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Supply Chain Risk Management

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1. INTRODUCTION

It is recognised that organisations having a superior Supply Chain Management process have a significant competitive advantage. However, over the last 15 years the exponential increase in supply chain globalisation, long-distance sourcing and offshoring has also brought about a proportional increase in the level of supply chain risk.

The list of possible causes of supply risk is almost inexhaustible and many organisations are able to identify more than 100 possible risk scenarios. The list may include diverse "man-made" or operational factors such as:

- Strikes
- Capacity shortages
- Raw material shortages
- Quality
- Transport
- Communication
- Insolvencies
- Terrorism

and, more recently, higher occurrences of natural disasters including:

- Flood
- Fire
- Earthquake
- Ash clouds

For many years organisations have developed and used contingency plans to mitigate the worst effects of a potential supply risk. However, with companies requiring ever greater flexibility, shorter lead times and reduced inventories from their highly distributed, global supply networks the probability of a supply failure has become heightened.

Organisations now recognise there is a need for a more structured and robust approach to risk management if their business performance and profitability is to be safeguarded and maintained. The need to undertake a level of risk identification, formal risk quantification and monitoring, and have a coordinated risk management and mitigation process has become paramount in preventing an organisation from experiencing a critical supply chain failure.

Having the tools to measure the level of risk, the potential impact, and mitigate the worst effects through actions such as holding safety stocks, better contingency planning, increased multi-sourcing and targeted staff training, are some of the steps organisations are now taking to protect their supply chains.

It is against this background that a team of existing risk management practitioners from the automotive industry was formed to document their operational experiences and develop this guideline of risk management standards and best practice.

This document has been developed to provide practical advice and guidance in the use of existing, proven techniques to identify, measure, monitor, mitigate and manage supply chain risk by both large and small organisations, whatever their level in the supply chain.

Vehicle manufacturers and Tier 1 suppliers who already have well developed SCRM processes and plans in place will be able to compare themselves with industry best practice contained in this document. However, the content is also specifically intended to help those organisations that do not currently have robust SCRM processes in place, or have not yet started implementing SCRM and are seeking to have a better understanding of the processes involved and need support to identify a practical starting point.

2. CONTRIBUTORS

Odette would like to acknowledge and thank the representatives of all the companies listed below for their input and help in completing this Supply Chain Risk Management guideline:

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3. SUPPLY CHAIN RISK MANAGEMENT PROCESS

In principle, there are 3 key steps in a Supply Chain Risk Management (SCRM) process, which are explained below:

3.1 STEP 1 - IDENTIFICATION AND QUANTIFICATION OF RISK

There are three elements that constitute the various stages of risk identification and quantification, which are described as follows:

Risk identification – it is generally accepted that there are 5 main types of external risks which can be driven by either upstream or downstream events in the supply chain, including:

- demand risks - caused by unpredictable or misunderstood customer or end-customer demand
- supply risks - caused by interruptions to the flow of product within the supply chain, whether raw material or parts
- production plant risks - caused by capacity constraints, the condition or capability of a supplier's facility, and/or compliance to regulatory requirements
- environmental risks – external to the supply chain and usually related to economic, social, governmental, and climate factors, including the threat of terrorism
- business risks - caused by factors such as a supplier's financial or management stability, or the purchase and sale of supplier companies.

Risk assessment – is the process of measuring and evaluating the probability that a failure may occur and the scale of the impact.

Risk monitoring – is the process of continuously or regularly measuring and reviewing whether the probability of a failure and/or the potential scale of impact has changed.

3.2 STEP 2 – DEVELOPMENT OF MITIGATION STRATEGIES

The key elements of mitigation strategies can be summarised as follows:

Coordination of risk management programs with partners – the introduction of customer/supplier collaborative projects to identify and minimise risk scenarios.

Development of sourcing risk reduction strategies – the preparation of alternative supply strategies including a detailed cost/benefit analysis and timing implications.

Coordination of risk communication with partners – development of a formal partnership agreement regarding the regular communication of risk status and the intervention process to be followed in the event of a serious supply failure.

3.3 STEP 3 - SUPPLY CHAIN DESIGN TO REDUCE RISK

The key points to be considered when specifically designing a supply chain to reduce and minimise risk are:

Supply Chain Business Rules – the establishment of policies and guidelines that minimise the exposure to risk throughout the supply chain.

