# Performance measurement enabling performance management

## designing a system for operational performance measurement for the Sony Consumer Audio & Video warehouse in Tilburg

Hesen, Anouk

*Award date:*
2004


# Performance Measurement

## Enabling Performance Management

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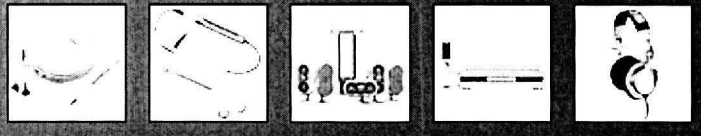
**Anouk Hesen**

**SONY**
**Sony Logistics Europe**



# Operational Performance Measurement
## Enabling Performance Management

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Designing a system for operational performance measurement for the Sony Consumer Audio & Video warehouse in Tilburg

**Tilburg,**
**24 February 2004**
**Anouk Hesen**

**Sony Consumer Audio & Video**

**Graduation project for the studies Industrial Engineering and Management Science at the Technische Universiteit Eindhoven**

**TU/e**

# Preface

The report that lies before you presents the methods and results of the graduation project for the studies "Industrial Engineering and Management Science" at the TU/e (Eindhoven University of Technology) in Eindhoven, the Netherlands. The graduation project has a duration of 6 months.

The project takes place at the Consumer Audio & Video division of the Sony Logistics Europe warehouse in Tilburg. I would like to use this opportunity to thank the people who have helped me during this project. I would like to thank the people within Sony as well as my teachers from the university. First of all I would like to thank Pascal Ott, who has helped me during all phases of this project. Second I would like to thank the managers of the Consumer Audio & Video warehouse for their cooperation and support during the development process of the performance indicators. From the university I would like to thank Nico Dellaert and Henk van der Veeken, for the comments they made that helped improve this project's process and products.

# Contents

# Abstract

This report describes the process and products of the development of an Operational Performance Measurement System for the Sony Consumer Audio & Video Warehouse. For each of the departments within this warehouse a specific selection of operational performance indicators is made, together with related analysis information. All items selected are described in an Information Guide presenting indicator definitions, calculation methods, source data, etc. A Microsoft Access tool is designed for storing all data needed to create performance indicators as well as calculating the indicator values and creating the graphs and department specific reports.

# Summary

Sony Logistics Europe is an internal logistics service provider in the Sony group of companies. The Consumer Audio & Video division is part of Sony Logistics Europe in Tilburg and is handling consumer electronics. The Consumer Audio & Video warehouse uses ca. 38.400 $m^2$ and its main processes consist of inbound and outbound activities.

Early 2002 Sony Corporation decided to overhaul its supply chain structure to reduce inventory and increase the hit rate to the customer. To achieve this, European distribution centres are consolidated into two main hubs (Tilburg and Barcelona). As preparation to become a hub, the Tilburg Consumer Audio & Video warehouse was changed in layout, warehouse management system and organisational structure. The changes have caused many operational problems during the first period, resulting in a high priority for improving performance, and a lower priority for management reporting.

It has been recognised that a lack of information resulted in a lack of insight into the actual performance and sources of problems, making it difficult to improve. There is a demand for structured supply of relevant performance information that will enable performance management, performance improvement, and the possibility of reporting the improved performance to the customer.

The following twofold project-goal is formulated:

| | |
|---|---|
| **A)** | **Designing an operational Performance measurement system, that includes the weekly /daily process performance information (indicators) for management of the operational level of the Consumer Audio and Video division, that is required to control and improve the processes, including defining what tool can be used for reporting and presenting this information** |
| **B)** | **Harmonising the logistics performance indicators (definitions) at the different logistic organisational levels and providing the links between the different indicators, that will make it possible to drilldown to get more detailed information such as the underlying causes of performance** |

This goal leads to a number of research questions that can be covered by the following:

| | |
|---|---|
| **A)** | **Which performance indicators are needed for the operational level of Consumer Audio and Video to gain insight into the weekly/daily performance-situation of the processes at Consumer Audio and Video and to locate bottlenecks – and – how should this information be measured, reported and presented?** |
| **B)** | **What needs to be done to harmonise and link the information at the logistic organisational levels?** |

All departments of the Consumer Audio & Video division of the Sony Logistics Europe warehouse in Tilburg are part of the scope of this project.

The project-parts A and B together consist of the following eight phases:

1. Operational analysis and determining warehouse or operations characteristics
2. Theoretical analysis to build a model for an operational performance system in a warehouse and distribution environment
3. Gathering information requirements from future users and creating a list with suggested performance indicators
4. Building operational performance indicators: verification, checking for consistency, creating definition and determining information sources
5. Setting targets and determining reporting frequency, as well as defining functionality needed for the reporting and publishing tool and designing an implementation plan

6. Link the indicators at the different levels to make a drilldown possible
7. Harmonising indicators for the logistic levels of Sony, assigning owners and developers and reviewing definitions
8. Reporting, including conclusions and recommendations

The main characteristics of the Consumer Audio & Video warehouse are:

- 40 docks for inbound and outbound, 1 for airfreight, 1 for express, 1 for battery charging and 2 for paper press containers
- Circa 1.800 different products are stored
- Number of pallet places varies between 18.000 and 22.000
- Different storage units: full pallets, master cartons and broken master cartons
- Different storage areas: normal racking, drive-in racking, block storage, pick to belt, mezzanine (pick to belt and item picking), high value area
- A sorter and radio frequency equipment is used
- Expected staff early 2004 will be 170 people

The main processes of Consumer Audio & Video consist of handling inbound volumes (receiving shipments, palletising and put away) and outbound volumes (picking, customisation, collecting, wrapping pallets in foil, loading). The following departments provide the facilitating processes: Customer Relations, Logistics Support, Operations Support, Planning and Services, Quality Centre, Returns

At the start of this project the information that is being created is not structurally available. Next to that the information is not covering all areas of performance. The list of available information for Consumer Audio & Video and the status can be found in appendix D. For the remaining logistic levels the available performance indicators are presented in appendix E. Information on productivity is has been retrieved by combining the results of a time study with data from the SAP ERP system and information used in a simulation tool used for the CAV warehouse. This data has been used to set productivity targets as well. It can be concluded that information is not available in a structured way, and that the available information is not sufficient to manage and improve the operation. The requests from future users, department managers should be used as a basis for a new operational performance measurement system.

Data for requested performance information is mainly gathered by interviews with future users, being the department managers. This has generated the list of requests for each user. As a next step, these requests are combined with information from the warehouse analysis and other meetings. This results in a list of possible performance indicators for the CAV operation.

The model for the development of an operational performance measurement system in a warehouse and distribution environment is created, based on reviewed literature. The result is an 11-step process that can be followed when developing a performance measurement system. Applying the development process model to the CAV warehouse operation resulted in a first selection of indicators at a general level, also the 15 main areas of performance. These 15 indicators are based on the list of possible indicators by ranking all possible indicators on cost, speed and delivery reliability. Next a specific selection of indicators is made for each of the departments together with the department managers. This ensures that the indicators presented to the managers contain only the relevant information. A second level is added to the selection of performance indicators, called analysis information. This information can be used to analyse performance whenever needed. For all indicators and analysis information an Information Guide is created containing all definitions, calculations, source data, etc.

The infrastructure needed for the performance measurement system is designed next. Data sources for all indicators are determined and methods for extracting the data are reviewed. A Microsoft Access tool will be used to store all data needed to create performance indicators. This Microsoft Access tool will at the same time be used for calculating the indicator figures and creating the graphs. The functionality of Data Access Pages is used to design reports and present these reports to the users. These reports will contain the graphs of the indicators, the possibility to add comments regarding performance and add information on actions that have been taken. Next to that, the report will provide links to the analysis information that has been selected as well as the indicators at the different logistic levels that are related to the selected indicators. For users that do not have immediate or continuous access to a computer, relevant data will be published on the plasma screens in the warehouse and on the SLE intranet. A monitoring process is designed that describes how the managers can monitor the performance on a weekly basis.

To come to a working Operational Performance Measurement System next steps have to be taken in this project. These steps are presented in an action plan and are related to:

- The implementation of indicators: extracting the data and importing this data into Microsoft Access as well as calculating the indicator values and creating the graphs.
- Creating the specific reports for all users.
- Monitoring the performance on a weekly basis.
- Reviewing and updating the Operational Performance Measurement System twice a year or whenever changes occur.

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# Glossary and Abbreviations

| | |
|---|---|
| Broken Master Carton | Master Carton that has been opened for single item picking |
| CAV | Consumer Audio & Video |
| Dispute | An inquiry or query of a logistical nature reported by a customer relating to an invoice, with the end to obtain a Proof Of Delivery (POD) or resolve a missing, an inversion or an over shipment. |
| EBU | European Business Unit |
| EMCS(-E) | Engineering Manufacturing Customer Service (Europe) |
| ERC | European Returns Centre |
| Goods Issue | Moment in time and administrative posting of a delivery being ready to be shipped This means it is completely picked, checked and loaded and this has been confirmed in the system. |
| Goods Receipt | Moment in time and administrative posting of an inbound delivery being completely unloaded and thus received by the warehouse. |
| HUB | Central warehouse. In the case of the Consumer Audio & Video warehouse, this is a central warehouse for Benelux, Germany, Northern France, Austria and Switzerland. |
| Infodis | Information system used by forwarders to register time-stamps of shipments. |
| KPI | Key Performance Indicator |
| LOE | Logistics Operations Europe |
| Master Carton | A cardboard box that can contain one single item, or multiple items |
| OPI | Operational Performance Indicator |
| Outpack area | Area used for staging the pallets once they are ready to be wrapped and shipped |
| Plasma Screens | The plasma screens are monitors that contain a Microsoft PowerPoint presentation with information relevant for the warehouse employees. Plasma screens are located near the coffee corners in the warehouse and thus visible to all employees. |
| TO | Transfer order. This is a task (order) in the information system, mainly used for managing movements (transfer) of products. |
| TU/e | Technische Universiteit Eindhoven |

| | |
|---|---|
| SAP | Supplier of the Enterprise Resource Planning (ERP) system and the warehouse management system (WMS) used within Sony |
| SLA | Service Level Agreement |
| SLE | Sony Logistics Europe, situated in Tilburg |
| VAS | Value Added Services |
| Wave | Way to group the outbound activities. Multiple deliveries are grouped into one wave so the workload will be better spread over the areas |
| WMS | Warehouse Management System |
| WWI | Walsh Western International. Third party logistics service provider for the European Returns Centre. |
| YMS | Yard Management System |

# 1 Sony Organisation

## 1.1 Introduction

This chapter gives an introduction to the Sony organisation, where this project takes place. The first paragraphs are about Sony in general, followed by paragraphs that will drill down in the organisation, going into further details of the warehouse branch. Charts presenting the organisational structure can be found in appendix A.

## 1.2 Organisational Structure

### 1.2.1 The origin of the word 'Sony'

Combining two words created the company name "Sony". One is the Latin word 'sonus,' which is the root of such words as 'sound' and 'sonic'. The other is 'sonny boy,' a popular expression used in Japan at the time to mean a young person with a free and pioneering spirit. The words were used to show that " Sony" is a group of young people who have the energy and passion toward unlimited creation. (Sony-Europe Internet, 2003)

### 1.2.2 Sony's corporate history

Founded in Tokyo in 1946, Sony was the brainchild of two men. Masaru Ibuka, an Engineer and Akio Morita, a Physicist invested the equivalent of Yen 190,000 to start a company with 20 employees repairing electrical equipment and attempting to build their own products.

**Photograph 1: Masaru Ibuka**

**Photograph 2: Akio Morita**

In May 1954, Sony launched Japan's first transistor and the first all-transistor radio the following year. Since then few companies have matched Sony's track record for invention and innovation. Significant developments include the first Trinitron Colour Television in 1968, the colour video-cassette in 1971, the Betamax VCR in 1975, the Walkman in 1979, the 3.5 inch micro floppy disk in 1989, an electronic camera in 1981, the world's first CD player in 1982, and the first consumer camcorder in 1983, 8mm video in 1988, the first digital VTR in 1985 and so on, through to the present day.

In the more than 50 years since the company first began trading, it has grown from 20 employees to over 180.000 people around the world. (Sony-Europe Internet, 2003)

### 1.2.3 Engineering Manufacturing Customer Service (Europe) & Logistics Operation Europe

The EMCS operation is split into 6 different areas:

- Technology Centre
- Customer Service Europe
- Computer Display Europe Engineering and Customer Service
- **Logistics Operations Europe**
- **Supply Chain Management Europe**
- Visual Products Europe / Network Products Europe

Only the two bold areas are directly related to logistics and thus have a relation with this project. Supply Chain management focuses on the overall inventory control mechanism, and coordinates with the business groups to achieve the appropriate bridge between the customers' needs and supplies. Logistic Operations Europe is a support organisation in the logistic branch. The logistic platform coordinates all distribution activities within Europe (Sony roadmap, 2003).

### 1.2.4 Sony Logistics Europe

Sony Logistics Europe BV (SLE) is an internal logistics service provider in the Sony group of companies. SLE provides the following services:

**Main Warehouse Operation Services**

- Storage of goods
- Inbound handling of products
- Outbound handling of products (picking, packing and shipping in accordance with the instructions of the sales company)
- Returns handling
- Providing Value Added Services (bundling, kitting, etc.)

**Supporting and Facilitating Services**

- Customs services
- Insurance & claims handling
- Arranging in- and outbound transport
- Technical services (e.g. testing of products)
- Etc.

These services are performed from an ± 80.000 $m^2$ distribution centre located in Tilburg. SLE employs about 420 staff, which during the peak period (October ~ December) is scaled up to approximately 700 staff. (Initial project formulation, 2003)

### 1.2.5 Consumer Audio & Video division

Consumer Audio & Video (CAV) is part of Sony Logistics Europe in Tilburg and is handling consumer electronics. Joining the "old" departments Benelux, Central Stock Operation, Quality Verification and the Logistics Service Department, created the Consumer Audio & Video Division. On the fifth of May 2003 the new department Consumer Audio & Video started. Not only the organisation changed, there have been big changes in layout and processes as well. The department will have 170 employees at the beginning of 2004, making the Consumer Audio & Video division the largest department within Sony Logistics Europe.

## 1.3 Brief Description of the Consumer Audio & Video Warehouse

The CAV warehouse is situated in Tilburg where it uses ca. 38.400 $m^2$. The main activities are the inbound and outbound processes. At inbound the unloading and put away to storage takes place. The outbound process is mainly picking and shipping. Next to these activities, several secondary and facilitating activities take place, like customisation, arranging transport, etc. The warehouse has many different storage areas that have different storage types. The storage types assure the proper storage of the different units stored: full pallets, master cartons, and broken master cartons. More details about the CAV warehouse can be found in chapter 3.

## 1.4 Recent Changes for CAV

### 1.4.1 Central stock for the Consumer Audio & Video Division

Early 2002 Sony Corporation decided to overhaul its supply chain structure in Europe. Sony Corporation's goal of this change in structure, is to reduce its inventory and increase the hit rate to the customer (percentage of order lines delivered to the dealers on time). To that effect a number of European distribution centres will be consolidated into two main hubs, one in Tilburg and one hub in Barcelona. The Tilburg hub will serve North-West Europe (Benelux, Germany, Austria, Switzerland and the northern part of France). (Sony, internal presentations)

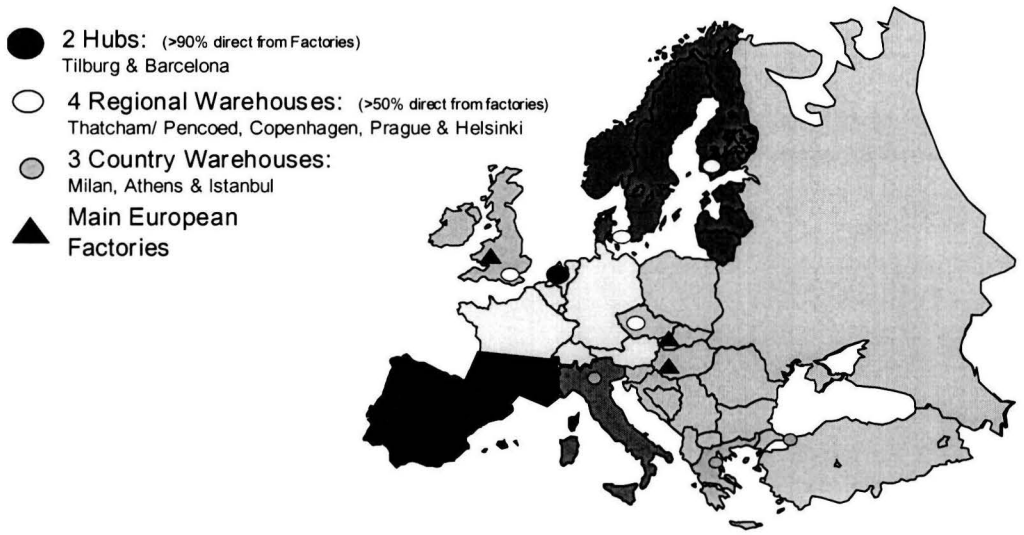



**Figure 1: Resulting European logistic structure / overview of warehouses**

The project to prepare the Tilburg location to become a hub was started in August 2002. The following areas in the Tilburg distribution centre were affected:

- A new lay-out was introduced
- A new Warehouse Management System (SAP WMS 4.7) was brought online
- A new organisation was set up

In the beginning of 2003, the above-mentioned changes were implemented. As a result of the ambitious time period that was given to implement the above-mentioned changes, a number of elements had to be de-scoped during the project in order to achieve the 5 May deadline. One of the areas where de-scoping took place was Management & KPI reporting. (Sony, initial project formulation)

# 2 Research Project Methods

## 2.1 Introduction

The Sony CAV management formulated a wish for performance indicators and management reporting and included a project for this purpose on the list of requirements. Of course, the ultimate goal is being able to manage the warehouse performance. However, when one wants to manage performance, the first step is to measure it. This project will focus on performance measurement, as it will enable performance management.

