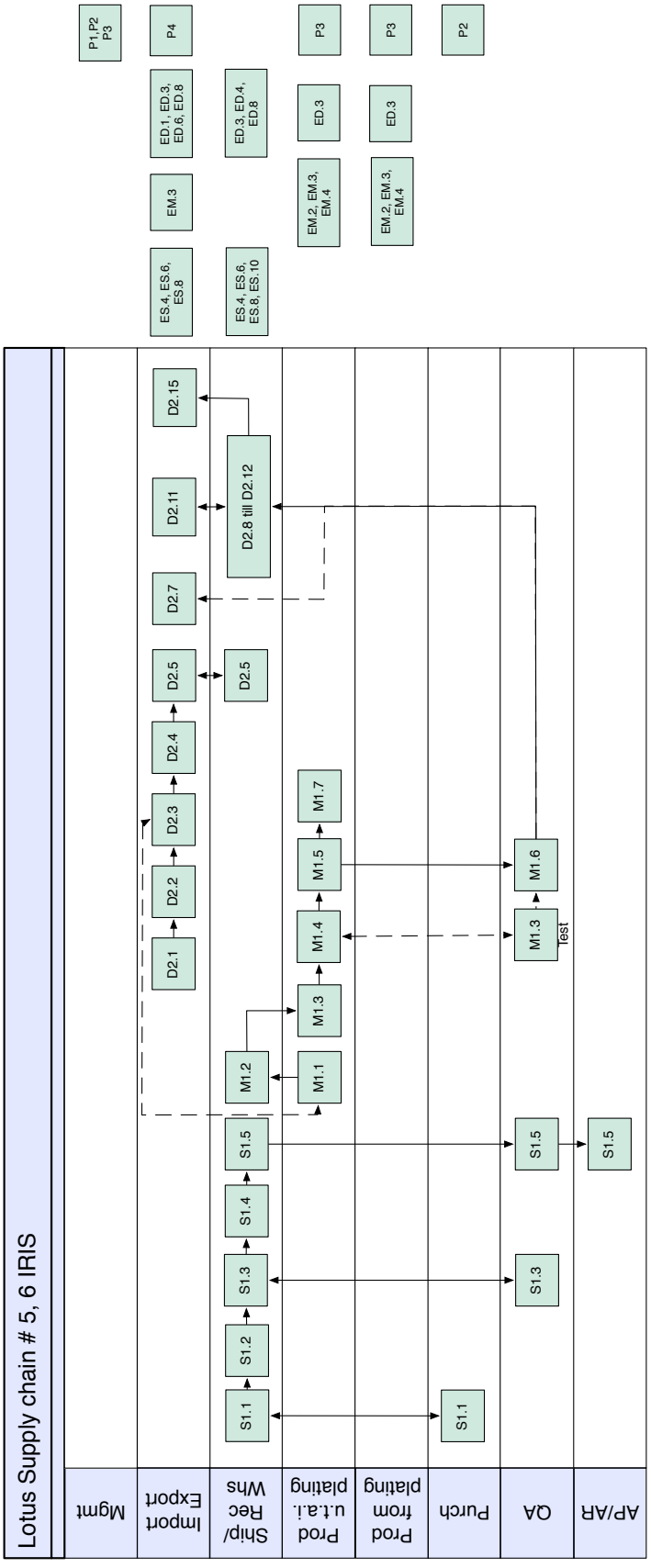


Figure 10 - Supply chains #5-6 IRIS

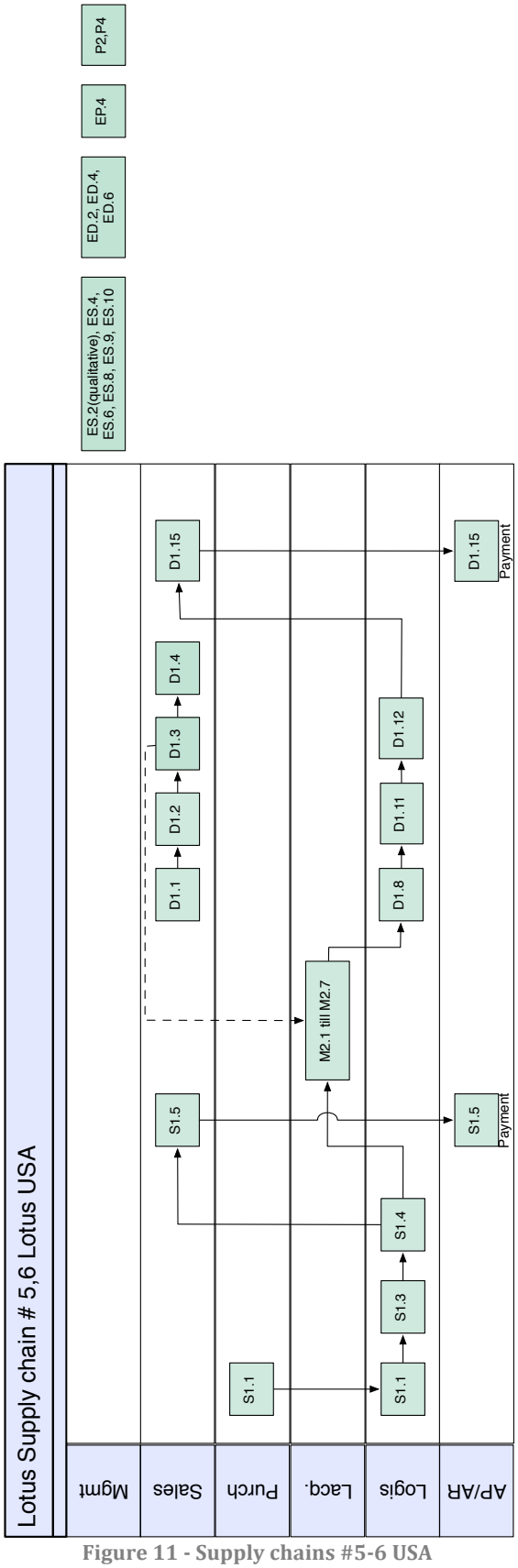


Figure 11 - Supply chains #5-6 USA

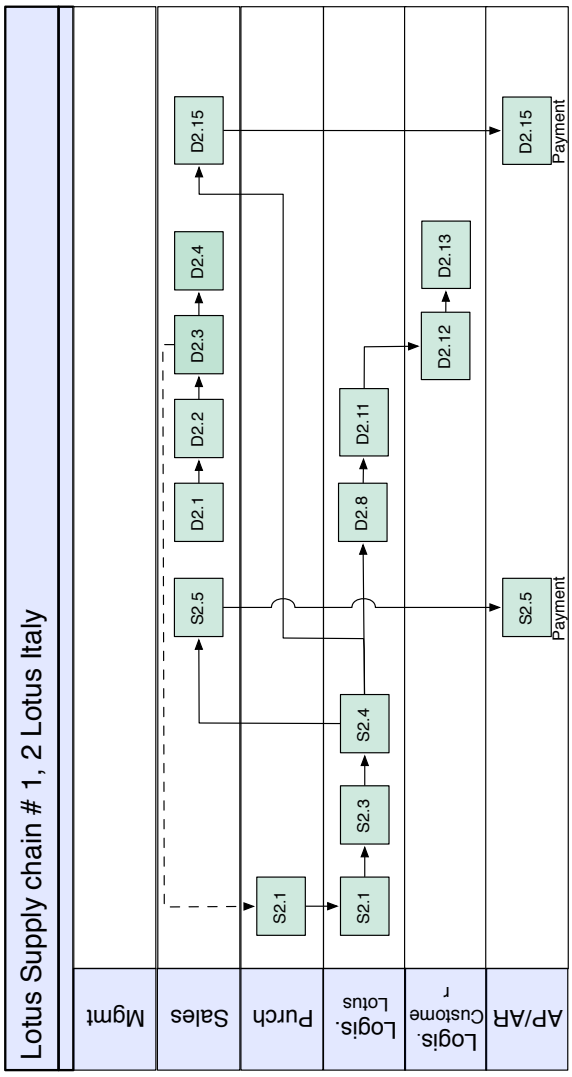


Figure 12 - Supply chains #1-2 Italy

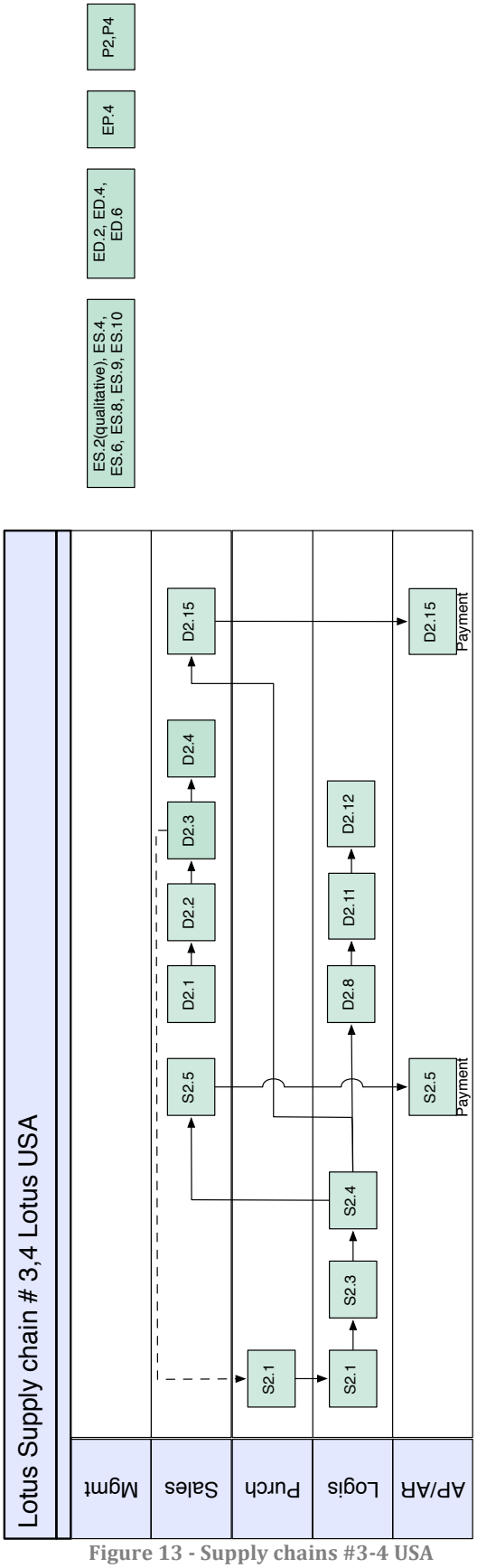


Figure 13 - Supply chains #3-4 USA

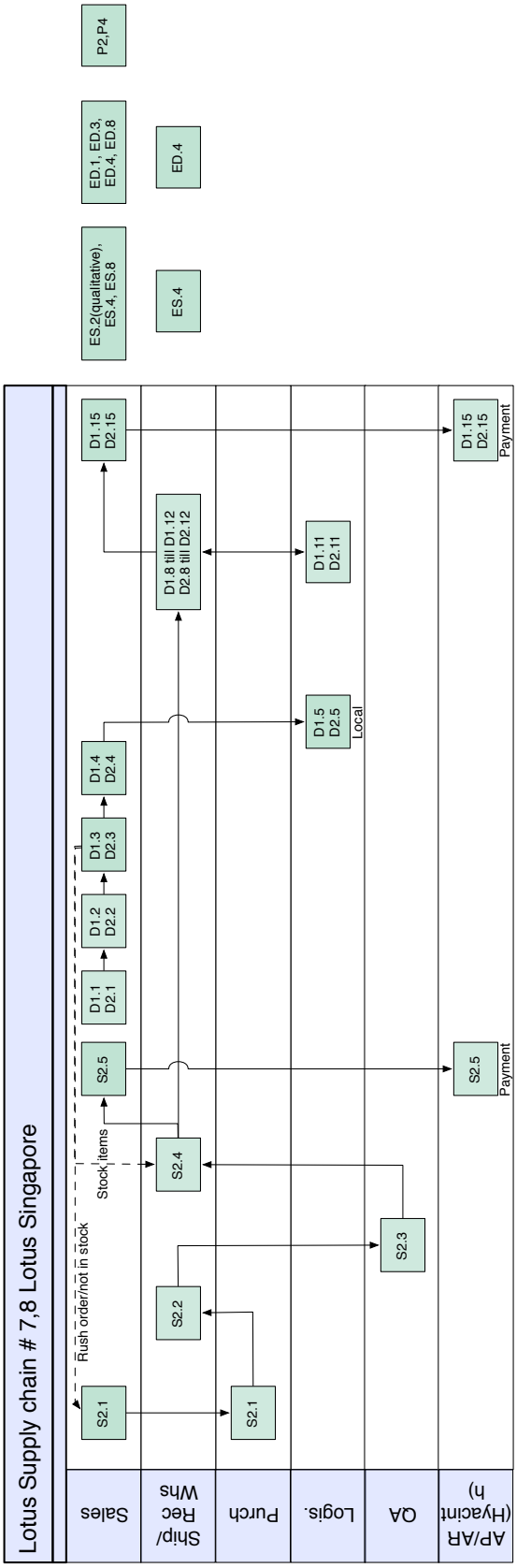


Figure 14 - Supply chain #7-8 Singapore

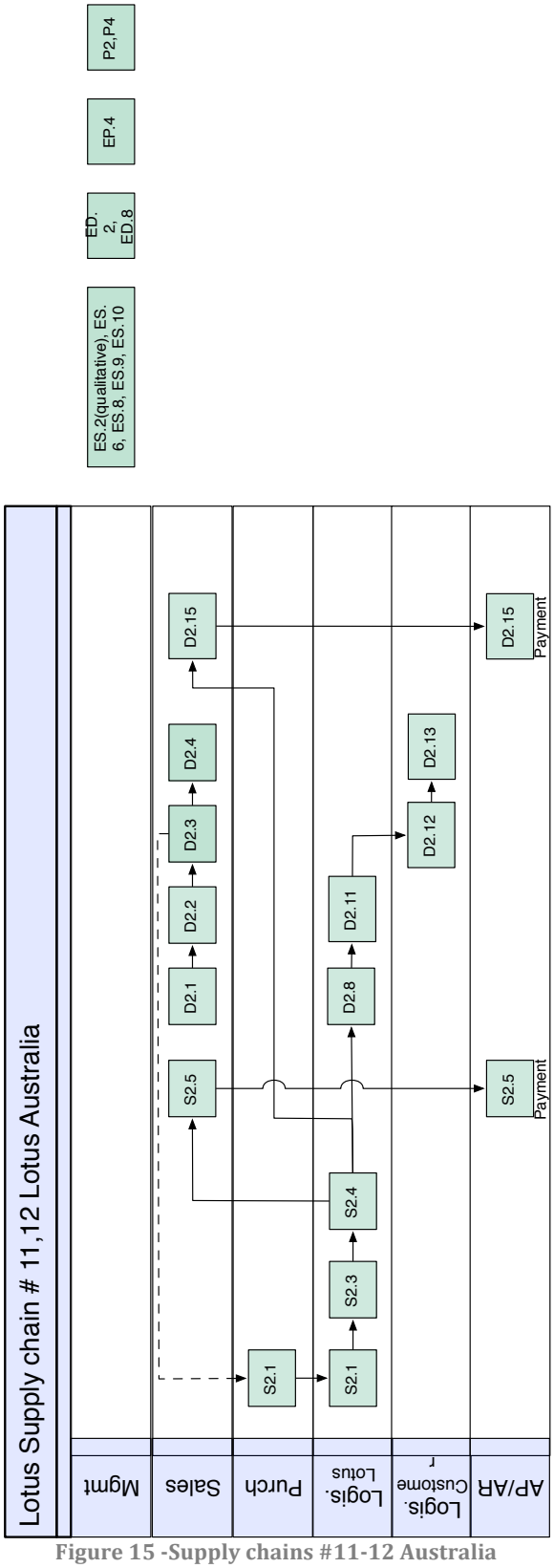


Figure 15 -Supply chains #11-12 Australia

6 Problems in the supply chains

After objectively establishing what activities take place and how they are performed (as done in chapter 5), this chapter will outline all problems that arise with executing these activities. This was done by performing the "Staple Yourself Interviews" (see section 3.1.4). These interviews will take the flowcharts of Chapter 5 as a starting point and analyze how the actual activities are performed to find the "disconnects". Remember that disconnects are defined as the generation, misinterpretation, usage or absence of information, plans, schedules, personal capabilities and/or products that negatively effect supply chain efficiency and reliability (Supply Chain Council, 2008). Disconnects can occur in processes within a company (for example between departments) as well as between different companies. The disconnects found during the interviews will then be analysed, grouped and filtered to eventually bring up the true cause(s) of the unreliable and inefficient supply from IRIS.

6.1 Staple Yourself Interviews & disconnects

To prepare for the interviews, we listed all level 3 process elements that are executed by the department/person to be interviewed on the staple yourself worksheet (see again section 3.1.4). They helped us guide the interview as it told us what activities are to be researched. Secondly, they were used as a final check to make sure all the activities performed by the interviewed department/person were discussed.

During the interviews, both interviewer and interviewee are responsible to notice any potential disconnects. We, as interviewer, had the advance of being 'new' to the business and used that to notice any disconnects that were hidden in acting to so called 'business rules' (or rather the lack of acting to them). Take for example the phrase: "usually, the production planning is sent every day" (personal communication, December 6th, 2010), pointing at a business rule that the production planning should be sent every day. However, the "usually" part of it suggests that this does not happen, and so a "disconnect" was born.

The interviewee on the other hand was able to use his/her elaborate experience to point out disconnects that were hidden in the smallest detail; disconnects that would have been hard to find on our own (they would eventually have come up, but it would have taken much longer).

Besides the actual interviews, a large number of documents, systems outputs, planning files, emails and other relevant files were collected to serve as examples of specific disconnects for discussion and reporting purposes.

Each horizontal lane in the flowcharts from Chapter 5 represents a department that performs tasks in the supply chain. This means that for each unique horizontal lane an interview was conducted. As most of the Lotus sales centres are quit small, some of the different departments are under the supervision of the same person. This decreased the total number of interviews quit severely, although still a total of 18 interviews were conducted. Again, all staff at IRIS and at the Singapore sales centre was interviewed in person, whereas the staff of the other sales centres was interviewed during conference calls (see again Appendix G; Reference of interviews). All 18 interviews resulted in 120 disconnect (see Appendix H; Disconnects). Where possible, we listed the level 3 process element where the 'disconnect' occurred, together with the entities involved. Furthermore, for each 'disconnect' we also listed a reference number and the department for tracing purposes. Finally, together with the project team we assigned a brainstorm category to each disconnects by using the method described in section 3.1.5.

6.2 Problem Statements

The obtained list with 120 disconnect is good starting point, but in order to develop useful solutions, we need to group and filter these disconnects as described in section 3.1.5. In order to reduce the number of issues we need to look at, we grouped the 'disconnects' into 'problem statements', giving a short description of the actual problems caused by the grouped disconnects. The brainstorm categories defined in section 6.1 were used as a starting point, as each brainstorm category already contained similar disconnects. We grouped disconnect together that:

- Describe the same problem between different entities
- Occur within the same level 3 process element of a particular department
- Are in any way similar to other disconnects, making it intuitively senseless to analyse them separately

By using these criteria, we brought the 120 disconnects back to 42 problem statements, as depicted in Table 10. The problem statements are sorted accorded to the brainstorm category they relate to. Besides the problem statement phrase and the problem statement description, Table 10 contains a reference number for each problem statement (again for tracing purposes), the reference back to the individual disconnects, the entities and the SCOR® level 3 process elements the problem statements relate to (this is done by simply grouping together all level 3 process elements of the individual disconnects that were grouped in that specific problem statement).

Ref. #	Disconnect reference	Brainstorm Category	Entit	Problem Statement Phrase	Problem Statement Description	SCOR Process
1	14, 73, 74, 78, 79, 80, 85	Administration	IRIS SING	Actual products delivered do not match documents	Copying data from Purschase Order (P.O.) to production order to invoice is done manually, causing plugs and flanges to be mixed up on documents, products are shipped against wrong P.O., a newer P.O. with the same items or P.O.'s that have no outstanding quantity of that item.	S2, D2, ES.3
2	50, 67, 83	Communication	IRIS SING	Unequal balances of outstanding orders	At the end of the month, all outstanding Singapore order are checked with Singapore. As the files used are different and entries at IRIS are done manually, differences frequently occur and are hard to trace back.	S2, D2, P2
3	81, 93	Communication	IRIS SING AUS	Shipping documents too late for customs clearance	Containers have to wait in port of destination to be cleared as shipping documents do not reach in time. This may incur extra costs as containers may be occupied longer than allowed by the freight forwarder.	S2, ES.6, ES.8, ED.6, ED.8
4	9, 97	Communication	IRIS	Work overload	As Import/Export is currently managing as well as executing by the same person, the quality of work is suffering, causing errors and communicational delays.	S1, D2, P2, P4, ES.8, ED.8
5	72, 87, 89, 91, 92, 107, 109, 120	Communication	IRIS SING AUS USA IT	Lacking of timely and consistent feedback to customers on delivery and shipment dates	Delay or absence of order acknowledgement, shipment dates conformation, notification of shipment delays and updates on order status resulting in last minute 'fire fighting' to relocate supply elsewhere in the Tri-Sure network. Time zone differences enhance this problem.	S2, D2, P2, P4, ED.3
6	82	Communication	IRIS SING	Shipments arrive without prior shipping notice	Containers arrived at the port of Singapore without Singapore knowing that a shipment was sent.	D2, ES.6, ED.3, ED.6