Supply Chain Information - the content, level, frequency and source of information that will be exchanged both internally and externally between functions and business partners in order to manage effectively the risk.

Supply Chain Network – a formal and ongoing relationship created for and supported by all partners in the supply chain

The mitigation and supply chain strategies undertaken by organisations differ greatly depending upon the business strategy, diversity of the supply chain and the consequences and scale of impact of a potential supply chain failure.

For example, business strategies that focus on customer service (e.g. reliable on-time delivery), or where the cost of late deliveries is high, will have a **low** risk tolerance.

In contrast, business strategies that focus on cost reduction, or where the cost of late deliveries is low, will generally have a **higher** risk tolerance.

Ultimately, the level of risk tolerance will determine how much an organisation is prepared to invest in proactive mitigation measures versus reactive management in the event of a failure.

The primary step in the introduction of a supply chain risk management process is the identification and assessment of risk. As a consequence this guideline focuses predominantly on this element of the process.

One proven method of identifying an organisation's supply chain risk and the consequences and scale of a possible failure is to conduct a full analysis with all of the functions associated with the supply chain, including purchasing, material planners and schedulers, transport and production. The techniques used would typically include processes such as brainstorming or the application of a simplified failure mode and effect analysis (FMEA) procedure. It is recommended that the initial high-level findings are recorded in a "Supply Chain Risk Categorisation Matrix" so that the scope and nature of the risks can be documented and further, more detailed analysis can be undertaken. Do not be alarmed by the number of risks that might be identified – it is not unusual for many larger organisations to recognise up to 300 possible risk scenarios. Typically, after further analysis of each of the risks, the list is reduced to a more manageable number based on a combination of the probability of a failure occurring and the scale of impact in the event of a supply chain failure. This will be discussed later in the document.

In the next section of the guideline we provide a recommended format for a "Supply Chain Risk Categorisation Matrix" and an explanation of the proposed content.

4. SUPPLY CHAIN RISK CATEGORISATION MATRIX

As stated earlier, the first step in the Supply Chain Risk Management process is to identify the scope and range of potential risks the organisation may be exposed to in order to define the risk boundaries and provide a clear listing of possible risk scenarios.

The purpose of a risk categorisation matrix is to record the high-level details of the various sources and probabilities of risk, and the likely resulting business impact in the event of a supply failure. The sources of risk may be categorised, varying from "natural causes" such as earthquakes or floods, to operational failures including elements such as insufficient capacity or transportation issues.

A recommended format and content of a risk categorisation matrix is shown in Appendix 1 of this guideline (this is an extract from the more comprehensive document contained in the attached Excel file: "*Risk Categorisation Matrix*"). Each risk is recorded in a separate row within the matrix. However, the matrix comprises two halves – the left-hand side contains information on the "source" of the risk, and the right-hand side contains information regarding the "impact" of a risk failure.

The "source" information comprising the initiator, initiating event and risk type should be recorded including a simple description of the risk type and the probability of a failure. Similarly, the "impact" details such as the consequences and likely impact of each risk should be summarised and explained including the type and magnitude of the impact, and the function and process that would be affected most by a supply failure.

An explanation of the content of each column within both sides of the matrix is given below:

Source

Initiator in supply chain	-	the origin of the supply chain issue
Initiating event	-	the source event highlighting the failure
Risk type	-	the failure category
Primary cause	-	the fundamental root-cause of the failure
Description	-	brief explanation of the failure
Probability of occurrence	-	the likelihood that a failure will occur (this could be a simple description such as "low" or "high", or a percentage (i.e. statistical probability)

Impact

Primary effect	-	a brief description of the effect of a failure
Type of effect	-	a description of the nature of the effect
Magnitude of the effect	-	the scale of the effect (a simple description such as "low" or "high", or a seriousness ranking)
Target in supply chain	-	the supply chain function that will be affected in the event of a supply failure
Affected material process	-	a description of the process that will be most affected by the failure

The matrix provides a format to document a high-level summary of the likely causes and effects of the various risks that have been identified.

In the next section of this guideline we discuss the benefits of using a Supply Chain Risk Categorisation Matrix and how the content can be used to prioritise the development of proactive risk measurement tools and associated mitigation strategies.