The project, like most projects, consists of three phases, on which the layout of this report is based as well. These phases are:

- Orientation Phase, chapters 1 and 2.
- Analysis Phase, chapters 3, 4 and 5.
- Design Phase, chapters 6,7, and 8.

This chapter will first give insight into the background and support for this project. It will present the project goals and related research questions. What follows is an overview of what is part of the scope of the project. Next the theoretical framework is given, that shows where this project can be positioned within the industrial engineering and management science areas. In paragraph 2.5 the project research model is presented and will be explained. This will be done by going into the research methods used during each of the phases.

## 2.2 Background of the Project

The Tilburg Consumer Audio & Video operation had to be prepared to change from a Benelux warehouse and a central stock operation to a hub for Benelux, Germany, Austria, Switzerland and the northern part of France. This implied several changes in the operation. A new layout of the warehouse, a new Warehouse Management System (WMS) and a new organisation have been implemented for this purpose. These changes have caused many operational problems. Because of the problems, all attention was directed to improving the performance of the warehouse that had declined to an unacceptable level. This has lead to the fact that the management and performance reporting was marked down on the priority list. However, a lack of information resulted in a lack of insight into the actual performance of the warehouse and the actual sources of the problems. This makes it hard to improve performance.

## 2.3 Importance of Project for the Organisation

It has been recognised throughout the organisation, especially by management, that a lack of performance information is making it hard to manage performance. There is a demand for a structured and / or central supply of relevant performance information. This currently cannot be provided. There are some reports on performance, however most of the time the existence of the reports is not known by all people that are interested in the information and the information lies with different people. This is why the general manager of Sony Logistics Europe has asked for this project.

This project provides the department managers with the operational performance information they need to control and improve the process. Further, performance information will be easily available for CAV general managers and Logistics Operations Europe, once there is an integrated performance measurement system in place. This information can also be used to explain or present the performance and improvements to the customer.

## 2.4 Project Formulation

### 2.4.1 Initial project formulation

Shortly after assigning the project, management has formulated the following project description.

*"Designing a tool that provides Management reporting and Key Performance Indicator (KPI) reporting for both internal (inside Sony Logistics Europe) and external (Sony sales companies, Sony Europe) purposes."*

This means operational performance information has to be developed and (available) indicators at other levels need to be integrated, to be able to report internally and externally. This creates a twofold project.

### 2.4.2 Final project formulation

Considering the just mentioned initial project formulation and the current circumstances the following twofold goal can be formulated:

**Goal**

| | |
|---|---|
| **A)** | **Designing an operational Performance measurement system, that includes the weekly process performance information (indicators) for management of the operational level of the Consumer Audio & Video division, that is required to control and improve the processes, including defining what tool can be used for reporting and presenting this information** |
| **B)** | **Harmonising the logistics performance indicators (definitions) at the different logistic organisational levels and providing the links between the different indicators, that will make it possible to drilldown to get more detailed information such as the underlying causes of performance** |

**Definitions of terms used**

***Performance indicator***: A performance indicator (PI) is a variable that expresses quantitatively the effectiveness or efficiency or both, of a part of or a whole process, or system, against a given norm or target. (Lohman, 2002)

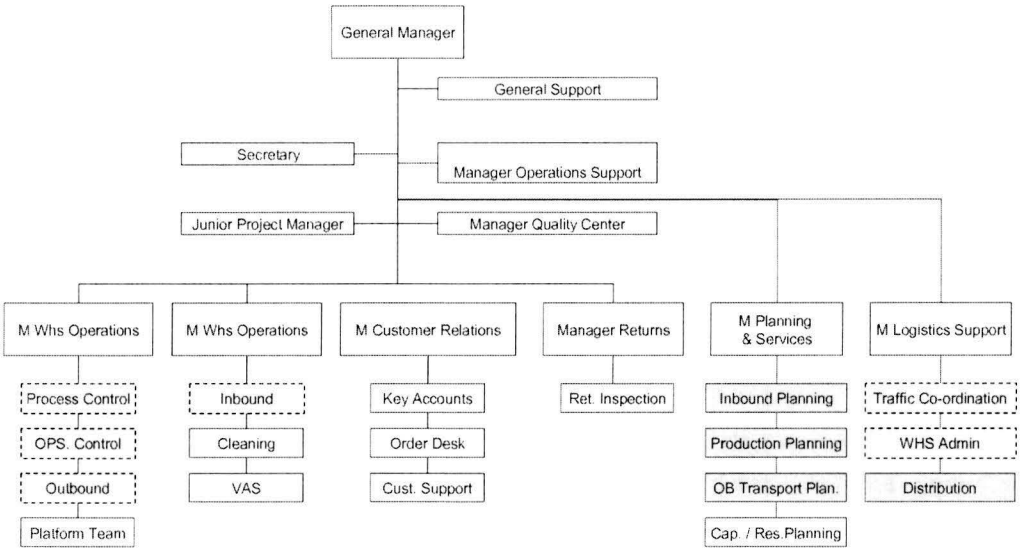
***Operational performance indicator***: A measure of performance on the operational level of the CAV operation that will give insight into the performance of the warehouse operations and the facilitating departments (Customer Relations, Logistic Support, Planning & Services, Quality Centre, Returns)

***Logistic performance indicator***: The term logistic performance indicator refers to all performance indicators that are available in the logistic branch, at the different logistic organisational levels.

***Performance measurement system***: A performance measurement system (PMS) is a system (software databases and procedures) to execute performance measurement, the activity of measuring performance using performance indicators, in a consistent and complete way. (Lohman, 2002)

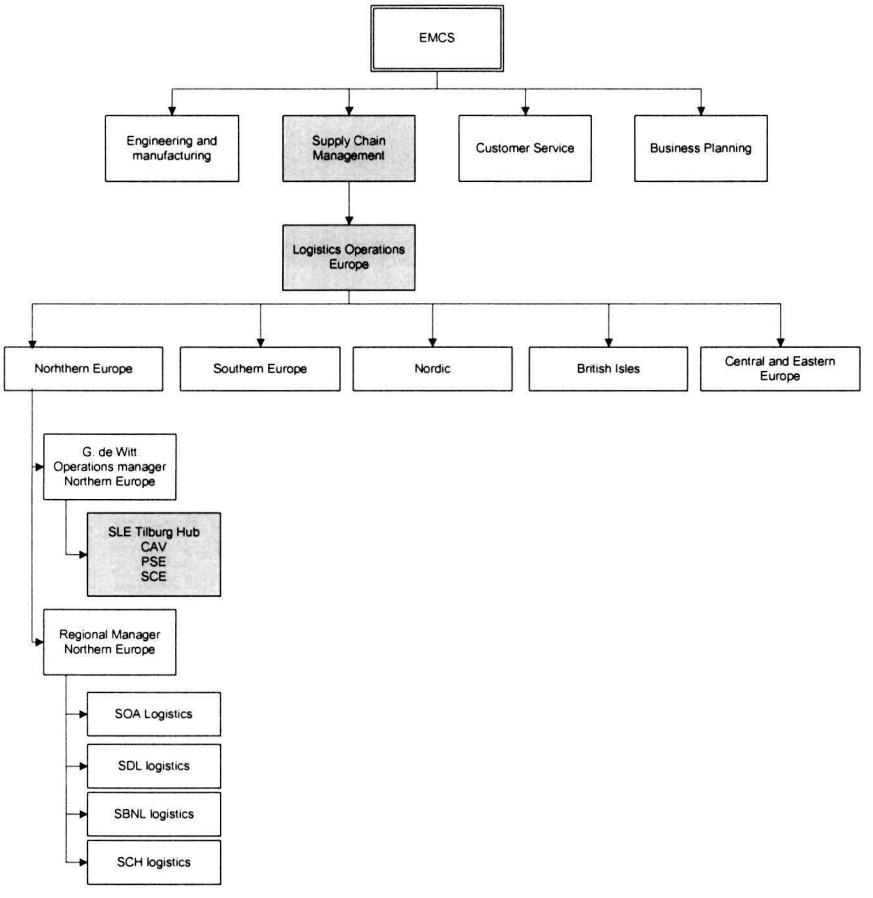
***Operational level***: See Organisational chart 1, purple shaded boxes.
The management of the operational level consists of (shaded boxes in Organisational chart 1: Consumer Audio & Video division:

- Warehouse operations: manager and shift managers.
- Facilitating departments (Customer Relations, Logistic Support, Planning & Services, Quality Centre, Returns): department managers.




**Organisational chart 1: Consumer Audio & Video division as of 12 January 2004**

***The Logistic organisational levels mentioned in part B of the project goal are:***




- Supply Chain management
- Logistic Operations Europe
- Sony Logistics Europe
- Consumer Audio & Video

**Organisational chart 2: Logistics organisational structure**

**Research Questions**

In order to reach this goal, a number of questions need to be answered.

***Part A***

I. What are the different parts of the CAV process?
- How are the CAV processes organised?
- What information on performance is currently available and can this be used?

II. Which information should be reflected in the performance indicators?
- What information is needed to control the operational process?
- What are the management information requirements?
- How often is the information needed or what should be the frequency to present it?

III. Can the information be gathered from the current IT-systems?
- What are the appropriate information sources (using SAP and other systems)?
- Are there gaps in the information sources?

IV. What are the performance indicators that will fulfil management information requirements?
V. What are possible ways of presenting the information and which way is the most suitable?

***Part B***

A What are the different levels of logistics performance indicators and what indicators are present?
B What is the relation between the indicators on the different levels and can these indicators be linked together if a relation exists?
C Are the performance indicators on the different levels correctly defined, meaning that definitions on different levels are clear and similar so the indicators can be compared and duplicate indicators (measured on more levels) are removed?

This leads to the following covering questions:

**A) Which performance indicators are needed for the *operational level of Consumer Audio & Video* to gain insight into the weekly performance-situation of the processes at Consumer Audio & Video and to locate bottlenecks – and – how should this information be measured, reported and presented?**

**B) What needs to be done to harmonise and link the information at the different logistic organisational levels?**

### 2.4.3 Scope and theoretical framework

**Scope**

The project will only look at the Consumer Audio & Video operation within Sony Logistics Europe.

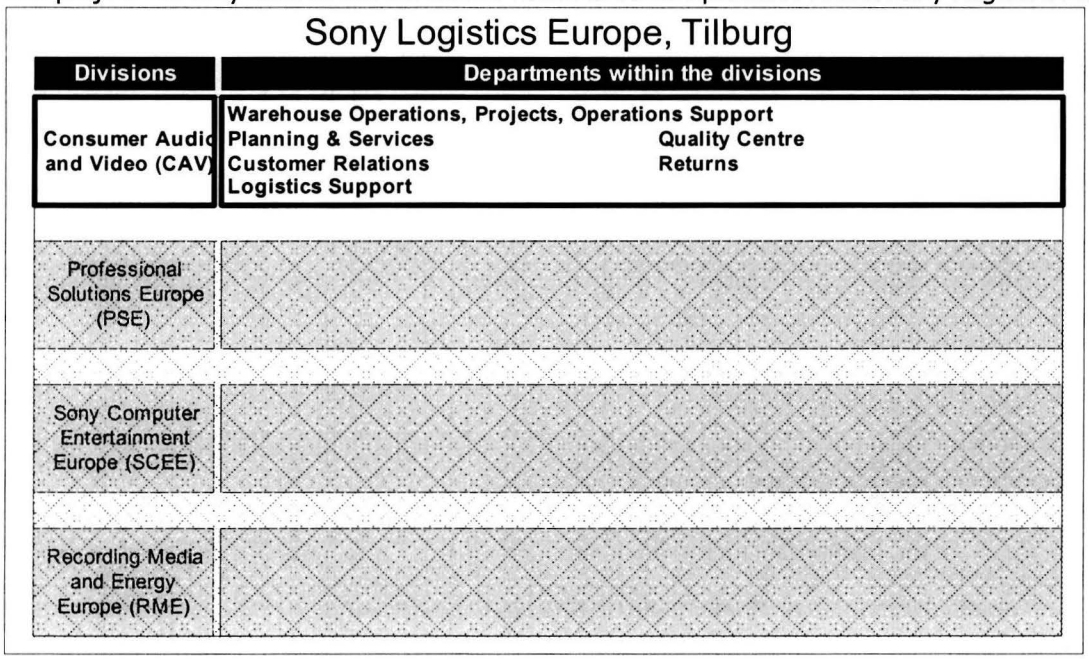



**Figure 2: Scope of project, Consumer Audio & Video division within Sony Logistics Europe Tilburg**

Within this operation, all departments will be part of the project. These departments are, see Figure 2:

- Warehouse Operations
- Customer Relations
- Logistic Support
- Planning & Services
- Quality Centre
- Returns

The departments projects and operations support are not directly addressed in this project. The reason for this is that operations support is, as the name says, supporting the operation. Therefore, the information they need on a structural basis, will be regarded equal to the information needed by the warehouse operations. Next to that, the information that is needed by as well the projects, as the operations support department will often have a temporary character.

**Theoretical framework**

Within the industrial engineering area, this project can be placed in the area of Management Accounting / Performance Measurement and Warehousing.

## 2.5 Research Project Model

The research project model gives an overview of the relations between different parts and phases of the project. The first paragraphs will discuss part A of the project, phases 1-5: the development of an operational performance measurement system. The following paragraph is about part B phases 6-7: harmonising the performance indicators at different levels. The last paragraph will discuss phase 8,

the conclusions and recommendations. The different phases do not always have to be executed in sequential order.

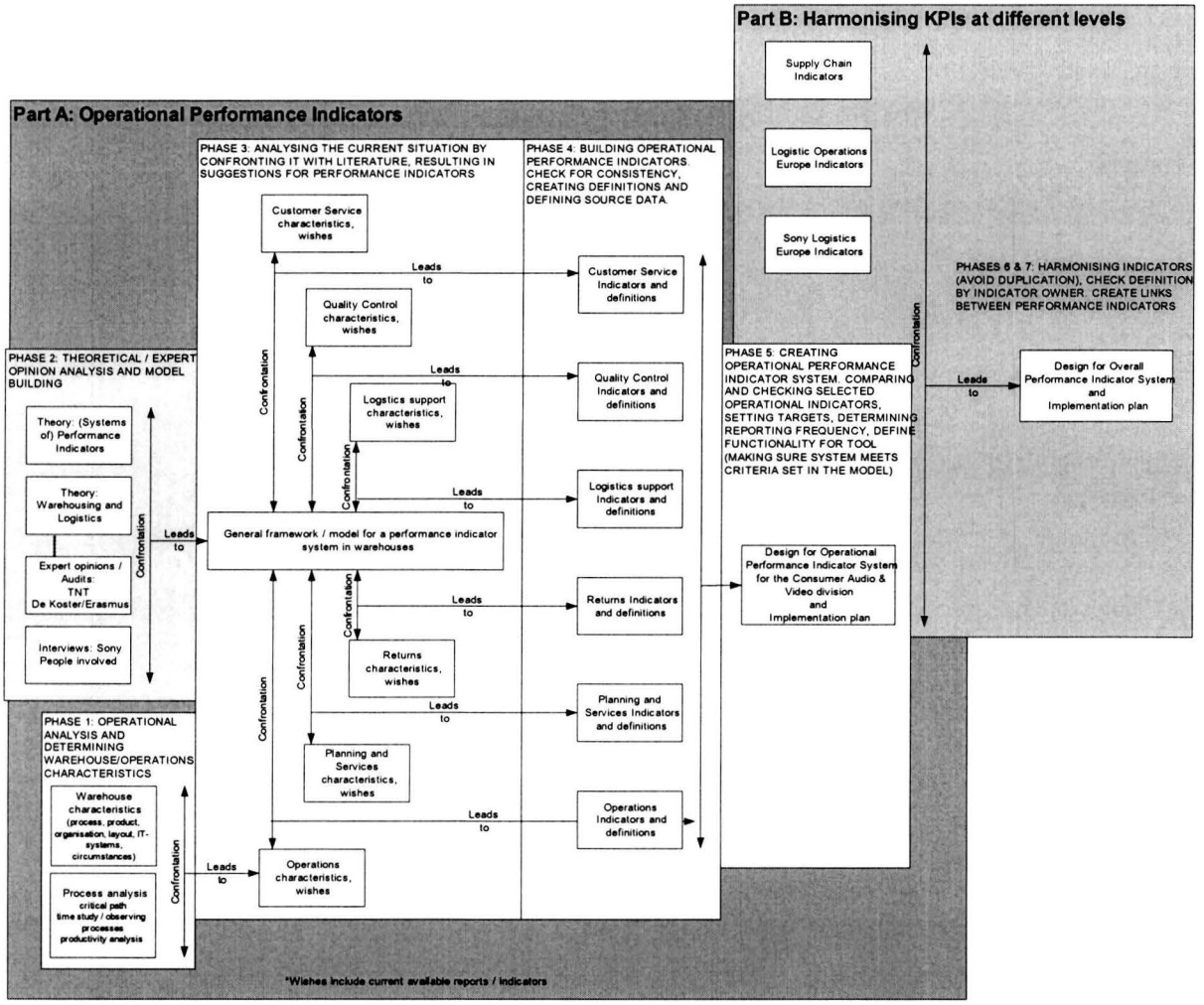



**Figure 3: Research Project Model**

## 2.5.1 Part A: Development of an operational performance measurement system, phases 1 -5

**Phase 1** is included to give insight into the actual physical operation. In this phase the warehouse characteristics are gathered through interviews and analysis of internal information (presentations and documents). These warehouse characteristics are:

- The organisation
- The departments
- The equipment
- Type of products
- The information systems

Next to that, a more detailed overview of processes and performance is obtained. The overview of the processes is partially obtained through working on a small time study of the warehouse processes. This has shown how the processes work. Insight into the current performance is obtained by asking owners of the improvement projects, manager of

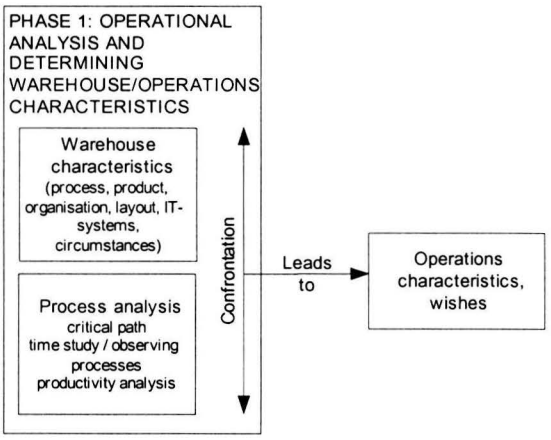



**Figure 3.1 : Model phase 1, operational analysis & warehouse characteristics**

operations support, and the person creating the information for reporting key performance indicators to Logistic Operations Europe for the information on performance that is available. Another way to get an idea of performance is looking at the results of a small time study. Because this data is not accurate enough, the data is only used as an indication. Interviews with warehouse supervisors and others have also given an indication of the problems they encounter.