7	66	P.O.	IRIS SING AUS USA	Different product descriptions	Description of products differs on different orders, invoices and planning files, causing confusion and mistakes in invoicing and dispatching. Product codes are not used at IRIS internally.	S1, S2, M2, D2, EM.3, ED.3
8	40, 90, 102	Product Issues	IRIS SING AUS	Products mixed up	Quantities of 2" and 3/4" mixed up, flanges dispatched instead of plugs (or vice versa) and mix up in local versus imported washers	S2, M2, D2, ED.3
9	23, 31, 32, 33, 41, 99, 100	Inventory	IRIS	Lack of inventory best practices (stock levels)	Unfinished inventory on shop floor, raw material levels contain defective (non-conform standards) materials, raw material on shop floor not incorporated in stock levels, same products stored in multiple locations, non standardized methods and procedures, stock levels based on forecast instead of actual orders, approved and unchecked items stored at the same location (packing floor)	S1, M1, M2, D2, ES.4, ED.4
10	111	Manufacturing	IRIS	Product mix up during production	Local and export products are mixed during production due to residual products on conveyors when switching over production lines.	M1
11	58, 59, 60	P.O.	IRIS SING AUS USA	Different order formats	Order formats differ and lead times (up to shipping) differ, complicating planning	S2, D2
12	44, 45, 46, 48	Supply	IRIS	Format for purchasing requests is lacking	Incomplete information, following up on missing information and the absence (or misuse) of clear formats delays procurement of non standard items, effecting supplier performance and machine downtime.	S2 (S3), ES.3
13	10, 12, 13, 52, 53, 54, 55	Planning	IRIS	Issues with Production Planning and Control (PPC) file	PPC not sent daily, washer quantities not always specified, different (old) names for customers, contains outdated information (tabs), not named properly, not digitally linked to other planning files.	M1, M2, EM.3
14	11, 15, 17, 18	Planning	IRIS	Issues with Production Planning and Control	Production plan has to be changed to deal with breakdowns and non availability of washers, delaying most urgent shipments.	S1, M2, P3

15	30, 37	Planning	IRIS	Non-availability of washers	Maintaining washers stock based on monthly requirements, without taking weekly production into consideration, causing stock out in peak situations and effecting production planning.	S1, M1, M2, D2, P2, ES.4
16	51, 56, 57, 86	Planning	IRIS SING	Weekly shipment schedule Singapore	Weekly container shipment schedule as provided by Singapore is deranged after Customer A orders are taken out and container configuration is lost anyway at the end of the month. Weekly plan has never been followed.	S2, M2, D2, P2, P4
17	6, 7, 8	Communication	IRIS	Lack of internal communication	Production does not (or only last minute) indicate if shipments get delayed. No set procedure to inform customers or what actions to take.	M1, M2, ED.3
18	114	Manufacturing	IRIS	Labour inconsistency	Labour inconsistency caused by high absenteeism and lack of relation between worker-earnings and company performance	M1, M2
19	110, 116	Manufacturing	IRIS	Low OEE	Machine inconsistency (low Overall Equipment Effeciency (OEE)) caused by (too) small maintenance crew, lack of developing and improving machines and non-availability of spare parts.	M1, M2, EM.2
20	39, 117	Packaging	IRIS	Product stickers for washer identification	Usage of stickers on the boxes is time consuming, confusing and not always done immediately after washering, causing differences between description on box and actual products.	M2
21	84, 95, 103, 112	Packaging	IRIS SING USA	Lack of single standard for pallet size	Different pallet quantities for USA and Singapore are confusing for packing and warehouse. Unequal and partial pallets (not according to SBU standard) shipped cause repacking efforts at customer warehouse.	M2, D2
22	76, 104, 108	Packaging	IRIS SING USA	Damaged packaging	Packaging is damaged during packing, loading or transportation due to moisture, improper stacking of boxes and stacking pallets to high, causing repacking efforts at the customer.	D2
23	68	Shipping/ Receiving	IRIS SING USA	Container issues	Singapore is charged for container washing and container may not seal well as it smells mouldy upon arrival in USA. IRIS need to inspect container thoroughly before loading and not smudge it during loading.	S2, D2
24	88, 101	Planning	IRIS Customer A	Customer A containers need to be shipped simultaneously	Customer A requires all containers of an order to be shipped simultaneously, causing storage issues at the warehouse and shipment delays as packed containers have to wait for the last container/products to be finished.	S2, D2, P2
25	61	Planning	IRIS	Not all products ready to be loaded	Container already at the factory but they cannot be packed completely as lots still need to be cleared by QA.	M2, D2, P4
27	26, 28, 34	Shipping/ Receiving	IRIS	Lack of inventory best practices (warehouse mgmt)	Storage space is not used efficiently, no fixed location for items, different items stacked together etc.	S1, D2, ES.4, ED.5
28	1, 2, 3, 38	Product Issues	IRIS	Quality check not foolproof	Not all defective products found during in process inspection or automated (computerized) check, causing major manual sorting efforts at the packaging stage (up to 65%) and delays in shipments.	S1, M1, M2
29	27, 29	Shipping/ Receiving	IRIS	Lack of proper use of equipment	Warehouse picking equipment is not used properly, damaging materials and products.	S1, M1, D2
30	16	Financial	IRIS USA	Invoice rates	Products are invoiced against different rates	D2, ED.8
31	94, 105	Packaging	IRIS USA	Labelling issues	No Lotus barcode on labels not always correct, causing relabeling efforts in USA.	M2, D2, ES.3, ED.3
32	98	Planning	IRIS AUS USA	Low vessel sailing frequency	Shipment are delayed in port as there is a time gap between containers leaving the factory and the time the vessel actually sails (up to 1 week).	D2, ED.6
33	24	Supply	IRIS	Limited supplier capacity	Production capacity of cut-gaskets supplier is currently insufficient, even if orders would be spread out evenly (which they are not).	S1, P2
34	19	Product Issues	IRIS SING	Required quality Singapore	Singapore requires top quality products (visual); products which are not up to standard are downgraded to local or other (non-Hyacinth) export. This makes actual output even harder to forecast.	M2
35	22	Non supply chain related	IRIS	Power cuts	Unexpected and uncontrollable power cuts effect production	M1, M2
36	70, 71, 75, 77	Inventory	SING	Lack of inventory best practices (warehouse mgmt)	No fixed order picking rules, lack of picking procedure, no separate area to stock low quantity items, no packing space	D1, D2. ED.4
37	69	P.O.	SING	Loss of order traceability	Due to manually changing the invoice number from SG number to IRIS invoice number for invoices to Korea, traceability of the original order is lost. This is done to match (IRIS) invoice number on Certificate of Origin.	D1, D2, ED.3
38	4, 113	Planning	IRIS	No stock of imported EPDM washer	All incoming imported washers are used immediately on outstanding orders, so no stock available. Imported washers from Brazil are delivered in sets only, causing unnecessary high stock levels of washers.	S1, M2, P2
39	118	Planning	IRIS	Overestimating production capabilities	Total of incoming orders is larger than best production level over the last months; overpromising of orders.	P3, P4
40	64	Planning	IRIS SING	Adjusting stock levels to sales trends	Long lead times and unreliable delivery from IRIS make it hard to timely adjust stock levels to sales trends.	S1, S2, ES.2
41	49	Supply	IRIS	High supplier dependency	Single sourcing for many items and materials, causing high supplier dependency.	S1, P2
42	119	Planning	IRIS Customer A	Short lead time Customer A orders	Short lead time and top priority of Customer A order heavily disturbs production planning.	M2, P3