5. BENEFITS OF USING A SUPPLY CHAIN RISK CATEGORISATION MATRIX

The matrix shown in Appendix 1 is not intended to be an exhaustive list of potential supply chain failure modes. Indeed, it is expected that users will continue to populate the matrix with additional risk categories that are appropriate to their organisation and supply chain.

The matrix is a reliable starting point for the development of a Supply Chain Risk Management strategy. It provides the basis for internal discussion on the possible risk scenarios and a means to identify risk management strategies and priorities.

The ability of an organisation to eliminate or mitigate all of the identified risks is normally limited due to the cost and resource required in managing the processes involved. Therefore, most organisations prioritise the risks and address those that have the highest probability of failure coupled with those that will have the biggest impact should a failure occur. This information is recorded within the risk categorisation matrix in the columns headed "Probability of Occurrence" and "Magnitude of Effect", respectively.

This reasoning is displayed graphically in Figure 1 below, which shows a 2 x 2 matrix of Probability versus Impact.

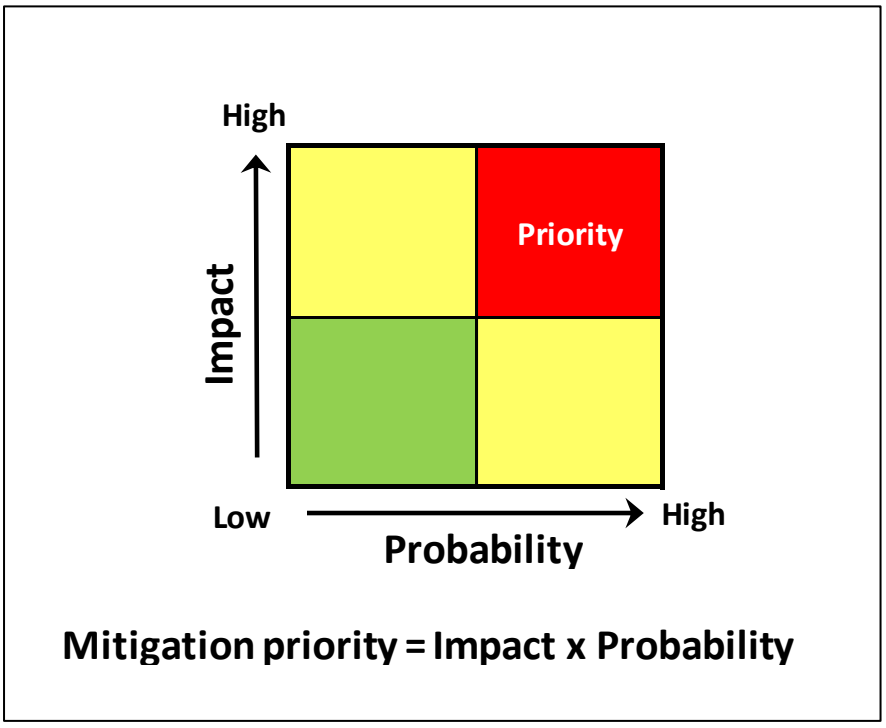

Figure 1. Risk Priority 2 x 2 Matrix

Clearly, mitigating the risks in the red quadrant of the chart is a sensible starting point for Step 2 of the recommended Supply Chain Risk Management Process – the development of mitigation strategies.

In principle there are two distinct risk mitigation strategies. The first is to take a proactive approach to avoiding or minimising the risk by actively monitoring the supply situation and taking corrective action with the supplier should a deteriorating condition be detected. The second option is to only take a reactive approach and respond accordingly immediately after a supply failure has occurred in order to minimise or alleviate the damage.

In reality it is recommended that an organisation develop strategies for both proactive and reactive methods of mitigation as it is not always possible to proactively manage all types of risk, particularly if the supply failure is caused by an unforeseeable event such as a natural disaster.

In Appendix 2 we show a "Risk Mitigation Steps" matrix of proven recommendations for proactive and reactive approaches which are used by organisations for managing the various categories of risk. The proactive approaches often involve invasive techniques for reviewing conditions at the supplier's site including process checks, audits and questionnaires, and practical safeguards such as dual-sourcing. The reactive approaches also involve invasive procedures such as the use of a customer-led task force coupled with supplier visits. Both the proactive and reactive approaches also involve an "escalation" process to ensure that complex and deep-rooted issues are managed appropriately and at the correct level within the organisation.