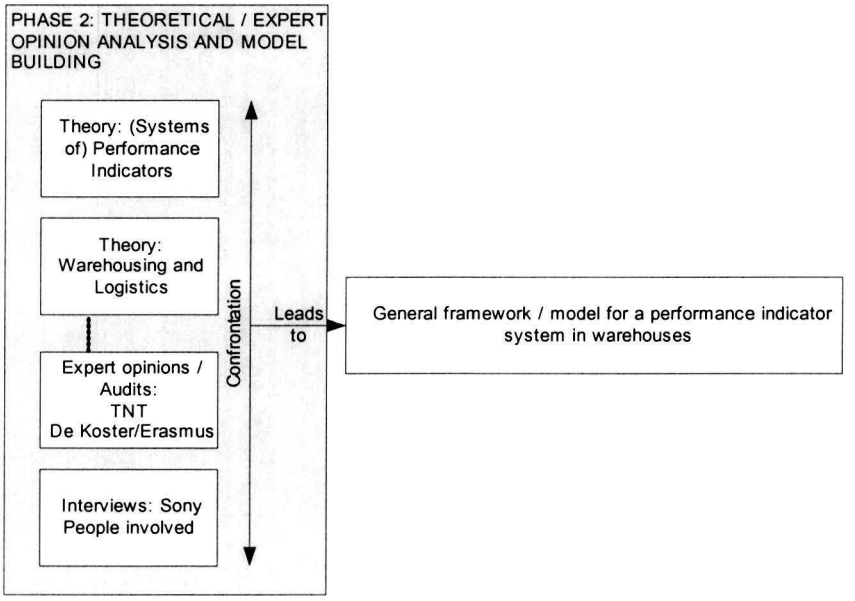



**Figure 3.2: Model phase 2, Theoretical analysis and model building**

**Phase 2** consists of a review of the available literature (desk research) and the collection of information from warehouse experts about the data needed for warehouse performance measurement. The information sources are books and articles on performance management, warehousing, process improvement etc. This information is available from the (TU/e) library, digitally available from magazines and journals that TU/e has subscribed to and / or the Internet.

This information is analysed for strong and weaker points as well as for relevance and usefulness for this project. The analysis of the information gathered in this phase will result in a general model for operational performance indicators in a warehouse environment. This model contains criteria for a performance indicator and an indicator system, gives an overview of possible categories of indicators etc. To be clear, no CAV specific information is present in this model. The literature review is presented in a separate report. The results are presented in chapter 5.

In **Phase 3** the information requirements will be gathered from the people on the operational level as defined in paragraph 2.4.2. In this phase the information that has been collected about the CAV operation and the information from the literature review will be used to draw conclusions about the CAV operation. This means that problems with current performance information are identified, a list of management

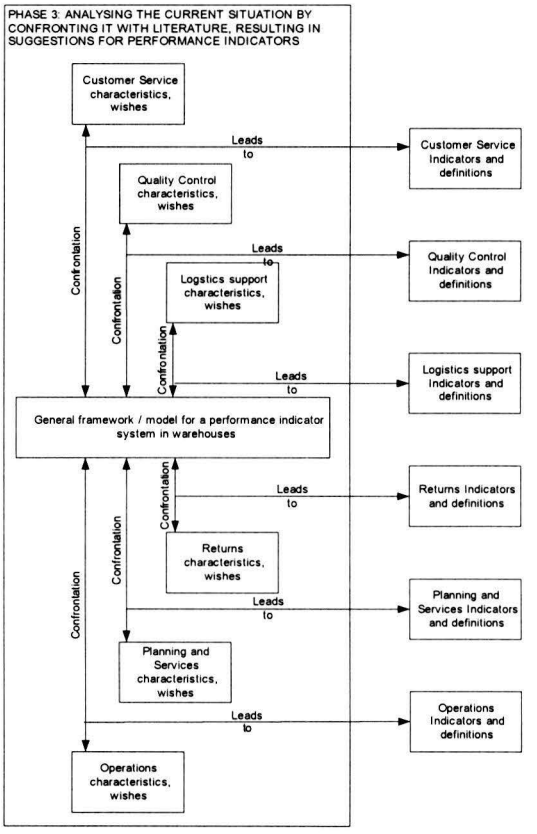



**Figure 3.3: Phase 3, Analysing current situation and suggesting performance indicators**

information requirements is created, and a list with possibly useful indicators is created as well.

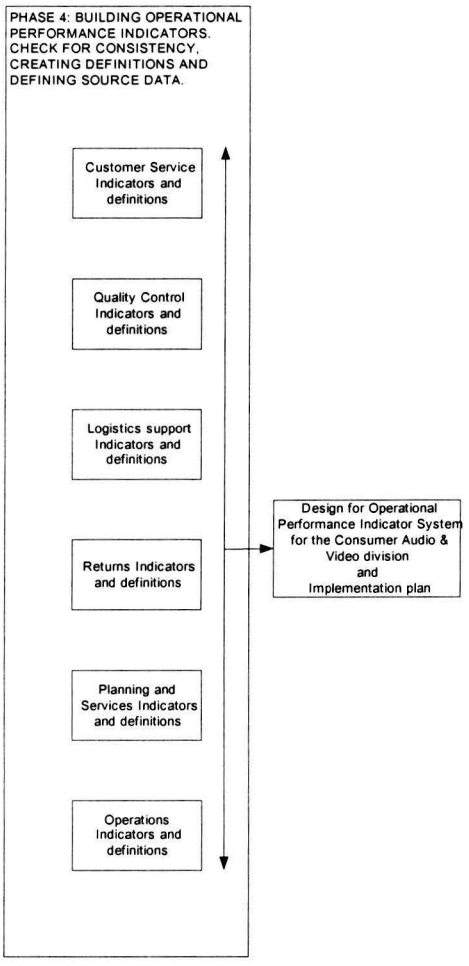



**Figure 3.4: Model phase 4&5, Building operational indicators and checking for consistency, and creating the system**

In **phase 4**, the building of operational performance indicators, the first thing to do will be to check the suggested indicators for the several departments for consistency. This will result in a list of selected indicators. After the selection of the indicators, the definitions will be created and validated, and the source data will be defined.

This phase may be divided into sub-phases:

1. Checking suggested indicators for consistency, make a selection
2. Creating a list of selected indicators and their definitions
3. Validation (checking with management)
4. Determining information sources

**Phase 5** consists of setting targets, determining reporting frequency (per indicator) and defining of the functionality needed for the reporting and publishing tool. In the end the information needs to be presented in the clearest possible way. Therefore, a tool is needed. This can be a tool that is already present, a tool that needs to be developed or a tool that is available at the market.

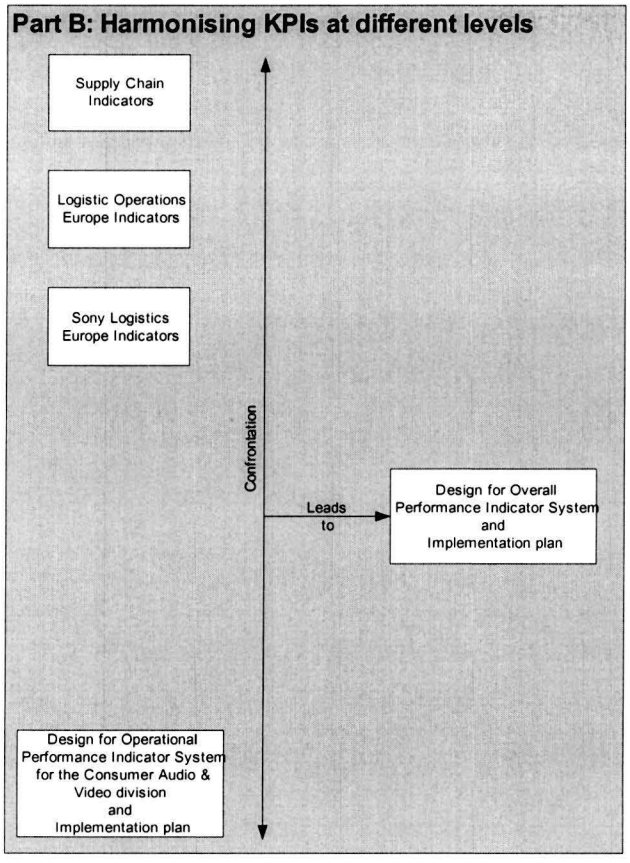
In this phase it is also checked if the created Operational Performance Measurement System meets the criteria set in the model. This all will result in an Information Guide with selected indicators and their definitions, targets and reporting frequency. Next to that an implementation plan will be created.

In the meanwhile, there is a temporary tool in which manually gathered information is reported, for operational purposes. This is a Microsoft PowerPoint presentation.

### 2.5.2 Part B: Harmonising performance indicators at different levels, phases 6-7

Part B of the project looks at the different performance indicators at the several logistic levels in the organisation. At the start of this project there is no overview of all the logistic performance indicators available. It is known however, that there is some duplication, meaning more people are separately working on creating the same information.

Part B of this project is intended to make clear which indicators are being reported and by whom. These performance indicators have to be harmonised. This means that, to avoid duplication of effort, a single indicator should not be measured by more than one logistic level in the organisation and an owner of the indicator has to be assigned. The owner of the indicator is then responsible for the definition, and will set this definition in consultation with the users and the other owners of performance indicators.




In consultation with all the owners of performance indicators the operational PIs can be linked to higher and lower level performance information to create the drilldown possibility.

It can be said that a performance measurement system for the logistic branch of the Sony organisation is in place, once it is clear which performance indicators exist, who is the owner, what are the definitions and how these indicators are being reported.

### 2.5.3 Phase 8: Conclusions and recommendations

In the final stage of the project, reporting will be done. In this phase conclusions and recommendations are written down and presented to management.

# 3 Detailed Analysis of the Consumer Audio & Video warehouse

## 3.1 Introduction

The CAV warehouse characteristics are presented in this chapter. The first items discussed are main characteristics, like size, type of products and other physical characteristics. What follows are the main processes, that will show the product flows through the warehouse. Finally, the main product flows are described in more detail in the last paragraph.

## 3.2 Main Characteristics Consumer Audio & Video Warehouse

The CAV Video warehouse is situated on the Dongenseweg in Tilburg, where it uses about 38.400 $m^2$. In addition to this location an overflow warehouse is used for temporary storage when the Dongenseweg location has not enough storage space available. This is currently situated at Versteijnen, about 1 km from the CAV warehouse. The location at the Dongenseweg will be the main focus of this project. This location has 40 dock doors available for regular inbound and outbound (trucks and containers), 1 dock for airfreight, 1 dock for express, 1 for the battery charging and 2 docks are used for paper press containers.

As the name says, only consumer audio and video products are stored in the Consumer Audio & Video warehouse. There are about 1.800 different products. When you look at storage, there are many different storage types (see warehouse layout in appendix B) that can be divided into three categories: Full pallets, Master Cartons and Broken Master Cartons. See Figure 4.

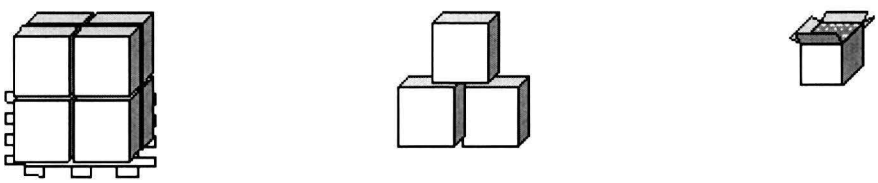


**Figure 4: Full pallet, Master Cartons, Broken master carton( items).**

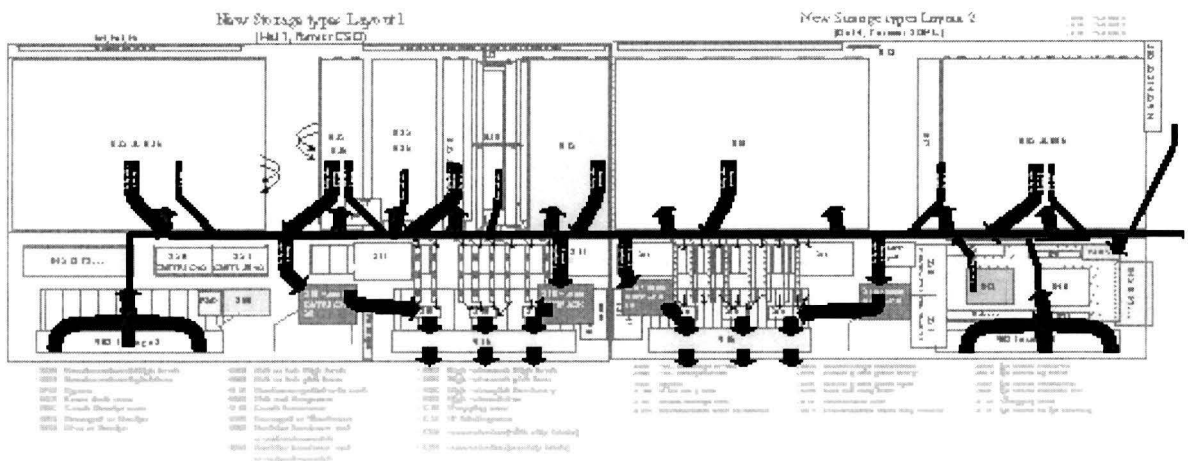
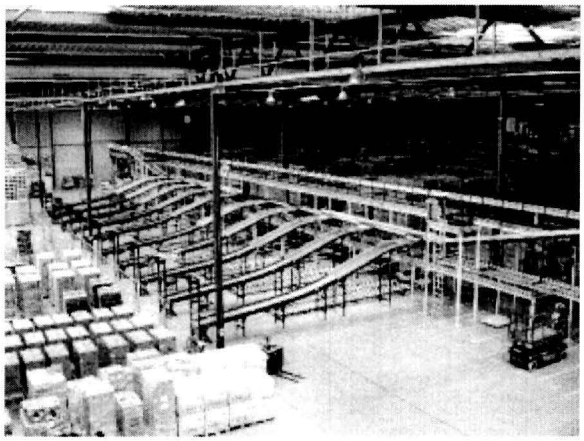


**Figure 5: Warehouse layout including inbound and outbound flows (enlarged view in appendix B)**

Full pallets are stored in two different reach truck racking areas (R and V storage areas), in block storage, and in the high value area (see Figure 5). Master Cartons are stored at the floor level or the reach truck racking, in the normal and high value pick-to-belt area at the ground floor and at the

mezzanine pick to belt area. Broken master cartons are stored on the mezzanine in flow racks and on shelves, as well as in the high value area.



In the CAV warehouse the number of available pallet places varies between 18.000-22.000. The actual number of pallet places depends on a several factors, like the pallet type that is used (Euro, Industrial, etc.) and if pallets may be stacked in block storage. The master cartons are stored on a pallet. The broken master cartons are stored on the mezzanine at shelves or in flow racks and in the high value area.

**Photograph 3: Chutes at one side of the warehouse (sorter under construction)**

The level of automation has changed since the go-live in the beginning of 2003. Since that time a sorter is in use (for the pick-to-belt and all mezzanine products) that has 20 chutes with 40 lanes. Each chute that comes from the sorter has a lane at each side (see Photograph 3 and Photograph 4). The people in the warehouse also use radio-frequency scanners, handheld and on trucks.

The CAV warehouse works for internal -Sony- customers. The customers of the CAV warehouse are the Sony sales companies and the Sony business groups. Basically, the inbound process is dependent on what business groups want to store in the warehouse and the outbound process is dependent on the sales orders that are generated by the sales companies (and other Sony warehouses for replenishment shipments).

**Photograph 4: Lanes (roller conveyors), one on each side of the chute (sorter under construction)**

The inbound shipments arrive in trucks, containers or as airfreight. The trucks and containers can contain several types of loading, namely pallets, slip-sheets and loose loading. Next to that containers can be used for multi consignments shipments, meaning there are several types of product (coming from multiple shippers) in one container. The outbound shipments leave in trucks. There are direct shipments to the retailers, platform shipments that go through a forwarders hub and replenishment shipments to other Sony warehouses. The different shipment types also have different outbound characteristics.