Table 10 - Problem Statements

6.3 Key Themes

After defining these problem statements, one grouping and filtering step from section 3.1.5 remains to get to the key themes. Together with the project team, we carefully evaluated the problem statements from Table 10 to see if any problem statements can be grouped together under an even broader category; the key theme. Each theme should be broad enough to contain all problems statements assign to it, but also specific enough to distinguish it from other key themes. At this stage, any problem statements that were

outside our grasp (for example problem statement #32 and #25) or problem statements that arose from business agreement (for example problem statement #30) were not considered any further. The remaining problem statements were grouped into key themes. We grouped problems that:

- Arise within the same brainstorm category as defined in section 6.1
- Have the same root cause

The problem statements that initially could not be grouped into a key theme were considered one last time, to see if they could potentially be solved within the realm of one of the already existing key themes. If so, they were added to that particular key theme. If not, they were no longer considered.
After performing this last grouping and filtering step, we arrived at 9 key themes, as depicted in Table 11. Per key theme, we also listed a short description of the major problems related to that theme, the reference numbers of all problem statement grouped together in that specific theme and the entity involved. If the entity lists 'All', then all customer and IRIS are affected by the problems listed under 'descriptions'.

Problem statement Ref. #	Entity	Key Theme	Description
13, 14, 15, 25, 38, 39	IRIS	Planning (internal)	Lack of coherence and between planning of production, materials and dispatch cause sever delays in delivery. Lack of proper planning and inventory practices (especially for imported washers) and overpromising of orders only worsen these problems.
3, 11, 16, 24, 42	All	Planning (external)	Different order formats, different lead times, rush orders and Customer A orders all cause extra disturbance in the already fragile planning. Containers have to wait for customs clearance as shipping documents did not arrived yet. Required simultaneous dispatch and priority of Customer A containers causes severe storage and planning issues and delays in shipment as packed containers await last products to be finished.
20, 21, 22, 23, 31	All	Packaging	Issues with stickering, unequal pallet quantities, different packing standards and packaging damages due to shipment and storage and absence of Lotus bar-coding. Also involves issues with container cleanness and proper sealing of container.
2, 4, 5, 6, 17	All	Communication	Delay or absence of order acknowledgement, shipment dates conformation, notification of shipment delays and updates on order status, resulting in last minute 'fire fighting' to relocate supply elsewhere in the Lotus network. Lack of consistent and timely internal communication and time zone differences enhance this problem.
28, 34	IRIS	Quality	In process quality inspection lacks accuracy as defects and deviations are mostly found during final inspection, causing major manual sorting efforts (up to 65%), delaying shipments.
7	All	Product Issues	Product description and (internal) product codes are different with all customers, causing confusion and mistakes in invoicing and dispatching.
9, 27, 29	IRIS	Shipping/Receiving	Lack of proper warehouse and inventory management cause issues with inventory visibility, product damages and proper use of storage space and equipment.
18, 19	IRIS	Manufacturing	Actual production volumes are unreliable due to low labor consistency and low OEE
33, 41	IRIS	Supply	Single sourcing of critical materials (washer) cause high dependencies. Supply capacity of washer supplier (normal as well as round) is currently insufficient.

Table 11 - Key Themes

These 9 key themes are considered to be the cause for the unreliable supply from IRIS. In order to improve the reliability, these problems should be solved. In Chapter 7 we will use the SCOR® best-practice database to find possible solutions for (the majority of) these problems.

7 Analysis of solutions

This chapter will describe the next step in the SCOR® project; using the SCOR® database to find best practices for the key problem themes found in chapter 6. Together with the SCOR® model, the Supply Chain Council has developed an elaborate database that contains all sorts of supply chain best practices, ranging from Kanban manufacturing to Electronic Data Interchange (EDI) and developing Standard Operating Procedures (SOP) for reoccurring activities (Supply Chain Council, 2008). This database is freely accessible for members of the Supply Chain Council.

7.1 Separating the useful best practices

One of the major advantages of this database (besides the fact that it solely consists of best practices), is the fact that it lists for each best practice what level 3 process element(s) may benefit from using that specific best practice. Or the other way around; it lists for every level 3 process element what best practices may solve or improve issues related to that process. As the database contains about 400 best practices, it is useful to separate the best practices that are not useful from the ones that might be. At this point we should clarify the term 'best practice' as defined by SCOR®. As the name suggests, a best practice is a method or technique that has consistently shown superior results than those achieved with other means. There is however no practice that is best for everyone in every situation (Supply Chain Council, 2008). We will therefore separate the best practices that are potentially useful from the ones that are not. To do this, we evaluated the entire database and listed only the best practices that:

- Were are not already used to some extent in the identified supply chains
- Directly relate to the level 3 processes that we found earlier (in section 5.2)
- Are clearly related to the industry (leaving out best-practices for retail etc)

By analysing the best practices database of the SCOR® model using these partition-criteria, we managed to reduce the total number of best practices from 400 to 151. We are now left with 151 best practices that could all potentially benefit the supply chain performance (see Appendix I; Best Practices). As this list is still far to elaborate to help us define to-the-point solutions for the problems from chapter 6, we need to reduce this list even further.

7.2 Best practices in IRIS's unique business context

All supply chain operations performed by any company are (amongst others) influenced by environmental factors (governmental regulations, culture etc) and factors that are specific for the business it is in (Wisner, Tan, & Keong Leong, 2009). All these factors will inevitably influence the usefulness of certain best practices in a specific business situation. Together with the project team, we evaluated the 151 best practices from section 7.1 on their usefulness for the unique business environment of the IRIS supply chains. Some unique elements of IRIS's business environment in this respect are:

- Most customers of IRIS within the scope of this research are within the same business group; both IRIS and the customers are part of Lotus®. This poses some unique restrictions on for example data exchange, as IRIS has to work together with Lotus® sales centres, but simultaneous has to guard their own budget with regards to profits.
- The current state of operations with IRIS. In order for the best practices to be successful, they should closely align with the current state of operations. It makes no

sense for example to consider EDI if all data is currently only available on paper. In this case a useful best practice would be electronic document management, and EDI could be considered as the next step after that. In this stage, any of these 'advanced' (with regards to IRIS) best practices are left out.

By analysing the 151 best practices from section 7.1 using these unique business elements, we reduced the total number of potential useful best practices to 70, as listed in Table 12. To understand what problems these remaining best practices might solve, we matched them to the appropriate problem statements (compare with Table 10), again giving the reference back to the individual disconnects, the brainstorm category, the business entity, the problem statement and the SCOR® level 3 process elements.

Ref. #	Disconnect reference	Brainstorm Category	Entity	Problem Statement Phrase	SCOR Process	Best Practices
1	14, 73, 74, 78, 79, 80, 85	Administration	IRIS SING	Actual products delivered do not match documents	S2, D2, ES.3	ERP Electronic Document Mangement EDI
2	50, 67, 83	Communication	IRIS SING	Unequal balances of outstanding orders	S2, D2, P2	ERP Electronic Document Mangement EDI
3	81, 93	Communication	IRIS SING AUS	Shipping documents too late for customs clearance	S2, ES.6, ES.8, ED.6, ED.8	Advanced Shipping Notice Direct connection to customs clearance Electronic document management Automatic document generation during shipment preparation
4	9, 97	Communication	IRIS	Work overload	S1, D2, P2, P4, ES.8, ED.8	Increase work force Split management from execution tasks
5	72, 87, 89, 91, 92, 107, 109, 120	Communication	IRIS SING AUS USA IT	Lacking of timely and consistent feedback to customers on delivery and shipment dates	S2, D2, P2, P4, ED.3	Share production and transportation status with customers EDI; Electronic document management Paperless order tracking for customer visibility Business rules for changing production plan
6	82	Communication	IRIS SING	Shipments arrive without prior shipping notice	D2, ES.6, ED.3, ED.6	Internet enabled shipment tracking Single source on information for customer Electronic and automated generation and downloading of shipping documents Share production and transportation status with customer
7	66	P.O.	IRIS SING AUS USA	Different product descriptions	S1, S2, M2, D2, EM.3, ED.3	Electronic document management Integrated order/financial system Download P.O. & advanced shipping notice for automated receiving EDI Electronic generation & download of shipping documents Electronic transfer of shipment information to finance
8	40, 90, 102	Product Issues	IRIS SING AUS	Products mixed up	S2, M2, D2, ED.3	ERP Electronic Document Mangement EDI
9	23, 31, 32, 33, 41, 99, 100	Inventory	IRIS	Lack of inventory best practices (stock levels)	S1, M1, M2, D2, ES.4, ED.4	Bar coding EDI with supplier to enhance visibility Integrated TMS/WMS with load planning Integrated order/financial system Reservation of inventory incl. priority rules Dynamic Sourcing Inventory planning at part level based on supply/demand variability Inventory measured in units and dollars Inventory targets are reviewed/adjusted frequently Dynamic location assignment VMI Rules based pick logic and simulation Use and regularly update safety stock levels Consignment inventory management
10	111	Manufacturing	IRIS	Product mix up during production	M1	See problem statements #8 & #28
11	58, 59, 60	P.O.	IRIS SING AUS USA	Different order formats	S2, D2	See problem statement #7 SOP for internal orders & lead time

12	44, 45, 46, 48	Supply	IRIS	Format for purchasing requests is lacking	S2 (S3), ES.3	SOP for purchasing requests EDI
13	10, 12, 13, 52, 53, 54, 55	Planning	IRIS	Issues with Production Planning and Control (PPC) file	M1, M2, EM.3	ERP Electronic Document Mangement EDI
14	11, 15, 17, 18	Planning	IRIS	Issues with Production Planning and Control	S1, M2, P3	Schedule reflects current plant status Real time performance reporting Master Production Schedule (MPS) Unplanned order are only accepted if there is no impact on other deliveries Demand pull manufacturing Kanban Drum-Buffer-Rope scheduling JIT demand flow techniques Lean Manufacturing Balancing supply deliveries throughout day/week
15	30, 37	Planning	IRIS	Non-availability of washers	S1, M1, M2, D2, P2, ES.4	Electronic Kanban replenishment with supplier ERP Integrated order management, WM and TM
16	51, 56, 57, 86	Planning	IRIS SING	Weekly shipment schedule Singapore	S2, M2, D2, P2, P4	Agreed limits on short time flexibility in demand Actual demand frequently updated to reflect actual production Continuous replenishment programs; VMI Electronic Kanban replenishment with supplier Automated configuration management Collaborative delopment of delivery schedules Collaborative planning tools Differentiate service and organize order entry according to customer segment Priority based inventory reservation for key customers
17	6, 7, 8	Communication	IRIS	Lack of internal communication	M1, M2, ED.3	Real time performance reporting SOP for communication
18	114	Manufacturing	IRIS	Labour inconsistency	M1, M2	Cross training/certification Link individual performance to organizational goals Benchmarking performance results and share with employees Provide continuous formal training Feedback process metrics to operators Minimize operator included errors Organize to enhance job flexibility
19	110, 116	Manufacturing	IRIS	Low OEE	M1, M2, EM.2	Design and upgrade production equipment Periodic review of production standards Real time performance reporting Include preventive maintenance in planning Production standards and measurements aligned to maximize SC performance
20	39, 117	Packaging	IRIS	Product stickers for washer identification	M2	Electronic material move transaction Paperless order tracking and customer visibility Bar coding to minimize handling time and maximize data accuracy EDI
21	84, 95, 103, 112	Packaging	IRIS SING USA	Lack of single standard for pallet size	M2, D2	Maintain accurate lot/batch information Standardization of packing quantities
22	76, 104, 108	Packaging	IRIS SING USA	Damaged packaging	D2	SOP for packaging
23	68	Shipping/ Receiving	IRIS SING USA	Container issues	S2, D2	SOP for packaging
24	88, 101	Planning	IRIS Custom er A	Customer A containers need to be shipped simultaneously	S2, D2, P2	Differentiate service and organize order entry according to customer segment Priority based inventory reservation for key customers Agreed limits on short time flexibility in demand
25	61	Planning	IRIS	Not all products ready to be loaded	M2, D2, P4	Integrated load planning and building with WMS EDI link between manufacturing and distributor to enhance visibility JIT demand flow techniques Colleborative planning tools
27	26, 28, 34	Shipping/ Receiving	IRIS	Lack of inventory best practices (warehouse mgmt)	S1, D2, ES.4, ED.5	Zone storage ABC zoning Intergrated warehouse management system
28	1, 2, 3, 38	Product Issues	IRIS	Quality check not foolproof	S1, M1, M2	Real time quality control Operation is authorized by quality assessment of previous operation
29	27, 29	Shipping/ Receiving	IRIS	Lack of proper use of equipment	S1, M1, D2	Cross training/certification Provide continuous formal training