One of the fundamental benefits of using a risk categorisation matrix is that a detailed analysis of both the "risk causal factors" and the "risk prioritisation" process provides a positive indicator to the specification of proactive risk measurement tools that should be introduced to monitor the risk, and the associated options for a mitigation process.

A further benefit in using a risk categorisation matrix is that it is possible to group together those risks that have similar causal factors. Using this approach it is possible to evaluate the combined effect of several individual risks that have a common root.

By way of example, during the course of this project the team members noted the number of risks recorded in the Risk Categorisation Matrix that are associated with "capacity" at the supplier's site and identified that this was an important characteristic highlighted by the categorisation matrix. From this observation and by further analysis the team decided that there was a need for some simple, proactive tools to measure and monitor the risks associated with capacity management at the supplier's site. The recommended tools would form the basis for a "capacity toolkit" comprising:

- A detailed capacity assessment tool to test the planned and demonstrated or actual capacity of a production facility during new product introduction, volume ramp-up and serial production stages
- A summarised capacity assessment tool capable of monitoring "bottle-neck" processes
- A benchmarking tool to assess the capability of a supplier to manage capacity from order/schedule receipt through production planning to final despatch.

Following this initial assessment, the team went further, and after undertaking a full review of the assessment requirements, recommended an existing Odette recommendation, the "Production Capacity Assessment Tool", as a standard to be used for the detailed capacity assessment element of the toolkit.

In this section of the guideline we have attempted to explain the benefits of creating and using a risk categorisation matrix to define the scope and scale of supply chain risk scenarios and as a means to identify and prioritise the development of appropriate risk mitigation strategies and tools.

It is recognised that the work involved in creating the matrix can be time-consuming and typically requires the support and assistance of many different functions within an organisation. However, it is also recognised that the time and energy expended during the initial data collection and risk quantification stage is value-added and the quality and diligence of the process typically provides benefits in the subsequent design stage of the corporate risk management process.

6. CONCLUSION

The automotive supply chain has undergone significant change over the last 15 years as a direct result of the need for the supply process to be more flexible and responsive to customer requirements. Customers, suppliers and service providers at all levels of the chain of necessity now work together more closely and are more reliant on each other despite the fact that supply chains have become more extensive due to globalisation.

These changes have bought great benefit to the industry and the consumer alike. However, these more complex and extended supply chains have also brought more risk and an urgent need to manage that risk.

In this recommendation we have attempted to provide a structured approach and robust and proven advice on how organisations wishing to introduce supply chain risk management processes should begin the process and have outlined the fundamental steps.

We have provided examples of some of the successful techniques and formats used by leading practitioners and the benefits of initiating the process through the application of a risk categorisation matrix.

The importance of having a structured and reliable process for measuring and managing supply chain risk cannot be overstated. It is a fundamental step in the development of a corporate Supply Chain Risk Management process and a key element in an organisation's progress towards the attainment of world class status.

APPENDIX 1

Risk Categorisation Matrix (Extract)