## 3.3 Main Processes of the Consumer Audio & Video Warehouse

In Figure 6 and Figure 7 respectively, the inbound and outbound processes are presented as a flow diagram. In these figures the departments involved in the processes are pointed out as well, to give an indication of the interaction and communication that is needed as well as showing some of the complexity. Each box represent a separate sub-process, explained in more detail in appendix C.

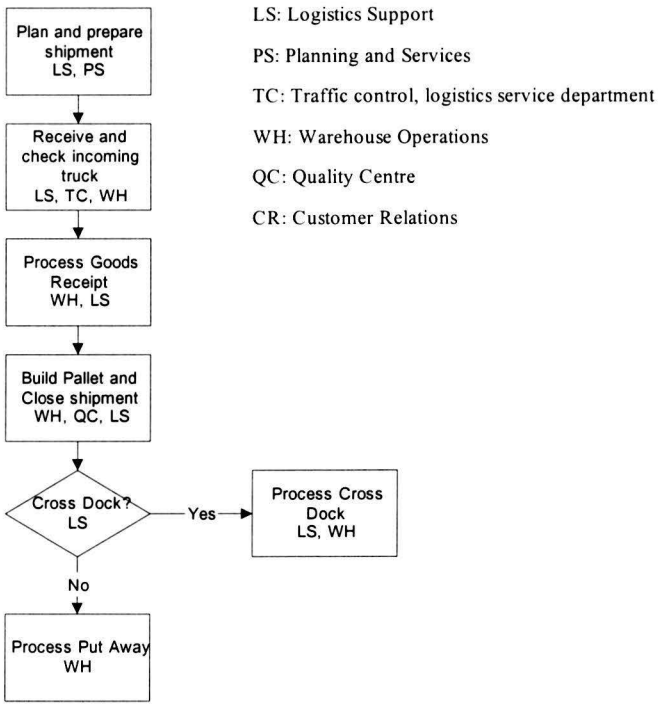



**Figure 6: Inbound processes and departments involved**

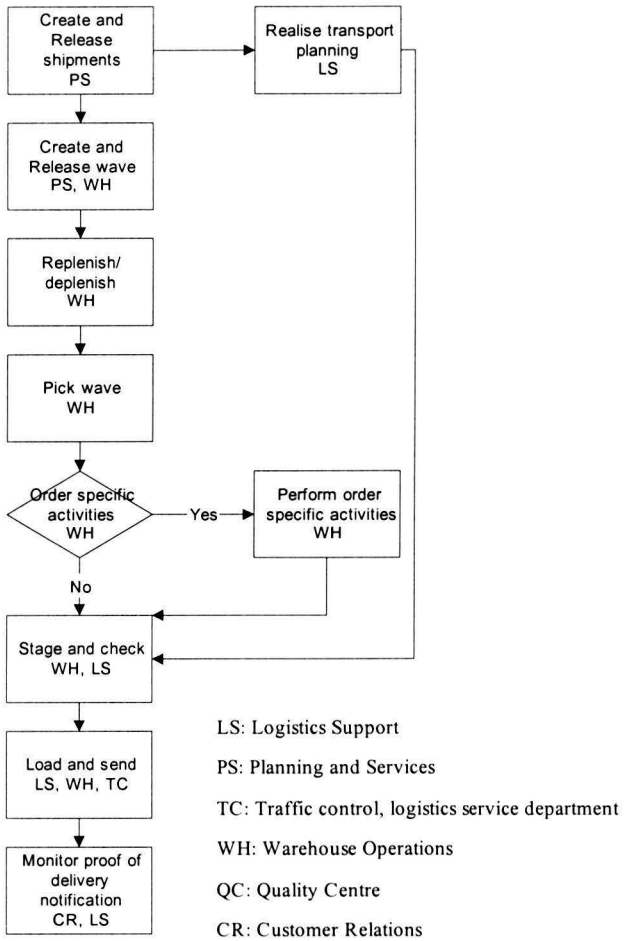



**Figure 7: Outbound processes and departments involved**

The following activities take place within the CAV warehouse. They are split into the actual goods flow processes and the facilitating or administrative processes.

### 3.3.1 Goods flow processes

The goods flow processes are part of the department warehouse operations. The services of the warehouse operations consist of executing the work plan according to the output from the Planning and Services department. These services can be split into two areas:

- Handle inbound volume: unload trucks, goods receipt, pallet build and put-away (bringing products to storage areas). This process is explained in more detail in § 3.4.1.
- Handle outbound volume: prepare order picking, picking, pallet build & customisation and load trucks (Platform shipments that go through a forwarders hub, direct shipments to the larger customers and replenishment shipments to other Sony warehouses) This process is described in more detail in § 3.4.2.

### 3.3.2 Facilitating processes

The facilitating processes are explained by Consumer Audio & Video department (in alphabetical order).

- Customer Relations: Act as a focal point between customers (BU's, sales organisations, stock owners) and logistics operation by answering questions and requests in a commercially sensible way (next to supporting Returns, Value Added Services and Outbound process)
- Logistics support (transport): Arrange and control transport and transport documentation
- Operations support: Contribution to realization of an optimised and cost efficient logistics operation
- Planning and services: Align the handling capacity of the Hub towards the requested throughput
- Quality Centre: Quality control during inbound, outbound, customisation and VAS processes; Stock control; Accurate and common master data (weight, length, width, height)
- Returns: Receipt and refurbishment of return quantities and feed-back of performance indicators (3rd Party under contract management)

## 3.4 Main Goods Flow Process Descriptions

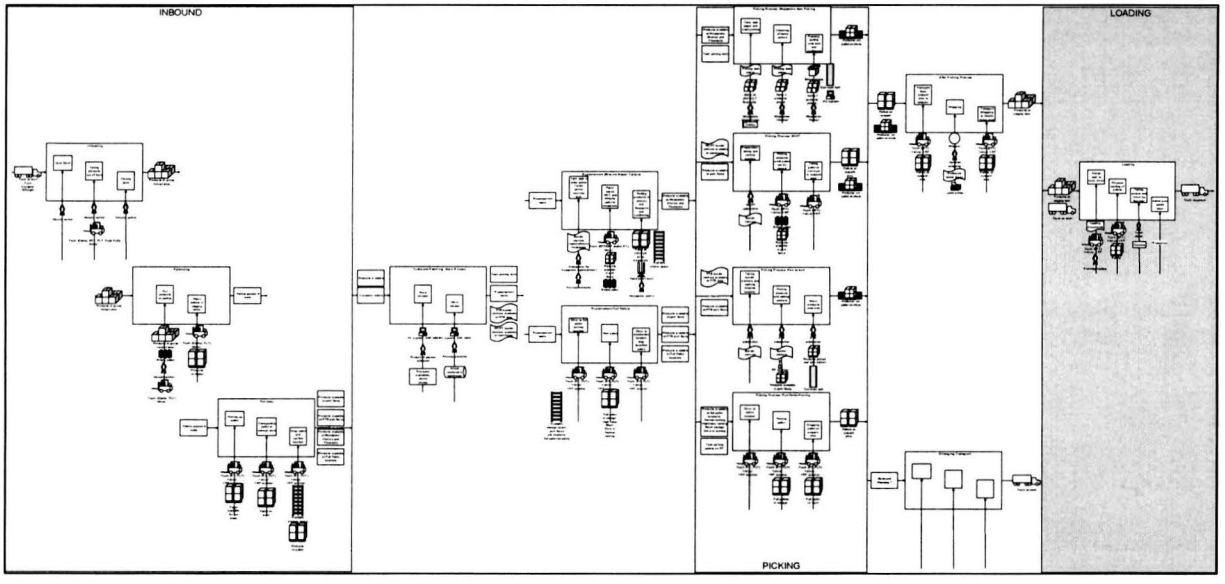



**Figure 8: Process overview: Input, output and resources per activity (enlarged view in appendix C)**

### 3.4.1 Inbound

The operations at the inbound side of the warehouse consist of the following (see Figure 8):

- Receiving shipments (unloading, pallet building)
  - Containers
  - Trucks
  - Air (The receiving of air shipments is only possible at the inbound area at one side of the warehouse, satellite 3.)
- Receiving returns
- Palletising
- Put-away of received shipments, returns and Value Added Services

**Short description**

*Either the supplier or the port confirmed the earliest availability date to deliver the shipment to SLE. Now, the shipments are available to be planned. An agreed (with forwarder and warehouse) unloading date and time needs to be maintained in the shipment. After the arrival of the shipment, the customs information needs to be captured and the* ***unloading and goods receipt process*** *can start. When the materials are unloaded a first check will take place, the materials, quantity and condition of the*

*materials is checked. Irregularities that are found need to be reported and mentioned on the driver's documents after which the driver can leave.*
*The receipt of the shipment will be posted by means of Radio Frequency (RF). The complete shipment will be posted into the warehouse.* ***Pallets are built****, each pallet will get a unique identifier (HU nr.) and* ***put away*** *will be started. The pallet will keep this identifier throughout the whole process chain until outbound. The put away process is supported by means of RF. When the put away is confirmed the materials are available for sales.*
(Sony, internal documentation: process descriptions → inbound complete)

**Detailed description based on interviews**

***Unloading & palletising***

When the inbound area is receiving shipments they have to do a number of things: First of all the container or truck has to be unloaded. Most of the times the products are not yet placed of pallets, so that is the second thing they should do. This is mainly handling work, which can take a lot of time. For instance, television shipments that are received from Barcelona arrive in trucks. The trucks are fully loaded, and products are not placed on pallets. In some cases there can only be two televisions on a pallet, and they have to be stacked in the right way (taking into account the centre of gravity). This means a lot of handling work (sometimes creating 90 pallets from 1 truckload), costing very much time. Often it is unknown beforehand what the exact content of a truck is. When all the products are placed on pallets they can be put away into storage.

According to one of the inbound supervisors there is a difference in the amount of handling for a truck or a container shipment. Containers do not cause many problems, they do not require a lot of handling and they can be in storage within the required time of 4 hours. However, truck shipments often do cause problems because the handling work takes so much time, that the deadline cannot be met. This is later confirmed by the results of the time-study.

The receiving of returns means that there are a lot of small shipments arriving at the warehouse. At the beginning of September 2003 this is causing some trouble because the pallets with returns are not full and therefore take up a lot of pallet places compared to full pallets.

***Put away***

A corner of the warehouse is used for Value Added Services. At this area additional gifts are added to products or products are combined, mostly because of marketing actions. When these activities are finished a "new" product has been created that will be stored in the warehouse. Inbound is responsible for storing these products (Put-away). A problem that was signalled at the inbound area is the lack of free storage places. This is caused by the amount of inventory that has exceeded the limit of 23 days of supply.

### 3.4.2 Outbound

The operations at the outbound side of the warehouse consist of the following:

- Order picking (also for replenishment)
- Customisation (not always)
- Collecting (e.g. Sorter)
- Wrapping pallets in foil to create a stable pallet and at the same time protecting products against rain and theft
- Shipping

**Short description**

*Shipments are planned by the outbound planner and the planning is distributed to the WMS. The planned date is agreed with the receiving party. Each shipment needs to be put into a wave, that will to be created. The warehouse supervisor will inform administration when to start the picking allocation. This will generate the full pallet picks. After picking allocation a replenishment run will be started to make sure that enough stock is available in the pick face to start the master carton picks. Transfer orders for the master carton need to be created and the wave released. This wave release will generate the tasks for master carton picks. After picking the pallets will be brought to a wrapping machine to be wrapped and a pallet label will be printed. The dock where the shipment will be loaded is printed on the pallet label. The pallet will be brought to the staging lane / dock and loading can start. After loading, the pallets will be assigned to the shipment, the shipment will be closed and the goods issue will be posted.*
(Sony, internal documentation: process descriptions → outbound complete)

**Detailed description based on interviews**

***Picking***

The outbound process starts with picking (by wave, a way of grouping outbound deliveries). Several order picking methods (with different destinations in the warehouse after picking) are used to collect all the products needed for a shipment.

| Picking method and storage type | Destination |
|---|---|
| • Item picking; Products from the mezzanine<br>- Shelves<br>- Flow racking<br>- Pick to belt | • Sorter belt |
| • Item picking; Pick to belt normal and high value area | • Sorter belt |
| • Master carton picking; Master Carton Tour (filling an empty pallet)<br>- Normal racking (low levels or pick faces)<br>- Heavy weight<br>- High value | • Sorter lane (pallet not full) or Outpack area (full pallet)<br>- Outpack area |
| • Full pallet picking<br>- Block storage<br>- Drive-in racking<br>- Normal racking<br>- High value | • Outpack area |

**Table 1: Picking method and destination after picking**

***After Picking***

Some products need customisation. This can be adding battery stickers or other stickers, changing pallet type (Euro pallet, industrial pallet, etc.) and other types of customisation. When products need customisation, they are sent to the customisation area or in some cases customisation can be done during picking. At the sorter chutes, the products that come from the sorter, thus from the pick-to-belt areas or the mezzanine, are put on pallets. This can be a pallet that comes from the master carton tour that is not fully loaded yet. If there is no pallet from the master carton tour, a new empty pallet is used. When a pallet is fully loaded or when the shipment is completely collected, the pallet is moved to the outpack area. This also goes for the pallets that are already full after picking, such as

full pallet picking or fully loaded pallets after a master carton tour. These full pallets do not go by the sorter lanes. For an overview of the destination of the products after picking see Table 1.

When picking and collecting is finished, all the pallets are in the outpack area and are ready to be wrapped and shipped. This means that they will be picked up at the outpack area, and placed in the wrapping area to be wrapped by the wrapping machine. Once the pallet is wrapped it will be brought to the goods issue area, where it will be in the lane of the dock allocated to the shipment. One truck can be used for several shipments, or a shipment can be on several trucks. Also, a shipment can contain multiple deliveries.

### 3.4.3 Internal replenishments

There are several housekeeping tasks. One of them is the internal replenishment that needs to be done before the master cartons can be picked. This means that products from other locations such as higher racking levels are brought to the pick faces.

# 4 Performance Information: Available and Suggested or Requested

## 4.1 Introduction

This chapter presents an overview of the performance information that is already available within the CAV warehouse. This can be reports and indicators that are available, as well as temporary reports or indicators that are created on request. The information on available information is gathered in the period September 2003 up to and including November 2003. Paragraph 4.2 will give an overview of the available information created in the first 3 months of this project. Next to presenting an overview of the available information, an overview with the possible operational performance indicators for the CAV warehouse is presented in paragraph 4.3. These possible indicators are based on a combination of the requested information from the future users, an analysis of the warehouse operations and suggestions from other people involved in this project.

## 4.2 Available Performance Information

### 4.2.1 General available Information and Reports for CAV

In the period September 2003 up to and including November 2003 an effort has been made to create an overview of all the information that is related to performance, either in reports or in performance indicators. Given the fact that reporting is an ongoing process and circumstances change, this overview will change over time. Therefore, the overview presented gives the information as it is at the end of November 2003. The overview discussed here contains only information for the CAV warehouse (it does not include information about the warehouse reported by Logistics Operations Europe or Supply Chain Management, this is presented in paragraph 4.2.2). In Table 2 a preview of this table is given to show the layout and elements, the entire list can be found in appendix D. Eight types of reporting can be found in this list, together resulting in about 80 pieces of information / indicators. The 8 types of reporting are:

1. Reports from the European Returns Centre (ERC)
2. Monthly Logistics Operational Data and KPI reporting
3. Monthly logistics operational data for financial reporting
4. Reporting for invoicing Consumer Audio and Video
5. Warehouse capacity usage
6. Improvement Projects
7. ARMI
8. Other OPI

| ID | Name / report | Status |
|---|---|---|
| ERC1 | ERC1:<br>Goods Receipt Performance:<br>All incoming deliveries must be logged in Phoenix within 24 hours | Available |
| ERC2 | ERC2:<br>Stock accuracy:<br>Percentage of counted items without differences between systems and physical number of quantity | Available |

**Table 2: example of first rows of the overview of available information**

Ad 1) The information that is actually structurally available and well-defined, is information on the performance of the returns centre. The set of indicators for the returns centre is finalised during the first 3 months of this project, in which this overview is created.

Ad 2, 3 and 4) The next items on the list are measures that are used in other Sony reports, mostly external, non-CAV reports. The data presented in the list with the status " available, only used as input ..." is not used for performance indicators in the CAV warehouse. Therefore, it is not actual performance information. The only measures that are used internally in the CAV warehouse are the inbound and outbound volumes per day. These figures are shown on the intranet, called warehouse monitor.

Ad 5) The column ID with the name " Warehouse capacity usage" shows four charts regarding warehouse capacity or storage utilisation. This report is send by e-mail, two times a week, to those people who requested the information. These people are mostly department managers.

Ad 6) The performance indicators that come from the improvement projects all started as temporary indicators. In the list only indicators for project "021 inbound", "028 ABC-analysis" and "040 claims and disputes" are included, because most projects are finished and indicators for those projects are not reported anymore. Project 021 reports weekly on the inbound lead-times per mode (Truck, container and air). Project 028 reports on items related to storage strategy or ABC- analysis. Project 040, claims and disputes, also still reports on claims and disputes backlog and time to treat a claim or dispute. The information for the improvement projects is stored on the projects network drive.