30	16	Financial	IRIS USA	Invoice rates	D2, ED.8	Determine business rules on freight costs
31	94, 105	Packaging	IRIS USA	Labelling issues	M2, D2, ES.3, ED.3	See problem statement #31
32	98	Planning	IRIS AUS USA	Low vessel sailing frequency	D2, ED.6	JIT demand flow techniques Real time package tracking Integrated order management, WM and TM Consignment inventory management
33	24	Supply	IRIS	Limited supplier capacity	S1, P2	See problem statement #41
34	19	Product Issues	IRIS SING	Required quality Singapore	M2	Continuous improvement
35	22	Non supply chain related	IRIS	Power cuts	M1, M2	Back up power supply
36	70, 71, 75, 77	Inventory	SING	Lack of inventory best practices (warehouse mgmt)	D1, D2. ED.4	See problem statement #9
37	69	P.O.	SING	Loss of order traceability	D1, D2, ED.3	Electronic document management Automated shipment documents
38	4, 113	Planning	IRIS	No stock of imported EPDM washer (Poppe)	S1, M2, P2	Electronic Kanban replenishment with supplier ERP Integrated order management, WM and TM
39	118	Planning	IRIS	Overestimating production capabilities	P3, P4	Unplanned orders only accepted if no influence on other deliveries Standards and measurements aligned to maximize supply chain performance Actual demand is update regularly to reflect actual consumption Performance expectation and business rules communicated to supplier Multi-plant supply/demand planning and execution
40	64	Planning	IRIS SING	Adjusting stock levels to sales trends	S1, S2, ES.2	Continuous improvement of supplier Cost reduction and avoidance are evaluated on periodic basis Supplier cost of non performance Performance expectation and business rules communicated to supplier
41	49	Supply	IRIS	High supplier dependency	S1, P2	Multiple sourcing Dual sourcing Dynamic sourcing
42	119	Planning	IRIS Customer A	Short lead time Customer A orders	M2, P3	Unplanned orders only accepted if no influence on other deliveries Colleborative development of delivery schedules Real time performance reporting Schedule reflects current plant status

Table 12 - Best practices for IRIS

7.3 Final solutions

As a list with 70 best practices can hardly be called a to-the-point solution, we again brought together the project team to discuss which of the 70 best practices would be most beneficial for IRIS in terms of improving the reliability and efficiency of supply. During this discussion, the feasibility, the implementation effort and the expected implementation time were some of the aspects that were taken into consideration. Besides these, factors regarding the alignment with the rest of the Lotus® group and (other) current projects were discussed as well. This discussion lead to the 16 final solutions listed in Table 13. These solutions are best practices from SCOR® that are totally customized to fit IRIS's business context and problems. Take for example the best practice 'real time quality control' from Table 12. This best practice from SCOR® has been translated to fit IRIS's business context and can be found in Table 13 as 'repair/reinstall visual check systems'. Similarly, all the solutions in Table 13 stem from one or multiple best practices from SCOR® (as in Table 12) and are adapted to fit IRIS's problems as defined in Chapter 6. Table 13 also provides a reference back to the individual problem statement from section 6.2 that will be solved by implementing these solutions.

Key theme	Solutions	Problem statement solved by solution
Planning (internal)	• *Use and configure new ERP system*. IRIS is currently implementing an ERP system, which could potentially solve some supply chain related planning issues. • *Link ERP to SOP for customer communication*. Communication should be a standard, repeatable process rather than an ad hoc decision on who will do what. The ERP system can provide some useful triggers for communication towards customers.	- 13, 14, 15, 25, 38 - 14, 39
Planning (external)	• *Standardize lead-time for supply from IRIS*. Lead-time for all customers should be equal, in order to facilitate production planning. • *Re-evaluated demand allocated to IRIS*. Actual production volume does not meet total demand. Since the production volume is at maximum capacity, some demand should be diverted elsewhere within the Lotus network. • *Separate Customer A orders from Singapore orders*. To facilitate planning and avoid confusion, orders for Singapore should be separated from order for Customer A. • *Partial shipment of Customer A orders, with top priority.* To prevent capacity issues in the warehouse and increase flexibility in production planning.	- 11, 42 - 39 - 16, 24 - 42
Packaging	• *New sticker design including Lotus barcode*. In order to solve issues with labeling, a new, standardized sticker should be designed. • *Container inspection*. To eliminate the use of dirty and leaking containers, implement a thorough inspection of empty containers upon their arrival at IRIS • *Upgrade cartons*. To prevent damaging products and packaging, upgrade the cartons to a higher quality.	- 20, 31 - 23 - 22
Communication	• *Develop SOP for customer communication*. Communication should be a repeatable, standard process with clear accountabilities, responses and timing of communication. • *Appoint/hire supply chain manager*. Key in improving the supply chain performance is dedicating manpower to it.	- 2, 5, 6, 17 - 4
Quality	• *Repair/reinstall visual check systems*. To minimize delays caused by quality issues	- 28
Product Issues	• *Standardize descriptions and codes throughout the Lotus network*. Descriptions and coding of products should be the same with every sales centre, warehouse and factory.	- 7
Shipping/ Receiving	• *Develop proper warehouse management practices*. In order to utilize capacity efficient and prevent product damages due to in-house movements of products.	- 9, 27, 29

Manufacturing	• *Salaries and cross training of personnel.* Make factory personnel more flexible and motivated. • *Upgrade production equipment.* To increase production output and reliability, equipment should be upgraded.	- 18 - 19
Supply	• *Develop new supplier for Buna (square & round) washes.* To decrease supplier dependency and eliminate non-availability of washers.	- 33, 41

Table 13 - Solutions

While performing this research, the need to quantify supply chain performance more detailed strongly grew within IRIS. In order to see whether the solutions suggested in Table 13 will actually improve the reliability and efficiency of the supply chain activities, we have to be able to keep track of performance. As it is hard to improve what you cannot measure, we also suggested to develop a monthly supply chain dashboard to keep track of the supply chain performance in addition to the solutions listed in Table 13.

At this point, the SCOR® project stops. Any further steps to develop these solutions into a detailed implementation plan are outside the scope of a traditional SCOR® project. However, to provide Lotus with hands on solutions, we will continue with these solutions and develop some of them into a preliminary implementation plan in Chapter 8.

8 Required action for solution implementation

As mentioned earlier, this chapter takes the results obtained from the SCOR® project (chapter 3 – 7) to develop some of the solutions into more detail. Due to limitations in time and resources, we will not develop all 16 solutions from section 7.3 into detail. Together with the project team, the key themes from section 6.2 were prioritized, taken into consideration the severity of the problems and the ease of implementing the matching solutions from section 7.3. Decided was, with regards to limitations in time, to only develop a preliminary implementation schedule for the most promising solution.

The solution with top priority at this point was: *the use and configuration of the new ERP system*. One of the (other) current projects at IRIS is the development of an ERP system, which is due to go live on the 1st of April 2011. As the internal planning issues could largely be solved by an ERP system (according to SCOR®), incorporating the supply chain issues in this development would kill two birds with one stone.

We will develop a preliminary plan to implement the supply chain issues in the ERP project in section 8.1, discussing what issues are to be taken into account, who should be accountable and what the milestones/deadlines will be. Besides working out this implementation schedule, we also responded to the need to quantify supply chain performance by developing a supply chain dashboard. This dashboard is discussed in more detail in section 8.2.

8.1 Use and configuration of ERP system

To define what actions need be taken in order for the ERP system to support the supply chain improvements, we organized a meeting with the project team in charge of the ERP implementation and discussed all the problem statement from section 6.2, to see for what supply chain problems the new ERP system could potentially be useful. From this meeting, it showed that many of the problems statements that can be solved by the ERP system where grouped under the key theme 'Planning (Internal)'.

For each of the issues where ERP has the potential to be useful from a supply chain point of view, we defined what additional actions are to be taken to optimally prepare the ERP system and its users. As the ERP system is due to go live on the 1st of April 2011, all these action should be finished by then. The entire ERP project is managed by the sr. quality manager (who is also part of the supply chain project team) and therefore he will be accountable for the timely completion of all the actions. The required actions are listed below. Per action listed, the problem statement (see again Table 10) solved by that specific action is given as well.

- Determine and implement priority rules for (re)scheduling production, based on different customers. Determine maximum order-quantity to be accepted per week to prevent overpromising of orders and make sure the ERP system gives appropriate feedback if the maximum order quantity is reached. This will solve problem statements 39 and 42.
- Determine safety stock levels for <u>all</u> materials, which account for peak demand, demand during lead-time and uncertainty (both in delivery and quality) in demand, based on the required fill rate. The ERP system will take care of inventory management using these safety stock levels, thereby solving problem statements 9, 15 and 38.

- Make sure ERP gives output to check outstanding orders at the end of the month, to solve problem statement 2.
- Install check with original P.O. before container dispatch, to track errors in manual system entries and ultimately solve problem statement 1 and 8.
- Make sure the right person receives an appropriate system warning in case of disturbances in production to inform the customers on delays, to solve problem statement 17.
- Make sure data entry procedures are incorporated in daily routines of personnel to prevent erroneous or forgotten entries. By doing this, problem statement 13 will be solved completely.
- Sent copy of sales order (the entry of a purchase order from a customer into the system) directly from the ERP system to the customer to acknowledge orders. This will contribute in preventing problem statements 1 and 8.
- Sent copy of the invoice directly from the ERP system to the customer upon container dispatch from factory to acknowledge actual shipment. Customers will be better informed, thereby solving problem statement 3,5,6 and 17.
- Develop standard order template for customers, to eliminate manual entries of orders all together, again to help solve problem statement 1 and 8.
- Make sure the ERP system gives the right output to calculate the supply chain key performance indicators for the supply chain dashboard.

By completing these actions, the ERP system will solve most of the issues related to the key theme 'Planning (Internal)'. Two important remarks that cannot be omitted with respect to the use of an ERP system in a supply chain context are:

- An ERP system is only as good as the people using it and the data entered. As mentioned, the ERP system has the potential of solving most of the internal planning issues, if it is used properly. If the system is not fully absorbed into the organization and the daily operations of the people using is, it will only create more confusion and the supply chain performance will be heavily affected.
- The actions listed above are to be taken to solve the current issues found during this project. Using the ERP system to gain additional efficiency during daily operations is not yet considered.

Just as we did for the *implementation and use or the new ERP system*, the remaining 15 solutions from section 7.3 should be worked out in detail as well, in order to solve all current problems in the identified supply chains. Unfortunately, due to limitation in time that will not be part of this research.

8.2 Supply chain dashboard

In order to quantify supply chain performance, we turn our attention back to the SCOR® model. As mentioned earlier (see section 3.2), the SCOR® model contains quit some Metrics that can help to assess the supply chain performance. The SCOR® model has defined metrics for (Supply Chain) Reliability, Responsiveness, Agility, Costs and Assets Management. As this research mainly aims to improve the reliability of supply from IRIS, metrics measuring exactly that were chosen to be incorporated into the supply chain dashboard. We will shortly elaborate on the chosen metrics and the targets set for these metrics.

8.2.1 Metrics

There are 8 Key Performance Indicators (KPI's) in the supply chain dashboard; all measuring a certain aspect of the supply chain reliability. The first 6 are individual metrics, that measure specific aspects of deliver reliability. These metrics are:

- *Percentage of orders delivered in full*. This metric indicates the percentage of orders that are delivered in the right quantity and with the right product types.
- *Percentage of orders delivered on time*. This metric gives the percentage of orders that is delivered within the agreed upon time frame.
- *Documentation accuracy*. This metric gives the percentage of orders that is delivered with correct documentation (invoices, bill of lading, excise documents etc.)
- *Perfect condition.* This metric indicates the percentage of orders that is delivered without any damages or deviations; all products of a specific order have to be good in order to qualify as perfect.
- *Percentage of order lines delivered on time.* This metric gives the percentage of order lines that is delivered within the agreed upon time frame. An order line in this respect is defined as a required quantity of one specific product, for example; 90.000 2" flanges with Dual washer. Obviously, an order can only be delivered on time if all its order lines are delivered on time. This metric is developed to keep track what product types are more often late then others.
- *Percentage of backorders.* This metric gives the percentage of outstanding orders that were not delivered on time.

The last 2 KPI's are combined metrics, measuring multiple aspects of deliver reliability simultaneously. These metrics are:

- *Percentage of orders delivered on time in full*. This metric indicates the percentage of orders that is delivered on time and in full.
- *Perfect Order Fulfilment*. This metric indicates the percentage of order delivered on time and in full and with accurate documentation and in perfect condition.

Obviously, obtaining a high level of 'Perfect Order Fulfilment' equals high supply chain reliability, which is exactly what this research hopes to achieve. The calculation for each of the 8 KPI's, together with the source needed for the data is given in Appendix J; Calculations supply chain dashboard.