	Risk - Source						Risk - Impact				
	Origin							Effect		Target	
Risk No. #	Initiator in supply chain	Initiating event	Risk Type	Primary cause	Description	Probability of occurrence	Primary effect	Type of effect	Magnitude of effect	Target in supply chain	material process
1	Environment	Nature	Earthquakes	Supplier breakdown due to natural catastrophe	A 1st tier supplier stops production and can't deliver any more for about 3 weeks due to a catastrophe that occured on his supply side.	Very low	Total loss of all parts from the supplier	Throughput	Very high	O.E.M.	Production processes
							Underutilized transport	Capacity utilisation	Medium	LSP Transport Outbound	Transport processes
2	OEM	Production planning risks	Pre material procurement	Unexpected increase of part demand order by OEM	The OEM orders more parts at short notice from his 1st tier supplier than he had forecast.	Very high	Extra shifts for the supplier	Process cost	High	First Tier Supplier	Production processes
							LSP must buy extra capacities on spot market	Process cost	Medium	LSP Transport Outbound	Transport processes
3	Tier One Supplier	Inbound supply risks	Material disposition	Supplier strike risk	Tier1/2 supplier disagreement with the union, thus may result with a strike in the supplier	Medium	Production and/or delivery stoppage at supplier	Throughput	Very high	O.E.M.	Production processes
4	OEM	Inbound supply risks	Material disposition	OEM planned downtime (shutdown)	Pre/after shutdown production may not be supported by overall supply base	Low	Overshipment/ undershipment, delivery breakdown, production loss	Throughput	Low	O.E.M.	Production processes
							*item 4 continued	Process cost	Medium	LSP Transport Outbound	Transport processes
5	OEM	Production risks	Machine capacity	OEM demand increase	Unexpected increase of part demand order by OEM	Medium	Extra shifts for the supplier	Process cost	High	O.E.M.	Production processes
6	Tier One Supplier	Outbound supply risks	Bankruptcy	Supplier bankruptcy risk	Under bankruptcy risk, purchasing dept. organizes transfer to a new supplier	High	Supplier stock securitisation	Capacity utilisation	High	O.E.M.	Production processes
7	Environment	Political and Social	Riots	Riots due to political instability	In case of riots the production capacity will be reduced.	Medium	Decrease of part deliveries	Throughput	High	O.E.M.	Production processes
8	LSP Transport	Transportation risks	Shipping	storm	A storm has a negative impact on oversea supply	Medium	Delays in oversea transports	Throughput	Medium	O.E.M.	Production processes
9	LSP Transport	Transportation risks	Shipping	Transport Strike	Spanish transport industry goes on strike and block access to French Spanish border	High	Supplies are discontinued	Throughput	High	O.E.M.	Production processes
10	Tier One Supplier	Inbound supply risks	Material disposition	New supplier site	Delay during ramp-up, in case of green field or transfer from one site to an other	Medium	Delay in parts delivery	Throughput	High	O.E.M.	Production processes
11	LSP Transport	Transportation risks	Shipping	Country issue - geo-political	Parts can no longer be produced nor shipped from ONE country because there is country wide issue such as war , political instability, custom closed (ie Tunisia)	Low	Parts can no longer be produced in the plant and no material can be shipped out side the country	Throughput	Very high	O.E.M.	Production processes
12	LSP Transport	Transportation risks	Shipping	Country issue - nation wide strike from carriers	National strike from manufacturer or negotiation with Unions (Italy spring 2012)	Very low	Parts can no longer be transported outside the country	Throughput	Very high	O.E.M.	Production processes
13	Environment	Nature	Volcanic disruptions	Natural disaster	Natural disaster preventing the making of the parts and/or their transportation (volcano, power shortage, ice, tsunami, flooding...)	Very low	Parts can no longer be produced nor shipped from ONE large Area	Throughput	Very high	O.E.M.	Production processes
14	Tier One Supplier	General enterprise risks	Bankruptcy	Supplier - financial risk	A supplier is filing for bankruptcy, for an unknown period the production of parts is stopped , no shipments are possible	High	Production and/or delivery stopped	Throughput	Very high	O.E.M.	Production processes

APPENDIX 2

Risk Mitigation Steps – Examples

Risk Type	Risk Mitigation Steps	
	Pro-active	Re-active
Nature Risk		
Flooding	1. Supplier selection 2. Emergency planning 3. Alternative sources of supply	1. Checklist evaluation 2. Escalation strategy 3. Task force 4. Supplier site visit
Earthquake	1. Supplier selection 2. Emergency planning 3. Alternative sources of supply	1. Checklist evaluation 2. Escalation strategy 3. Task force 4. Supplier site visit
Volcanic disruptions	1. Supplier selection 2. Emergency planning 3. Alternative sources of supply	1. Checklist evaluation 2. Escalation strategy 3. Task force 4. Supplier site visit
Storms	1. Supplier Selection 2. Seasonal safety stock 3. Alternative sources of supply	1. Checklist evaluation 2. Escalation strategy 3. Task force 4. Supplier site visit
Ice	1. Supplier Selection 2. Seasonal safety stock 3. Alternative sources of supply	1. Checklist evaluation 2. Escalation strategy 3. Task force 4. Supplier site visit
Heat	1. Supplier selection 2. Emergency planning 3. Alternative sources of supply	1. Checklist evaluation 2. Escalation strategy 3. Task force 4. Supplier site visit
Political and Social Risk		
Strikes	1. Supplier selection 2. Knowledge of supplier's collective labour agreement 3. Safety stock prior to collective labour agreement	1. Escalation strategy 2. Task force
Inflation	1. Global versus local sourcing	1. Checklist evaluation 2. Escalation strategy 3. Task force
Riots	1. Supplier selection 2. Dual sourcing	1. Checklist evaluation 2. Escalation strategy 3. Task force
Crime	1. Supplier selection	1. Checklist evaluation 2. Escalation strategy 3. Task force
Governmental Risk		
Taxes	1. Supplier selection 2. Corporate Security Network 3. FBU, SKD and CKD strategies	1. Checklist evaluation 2. Escalation strategy 3. Task force
Bills	1. Supplier selection 2. Corporate Security Network 3. FBU, SKD and CKD strategies	1. Checklist evaluation 2. Escalation strategy 3. Task force
Tolls	1. Supplier selection 2. Corporate Security Network 3. FBU, SKD and CKD strategies	1. Checklist evaluation 2. Escalation strategy 3. Task force
Embargos	1. Supplier selection 2. Corporate Security Network	1. Checklist evaluation 2. Escalation strategy 3. Task force