Ad 7) The indicators named ARMI (Archiving and Reporting Management Information) were developed during the ARMI project, and reflect requests from Sony Logistics Europe management. The status of this system (MS Excel files) is that the indicators have been defined and developed in a Microsoft Excel file, into which information is fed every night. This system has been released for review. After review however, some definition issues and technical issues like calculation problems arose, resulting in questionable accuracy. One example is the indicator for damage and missing measured in value, which is set off to the value of movements of products. The problem is, when you move the product 6 times in the warehouse, the value of the product will be 6 times the actual value. This is not wanted, because from a customer point of view you are handling one product and they do not care if you move it internally, the value of the product does not increase. These kinds of issues result in inaccuracy and unreliability of the information and need to be resolved before the system can be used. At the moment there are no resources available to update the system and remove the issues.

Ad 8) The category other OPI (Operational Performance Indicators) contains recently created files that were created upon request. These files are now available, including the productivity on full pallet and master carton level. This is a manual calculation.

The conclusions that are drawn from the process of analysing available information are presented in paragraph 4.2.5.

### 4.2.2 General available Information and Reports for all logistic levels

The overview that is created for part B of the project goal contains the indicators for all logistic levels and can be found in appendix E. This overview has been created during several meetings with owners of the information at the other logistic levels.

### 4.2.3 Productivity information

One of the items that first comes to mind when people talk about performance, is productivity. This is measured as units per man-hour, where units can be cubic meters, pallets or other handling units. Productivity is important because it is influencing costs in man-hours. When in the future the operation is going to handle more volume, this will be even more important. At the start of this project, productivity was not measured on a regular basis. The main reason for this is that information on man-hours was not available. Half way through November 2003, the information on man-hours became available on a high level, with little detail. Productivity can now be measured for the inbound and the outbound process (Table 3).

| | **Productivity high level** | | |
|---|---|---|---|
| | Data on cubic meters | Data on Man-hours | Performance indicator structurally available from (date) |
| Outbound | Available | Available beginning of November | Beginning of November |
| Inbound | Available | Available beginning of November | Beginning of November |

**Table 3: Productivity on high level, inbound & outbound**

Although the productivity on the inbound and outbound process is now available, this is still not giving the people in the warehouse enough information to control the operation. The request is for a more detailed level of performance, per area in the operation as presented in Figure 9. This information cannot be created without having the number of man-hours that are worked in each area and the cubic meters that are handled there. On this level of detail the information on man-hours is not available. The most detailed information on man-hours will be available from a tool called Hours and Efficiency that is being developed at this moment (February 2004). This tool stores all hours of CAV personnel that is registered by supervisors and managers. For the master carton tour and the full pallet pick an indication of productivity can be made based on information from SAP PWD. With this information it is possible to see per person how many boxes or pallets a person has confirmed to have moved in a certain time interval. For an overview of the information on productivity that will be available in the future see Table 4.

| | **Productivity detailed** | | |
|---|---|---|---|
| | Data on cubic meters | Data on Man-hours | Performance indicator structurally available from (date) |
| Productivity per area master carton tour and full pallet pick | Available end of November 2003 | Available December 2003 | Already available |
| | Units | Man-hours | Structurally available from (date) |
| Productivity per department | Available by March 2004 | Available from Hours and Efficiency tool, estimated March 2004 | Estimated to be available in March |

**Table 4: Productivity end situation, detailed productivity by warehouse department, and for master carton tour and full pallet picking**

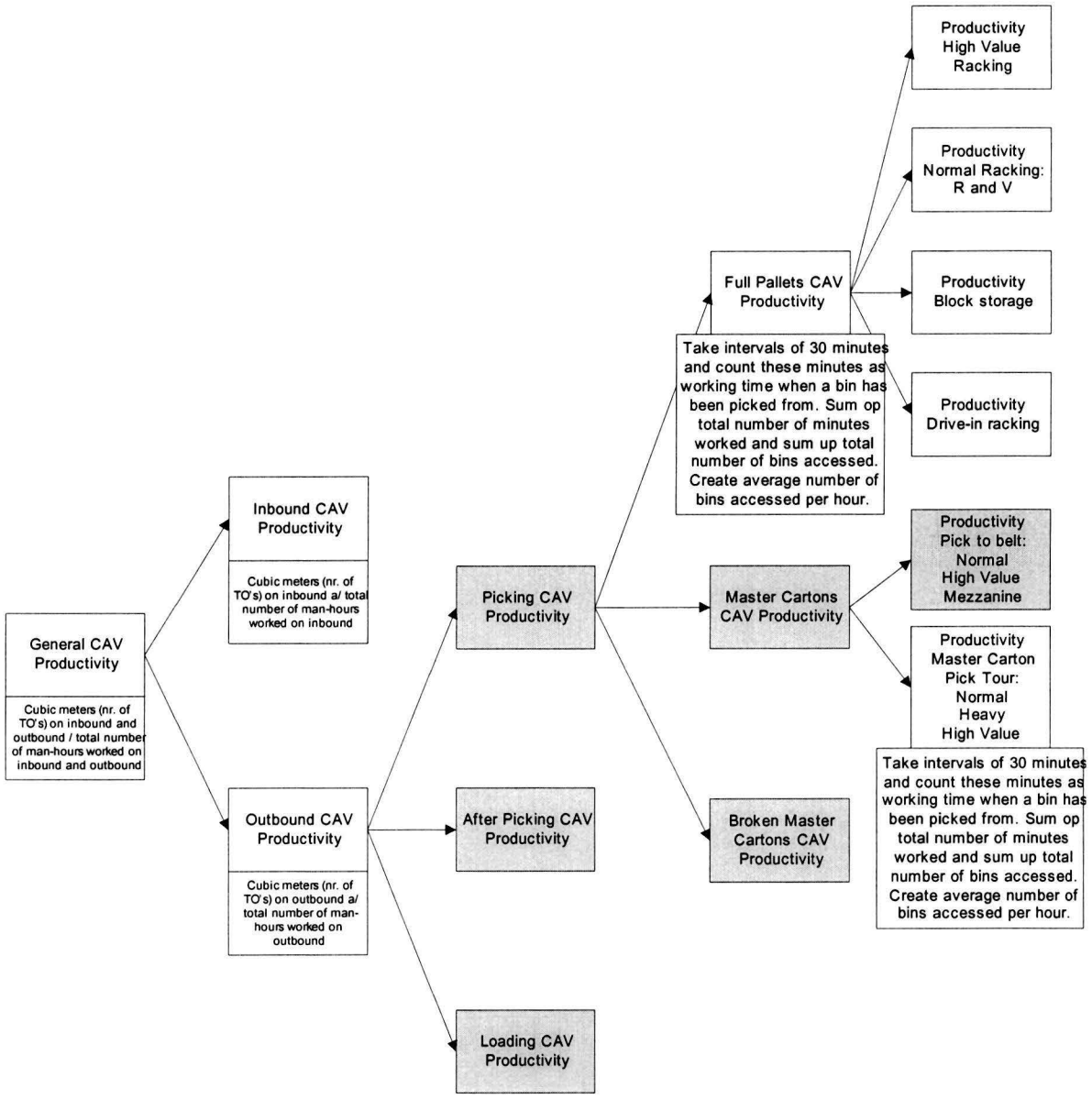



**Figure 9: Warehouse productivity drill-down**

### 4.2.4 Current productivity levels

To get an idea of current productivity a time study has been executed. This was a time study executed during 3 weeks, working with 2 to 4 people, covering all activities of the department warehouse operations. Because of the many different activities, low level of activity in the warehouse and the limited amount of time, the number of measurements cannot give accurate results but will give an indication of current performance. Details of the time study can be found in appendix F and G. Since the time study results alone cannot give figures on current productivities that are accurate enough, more information is collected. The SAP system has been used to get system information on productivity. This data is then compared to the results from the time study, as well as to data used to simulate the warehouse processes. During several meetings with the manager from Operations Support, manager from Planning and Services, general manager from EMCS logistics and others, the data is discussed and a current productivity level is agreed upon. These productivity levels can be found in appendix J.

With the current productivity figure available and the volume available, an estimate can be made on the man-hours needed (Table 5). The estimated man-hours needed can be added up and compared to the actual man-hours used. This will give an indicator on efficiency or accuracy of the planning of man-hours.

| | Productivity detailed interim | | |
|---|---|---|---|
| | Data on cubic meters | Data on Man-hours | Performance indicator structurally available from (date) |
| Inbound unloading | Available | Not available, but estimate made based on current productivity | Half December 2003 |
| Inbound put away | Available | Available from SAP (manual data extraction) | End of November 2003 |
| Outbound full pallets | Available end of November 2003 | Not available, but estimate made based on current productivity | Half December 2003 |
| Outbound master cartons | Available end of November 2003 | Not available, but estimate made based on current productivity | Half December 2003 |

**Table 5: Productivity interim solution, sub-process level estimates**

### 4.2.5 Conclusions related to available information

Only a part of the information available is used to actually control the operation. Thus not all information that is being created can be seen as useful. Next to that managers' requests indicate that not all information that is needed is present. Information is not available from one person, but is created by multiple people and stored on many different locations. In some cases more people create the same information. This results in a duplicate of effort and the possibility of miscommunication if indicators are not clearly defined. The fact that information is scattered indicates that it is not supplied in a structured way. For almost all indicators not an exact definition is available, allowing miscommunication when people interpret information in a different way. The creation of information often depends on the presence of one person. This means that information is not created once that person is not in the office because of illness or holidays.

It can be recommended to make a selection of performance indicators that are relevant and cover all information needed for all CAV departments. This information should be supplied in a structured way, making it easy to find the information and use it to manage and control the operations. The availability of information should not be depending on the presence of one person creating the information. Next to that, clear definitions need and all elements of the indicator such as source data and calculation methods need to be described to avoid miscommunication.

### 4.2.6 Interim publishing

The information that is available is collected and some minor additions are made to start publishing information in a structured way as soon as possible. This means that from December 2003 onwards, a Microsoft PowerPoint presentation with Operational Performance Indicators is created for as far as information was already available. Since January 2004, this presentation includes most indicators requested by the German Sony warehouse as well. These indicators are requested to give the German

operation insight into the Tilburg warehouse operations, for the reason that they want to be sure that the Tilburg warehouse can handle the German volumes in a correct way. These requests from Germany will be part of the final tool as well. An example of this presentation can be found in appendix I.

## 4.3 Possible Performance Indicators for the CAV Operation

### 4.3.1 Requests from future users

In order to get an overview of the requests of the future users of the performance measurement system meetings are held with department managers. These meetings have the goal to retrieve all requests and wishes they have so these can be taken into account when designing the performance measurement system. These requests are used to make a selection of the most relevant areas of performance as described in paragraph 6.3.

**Shift managers (warehouse operations)**

During an interview with both shift managers the following items are viewed as important to manage the warehouse operation.

| | **Requests from warehouse shift managers** |
|---|---|
| Area | Performance indicator wanted |
| Inbound | Lead-time |
| Outbound | Lead-time per area<br>Lead-time per shipment<br>Lead-time per wave |
| Outbound | Difference between times (gives administration times): products at 916 (staging area at the docks) up to and including Goods Issue (products are administratively loaded) versus products at 916 up to and including physical loading |
| Outbound | Actual versus Planned: goods issue time<br>Actual versus Planned: loading time |
| General | Productivity per area |
| Inbound and Outbound | Damages at inbound and<br>Damages at outbound |
| General | Efficiency, not from hours and efficiency (too much manual work) but from Radio Frequency equipment. |
| General | Utilisation rates: storage and docks |
| Outbound | Workload per area |

**Manager Customer Relations**

For Customer Relations most performance indicators that would be requested are in place or under development. On a daily base an overview is made of the disputes that are open (already validated by the sales company), the disputes that have been closed by Customer Relations and the new disputes that have been opened by the Sales Company. For the disputes a cube in SAP Business Warehouse is under development. Current requirements regarding disputes will be available starting from the end of December. As a prior solution a Microsoft Excel based tool was developed. This file contains multiple indicators regarding disputes.

For the other customer complaints or questions (non-disputes) an issue list is created in Microsoft Excel. The wish is to use a Microsoft Access database tool for this purpose. There is a database like this available at the Playstation (Sony Computer Entertainment) warehouse. It is tried to use the same

database tool for CAV Customer Relations. Open requests from Customer Relations also include some financial indicators. Although the focus of this report is operational and non-financial, the financial indicators mentioned are taken into account. The reason for this is that the Customer Relations department is working with values as operational information, because one of the important tasks is to trace who is financially responsible for a customer complaint.

| | **Requests from Customer Relations manager** |
|---|---|
| Type | Performance indicator wanted |
| Financial | Value of disputes versus invoice values |
| Financial | Costs of a dispute (versus claim value): costs of unsatisified customer, and all hours spent on solving a dispute |
| Non disputes | Issue list in Microsoft Access database (under development) |
| | **Background information that is useful for Customer Relations** |
| Transport | Planned versus Actual departure time of truck at the warehouse |
| Transport | Forwarder Performance (project 50) |

**Table 6: Requests from Customer Relations**

### Manager Planning and Services

The interview with the manager from the Planning and Services department resulted in the following items (Table 7) that are viewed as important to manage Planning and Services.

| | **Requests from Planning & Services manager** |
|---|---|
| Type | Performance indicator wanted |
| Lead-time | Planning for next day finished before deadline (inbound and outbound have separate fixed times) |
| Lead-time | Outbound express deliveries: duration for requests to be added to plan (target: as soon as possible, within 1 hour) |
| Forecast | Pre-planning (expected volumes and needed resources per area) finished before deadline |
| Accuracy | Accuracy of pre-planning: pre-planning versus actual figures |
| Accuracy | Percentage of deliveries forgotten (not added to plan) |
| Accuracy | Percentage of shipments deliberately put into a wave that is released later than what would be required to meet the deadline (according to Service Level Agreement) |
| Accuracy | Percentage of inbound shipments planned within norm from Service Level Agreement (already produced) |
| Accuracy | Workload planning: planned workload versus actual workload (per wave) |
| Type | Performance indicator wanted for long term planning |
| Lead-time | Long term planning (for three months) finished before deadline (monthly) |
| Accuracy | Long term planning versus actual |

**Table 7: Requests from Planning and Services**

It is noticed that not all information requested is available from the SAP systems or other frequently used information sources, but is mostly available from manually kept information in Microsoft Excel files. It is possible that not all information should be seen as performance indicators, but that some operational tasks that need daily monitoring are included as a request.

**Manager Quality Centre**

The requests from the quality centre are related to the task they executed: Updating master data for new products at inbound, green program for new products, and different stock control tasks.

| Type | Requests from Quality Centre manager<br>Performance indicator wanted |
|---|---|
| Damages frequency | Amount of products damaged per week, per material |
| Damages shipped | Amount of damages shipped to the returns centre, per material |
| Damages administrative, accuracy | Status of stock transport orders, indicates whether the products that are shipped are correctly processed in the system |
| Clearing (result of stock count) | Write on and write offs per day (in quantity or value) |
| Stock count | Frequency of stock count |
| Stock count | Accuracy of stock count (status) |
| Inbound not processed | Stock age of products not processed on inbound |
| Damage at goods receipt | Stock age of items in storage type 904, by material and qty |
| Missing at goods receipt | Stock age of items in storage type 903, by material and qty |
| Picking errors | Stock age of products in storage location NLPT, indicates products missing or over when delivering to the customer (customer claims), by material and qty |

**Table 8: Requests from Quality Centre**

**Manager Logistics Support**

| Type | Requests from Logistics Support manager<br>Performance indicator wanted |
|---|---|
| Accuracy | All data correctly entered in Yard Management System (no empty fields) |
| Accuracy | All data for shipment statuses correctly entered in SAP |
| Accuracy | All items on transport plan are ordered |
| Inbound | Expected time of arrival at SLE versus actual (truck, container and air) |
| Inbound lead-time | Cross-dock lead-time |
| Inbound lead-time | Time products spent in NL0X (before put-away) |
| Outbound | Expected time of arrival (driver notification) versus actual |
| Outbound | Expected time of departure truck at gate versus actual |
| Outbound | Expected time of arrival at customer versus actual |
| Outbound lead-time | Time between end loading and goods issue (status 5 -/- status 4) |

**Table 9: Requests from Logistics Support**

### 4.3.2 Total overview of possible performance indicators

A total overview of the possible performance indicators for the CAV operation that are suggested to put into place is made by combining information. First, there is requested information that has come from interviews with the managers of the CAV departments. Also, information is available from talking to people in the warehouse and looking at the process (during the time-study). All this information is listed and creates an overview of circa 100 elements to measure performance on, presented in appendix L (This appendix includes other information as well). This list contains all suggestions and

wishes, but is obviously too long to be fully implemented. The next step is to reduce this list to a list containing only the most relevant indicators. This selection process is described in Chapter 6.

# 5 Model for the Development of an Operational Performance Measurement System in a Warehouse and Distribution Environment

## 5.1 Introduction

This chapter presents a model for the development of an operational performance measurement system that can be applied to a warehouse and distribution environment. This model is based on available literature on performance measurement, performance management and warehousing. When browsing through literature on these items, it is noticed that the items are viewed from several perspectives such as the financial perspective (the root of performance measurement) and the operations management perspective that is more focused on the physical operation. Several levels of measurement can also be found, such as the strategic level (where the balanced scorecard is frequently used) or the operational level. In this project the focus is on information on the operational level and looked at from a non-financial operations perspective.

The first thing discussed is the use of a model. Second, the definitions of often-used terms are presented followed by the development process for a performance measurement system. Criteria are given for developing a valid performance measurement system. After that, the development process steps are explained in more detail, indicating how to execute the steps. The chapter will conclude with describing how the model can be applied in practice.