8.2.2 Targets

The targets for the KPI's are based on a benchmark study performed by the Performance Measurement Group (The Performance Measurement Group, 2011) and internal standards of Hyacinth (Hyacinth, 2009). The individual metrics are logically higher then the combined metrics, as they only deal with one aspect of deliver reliability, whereas the combined metrics deal with multiple aspects. The dashboard entails the performance for the current month as well as for the 3 previous months and a 4-month rolling average. This is done to observe trends. The 'reason for deviation' and 'corrective action' columns are added to gain insight as to why targets are not met and what actions are taken to prevent this from happening again. The entire dashboard is given in Figure 16.

Month											
Year											
Category	Key Performance Indicator	Unit	Perf.	Target	Actual				Rol. ave.	Reason for deviation	Corrective action
					Jan	Dec	Nov	Oct			
Order fulfilment	Orders delivered in full	%		100%							
	Orders delivered on time	%		98%							
	Documentation accuracy	%		100%							
	Perfect condition	%		100%							
	Order lines delivered on time	%		98%							
	Backorders	%		0%							
	Combined metrics										
	On Time In Full	%		95%							
	Perfect Order Fulfilment	%		95%							

Figure 16 - Monthly Supply Chain Dashboard

9 Conclusions and Recommendations

9.1 Conclusions

This research has covered a lot of ground in investigating what the causes for the unreliability of supply from IRIS are. Using the SCOR methodology, many small problems articulating into several key issues have been uncovered. Each of these key issues have to be addressed in order to improve the overall supply chain performance. These key issues are:

1. *Planning (Internal)*. Lack of coherence between planning of production, materials and dispatch cause sever delays in delivery.
2. *Planning (External)*. Different order formats, different lead times, rush orders and Customer A orders all cause extra disturbance in the already fragile planning.
3. *Packaging.* Issues with stickering, different packing standards and packaging damages due to shipment and storage and absence of Lotus bar coding. This also involves issues with container cleanness and proper sealing of container.
4. *Communication*. Delay or absence of order acknowledgement, shipment dates conformation, notification of shipment delays and updates on order status, resulting in last minute 'fire fighting' to relocate supply elsewhere in the Lotus network. Lack of consistent and timely internal communication and time zone differences enhance this problem.
5. *Quality*. In process quality inspection lacks accuracy as defects and deviations are mostly found during final inspection.
6. *Product issues*. Product description and (internal) product codes are different with all customers, causing confusion and mistakes in invoicing and dispatching.
7. *Shipping/Receiving*. Lack of proper warehouse and inventory management cause issues with inventory visibility, product damages and proper use of storage space and equipment.
8. *Manufacturing*. Actual production volumes are unreliable due to low labour consistency and low OEE
9. *Supply*. Single sourcing of critical materials (washers) cause high dependencies on suppliers. Supply capacity of Buna washer supplier (square & round) is currently insufficient.

Besides defining the causes for the unreliability of supply from IRIS, this research also provided improvement opportunities to resolve these issues and ultimately improve the overall supply chain performance. Per key issue as described above, the solutions provided in this research are given below.

1. *Planning (Internal)*	- Use and configure new ERP system. - Link ERP to SOP for customer communication.
2. *Planning (External)*	- Standardize lead-time for supply from IRIS - Re-evaluated demand allocated to IRIS - Separate Customer A from Singapore orders - Partial shipment of Customer A orders
3. *Packaging*	- New sticker design including Lotus barcode - Container inspection - Upgrade cartons
4. *Communication*	- SOP for customer communication - Appoint/hire supply chain manager
5. *Quality*	- Repair/reinstall visual check system
6. *Product Issues*	- Standardize descriptions and codes throughout the Lotus network
7. *Shipping/Receiving*	- Develop proper warehouse management practices
8. *Manufacturing*	- Salaries and cross training of personnel - Upgrade production equipment
9. *Supply*	- Develop new supplier for Buna (square & round) washers

By implementing these solutions, the majority of the problems regarding the unreliability of supply from IRIS will be solved. Furthermore, as will all implementations of 'new' work practices or agreements, closely monitoring them in order to prevent a lapse back into old, non-efficient and unreliable habits is of key importance.

9.2 Recommendations

Due to limitation in time, we could only work out a single solution from section 9.1 into the hand-on implementation plan that is required to solve the issues. This implementation plan was developed for the *'use and configuration of the new ERP system'*, and contains the following point of action that Lotus should execute to solve the internal planning issues:

- Determine and implement priority rules for (re)scheduling production.
- Determine safety stock levels for <u>all</u> materials.
- Make sure ERP gives output to check outstanding orders at the end of the month
- Install check with <u>original</u> P.O. before container dispatch.
- Make sure the right person receives an appropriate system warning in case of disturbances in production to inform the customers on delays.
- Make sure data entry procedures are incorporated in daily routines of personnel.
- Sent a copy of the sales order to the customer to acknowledge orders.
- Sent copy of the invoice to the customer to acknowledge actual shipment.
- Develop standard order template for customers.
- Make sure the ERP system gives the right output to calculate the supply chain key performance indicators for the supply chain dashboard.

Besides developing these points of actions for this specific solution, the detailed manner in which the SCOR methodology helped uncovering all the issues and provided a good direction for solutions, resulting in a very strong basis that should be used to develop and implement hands-on solutions for the remaining key themes.

Finally, in order to keep track of the actual supply chain performance, we advise Lotus to start using the supply chain dashboard as developed during this research. Especially when Lotus should decide to develop the other solutions into a detailed action plan as done for the *use and configuration of the new ERP system',* measuring actual performance will become increasingly important. Furthermore, we advise to carefully review the reasons for deviations in performance and the corrective action planned to prevent this deviation from reoccurring, in order to continuously improve the supply chain performance.

9.3 Recommendation for further research

During this research, several problems came up that span much wider then the supply chains we defined and are applicable to the entire Lotus group. Some of these problems already came up during the North America project (see section 3.3) and are reoccurring in this research. Taken this into consideration, there are some overriding themes in the Lotus group that should be researched further as they represent company-wide areas of opportunity. This mainly includes the standardization of:

- Lead times
- Product codes
- Product descriptions
- Order formats
- Product quantities on pallets
- Container packing

As many of the current Lotus factories are not Lotus factories from origin, the current differences with regard to these issues can easily be explained. The standardization will take considerable time and resources, but judging by the problems they cause for IRIS, this investment will easily be offset by the potential gains on a company-wide level.

9.4 Discussion

After performing this research and developing specific knowledge on the particular problems and potential solutions for supply from IRIS, we would like to conclude this research with the two following remarks:

1. Managing any supply chain remains a very tricky, elaborate and sometimes confusing task, that require the cooperation and integration of many different companies, departments and individuals. The key in successfully managing the supply chain requires not only hands-on solutions to identified problems (as presented in this research), but more important the dedication and understanding of every individual involved. We like to believe that this research helped creating that awareness with IRIS, but stress that there is still a long way to go in order to achieve to a successful, high performing and fully integrated supply chain.

2. Many of the issues found during this research, find their root cause inside the factory. They are heavily enhanced by for example the lack of communication or lack of inventory practices, but the effect would have been considerably less if production would have run smoothly. As long as this cannot be achieved, supply from IRIS will remain unreliable (albeit much better then it is now), even after all the proposed solutions have been implemented.

10 References

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Appendix A; SCOR® Project Roadmap

Phase	Focus	Major Deliverables	Resolves
0	SUPPORT	• Organization Support Structure	Who is the project team?
I	SCOPE	• Supply Chain Definition • Supply Chain Priorities • Project Charter	What is the scope of the project?
II	METRICS	• Scorecard • Benchmark • Competitive Requirements	How am I performing? What are my strategic requirements?
III	ANALYSE	• Geographic Map • Thread Diagram • Disconnect Analysis	Am I moving material efficiently and effectively?
IV	WORK	• Transaction Analysis • Level 3, Level 4 processes • Best Practices Analysis	Are my processes efficient and effective?
V	IMPLEMENT	• Opportunity Analysis • Project Definition • Deployment Organization	What is the financial opportunity? How should I deploy?

Table 14 - SCOR project Roadmap (Supply Chain Council, 2008)

Appendix B; Example of a thread diagram

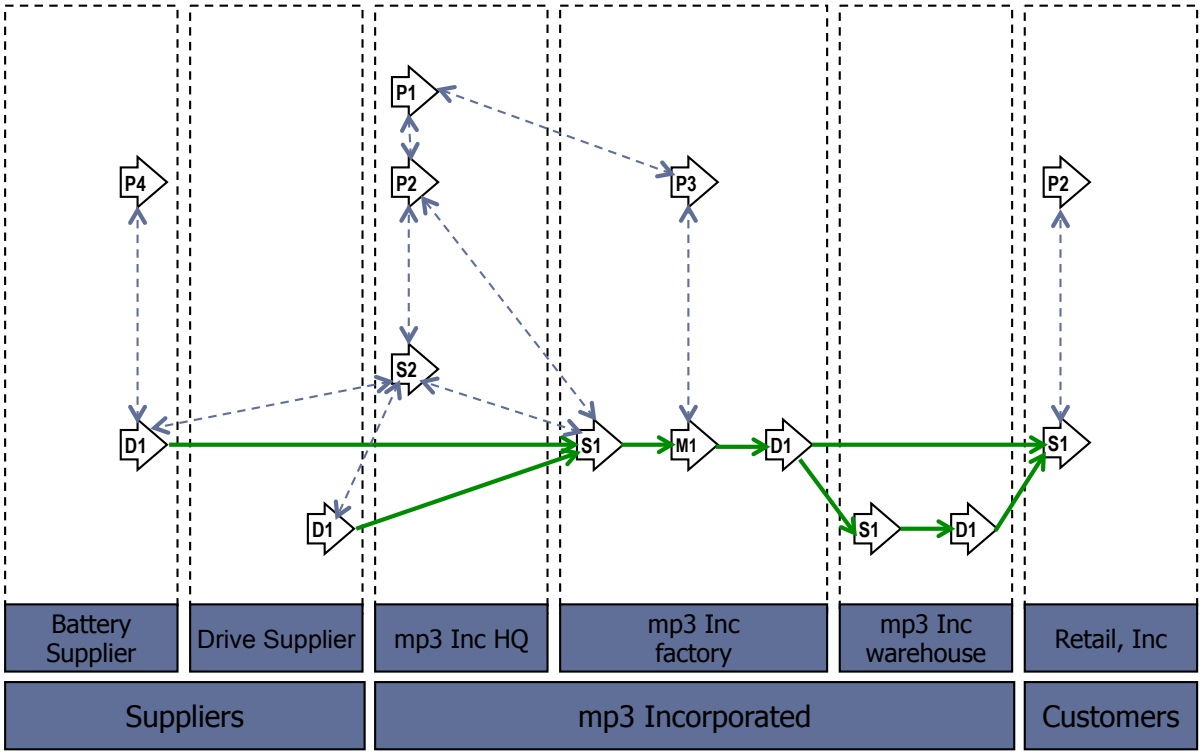

Figure 17 - Example of a thread diagram (Bolstorff & Rozenbaum, 2007)

The thread diagram in Figure 17 shows the flow of information (dashed arrows) and products/materials (green arrows) between the different departments within the different supply chain entities. We see for example that the Battery Supplier delivers their products to the mp3 Inc factory according to the Deliver-Make-to-Stock Products (D1) configuration. The mp3 Inc factory on it's turn sources Make-to-Stock Products (S1), produces products to stock (M1) and finally delivers Make-to-Stock Products (D1) to the mp3 Inc warehouse as well as directly to the customer, Retail Inc.

The *execution* processes as described above are supported by various *plan* processes, as for example Plan Source (P2) at the mp3 Inc Headquarter (HQ), Plan Make (P3) at the mp3 Inc factory and Plan Deliver (P4) at the Battery Supplier.