Risk Type	Risk Mitigation Steps	
	Pro-active	Re-active
General Enterprise Risk		
Bankruptcy	1. Financial risk assessment during sourcing 2. Ongoing financial assessment	1. Supplier support 2. Escalation strategy 3. Task force
Staff fluctuation	1. Supplier capacity audits during sourcing 2. Contract design	1. Supplier visit 2. Problem solving 3. Escalation strategy 4. Task force
Production Planning Risks		
Infrastructure installation	1. Audits 2. Process analysis	1. Checklist assessment 2. Supplier visit 3. Escalation strategy 4. Task force
Pre material procurement	1. Audits 2. Process analysis	1. Supplier visit 2. Escalation strategy 3. Task force
Ramp-up (time-) planning	1. Audits 2. Process analysis	1. Checklist assessment 2. Supplier visit 3. Escalation strategy 4. Task force
Machine installation	1. Audits 2. Process analysis 3. Run at rate	1. Checklist assessment 2. Supplier visit 3. Escalation strategy 4. Task force
Inbound Supply Risks		
Material disposition	1. Monitoring	1. Checklist evaluation 2. Conference calls 3. Supplier visit
Transport planning	1. Monitoring	1. Checklist evaluation 2. Conference calls 3. Supplier visit
Production Risks		
Order entry	1. Audits 2. Process analysis	1. Checklist evaluation 2. Supplier visit
Staffing	1. Audits 2. Process analysis	1. Checklist evaluation 2. Supplier visit
Personal capacity	1. Capacity submission warrant 2. Capacity audits 3. Capacity comparison with EDI demand	1. Shortage management 2. Supplier visit 3. New capacity added 4. New product definition
Machine capacity	1. Capacity submission warrant 2. Capacity audits 3. Capacity comparison with EDI demand	1. Shortage management 2. Supplier visit 3. New capacity added 4. New product definition
Scrap rate	1. Capacity audit 2. Process analysis	1. Capacity audit

Risk Type	Risk Mitigation Steps	
	Pro-active	Re-active
Outbound Supply Risks		
Transport disposition	1. Monitoring	1. Supplier visits 2. Shortage management
Transport planning	1. Monitoring	1. Supplier visits 2. Shortage management
Inbound Transportation Risks		
Transport planning	1. Monitoring	1. Supplier and/or LSP visits 2. Shortage management
Loading	1. Monitoring	1. Supplier and/or LSP visits 2. Problem management
Shipping	1. Monitoring	1. LSP visits 2. Problem management
Unloading	1. Monitoring	1. Supplier and/or LSP visits 2. Problem management
Outbound Transportation Risks		
Transport planning	1. Capacity agreement 2. Regular programming meeting 3. Monitoring	1. Problem management 2. Supplier and/or LSP visits
Loading	1. Monitoring	1. Supplier and/or LSP visits
Shipping	1. Capacity agreement 2. Regular programming meeting 3. Monitoring	1. Spot market transportation 2. LSP visits
Unloading	1. Monitoring	1. Supplier and/or LSP visits
Material Distribution		
Staffing	1. Capacity audit 2. Monitoring	1. Supplier visit
Personal capacity	1. Capacity audit 2. Monitoring	1. Supplier visit
Machine capacity	1. Capacity audit 2. Monitoring	1. Supplier visit