## 5.2 A Model for Developing a Performance Measurement System

The model presented is based on a literature review for which over 30 articles were used (references added after the report chapters). The 11-step process that is the result of the literature review can be used as a guideline for developing a performance measurement system in a warehouse and distribution environment. Using this model enlarges the chance that no crucial elements of the development process are forgotten and thus increases the chance for success. The definitions presented in paragraph 2.4.2 are partly extracted from the reviewed literature and can be applied to this chapter as well.

## 5.3 Performance Measurement System Development Process

### 5.3.1 Steps in the Development of a Performance Measurement System

The result of the literature review, regarding the development of a performance measurement system is an 11-step development process. These steps are discussed in more detail in paragraph 5.4. Looking at the separate steps they can be grouped into 5 phases:

1 Strategy identification
   - **Step 1: Identify a company's strategy, objectives etc.**
     → Strategy identified

2 Indicator development
   - **Step 2: Derive relevant dimensions of performance from strategy**
     → Dimensions of performance identified
   - **Step 3: Select indicators based on dimensions** (ensuring compatibility for indicators between business processes and/or functions and identifying links between indicators)
     → Performance indicators identified

- **Step 4: Audit the existing performance indicators / measurement system, identify existing measures, gaps and "false alarms"** (existing indicators that are not wanted)
  → Overview of what needs to be implemented from scratch
- **Step 5: Ensuring acceptance, communicate strategic objectives and process goals**
  → Future users accept the performance measurement system and see the value of this tool
- **Step 6: Create definitions, define data sources and target values for performance indicators**
  → Characteristics of each indicator formally listed to avoid misinterpretations

3 Infrastructure development
- **Step 7: Develop methodologies for taking the new measures, decide on format and frequency of performance measurement reports**
  → Development plan for creating the infrastructure to report performance indicators
- **Step 8: Judging technical feasibility and economic efficiency**
  → Feasibility check of development plan

4 Implementation
- **Step 9: Implementing the performance measurement system**
  → Execution of development plan

5 Use
- **Step 10: Using the performance measurement system**
  → Using the performance measurement system
- **Step 11: Periodic review of the appropriateness of the performance measurement system**
  → Periodic review of the system (selected indicators, format of reports, etc.)

The 11-step process as presented can be applied in many types of business and does not necessarily have to be applied to a warehouse and distribution environment. The items that are specific for a selected environment will be the indicators.

### 5.3.2 Criteria for a Performance Measurement System

When developing a performance measurement system as described above, there are criteria that one can take into account as guidelines to validate correct development. Using these criteria will result in a more solid system.

| Author | Criteria for a system | Description (if available) |
|---|---|---|
| Caplice (1995) | Comprehensive | The measurement system captures all relevant constituencies and stakeholders for the process |
| | Causally Oriented | The measurement system tracks those activities and indicators that influence future, as well as current, performance |
| | Vertically integrated | The measurement system translates the overall firm strategy to all decision makers within the organisation and is connected to the proper reward system |
| | Horizontally integrated | The measurement system includes all pertinent activities, functions and departments along the process |
| | Internally Comparable | The measurement system recognises and allows for trade-offs between the different dimensions of performance |

| Author | Criteria for a system | Description (if available) |
|---|---|---|
| | Useful | The measurement system is readily understandable by the decision makers and provides a guide for action to be taken |
| | Cohesive | |
| | Complementary | |
| Fortuin (1988) | Simple and easy to understand | |
| | Clearly defined | |
| | Meaningful | |
| | Available on time | |
| | Available with the frequency agreed upon | |
| | Consistent | |
| | Derived from already existing data (if possible) | |
| | • The goals of the organisation are clear, to the supplier as well as to the customer<br>• All users accept the performance indicators as measures<br>• The performance indicators yield insight into the state of affairs<br>• The performance indicators derived from quantities that can be influenced or controlled, by the user, alone or in cooperation with others<br>• Supplier and customer, both users of the a performance indicator in their own right, agree that given performance indicators indeed are relevant for customer satisfaction | |

**Table 10: Overview of criteria for a performance measurement system**

## 5.4 Development Process Steps

In this paragraph the development phases and the corresponding development steps are described in more detail. These descriptions are extracted from reviewed literature and can be the result of the combination of different articles.

### Step 1: Strategy Identification

The first step is the identification of strategy. An organisation should define its objectives, i.e. its 'targets', and assign a priority to each of them. Next, plans should be made, actions started to reach the targets, and parameters defined by means of which the performance will be measured. At this point, performance indicators can enter the picture: they can indicate quantitatively how the performance is qualitatively going. This implies that good performance indicators are derived from the organisation's objectives. (Fortuin, 1988)

For the sake of involvement of personnel, during implementation as well as thereafter, the organisation to be monitored via performance indicators, should have objectives that are clear to everybody (Fortuin, 1988). When there is no formal strategy formulated, other goals or objectives of the company should be used. Since this is only an identification step and not a development step, no further details are given.

### Step 2: Deriving relevant Dimensions of Performance from Strategy

Phase 2, indicator development, starts with deriving dimensions of performance. These dimensions are derived from strategy. When selecting dimensions, basically two decisions have to be made. The first decision regards the level in the organisation and/or the type of indicators. In this report the

focus is on operational, non-financial measures. Once the level and/or type of indicator are decided on, a selection can be made of the dimensions. Since this report discusses operational indicators, the operational level is used for selecting dimensions. An overview of possible levels is presented in Table 11, an overview of dimensions is given in Table 12. This overview has been created by reviewing multiple articles (Flapper, 1996; Kueng, 2000; Nevem werkgroep, 1989; van Damme, 2000; Caplice, 1994; Lohman, 2002; Neely, 1995).

| Levels | Examples |
|---|---|
| Decision type | Strategic / tactical / operational (Organisational hierarchy, Global versus local, Area of application, Link / Function / Subsystem / Activity) |
| Level of aggregation | Overall / partial |
| Measurement unit | Monetary (Financial versus non financial) / physical / dimensionless |
| Internal versus external | |

**Table 11: Possible levels of indicators**

| Operational Dimensions |
|---|
| Utilisation (Actual input/normal input) |
| Effectiveness (Actual output/normal output) |
| Productivity (Actual input/actual output) |
| Efficiency (Norm input / actual input) |
| Process parameter: actual state variable |
| Flexibility |
| Qualitative |
| Performance |

**Table 12: Operational dimensions for performance indicators**

The selected dimensions can be applied to all kinds of operations; it does not necessarily have to be a warehouse and distribution environment. However, it can also be applied to a warehouse and distribution environment. Some examples can be: storage utilisation, productivity in number of pallets handled per man-hour, and for flexibility the number of express deliveries.

## Step 3: Selecting Indicators based on Dimensions

What gets measured gets attention, particularly when rewards are tied to the measures. Grafting new measures onto an old accounting-driven performance system or making slight adjustments in existing incentives accomplishes little. Enhanced competitiveness depends on starting from scratch and asking: "Given our strategy, what are the most important measures of performance?" "How do these measures relate to one another?" "What measures truly predict long-term financial success in our businesses?" (Eccles, 1991)

The third step of the system development process is the second step of the development of indicators. In the process of selecting indicators (grouped by the previously selected dimensions) one has to remember that indicators are related to each other. Therefore, these relations are discussed for ensuring that these relations are taken into account during development. Also some criteria can be taken into consideration when selecting indicators, so the selected indicators will be valid. Some examples of indicators used in a warehouse and distribution environment that are extracted from literature, can be found in appendix N.

### Relations between indicators

Eccles (1992) states that, when non-financial performance measures are introduced into the management process, explicit attention needs to be paid to what the relationships are among the various measures (examples are: the relation between quality and customer satisfaction or the relation between customer satisfaction and profitability). It is important to ensure compatibility of indicators between business processes and/or functions and to identify the links between indicators.

### Criteria for indicators

There are some conditions one can give for ensuring solid performance indicators and solid performance information. These conditions are formulated as criteria for indicators and presented in Table 13. They can be applied to a warehouse and distribution environment as well as to other business environments.

| Author | Criteria for performance indicators |
|---|---|
| **Caplice, 1994** | Validity |
| | Robustness |
| | Usefulness |
| | Integration |
| | Economy |
| | Compatibility |
| | Level of detail |
| | Behavioural soundness |
| **Schneiderman, 1996** | A reliable proxy for stakeholder satisfaction |
| | Weakness or defect oriented (have an ideal value of zero) and continuous valued |
| | Simple and easy to understand |
| | Have well documented, unambiguous, consistent, appropriately smoothed, and metrological sound operational definitions |
| | Timely and accessible to those who can best use them |
| | Linked to an underlying data system that facilitates the identification of root causes of gaps in scorecard results, and |
| | Have a formal process for their continuous review and refinement |
| | Wherever possible and sensible, scorecard goals should be disaggregated and deployed downward in the organisation so that each employee understands their piece of the big picture |
| **Fortuin, 1988** | Performance indicators should be well-defined, simple, understandable and available promptly to their users. |
| | The presentation of performance indicators should be accompanied by an indication of the target to be achieved. |
| | Targets have to be challenging, but realistic. |
| | Upon reaching a target, a new target (more difficult and challenging) should be set. |
| | Performance indicators should be relevant, i.e. referring to affairs or parameters that are controllable by the recipient of the performance indicator. |
| | Supplier and consumer of the performance indicators should agree on their relevance and meaning. Preferably, they select the performance indicators to be used in close cooperation. |
| | When implementing performance indicators, an organisation should concentrate on a limited number (say, between five and ten) of the most important indicators |

| Author | Criteria for performance indicators |
|---|---|
| | Performance indicators have to be used in combination with each other so as to cover all relevant aspects of an activity, product or service. |

**Table 13: Overview of criteria for a performance indicator**

## Step 4:Audit the existing Performance Indicators / Measurement System

In Step 4 of the systems development process the existing performance indicators or the existing measurement system will be audited. This means that the newly identified measurement requirements (in step 3) are compared to the information that is already available. This way identification can be done of existing measures, gaps (measures not yet available) and "false alarms" (existing indicators that are not wanted). This will result in an overview of what needs to be implemented from scratch. (Based on Medori (2000)) Stage 4 in the process described by Medori (2000) presents the process for auditing already existing performance indicators.

This step is about auditing a company's existing performance measurement system. The procedure is straightforward: primarily an existing set of measures are listed down and compared to the new measures that have been identified and selected. The audit process follows three distinct themes: (1) Existing measures that tie (congruent) with the new selected measures are kept and continually used. (2) Existing measures that do not tie (divergent) with the new selected measures are deemed no longer relevant or useful to a company. These measures are termed "false alarms" (Dixon et al., 1990) - which are presently being used to improve something that has few positive, and perhaps many harmful consequences for a company, and so should be scrapped. (3) New measures selected that do not tie with existing measures are implemented. These measures are critical measures and are termed as "gaps". Gaps are measures that are important to a company's success but are presently not being measured by the company's measurement system (Dixon et al., 1990). Implementing this category of measure creates an opportunity for a company to enhance its measurement system. Failing to use these measures results in something important to a company being neglected. (Medori, 2000)

## Step 5:Ensuring Acceptance, communicate Strategic Objectives and Process Goals

A very important aspect of developing performance indicators is how to make sure that the measured variables can be related to the responsibility area of one or more people in the organisation (De Kok, Bertrand, 1995). This can be done by involving these people and asking them for their responsibilities and how what they think is needed to manage these responsibilities. Managers and employees also benefit from having clear objectives and responsibilities. (For further details see step 10)

## Step 6:Create Definitions, define Data Sources and Target Values

Each indicator needs to be clearly defined in order to avoid misinterpretation. Things like scope and the calculation of the indicator need to be described in detail, to ensure that any person calculating the indicator will calculate the correct result. For each indicator one has to define where data (input) comes from and how this data can be accessed. Furthermore, target values (to-be values) have to be determined for each indicator. (Kueng, online: Building a Process Performance Measurement System: some early experiences)

In order to avoid confusion it may be useful to indicate who supplies the performance indicator and for whom the information is intended, the supposed users. If possible and relevant, the supplier could also mention recommended actions for improvement, together with the name of the person(s) or of

the organisational unit responsible for carrying out these recommendations. This is important especially for performance indicators at middle management level. (Fortuin, 1988)

## Step 7:Develop Methodologies for taking the new Measures, decide on Format and Frequency of Reports

Part of developing new performance indicators is developing the methods to take the measures. This can be retrieving the data source, looking at data extraction methods to get the data and deciding how to calculate the indicator values. Next to that, it needs to be decided how the information will be presented and how often.

Fortuin (1988) mentions that each performance indicator characterises an activity at a certain instant of time. In order to facilitate comparison with the past – only then does progress become visible! – previous outcomes are also shown. Moreover, the target has to be included, thus indicating how far away the objective still is. Once a target is reached, a new, more challenging (and motivating) target is set, because improvement is always possible.

Eccles and Fortuin seem to have a difference of opinion on the importance of historical data. While Eccles states that only the comparison to the performance competition matters, and not a company's own past, Fortuin states that progress only becomes visible once the performance is compared to previous outcomes.

## Step 8:Judging Technical Feasibility and Economic Efficiency

To assess the current performance level of the selected indicators, different data sources have to be accessed. Through the identification and definition of data sources, hints concerning feasibility and costs can be obtained. In short, the benefits of an indicator must exceed the costs. This step provides a feasibility check of the development plan. (Kueng, online: Building a Process Performance Measurement System: some early experiences)

## Step 9:Implementing the Performance Measurement System

Phase 4 equals step 9, the implementation. Implementation has several aspects. Since this is a complex process, several views of authors are listed below.

Veterans know it is easier to preach revolution than to practice it. Even the most favourable climate can create only the potential for revolutionary change. Making it happen requires conviction, careful preparation, perseverance, and a decided taste for ambiguity.
Eccles (1991) identifies five areas of activity that sooner or later need to be addressed:

1. Developing an information architecture
2. Putting the technology (hardware, software, and telecommunications technology) place to support this architecture
3. Aligning incentives with the new system
4. Drawing on outside resources
5. Designing a process to ensure that the other four activities occur

(Eccles, 1991)

Implementation is only sensible if the organisation has decided to go for 'continuous improvement'. This is an essential condition because it guarantees that, information presented as performance indicators, will indeed be used. Of equal importance is top-management involvement. (Fortuin, 1988)

Schneiderman (1996) offers the following view as to why most balanced scorecards fail:

1. The independent (i.e. non-financial) variables on the scorecard are incorrectly identified as the primary drivers of future stakeholder satisfaction.
2. The metrics are poorly defined.
3. Improvement goals are negotiated rather than based on stakeholder requirements, fundamental process limits and improvement process capabilities.
4. There is no deployment system that breaks high level goals down to the sub-process level were actual improvement activities reside.
5. A state of the art improvement system is not used.
6. There is not and cannot be a quantitative linkage between non-financial and expected financial results.

It is believed that these areas of failure can also apply to using a performance measurement system in general even if this is not a balanced scorecard.

## Step 10:Using the Performance Measurement System

This step consists of two items. First, a monitoring process is described that explains how to use the measurement system as a management tool. The second item that is discussed, are the benefits of the performance measurement system for managers and employees. This is discussed because it is thought that without seeing the benefits of the system, the system will not be used correctly or not at all.

### Monitoring process

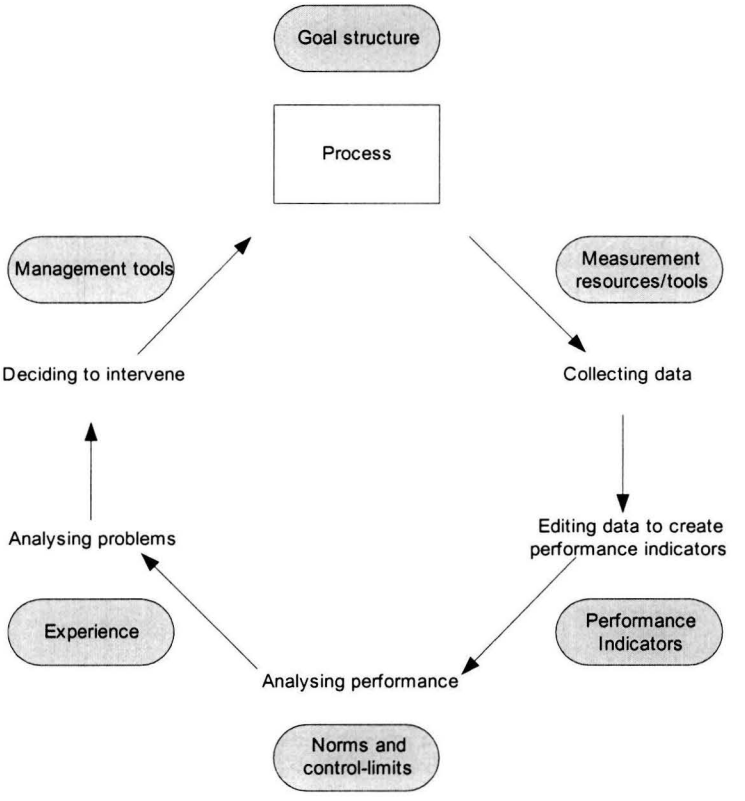



**Figure 10: Management control circle (Nevem werkgroep, 1987)**

A management circle, used to control a process, can be seen as a number of phases that one has to follow sequentially. These phases are presented in Figure 10. It may be noted that the steps "collecting data" and "editing data to create performance indicators" are steps that could be executed automatically when a macro is created to import data and by using the database query functions.

**Benefits for employees and managers**

It is thought that a performance measurement system will not be used when the users are not aware of the actual benefits and possibilities. These benefits are listed below.