Appendix C; SCOR® level 3 process elements

Source

Stocked Product (S1)	Make-to-Order (S2)	Engineer-to-Order (S3)
		S3.1 Identify Sources of Supply
		S3.2 Select Final Supplier(s) and Negotiate
S1.1 Schedule Product Deliveries	S2.1 Schedule Product Deliveries	S3.3 Schedule Product Deliveries
S1.2 Receive Product	S2.2 Receive Product	S3.4 Receive Product
S1.3 Verify Product	S2.3 Verify Product	S3.5 Verify Product
S1.4 Transfer Product	S2.4 Transfer Product	S3.6 Transfer Product
S1.5 Authorize Supplier Payment	S2.5 Authorize Supplier Payment	S3.7 Authorize Supplier Payment

Table 15 - Level 3 Source process elements (Supply Chain Council, 2008)

Make

Make-to-Stock (M1)	Make-to-Order (M2)	Engineer-to-Order (M3)
		M3.1 Finalize Production Engineering
M1.1 Schedule Production Activities	M2.1 Schedule Production Activities	M3.2 Schedule Production Activities
M1.2 Issue Material	M2.2 Issue Sourced/In-Process Product	M3.3 Issue Sourced/In-Process Product
M1.3 Produce and Test	M2.3 Produce and Test	M3.4 Produce and Test
M1.4 Package	M2.4 Package	M3.5 Package
M1.5 Stage Product	M2.5 Stage Finished Product	M3.6 Stage Finished Product
M1.6 Release Product to Deliver	M2.6 Release Finished Product to Deliver	M3.7 Release Product to Deliver
M1.7 Waste Disposal	M2.7 Waste Disposal	M3.8 Waste Disposal

Table 16 - Level 3 Make process elements (Supply Chain Council, 2008)

Deliver

Stocked Products (D1)	Make-to-Order (D2)	Engineer-to-Order (D3)	Retail Products (D4)
D1.1 Process Inquiry & Quote	D2.1 Process Inquiry & Quote	D3.1 Obtain & Respond to RFQ/RFQ	D4.1 Generate Stocking Schedule
D1.2 Receive, Enter & Validate Order	D2.2 Receive, Configure, Enter & Validate Order	D3.2 Negotiate & Receive contract	D4.2 Receive Product at Store
D1.3 Reserve Inventory & Determine Deliver Date	D2.3 Reserve Inventory & Determine Deliver Date	D3.3 Enter Order, Commit Resources & Launch Program	D4.3 Pick Product from Backroom
D1.4 Consolidate Order	D2.4 Consolidate Order	D3.4 Schedule Installation	D4.4 Stock Shelf
D1.5 Build Loads	D2.5 Build Loads	D3.5 Build Loads	D4.5 Fill Shopping Cart
D1.6 Route Shipment	D2.6 Route Shipment	D3.6 Route Shipment	D4.6 Checkout
D1.7 Select Carriers & Rate Shipments	D2.7 Select Carriers & Rate Shipments	D3.7 Select Carriers & Rate Shipments	D4.7 Deliver and/or Install
D1.8 Receive Product from Source or Make	D2.8 Receive Product from Source or Make	D3.8 Receive Product from Source or Make	
D1.9 Pick Product	D1.9 Pick Product	D1.9 Pick Product	
D1.10 Pack Product	D1.10 Pack Product	D1.10 Pack Product	
D1.11 Load Product & Create Documentation	D1.11 Load Product & Create Documentation	D1.11 Load Product & Create Documentation	
D1.12 Ship Product	D1.12 Ship Product	D1.12 Ship Product	
D1.13 Receive & Verify Product by Customer	D1.13 Receive & Verify Product by Customer	D1.13 Receive & Verify Product by Customer	
D1.14 Install Product	D1.14 Install Product	D1.14 Install Product	
D1.15 Invoice	D1.15 Invoice	D1.15 Invoice	

Table 17 - Level 3 Deliver process elements(Supply Chain Council, 2008)

Return (Source)

Defective Product (SR1)	MRO Returns (SR2)	Excess Products (SR3)
SR1.1 Identify Defective Product Conditions	SR2.1 Identify MRO Product Condition	SR3.1 Identify Excess Product Condition
SR1.2 Disposition Defective Product	SR2.2 Disposition MRO Product	SR3.2 Disposition Excess Product
SR1.3 Request Defective Product Return Authorization	SR2.3 Request MRO Return Authorization	SR3.3 Request Excess Product Return Authorization
SR1.4 Schedule Defective Product Shipment	SR2.4 Schedule MRO Shipment	SR3.4 Schedule Excess Shipment
SR1.5 Return (Ship) Defective Product	SR2.5 Return (Ship) MRO Product	SR3.5 Return (Ship) Excess Product

Table 18 - Level 3 Source Return process elements (Supply Chain Council, 2008)

Return (Deliver)

Defective Product (DR1)	MRO Returns (DR2)	Excess Products (DR3)
DR1.1 Authorize Defective Product Return	DR2.1 Authorize MRO Product Return	DR1.1 Authorize Excess Product Return
DR1.2 Schedule Defective Product Receipt	DR2.2 Schedule MRO Product Receipt	DR1.2 Schedule Excess Product Receipt
DR1.3 Receive & Verify Defective Product	DR2.3 Receive & Verify MRO Product	DR1.3 Receive & Verify Excess Product
DR1.4 Transfer Defective Products	DR2.4 Transfer MRO Products	DR1.4 Transfer Excess Products

Table 19 - Level 3 Deliver Return process elements (Supply Chain Council, 2008)

Plan

Plan Supply Chain (P1)	Plan Source (P2)	Plan Make (P3)	Plan Deliver (P4)	Plan Return (P5)
P1.1 Gather Supply Chain Requirements	P2.1 Gather Materials Requirements	P3.1 Gather Production Requirements	P4.1 Gather Delivery Requirements	P5.1 Gather Return Requirements
P1.2 Gather Supply Chain Resources	P2.2 Gather Material Resources	P3.2 Gather Production Resources	P4.2 Gather Delivery Resources	P5.2 Gather Return Resources
P1.3 Balance Supply Chain Resources with Requirements	P2.3 Balance Material Resources with Requirements	P3.3 Balance Production Resources with Requirements	P4.3 Balance Delivery Resources with Requirements	P5.3 Balance Return Resources with Requirements
P1.4 Establish & Communicate Supply Chain Plans	P2.4 Establish Sourcing Plans	P3.4 Establish Production Plans	P4.4 Establish Delivery Plans	P5.4 Establish & Communicate Return Plans

Table 20 - Level 3 Plan process elements (Supply Chain Council, 2008)

Appendix D; SCOR® Enable processes

Enable Plan (EP)	Enable Source (ES)	Enable Make (EM)	Enable Deliver (ED)	Enable Return (ER)
EP.1 Manage Business Rules for Plan Processes	ES.1 Manage Sourcing Business Rules	EM.1 Manage Production Rules	ED.1 Manage Deliver Business Rules	ER.1 Manage Deliver Rules for Return Process
EP.2 Manage Performance of Supply Chain	ES.2 Assess Supplier Performance	EM.2 Assess Production Performance	ED.2 Assess Delivery Performance	ER.2 Assess Performance of Return Process
EP.3 Manage Plan Data Collection	ES.3 Maintain Source Data	EM.3 Maintain Make Data	ED.3 Maintain Deliver Information	ER.3 Maintain Return Data Collection
EP.4 Manage Integrated Supply Chain Inventory	ES.4 Manage Product Inventory	EM.4 Manage In-Process Product Inventory (WIP)	ED.4 Manage Finished Goods Inventory	ER.4 Manage Return Inventory
EP.5 Manage Integrated Supply Chain Capital Assets	ES.5 Manage Capital Assets	EM.5 Manage Make Equipment and Facilities	ED.5 Manage Deliver Capital Assets	ER.5 Manage Return Capital Assets
EP.6 Manage Integrated Supply Chain Transportation	ES.6 Manage Incoming Product	EM.6 Manage Transportation (WIP)	ED.6 Manage Transportation	ER.6 Manage Return Transportation
EP.7 Manage Planning Configuration	ES.7 Manage Supplier Network	EM.7 Manage Production Network	ED.7 Manage Product Life Cycle	ER.7 Manage Return Network Configuration
EP.8 Manage Plan Regulatory Requirements and Compliance	ES.8 Manage Import/Export Requirements	EM.8 Manage Make Regulatory Environment	ED.8 Manage Import/Export Requirements	ER.8 Manage Return Regulatory Requirements and Compliance
EP.9 Manage Supply Chain Plan Risk	ES.9 Manage Supply Chain Source Risk	EM.9 Manage Supply Chain Make Risk	ED.9 Manage Supply Chain Deliver Risk	ER.9 Manage Supply Chain Return Risk
EP.10 Align Supply Chain Unit Plan with Financial Plan	ES.10 Manage Supplier Agreements			

Table 21 - SCOR® Enable Processes (Supply Chain Council, 2008)

Appendix E; Example flow chart

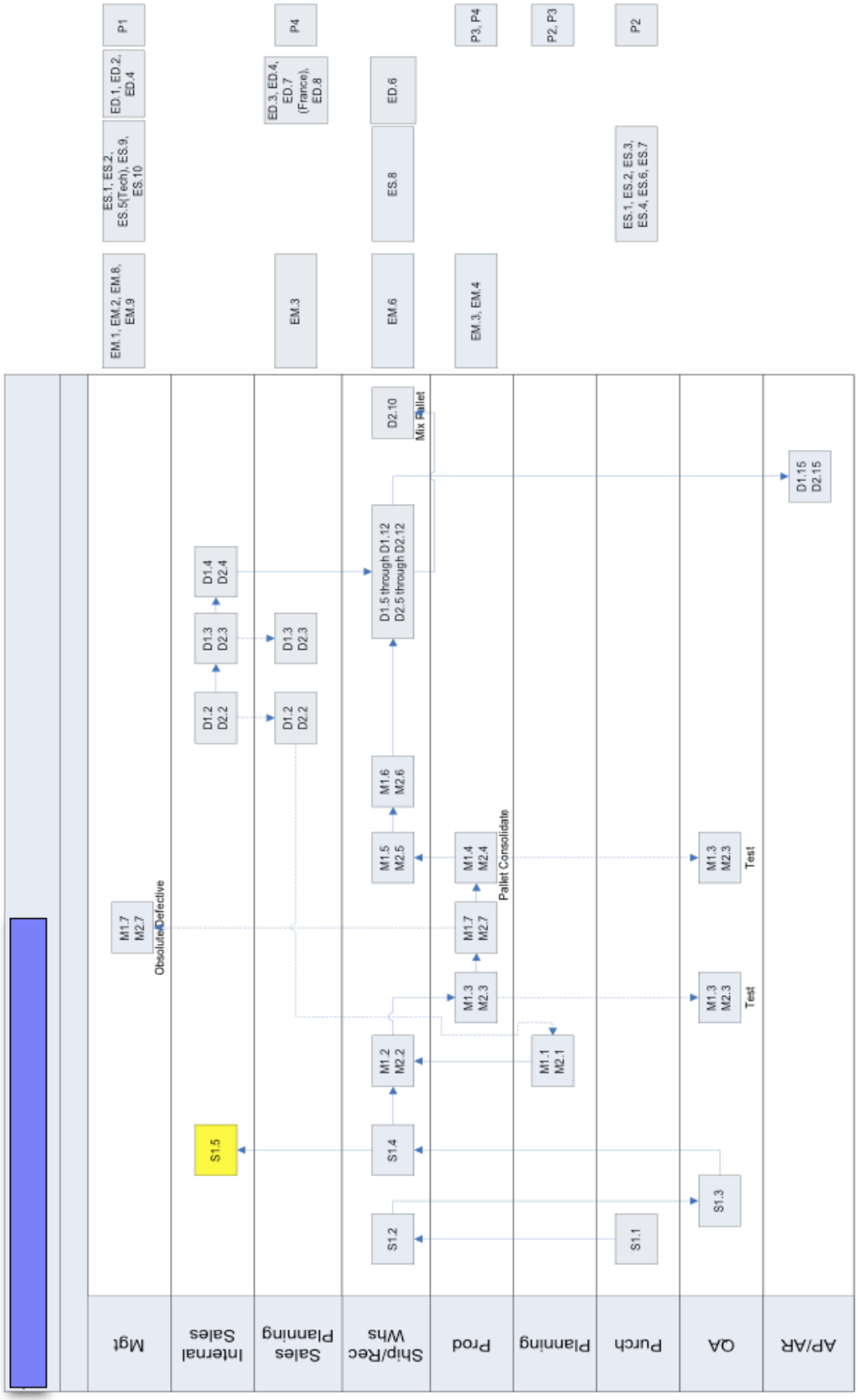

Figure 18 - Example Flow Chart(Hyacinth, 2009)

Appendix F; Lotus® Steel Closures

Flanges & Plugs

Flanges (G2 & G¾)	Plugs (G2 & G¾)
	