***Benefits for Managers***

- Improved control: feedback provided by performance measures gives managers better control over their areas of responsibility.
- Clear responsibilities and objectives: Good performance measures clarify who is responsible for specific results or problems.
- Strategic alignment of objectives: Performance measures are probably the best way to communicate a company's strategy throughout the organisation.
- Understanding business processes: When it comes to understanding a production process, the simple fact is that if you are not measuring a process, you cannot understand how it works.
- Knowing what a process can do-its capabilities: Knowing the capability of a machine is essential for determining what action needs to be taken to correct a problem.
- Improved quality and productivity: To make quality improvement work, the following measures are needed.
    1. The size of the gap between what customers want and what they are getting. This determines the size of the performance problem. In fact, without knowing this gap, you do not even know there is a problem.
    2. Measurements of the process providing the goods or services. This provides an understanding of the process. Without measures, how do you know where the problems are located and which ones should be attacked first? The answer is you cannot know, which is why getting performance measures in place should be one of the first steps anyone takes when trying to improve quality and productivity.
    3. The size of the performance gap, after changes have been made to improve the process providing the goods or services. This tells you whether your attempts to improve performance worked. Without this measure, you are just guessing or engaging in wishful thinking.
- More efficient allocation of resources: Good measures greatly improve managers' decisions about where to allocate resources by establishing the relative importance of problems and opportunities.
- Better planning and forecasting: Managers who understand how processes work and their capabilities, are obviously able to make more reliable plans and forecasts than those who do not.
- The freedom to delegate: When managers can stay in touch with what is happening through performance measures, the fear of delegating disappears. So too, does the tendency to micro-manage, which is degrading to most employees. Being able to manage from a distance can de more to increase a manager's personal productivity and mental health than just about anything.
- Defending your position: In the business world, covering your ankles and arguing your position is much easier to do when you have the numbers on your side.
- Changing a company's culture: By defining common goals, performance measures promote teamwork. A team cannot exist if there is no shared goal, so when group goals are defined a clear reason for teamwork is created. Numbers get people oriented toward rational discussion instead of debating on the basis of feelings and opinions.

(Kaydos, 1999)

***Benefits for Employees***

- Clear responsibilities and objectives: In essence, performance measurement is all about telling everyone in a company what is important for them to accomplish and giving them feedback on how well they are doing. Making people accountable is one thing, but specifically saying what they are accountable for is quite another.

- Seeing accomplishments and receiving recognition: The capacity for managers to coach, appraise, give feedback, and reward performance is the area where employees say their managers need to improve the most.
- Being evaluated objectively: Fair reward and recognition is the cornerstone for building a motivated and effective organisation. Even with good measures, judgements have to be made about the performance of individuals and groups, but without them, properly equating performance with reward is practically impossible.
- More empowerment: As mentioned before, performance measures enable managers to delegate responsibility and manage from a distance. Performance measures also discourage micro managing by focusing attention on results and away from the minute details of how they were obtained. This will lead to more freedom for supervisors, employees, and work teams, making work more enjoyable. Life also becomes more enjoyable for managers when they do not have to worry about being blind-sided by problems, do not have to get into all the details of operations, and see the higher performance yielded by delegation and empowerment.

(Kaydos, 1999)

### Step 11: Periodic Review of the appropriateness of the Performance Measurement System

For many companies the problem is that there are too many performance measures – too many that are obsolete and too many that are not consistent (Keegan, 1989) Even if new metrics are rigorously examined, existing metrics are typically not reviewed in the context of the entire system which could result in an outdated and untested performance measurement "system" where the interrelations between the metrics are not known, duplication is frequent, and omission is undetectable (Caplice, 1995). Finally, recognise that once begun, this is a revolution that never ends. It can be regarded as an ongoing, evolving process.

(Eccles, 1991)

Many performance measurement systems have neither kept up with the changing role and scope of logistics nor have they been systematically examined or evaluated (Caplice, 1995). Evaluation can take place on two levels, the individual metric and the performance measurement system in order to maintain the relevance and effectiveness. The re-evaluation of performance measurement systems should be conducted for both the individual metrics and the performance measurement system as a whole. Three objectives exist for the evaluation of the individual metric:

1. Establish useful criteria which can be applied to evaluate individual logistics performance metrics.
2. Identify any trade-offs which are present in the selection of individual performance metrics.
3. Classify and critique existing performance metrics for a process, rather than functional orientation. (Caplice, 1994)

## 5.5 Applying the Model

In the next chapters the guidelines presented in this chapter will be applied to the CAV warehouse. It is checked if the different steps can be directly applied in this environment and what the end result would be for each of the different steps. In some cases the steps can not exactly be applied, but they are used as a guideline.

# 6 Development of Operational Performance Indicators for CAV

## 6.1 Introduction

The development process described in the previous chapter is applied to the CAV warehouse. In this chapter the phases 1 and 2 from the development process are discussed. Phase one, the identification of strategy, is presented first. Second, the selection of indicators is presented. The first selection is on a general level; the second selection is based on the general selection and developed in further detail by department. The selection of indicators covers steps 2 and 3 of the development process.

After the selection of indicators, the development plan for the indicators is created. In this development plan step 4 of the development process is covered. Step 5 is relevant for ensuring acceptance. Selecting indicators together with the future users and keeping them aware of the project progress ensures acceptance. This step is not discussed in detail in this report, because it is very operational. The last part of this chapter discusses the last step of phase 2, the creation of definitions, the identification of source data and target values.

## 6.2 Goal of the CAV Operation

The transformation process from a country warehouse to a European Hub that the CAV operation is going through is part of a bigger project that creates a new organisation. This new organisation is put into place, because of the wish for achieving specific objectives. These objectives are the following:

Objectives of the new organisation (Not only for logistics, communicated on the plasma screens):

- Improving the service to the customer.
- Reducing inventory levels.
- Reducing logistic costs.

Next to these objectives, a specific goal is available for logistics. Although this goal is not formally announced, it is the general feeling that this is what should be achieved. As this goal is most related to the logistic operation and thus also the CAV warehouse this goal will be used as a reference for the Operational Performance Measurement System.

The goal for the logistics organisation is to deliver the goods to the customer:

- On time,
- In the right quality, and
- At the lowest possible cost.

Next to these goals, the operation is putting a lot of work in the preparation of the Go-live for Germany (the moment when German customers will be getting deliveries from Tilburg). For this purpose, the Germany Go-live, the indicators are used as well to monitor if the operation is ready to handle this extra task. Requests for performance information that have come from the German operation are therefore also included (appendix K).

It should be possible to monitor on an operational level, the choices that have been made on a strategic level regarding the new organisation.

## 6.3 Operational Performance Indicator Selection on General Level

Before the indicators for each department are selected, a selection of the indicators is made on a general level, covering the entire CAV operation. This means that the selection at this level contains the indicators that are considered most important for the CAV warehouse.

As presented in the previous chapter, as a part of step 2 of the development process, the level or type of indicators needs to be defined. In chapter 2 it is already decided that the level for the decision type will be operational. The level of aggregation will cover as well overall as partial processes. The focus is on non-financial indicators, however in case of customer relations some requests contain financial values. While most measures focus on the internal operations, indicators like carrier lead-time might be seen as external.

| Levels | Applied to this project |
|---|---|
| Decision type | Operational, CAV warehouse related |
| Level of aggregation | Overall / partial |
| Measurement unit | non financial/ physical |
| Internal versus *external* | Both |

**Table 14: Levels of performance indicator for the CAV performance measurement system**

The selection process for the indicators on the general level mainly consists of two steps.

1. Priorities are assigned to the list with possible performance indicators for the CAV operation that contains managers wishes completed with indicators mentioned during other interviews or meetings (about 100 items, this is the list presented in the last paragraphs of chapter 4). The ranking of indicators is made in two ways:

    - The impact of an indicator on cost, speed and delivery reliability (sometimes also referred to as quality). This covers the goals of the CAV operation. The ranking is made by the General Manager of EMCS E / Logistics and the manager from CAV Operations Support.
    - Priorities given by managers from the CAV warehouse.

In both rankings the entire list is presented to the people making the ranking. For each item on the list a score is assigned on a scale of 1(low priority) – 3(high priority), or it is left open if it is not of interest at all. Ranking these indicators resulted in a suggestion-list of 14 General Level Operational Performance Indicators that are frequently seen as important and/or have a high impact. This list is presented as a suggestion for selecting these indicators on a general level and can be found in appendix L.

2. The second step is discussing this suggestion-list of 14 General Level Operational Performance Indicators during a meeting with the general manager for CAV, manager of operations support, general manager for EMCS/logistics and others on 15-12-2003. Involving these people in the selection process will create more management support and more valid indicators. The result of this meeting is a change of the list that hereafter contains 15 indicators. The indicators selected are listed below and the comments made during these meeting are presented in the appendices (M: Comments made during meeting selecting general level indicators). These 15 indicators can also be seen as the main areas of performance.

1. Productivity (Inbound; unloading & put away / Outbound; picking per area & loading)
2. Lead-time (Inbound; goods receipt – pallet build - pick up pallet – put away / Outbound; wave start – to creation – to confirmation – start loading – end loading – start goods issue-print documents – print CMR)
3. Stock accuracy
4. Stock count frequency and progress
5. Damage and Missing
6. Storage utilisation (capacity usage report)
7. Accuracy of planning or outbound production (volumes) actual versus plan
8. Expected versus actual truck arrival and departure
9. Planned Goods Issue – versus – Actual
10. Delivery changes
11. Disputes versus deliveries
12. Carrier transport lead-time
13. Complexity of operation (background information, to be defined)
    - Nature of inbound (slip sheets, loose loading, pallets, etc.)
    - Inbound profile (truck, air, container)
    - Delivery profile (% of directs, platform and replenishments)
    - Nature of outbound (cubic meter per TO)
    - Volumes versus limits in SLA
14. Disputes lead-time
15. Returns Classification

The selected indicators can be compared to the dimensions found in literature and by doing this it shows that all dimensions found are relevant for the CAV operation as well (Table 15: Dimensions found in literature applied to CAV). The selected Operational Performance Indicators on the general level (the 15 indicators presented above) form the basis for the specific Operational Performance Indicators for each department (presented in the next paragraph), although these departments specific indicators will be defined on a more detailed level.

| Operational Dimensions | Applied to CAV in the indicator: |
|---|---|
| Utilisation (Actual input/normal input) | Storage utilisation |
| Effectiveness (Actual output/normal output) | Planned versus actual goods issue or truck departure / lead-times |
| Productivity (Actual input/actual output) | Productivity |
| Efficiency (Norm input / actual input) | Productivity rating |
| Process parameter: actual state variable | Number of open disputes (backlog as part of lead-time) / stock accuracy / stock count frequency and progress |
| Flexibility | Express orders added to plan (planning accuracy) |
| Qualitative | Damage and missing / Stock count results / planning accuracy / delivery changes / disputes versus deliveries / complexity of operation / returns classification |

**Table 15: Dimensions found in literature applied to CAV**

## 6.4 Operational Performance Indicators Selection per Department

The selection of Operational Performance Indicators for each department is based on the list of 15 Operational Performance Indicators that are selected on general level, the main areas of performance. This list is used to match the initial requests from manager for each of the departments. Next, this

"match" is discussed with the concerning managers and a final selection is made. In this chapter, this process will be shown in detail for one department. For the other departments the selected indicators are presented in appendix O.

### 6.4.1 Matching of requests from a department to general indicators

Two levels of information are created to distinguish between performance indicators and related analysis information.

- The first level contains information that is regarded as most important management information for a department. These are the **performance indicators**.
- The second level contains information that is used for further analysis such as further details of an indicator or performance on other parts of the process or other departments that influences the performance of the department. This is called **analysis information**.

| Selected indicators general level | Logistics Support<br>Managers requests<br>First level; Performance indicators | Second level; analysis information |
|---|---|---|
| 1. Productivity | *Number of shipments per man-hour LS* | |
| 2. Lead-time | • **Cross-dock lead-time**<br>• **Time products spent in NL0X (before put-away)**<br>• **Time between end loading and goods issue (status 5 -/- status 4)** | *Inbound lead-times from SLA until warehouse (NL0X)*<br>*All statuses correctly entered in SAP (accuracy)*<br>*All data correctly entered in YMS (accuracy)* |
| 3. Stock status and integrity | | |
| 4. Stock count frequency and accuracy results | | |
| 5. Damage and Missing | | |
| 6. Storage utilisation (capacity usage report) | | |
| 7. Accuracy of Pre-planning or outbound production (volumes) actual versus plan | *Number of pallets per shipment actual versus planned* | |
| 8. Expected versus actual truck arrival and departure | • **Expected time of arrival at SLE versus actual (truck, container and air)**<br>• **Expected time of arrival (driver notification) versus actual**<br>• **Expected time of departure truck at gate versus actual** | • **All data correctly entered in Yard Management System (no empty fields)**<br>• **All data for shipment statuses correctly entered in SAP**<br>• |
| 9. Planned Goods Issue – versus – Actual | *Difference in hours planned versus actual goods issue* | *Time between end loading and goods issue*<br>*Outbound lead-times picking, loading* |
| 10. Delivery changes (instead of picking accuracy) | | |
| 11. Disputes versus deliveries | | |

| Selected indicators general level | Logistics Support<br>Managers requests<br>First level; Performance indicators | Second level; analysis information |
|---|---|---|
| 12. Carrier transport lead-time | • **Expected time of arrival at customer versus actual**<br>*Carrier transport lead-time versus target (in hours or time stamps)* | • **All items on transport plan are ordered** |
| 13. Complexity of operation (background information) | *Number of T1 shipments*<br>*Number of shipments inbound and outbound*<br>*Number of cross docks*<br>*Delivery profile* | |
| 14. Disputes lead-time | | |
| 15. Returns Classification | | |
| Items in **Bold** are requests from paragraph 4.3.1. | In **red and Bold** are items that were an initial request but priority changed during review. | Items in *italic* are items added during the review as discussed in paragraph 6.4.2. |

**Table 16: Logistics Support, total overview of selected indicators. Matching departments requests to selected indicators on general level (in bold font) , and added indicators during review (in *italic* font)**

## 6.4.2 Selecting indicators for a department

To select the indicators, specific for each department, a meeting with the department manager is scheduled to select the indicators for the concerning department. During this meeting the list of indicators with the requests matched to the main areas of performance is presented (the requests are the bold items in Table 16). This list is then discussed and reviewed and changes are made. These changes can be:

- Adding an indicator (in italic presented in this table)
- Removing an indicator (not applied in this case)
- Changing the priority of an indicator (in red and bold in this table)

Not all main areas of performance are relevant for each department. These irrelevant areas are indicated with a cross in the last two columns of the table.

For Logistics Support the final selection is presented in Table 16. Looking at this table with the matched indicators and the final selection, it can be seen that the following items have changed, for the reasons mentioned.

**Added**

- Number of shipments per man-hour LS; added as general management requirement
- Inbound lead-times from SLA until warehouse (NL0X); added as Logistics Support requirement
- Number of pallets per shipment actual versus planned; added as Logistics Support requirement
- Difference in hours planned versus actual goods issue; added as Logistics Support requirement
- Outbound lead-times picking, loading; added as Logistics Support requirement
- Carrier transport lead-time versus target (in hours or time stamps); added as Logistics Support requirement
- Number of T1 shipments, Number of shipments inbound and outbound, Number of cross docks, Delivery profile; added as Logistics Support elements of complexity

**Location/priority changed**

- All statuses correctly entered in SAP (accuracy); location changed
- All data correctly entered in YMS (accuracy); location changed
- Time between end loading and goods issue; location changed
- All items for transport plan are ordered; location changed

The indicators added as a requirement from Logistics Support are mostly indicators that are already formulated as a request from another department. Adding this information will therefore not be as complex or time-consuming as it would be if it were a new requirement. This situation, where indicators are added because information is available, also occurs during meetings with managers from other departments. It has to be watched for that information is not added just because it is available, because that would create an overflow of information.

The analysis information sometimes contains information that can possibly be part of the Operational Control Framework. During the review of the Operational Control Framework a link will be made between this framework and the selected performance indicators. Whenever it is felt that analysis information of the performance measurement system should be part of the Operational Control Framework or vice versa, changes will be made. This Framework is being reviewed during the final phase of this project and continuing after the end of this project.

After these meetings for each department specific indicators are selected. It should be noted that it needs to be possible to change a selection, when circumstances change. One of the requirements of the publishing tool will be to be flexible in the creation of reports that present the information to the different users.

## 6.5 Operational Performance Indicator Development Plan

With the 15 indicators selected, a development plan can be created containing the steps that need to be taken and the time needed. The full version of the development plan can be found in appendix H. The items discussed are:

- Status Mid-December
- Creating Operational Performance Indicators per department
- Indicator Information Guide development
- Reporting tool development
- Publishing tool development
- Creating Implementation and Communication plan

## 6.6 Performance Indicator Definition, Source Data and Targets

Step 6 of the development plan consists of creating exact definitions, source data and targets. To present the information for each indicator a Microsoft Excel file is created. An example of the information available for one indicator is presented in Figure 11: Example of the Microsoft Excel file containing definition, source data and targets. For each indicator this information is defined resulting in an Information Guide with all details for as well the indicators as the analysis information.

The Microsoft Excel file contains a worksheet for each Operational Performance Indicator with the following information:

- Unit of measure; indicates the format of the result. This can be percentages, a measure of time (hours or days), quantities, etc.
- Scope; indicates what the indicator is used for and specifies the areas that are part of this indicator (explained in detail in paragraph 6.6.1).