Table 22 – Flanges & Plugs

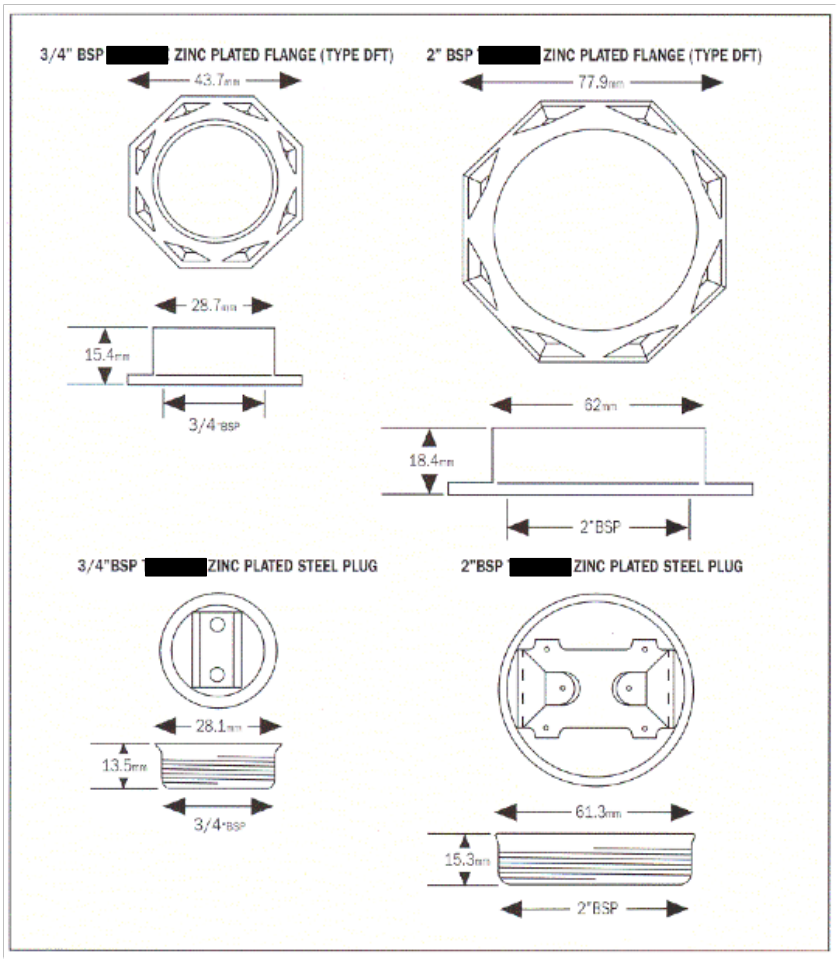

Figure 19 – dimensions of G2 & G¾ flanges and plugs

Washers

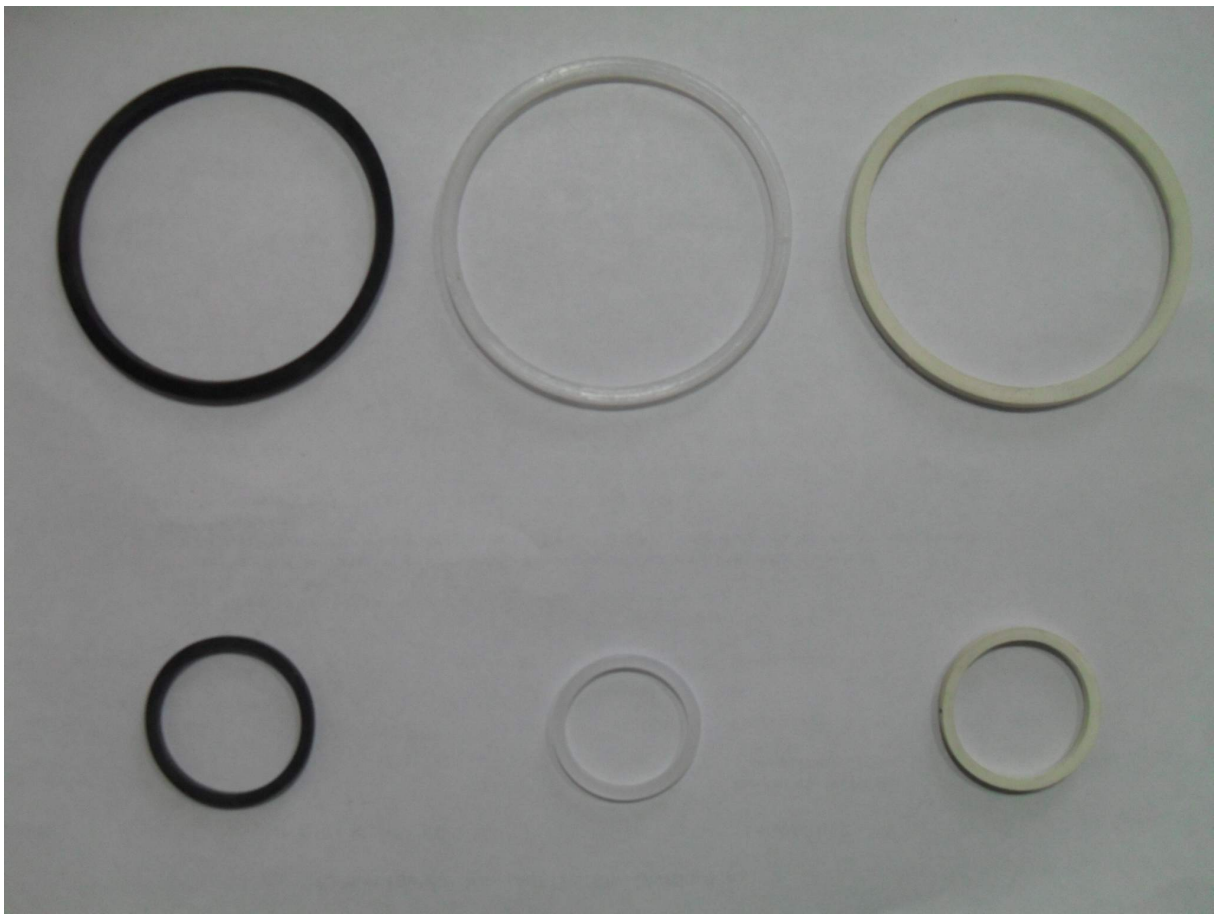

Figure 20 - Washers for flanges and plugs

Appendix G; Reference of interviews

			Interviewed for			
Interviewee	**Company**	**Function/ Department**	Section 5.1	Section 5.2	Section 6.1	Method*
Confidential	IRIS	Import/Export		x	x	1
Confidential	IRIS	Managing Director		x	x	1
Confidential	IRIS	Sr. manager QA	x	x	x	1
Confidential	IRIS	Factory Head	x	x	x	1
Confidential	IRIS	Purchasing	x	x	x	1
Confidential	IRIS	Packaging		x	x	1
Confidential	IRIS	Production		x	x	1
Confidential	IRIS	Warehouse		x	x	1
Confidential	IRIS	Warehouse		x	x	1
Confidential	Lotus Singapore	BU manager	x	x	x	1
Confidential	Lotus Singapore	Sales			x	1
Confidential	Lotus Singapore	Warehouse			x	1
Confidential	Aster	BU manager	x	x	x	2
Confidential	Aster	Purchasing			x	2
Confidential	Lotus Australia	BU manager	x	x	x	2
Confidential	Lotus Australia	Purchasing			x	2
Confidential	Lotus Australia	Sales			x	2
Confidential	Lotus Italy	BU manager	x	x	x	2

Table 23 - Reference of interviews

* 1 = Interview conducted in person
2 = Interview conducted using conference call

Appendix H; Disconnects

Ref. Numb	Disconnect description	Department	SCOR process	Entity	Brainstorm Category
1	Defects in products not found during final check	QA	M2.3	IRIS	Product Issues
2	Deviations in gasket dimension not found during check	QA	S1.3	IRIS	Product Issues
3	Computer checked products still contain defects	QA	M2.4	IRIS	Product Issues
4	Imported washers from brazil only delivered in sets (2" & 3/4")	Import/Export	S1.1	IRIS	Supply
5	No assurance on actual weekly production	Import/Export	M2.1	IRIS	Manufacturing
6	Production does not give feedback on actual production	Import/Export	M2.1	IRIS	Communication
7	Last minute notice from production if containers cannot be shipped in time	Import/Export	M2.6	IRIS	Communication
8	Changes in production planning not always known to import/export	Import/Export	M2.1	IRIS	Communication
9	No back up to check actual production	Import/Export	D2.3	IRIS	Communication
10	Production Planning & Control sheet (PPC) not sent every day; no real time information on production schedule	Import/Export	M2.1	IRIS	Planning
11	Production does not always produce pending order first	Import/Export	M2.3	IRIS	Planning
12	Quantities of washer types not always specified in PPC	Import/Export	M2.1	IRIS	Planning
13	Different names for same customers in PPC	Import/Export	M2.1	IRIS	Planning
14	Manual transcription of product description from purchasing order (P.O.) to production planning and than to invoice causing errors	Import/Export	D2.3, D2.15	IRIS	P.O.
15	Container plan is based on orders, not on availability of material or capacity	Import/Export	M2.1	IRIS	Planning
16	Different freight rates incur costs for IRIS	Import/Export	D2.15	IRIS	Financial
17	Packing plan changed according to the availability of washers	Production	S1.1, M2.3	IRIS	Planning
18	Container plan not exactly followed due to non-availability of washers	Production	S1.1, M2.1, M2.4	IRIS	Planning
19	Singapore requires best quality products; if final products are not, downgraded and packed for other customers	Production	M2.1, M2.6	IRIS	Product Issues
20	Quality of output in unsure	Production	M2.1, M2.3	IRIS	Manufacturing
21	Quantity of output is unsure	Production	M2.1, M2.3	IRIS	Manufacturing
22	Unexpected (and uncontrollable) power cuts	Production	M2.1, M2.3	IRIS	Non supply chain related
23	If multiple product types on lines; can only use the conveyors for one type (usually export), creating unfinished inventory on the shop floor	Production	M2.3	IRIS	Inventory
24	Capacity of washer supplier is insufficient, even if orders would be spread out evenly (which they are not)	Whs	S1.1	IRIS	Supply
25	Large inventory of steel at the slitter; multiple shipments a week to IRIS	Whs	S1.1	IRIS	Inventory
26	Aisles in Whs only have one entrance point, causing a lot of extra work	Whs	S1.4	IRIS	Shipping / Receiving
27	Picking equipment is unsafe and does not fit into isles	Whs	S1.4, D2.9, D2.10, D2.11	IRIS	Shipping / Receiving
28	Warehouse layout causes a lot of work (re)moving products that are in the way	Whs	S1.4, D2.5, D2.9, D2.10	IRIS	Shipping / Receiving
29	No proper materials to store steel coils; causes seals to break and coils to unroll and damage	Whs	S1.4, M1.2	IRIS	Shipping / Receiving
30	Requests for washers are always rush orders as no proper planning documents received from production	Whs	S1.1, M1.2	IRIS	Planning
31	Whs issues materials to Production, but is not aware of stock levels on production floor	Whs	S1.1, M1.2	IRIS	Inventory
32	Raw materials stock levels contain defective materials	Whs	S1.1	IRIS	Inventory
33	Maintaining stock levels based on forecast, not on incoming and outstanding orders	Whs	S1.1	IRIS	Inventory

34	Not completed orders (missing sets) occupy lot of storage space	Whs	D2.9, D2.10, D2.11	IRIS	Inventory
36	Local and export products are packed differently	Whs	M2.4	IRIS	Packaging
37	Planning not all based on same container overview	Production, Whs, Gasketing	M2, D2	IRIS	Planning
38	Large part of packed products needs to sorted manually (up to 65%)	Gasketing	M2.3, M2.4, M2.5	IRIS	Product Issues
39	Necessity of stickers for washer identification is confusing and time consuming	Gasketing	M2.4	IRIS	Packaging
40	Washer mixed up, as they look alike	Gasketing	M2.3	IRIS	Product Issues
41	Packing area over spilled with packed product (to be sorted or checked)	Gasketing	M2.5	IRIS	Inventory
42	Operators can decide to change over to different washers without prior notice or permission	Gasketing	M2.3	IRIS	Manufacturing
43	Sorting personnel is hired in and is quite expensive	Gasketing	M2.4	IRIS	Financial
44	No policy on format purchasing request	Purchasing	S1.1	IRIS	Supply
45	Anyone can enter a purchase request	Purchasing	S1.1	IRIS	Supply
46	Information often not complete	Purchasing	S1.1	IRIS	Supply
47	Interviewee spends most of his time following up on incomplete information	Purchasing	S3.1	IRIS	Supply
48	Supplier performance affected by lack of right specifications (information)	Purchasing	S1.2	IRIS	Supply
49	Single sourcing for many items; high dependency on supplier	Purchasing	S1	IRIS	Supply
50	Quantity of outstanding orders does not match Singapore's	Import/Export	D2 (IRIS) S2 (SING)	IRIS SING	Communication
51	Containers as determined by Singapore not traceable in planning (no coding per containers, only total quantity)	Import/Export	M2.1	IRIS	Planning
52	Planning files contain information from previous months, useless information and names are not up-to-date	Import/Export, Production, Whs	M2.1	IRIS	Planning
53	Internal planning files are all in different formats	Import/Export, Production, Whs	M1.1, M2.1	IRIS	Planning
54	PPC has no date in the name and the name itself is not up to date	Import/Export, Production, Whs	M1.1, M2.1	IRIS	Planning
55	No link between planning files, all numbers are transferred manually	Import/Export	M1.1, M2.1	IRIS	Planning
56	Once planned orders for SING cannot be delivered in the planned month, the 'weekly schedule' is lost	Import/Export	M1.1, M2.1	IRIS	Planning
57	Because Singapore sent accumulated orders (including Customer A), and later specify what quantities where ment for Customer A, they mess up there own weekly schedules, as the quantities do not match	Import/Export	S2.1 (SING)	IRIS SING	Planning
58	Orders are not in the same format, making it hard to determine priority	Import/Export	S2.1	IRIS SING	P.O.
59	IT orders are not in the same format, making it hard to determine priority	Import/Export	S2.1	IRIS IT	P.O.
60	USA orders are not in the same format as other orders	Import/Export	S2.1	IRIS USA	P.O.
61	Container loading has to wait for lots to be checked by QA as containers are already at the factory	Whs, QA	M2.6, D2.11	IRIS	Planning
62	Order from IRIS are always late	n.a.	S2	IRIS SING	Planning
63	Lead times are very inconsistent	n.a.	S1, S2	IRIS	Planning
64	Long lead times causes delay in changing stock levels (needed for increasing/decreasing sales trends)	n.a.	S2	IRIS SING	Inventory
65	Difficulties with direct airfreight to China; as certificate of origin does not match Singapore invoice and import duties are different.	n.a.	D1, D2	SING	Direct shipment
66	Description of products on invoices is still different (2" vs. G2) and no product code is used at IRIS	n.a.	S2	IRIS SING	P.O.
67	Balancing outstanding order sheets are in different formats making it extremely difficult to trace the origin of difference	n.a.	S2	IRIS SING	Administration

68	SING is billed (and bill it to IRIS) for container washing costs; IRIS makes the container dirty during loading or receive a dirty container to start with	n.a.	S2	IRIS SING	Shipping / Receiving
69	Due to manually changing the invoice in SING to match the Indian invoice, order and shipment traceability is lost	Purchasing	D1, D2	SING	P.O.
70	Not able to stick to warehousing rules	Whs	D1, D2	SING	Shipping / Receiving
71	No fixed order picking rules or procedure on picking progress; cannot be taken over by someone else.	Whs	D1, D2	SING	Shipping / Receiving
72	Last minute informed if committed shipment date will be postponed	n.a.	S2	IRIS SING	Communication
73	Plugs and flanges are mixed up on the invoice and the balance sheet	n.a.	S2	IRIS SING	Administration
74	Products shipped against wrong P.O. number	n.a.	S2	IRIS SING	Administration
75	No separate area to stock low quantity items (less then 1 pallet)	Whs	D1, D2	SING	Shipping / Receiving
76	Damages due to improper stacking (both by the supplier as in the warehouse)	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Shipping / Receiving
77	No real space for packed (outgoing) products	Whs	D1, D2	SING	Shipping / Receiving
78	Invoice states different washer type then received products (local vs. import washers)	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Administration
79	Shipped quantities booked on different P.O. numbers	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Administration
80	Some P.O.'s have no outstanding order lines, but items are still shipped against that P.O.	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Administration
81	Shipping documents and invoices are to late for customs clearance in SING; container has to wait before it can be unloaded	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Communication
82	Containers arrived in SING port without notification a container was shipped	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Communication
83	Always differences when comparing outstanding balances at the months end	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Administration
84	Partial pallets shipped	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Packaging
85	New orders shipped before outstanding orders fulfilled	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Planning
86	Monthly container schedule never followed	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Planning
87	No estimate of shipping date given to SING	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Communication
88	Orders to Customer A can only be shipped in full, because Customer A requires that (Letter of credit opened for entire shipment only) This causes delays as 3 complete containers may have to wait for last products.	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Planning
89	Lack of communications on urgent requests for supply	n.a.	D2 (IRIS) S2 (AUS)	IRIS AUS	Communication
90	Wrong items shipped (mixed up 2" and 3/4")	n.a.	D2 (IRIS)	IRIS AUS	Delivery
91	Time difference creates communicational difficulties	n.a.	D2 (IRIS) S2 (AUS)	IRIS AUS	Communication
92	No prior notifications of delayed orders, even after initial date was confirmed	n.a.	D2 (IRIS) S2 (AUS)	IRIS AUS	Communication
93	Shipping documents are to late for customs clearance; container has to wait before it can be cleared	n.a.	D2 (IRIS) S2 (AUS)	IRIS AUS	Communication
94	Bar-coding on labels not correct	n.a.	D2 (IRIS)	IRIS USA	Packaging
95	Pallet quantities do not match USA specifications	n.a.	D2 (IRIS)	IRIS USA	Packaging
96	No forecast of round Buna washers given; large quantities needed for specific months cannot be delivered in time due to capacity limitations with supplier	n.a.	S2.1 (SING)	IRIS SING	Planning
97	Import and export is to much work to be done by a single persons; either one will suffer in performance	Import/Export	D2	IRIS	Communication

98	Shipments get delayed (even further) in the port of Mumbai	n.a.	D2 (IRIS)	IRIS AUS	Planning
99	Same products stored in multiple locations; hard to keep accurate stock levels	Whs	D2	IRIS	Inventory
100	Lack of inventory organization; non standard methods and locations	Whs	D2	IRIS	Inventory
101	All Customer A orders shipped together cause problem in warehouse due to limited storage capacity	Whs	D2 (IRIS) S2 (SING)	IRIS SING	Shipping / Receiving
102	Products mixed up (flanges & plugs)	n.a.	D2 (IRIS) S2 (SING)	IRIS SING	Delivery
103	Pallet quantities shipped are not equal and deviating from standard specification	n.a.	D2 (IRIS)	IRIS USA	Packaging
104	Packaging is damaged (sagged cartons) due to moisture issues somewhere in the transportation process, causing repacking efforts	n.a.	D2 (IRIS)	IRIS USA	Packaging
105	(Lotus) Item barcodes are missing on the labels, causing relabeling efforts	n.a.	D2 (IRIS)	IRIS USA	Packaging
106	Sheet of plywood between the stacked pallets, which is added to spread pressure equally and prevent packaging damage, is considered extra garbage	n.a.	D2 (IRIS)	IRIS USA	Packaging
107	Regular follow up on status of orders in not given (anymore) after order has been placed	n.a.	D2 (IRIS) S2 (USA)	IRIS USA	Communication
108	Containers smell mouldy upon arrival	n.a.	D2 (IRIS)	IRIS USA	Packaging
109	Shipment dates are changed last minute without prior notice, causing late deliveries (up to 3 months)	n.a.	D2 (IRIS)	IRIS USA	Planning
110	Low Overall Equipment Effectiveness (OEE) causes total production to lag behind forecasted volumes	Production	M1.3, M2.3	IRIS	Manufacturing
111	local and export products get mixed up during production, causing customer complaints	Production	M1.3, M2.3	IRIS	Manufacturing
112	Standard packaging changed from standard to SING standard	Production, Whs, Gasketing	M2.4	IRIS	Packaging
113	No stock of imported EPDM washers as everything that comes in is used immediately	Import/Export, Production, Whs	M2.2	IRIS	Planning
114	Labor is very inconsistant due to high absenteism and earnings are not related to company's performance	Production	M1.3, M2.3	IRIS	Manufacturing
115	Factory performance is unreliable due to machine and labor inconsistency	Production	M1.3, M2.3	IRIS	Manufacturing
116	OEE is low due to a (too) small maintainance crew, machines have not been improved (enough) and non availability of spare parts	Production	M1.3, M2.3	IRIS	Manufacturing
117	Boxes are not stickered after packing; lot of boxes without correct product labels on packing floor	Gasketing	M2.4	IRIS	Packaging
118	Total of incoming orders is equal to (or larger than) best production level over the last months; overpromising of orders	Mgmt	P3, P4	IRIS	Planning
119	Short lead time and top priority of Customer A order heavily disturbs production planning.	Import/Export, Production, Whs	M2.1, M2.3	IRIS SING	Planning
120	No timely communincation on delays of shipments	Import/Export	D2 (IRIS) S2 (IT)	IRIS IT	Communication
121	Shipments to Port of Ancona delayed more as container has to be transfered in South Italy; connection sometime takes 2 weeks	n.a.	S2 (IT)	IT	Planning

Appendix I; Best Practices

Process	S1	S2	M1	M2	D1	D2	ES.2	ES.3	ES.4	ES.6	ES.8	ES.10	EM.2	EM.3	EM.4	ED.1	ED.2	ED.3	ED.4	ED.6	ED.8	P2	P3	P4
Best practice																								
Component/lot tracking											1										1			
Electronic document mgmt	1	1	1	1	1	1																		
Electronic batch records			1	1																				
Electronic batch recording/configuration			1	1																				
Additional capacity for overflow demand			1	1																				
Advanced Ship notices	1	1																						
Bar coding; EDI; integrated transportation/warehouse mgmt					1	1																		
Supply chain event mgmt systems																						1		
Transportation Mgmt system										1										1				
Multi country Export/Import documentation compliance											1										1			
Operations is authorized by quality assesment of previous operation			1	1																				
Automated Configuration Mgmt			1	1																				
Automated Document for international shipments					1	1				1										1				
Automated notification of laboratory regarding sample availability			1	1																				
Bar coding & Radio frequency communications					1	1																		
Automatic Label and Seal verification			1	1																				
Integrated Order/Financial Mgmt					1	1																		
Automatic reservation of Inventory and dynamic sourcing					1	1																		
Available to promise					1	1																		
Back flush material at order completion			1	1																				
Bar coding to min handling time and max data accuracy	1	1			1	1																		
Backhaul trading exchange										1										1				
Build load in stop sequence					1	1																		
Build subassemblies at highest generic level to min cycle time				1																				
capability transfer to customer		1																						
capabiltiy transfer to organization	1																							
Capacity and supply contraints are balanced during planning cycle																						1		
Capture and maintain mode specific data										1										1				
Carrier agreement	1				1	1	1					1												
Carrier/route optimization					1	1																		
Cellular and demand pull manufacturing				1																				
Comperative analysis of supplier performance in sourcing decisions							1																	
Complete lot history			1	1																				
Comprehensive history of customer interactions																		1						
Consignment inventory mgmt	1	1																						
Ingrated load planning and building with WMS					1	1																		
Consolidation of carriers					1	1																		
Consolidation of Inbound and Outbound Requirements					1	1																		
Continuous Improvement														1										
Continuous Improvement of supplier							1																	
Continuous replenishment programs; VMI etc	1	1			1	1																		
Cost reduction and cost avoidance are evaluated on periodic basis							1																	
Cross training/certification			1	1																				
Cross docking					1	1																		
CRP & VMI loads optimized for utilization	1	1			1	1																		
Internet enabled shipment tracking																		1						
Customer service data validation																		1						
Data accessibility across the enterprise for BU's								1																
Balancing deliveries throughout the day/week	1	1																						
Collaborative Development of delivery schedules				1																				
Demand pull manufacturing			1	1																				
Kanban replenishment			1	1																				
Design/upgrade production equipment			1	1																				

Direct connection to customs clearance											1									1			
Share production and transportation status with customers			1	1	1	1																	
Electronic document submission											1									1			
Multi plant supply/demand planning and execution																						1	
Automatic document generation during shipment preperation											1									1			
Download PO & Advanced shipping notices for automated receiving					1	1																	
Deliver directly to point of use	1	1																					
Drum-Buffer-Rope scheduling			1	1																			
Dunnage control														1									
Dynamic Deployment						1																	
Dynamic Location assignment					1	1																	
Rules based picking logic and simulation					1	1																	
EDI link between manufacturing and distributor to enhance order visability					1	1																	
Intercompany resource planning with EDI																					1		
Efficient consumer response					1																		
Electronic catalogues					1																		
Electronic generation and download of shipping documents					1	1																	
Electronic manifest and billing									1										1				
Electronic material move transaction			1	1																			
Electronic sourcing and negotiation											1												
Electronic transfer of shipment information to finance					1	1																	
Enterprise level policies/rules											1												
Enterprise level spend analysis											1												
Full visibility of credit history by shipping personnel					1	1																	
WIP handling rules														1									
Integrated credit checking					1	1																	
Integrated order mgmt, WM and TM									1										1				
Internet ordering					1																		
Internet pooling									1										1				
Inventory allocation exception process clearly defined					1	1																	
Inventory planned at part level, based on supply/demand variability																					1		
Inventory performance measured in units and dollars																					1		
Inventory targets are reviewed/adjusted frequently																					1	1	
Collaborative planning tools					1	1																	
JSA with defined flexibility and availability																					1		
JIT demand flow techinques			1	1																			
Lean Manufacturing			1																				
Link individual performance to organizational goals			1	1																			
Long term supplier agreements											1												
Maintain accurate lot/batch information			1	1																			
Detailed production model that synchronizes PLAN and MAKE			1	1																			
Manage information across 100% of shipments									1										1				
Master Production Schedule																					1		
Carrier performance for On-time and completness									1										1				
Measures process metrics and feedback to operators			1	1																			
Electronic Kanban replenishment with supplier	1	1																					
Merge in Transit					1																		
Minimize operator included errors			1	1																			
Minimize WIP														1									
Minimize product handling														1									
Obsolete Inventory is reviewed at part level																					1	1	
On demand access to ATP, prod schedules and inv status by operators and customers													1										
Online Real-Time customer Entry and Edit																	1						
Web access to preferred and recommendated supplier information											1												
Order entry organized by customer segment with differentiated service						1																	

Organize to enhance Job flexibility			1	1																			
Paperless order tracking and customer visibility of orders			1	1																			
Paperless production control			1	1																			
Paperless production order and inventory tracking			1																				
Performance expectations and business rules communicated to supplier							1																
Benchmarking of performance result and shared with employees			1	1																			
Periodic review of metrics and strategy compared to industry benchmarks									1									1					
Periodic review of production standards												1											
Posted performance results			1	1																			
Postponement			1	1	1	1																	
Priority based inventory reservation for key customers					1	1																	
Product level loading			1	1																			
Provide continuous formal training to employees			1	1																			
Provide scheduling output back to material and labor planning			1	1																			
Provide single source of information to customer																1							
Quote capacity that can be converted into an order in a single step					1	1																	
Real time data on current status									1								1						
Real time package tracking															1								
Real time performance reporting			1	1																			
Real time quality control			1	1																			
Real time statistical control			1	1																			
Real time optimized shipment method selection										1								1					
Real time shipment tracking via internet										1								1					
Reduce chances of operator error			1	1																			
Reduce non value adding activities			1	1																			
Reduce non value adding paperwork, but maintain metrics measurement			1	1																			
Remote order entry capability					1	1																	
Review batch records by exception			1	1																			
Sales and operations agree to limits of short term flexibility																				1			
Schedule include preventive maintenance program			1	1																			
Schedule minimizes changeover costs between products			1	1																			
Schedule optimizes use of shared resources			1	1																			
Schedule reflects current plant status			1	1																			
Rules based carrier selection					1	1																	
Changes in plan are agreed and in according with the defined business rules																							1
Standards and measurements aligned to max SC performance												1											
Use safety stock levels			1	1	1	1																	
supplier cost of non performance							1																
Supplier certificate program to reduce receiving inspection	1	1																					
Actual demand plan is updated frequently to reflect actual consumption																				1			
Unplanned orders are accepted only when there is no impact on other deliveries																					1	1	
Electronic work instructions			1	1																			
Use of speed racks for automated material handling					1	1																	
Wave picking					1																		

Appendix J; Calculations supply chain dashboard

Category	KPI	Unit	Calculation	Remarks	Source
Order fulfilment	Orders delivered in full	%	% of orders delivered with right items and quantities		Customer/complaints database/ERP
	Orders delivered on time	%	% of orders delivered before or on committed date		Customer/complaints database/ERP
	Documentation accuracy	%	% of orders with perfect documentation		Customer/complaints database/ERP
	Perfect condition	%	% of orders with no damages to products or packaging		Customer/complaints database/ERP
	Order lines delivered on time	%	% of order lines delivered on time (i.e. 90.000 2" Flange c/w Buna washer is an order line)		
	Backorders	%	% of orders taken to next month		
	Combined measures				
	On Time In Full	%	% of orders delivered on time and in full	Not the same as min(orders delivered in full, orders delivered on time)	ERP
	Perfect Order Fulfilment	%	% of orders delivered on time and in full and with perfect documentation and in perfect condition	Not the same as the min(orders delivered in full, orders delivered on time, documentation accuracy and perfect condition)	ERP

Figure 21 - Supply chain dashboard calculations