- Definition; formulates as precise as possible what is meant by an indicator.
- Target; indicates the value of the indicator that should be strived after. The target will have the same unit of measure as the indicator (explained in detail in paragraph 6.6.2).
- Calculation; formulates as precise as possible how an indicator should be calculated from existing data.
- Frequency; indicates how often new information regarding this indicator should be available and thus how often the indicator should be monitored.
- Source data; the list of source data shows where the information can be extracted from, for each data element needed to calculate an indicator (explained in detail in paragraph 6.6.3).
- Owner (definition), Data owner, Developer (enable data extraction), Reporter (delivering data), Publisher (distributing information) (explained in detail in paragraph 6.6.4)
- Influenced by / influences; these two lists give an overview of the indicators that influence the current indicator as well as the indicators that are influenced by this indicator. This identifies the links between the operational indicators.

The less obvious items from the above list are explained in further detail in the following paragraphs.

### 6.6.1 Scope

The scope of an indicator specifies two things at a time. The first item that is specified is the intention of the indicator: "what are we going to do with this information?". The second item that is specified by the scope is the elements of a process or information system that are part of the indicator. An example can clarify this: *The indicator "delivery changes" counts the number of changes on outbound deliveries. This means deliveries created for administrative purposes are not included.*

### 6.6.2 Target

*"Nothing is good or bad but by comparison" Thomas Fuller*

Targets are set for each indicator and for each level of detail. The targets can be based on several items. In some cases the targets are specified in the service level agreement, in other cases the target is available from budgets or a target is not present at all. Where targets are not currently available they are set together with the general manager of the CAV warehouse and based on history and experience. Targets are set so they are challenging, but also achievable.

### 6.6.3 Source data

All indicators need to be calculated from basic data. Each indicator needs more than one data element (volumes and man-hours for productivity, number of pallet places available and number of pallet places occupied for storage utilisation, etc.). All data needs to be extracted from information systems or other information sources. The different sources are:

- SAP PRC (Enterprise Resource Planning system)
- SAP PWD (Warehouse Management System)
- SAP BW (Reporting tool for SAP data)
- YMS (Yard Management System, Access tool for Sony Logistics Europe)
- Hours and Efficiency (Access tool for Sony Logistics Europe)
- Human Resources tool (Access tool for Sony Logistics Europe)

For each data element the data source is specified as precise as possible. This means that for the SAP PWD system the tables (codes) are given that contain the data (if this information is known).

### 6.6.4 Owner (definition), Data owner, Developer (enable data extraction), Reporter (delivering data), Publisher (distributing information)

There can be multiple people involved in actually producing performance indicators. To clarify each person's role in the production of performance indicators all roles are specified. The owner of the definition is in most cases the owner of the performance measurement system/project. This is the person who is responsible for the definitions and making sure that these are clear. The data used for the definitions can be owned by the person owning the process related to the data. This is to prevent people being addressed for bad performance, while the cause of the bad figures is incorrect data from another department or person. As an example the data from the Yard Management System can be used. This data is maintained by Logistics Support, and thus Logistics Support is seen as the owner of the data and is responsible for the data integrity. Data is not always widely and easily available. In some cases only certain people have the knowledge or ability to extract the data (reporter) or can make a system that will enable the extraction of data (developer). The person who is making the information available for the users is the publisher of the information.

## 6.7 Evaluation of Selected Operational Performance Indicators

The indicators that have been selected are created with the goals as defined in paragraph 6.2 in mind. This ensures that the most important aspects for the logistics warehouse operation are covered and relevant indicators are selected. The indicators from the service level agreement are also taken into account and the topics discussed in the service level agreement are represented in the operational indicators.

The approach of selecting the indicators together with the future users increases validity and usefulness. Since all requests are used to create the 15 main areas of performance and department indicators related back to the 15 main areas of performance it can be said that it the set of indicators is integrated. The indicators are compatible because the same definitions are used for all departments, whenever they need the same information. Next to that, the definitions for lead-time on a detailed level add up to the total inbound or outbound lead-times.

The Information Guide provides clear and unambiguous definitions of indicators, and describes more detailed information such as calculation methods, source data and data owners as well. Targets are also included in this Information Guide and these are defined to be challenging but achievable.

| KPI identifier | | OPI 2 | |
|---|---|---|---|
| Name | Nr. | Lead-time | |
| | | | |
| Scope | | Monitor the time it takes to receive or ship one shipment (or other unit) | |
| | | | |
| Units of measure | | Hours, one after comma position | |
| | | | |
| Definition First Level | 2.1.I | Inbound shipment Lead-time per mode (air, truck, container): Hours between Goods Receipt and Put-away | |
| | 2.1.O | Outbound shipment (with possibility to group by wave) lead-time: Hours between wave start and print CMR | |
| Target | | From SLA<br>Internal target: On premises to Goods Receipt within 4 hours | SLA |
| Calculation | 2.1.I | Time of latest Put away TO confirmation -/- time of Goods receipt of shipment | |
| | 2.1.O | Time of Print CMR -/- time of wave start for shipment | |
| Frequency | | Weekly | |
| Source data | | **Time stamps from SAP and YMS**<br><br>**SAP PWD Quickviews:**<br>**Inbound:**<br>Inbound putaway: LTAK - LTAP - LSEG (combined with Excel calculations)<br>Inbound shipment: VTTK - VTTP - LIKP - LIPS - SLEG<br>**Outbound:**<br>Shipment duration (outbound TO's): T311 - LTAK - LTAP (manual shipment type and route)<br>Shipment duration (shipments): T311 - T311A - LIKP - VTTP - VTTK<br><br>**YMS:** Truck at dock | SAP<br>YMS |
| | | | |
| Owner (definition) | | CAV OPI project owner | |
| Data Owner | | CAV Logistics support (shipment status), CAV whs operations / ERC manager | |
| Developer (facilitate extracting data) | | Ronald Vermeer / Rob Franssen / Roel Trommelen? | |
| Reporter (extracting data on required frequency) | | Automatically import data tables into Access / manually: Ronald Vermeer (SAP Quickviews), OPI project owner (YMS data) | |
| Publisher (make available for public) | | CAV OPI project owner | |

| Influenced by | Influences |
|---|---|
| Productivity | Planned Goods Issue versus Actual Goods Issue |
| Expected versus Actual truck arrival | Actual truck departure from warehouse / actual truck arrival at customer |

| Comments: |
|---|
| |

**Figure 11: Example of the Microsoft Excel file containing definition, source data and targets**

# 7 Design of Performance Measurement System Infrastructure

## 7.1 Introduction

This chapter discusses the design of the infrastructure: Phase 3 (steps 7 and 8) of the development process. Next to that phases 4 and 5, implementation and use, are touched upon in this chapter. Phases 4 and 5 are not part of the scope of this project. However, since they are closely related, the information that is available for these phases will be presented.

The different elements of the infrastructure are described first. Once the elements are known, a development plan is presented for the reporting and publishing tool. After that, all the elements are discussed in more detail and the design for each of the elements is presented.

## 7.2 Elements of Infrastructure

> "Count what is countable,
> Measure what is measurable,
> and what is not measurable,
> make measurable."
>
> Galileo Galilei (1564-1642)

- Data availability
  - Data sources
  - Methods for extracting data from data sources
  - Database for storing performance related data
- Creating information
  - Methods for calculating indicators (numbers)
  - Methods for creating graphs of indicators (graphs)
- Publishing information
  - Tool for publishing indicators (reports)
  - Overview of users with information needed per user and possibilities for sending the information

## 7.3 Operational Performance Measurement System Development Plan

For the development of the reporting and publishing tool a development plan is created. The steps of this plan can be found in Table 17: Operational Performance Indicators tool in Microsoft Access development process steps
and more details of this plan are presented in appendix P.

| Development process steps | Element of infrastructure |
|---|---|
| 1. Defining parameters | A: Data availability |
| 2. Defining source of parameters | A: Data availability |
| 3. Importing data files into Access (first manually, later automatically) | A: Data availability |
| 4. Calculating Operational Performance Indicators (creating queries) | B: Creating information |
| 5. Creating and validating format of graphs | B: Creating information |
| 6. Programming graphs in Access | B: Creating information |
| 7. Creating reports per department | B: Creating information / C: Publishing information |
| 8. Creating interface (Menu structure / web-like) | B: Creating information / C: Publishing information |
| 9. Test | C: Publishing information |
| 10. Use | C: Publishing information |

**Table 17: Operational Performance Indicators tool in Microsoft Access development process steps**

## 7.4 Data availability

The source and availability of the data that is needed for creating performance indicators has been discussed in paragraph 6.6.3. In order to easily access this data, the data needs to be extracted from the source information system and stored together with other relevant performance data. This implies the need for a database.

### 7.4.1 Extracting the data

For each of the different information systems that function as a data source, the data extraction method is different. Even within one information system, the data extraction can differ. Data from all SAP systems can be uploaded into Access automatically. However, this needs to be programmed by the Information System department of SLE. It needs to be checked how many hours this will cost, however it has been done before indicating that it is feasible.

**SAP PRC (Enterprise Resource Planning system)**

Information needed from the SAP PRC system can be extracted by using the existing queries available in SAP BW. When information from PRC is not available in Business Warehouse it needs to be investigated if it can be added or downloaded in another way.

**SAP PWD (Warehouse Management System)**

There is more than one method to extract the data needed from the warehouse management system. Data can be found by using transactions, looking at tables. Next to that, quick-views can be made that contain multiple tables linked together. Also, data from SAP PWD can be retrieved from SAP BW once this has been programmed. Some of the programming has already started.

**SAP BW (Reporting tool for SAP data)**

In SAP Business Warehouse different types of data is available. The data can be extracted by using pre-defined queries that extract the requested information into a Microsoft Excel file. The information from the Microsoft Excel files can be imported into Access.

**YMS (Yard Management System), Hours and Efficiency and Human Resources tool**

These three tools are all created with Microsoft Access and build for Sony Logistics Europe. For each tool it needs to be checked separately how the information can be automatically loaded into Access.

### 7.4.2 Storing data in a database

As a database tool Microsoft Access is chosen. This tool is already in use within Sony for multiple purposes (as mentioned during the discussion of data sources). Since this application can fulfil the demands and this tool is available, it is chosen. Data will be stored in different tables, and will be available for the creation of the indicators.

## 7.5 Creating information

For the creation of information the calculating and reporting functions of Microsoft Access are used.

### 7.5.1 Indicator numbers

Once the data needed to create the indicators has been imported to Microsoft Access tables, these tables can be used to create the actual performance indicator figures. This is done by creating queries based on the data tables.

### 7.5.2 Indicator graphs

The functionality in Microsoft Access to create a so-called Data Access Page creates the possibility to make a report including functions you normally find in forms. This makes it possible to add comments to a certain graph, whenever there is a need for that.

## 7.6 Publishing information

As mentioned during the creation of indicator graphs, Data Access Pages provide the functionality to create a report containing graphs and with the possibility to add comments. This functionality will be used for publishing the information. It should be noted that it needs to be possible to change a selection, when circumstances change. One of the requirements of the publishing tool will be to be flexible in the creation of reports that present the information to the different users.

### 7.6.1 Design of the Tool for Publishing Indicators

The tool that needs to be developed for reporting and publishing performance indicators, the Operational Performance Measurement System, needs to fulfil some requirements. These requirements are:

- Possibility to add comments and monitor the status of actions taken.
- Create reports with graphs, make it possible to see the underlying data tables.
- Show history and where possible show information by EBU /sales company drilldown.
- Show department/user specific reports.
- Possibility to extract reports for publication on other locations and for sending reports by e-mail.
- Structured and frequent reporting should be possible.

For publication of the performance indicators to for instance warehouse operators, who do not have immediate access to a PC, other locations for publishing can be used. These locations can be the plasma screens in the CAV warehouse.

### 7.6.2 Design of the Reports

The report will first show the most important aspects of performance, the performance indicators, for a specific user (level 1). The graphs of these indicators will contain historic data and if possible a trend line as well. On the same sheet, links will be available to more detailed information that has been requested, the analysis information (level 2). Two items in the report have the functionality of a form, because they allow the filling in or adding of data. The first field allows adding comments whenever this is needed. The next field allows adding information on actions taken and the progress on these actions. Next to that, links will be available to performance indicators on different organisational levels (where applicable) such as Service Level Agreement indicators, Logistics Operations Europe indicators and EMCS Supply Chain indicators. See Figure 12: Example layout of publishing tool as an example.

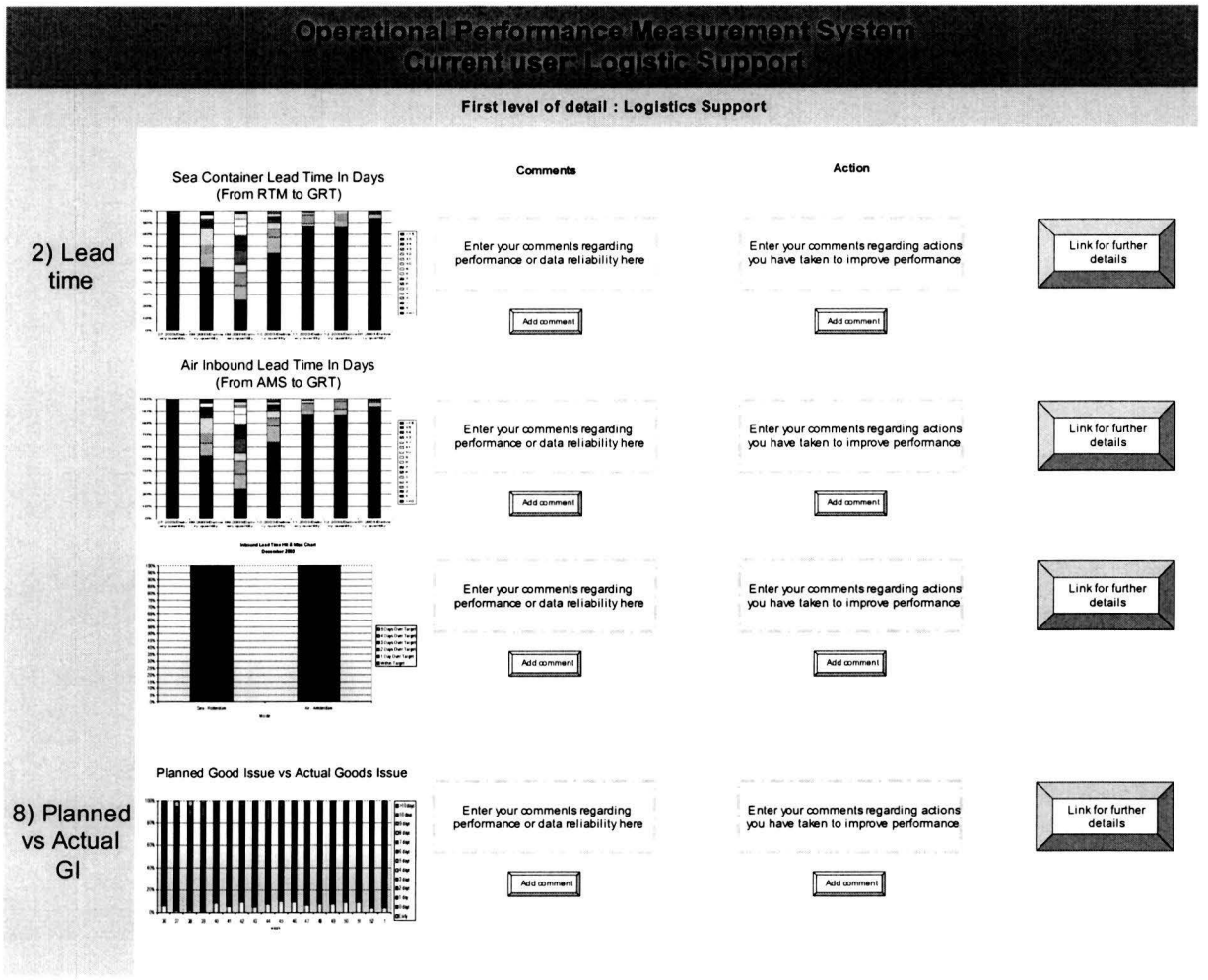



**Figure 12: Example layout of publishing tool**

All indicators relate to warehouse *processes*. The reports are made specific for the different *departments.*

### 7.6.3 Overview of users, the information needed and way of receiving information

There are different users of the Operational Performance Measurement System. Not all users are able to receive the information in the same way. All managers can receive the performance information in the form of a Microsoft Access Data Page. This page can be stored on the CAV network drive or on the user's own desktop. The warehouse operators do not have constant access to a computer, therefore the relevant information for this group is presented on the Plasma Screens in the CAV warehouse. On a high level (not much details) the information is put onto the SLE intranet, accessible for all SLE employees.

| Department | Location to view requested data |
|---|---|
| General management | Data Access page |
| Manager Operations support | Data Access page |
| Manager Warehouse operations (including shift managers) | Data Access page |
| Manager Planning & Services | Data Access page |
| Manager Logistics Support | Data Access page |
| Manager Quality Centre | Data Access page |
| Manager Customer Relations | Data Access page |
| Manager Returns Centre | Data Access page |

| | |
|---|---|
| All CAV employees | Plasma screens near CAV coffee corners |
| All SLE employees | SLE intranet |

**Table 18: Users of the Operational Performance Measurement System and how they receive the information**

## 7.7 Harmonising Indicators at different Levels

Linking operational indicators to other level indicators only makes sense if the other indicators have been audited. This audit basically consists of meetings with the owners of the other indicators discussing duplicate indicators, deciding who will own those indicators thus removing duplicates and discussing definitions. For these meetings an inventory has been made of all the indicators at the different levels.

The result of the harmonisation process is a list containing all indicators available at the different levels, together with details about definition, status, availability in SAP Business Warehouse, actions that need to be taken, responsible level of the organisation, owner of the definition, etc. Of this list a hierarchy scheme is created showing the relation between the indicators at the different levels. An example for the inbound process is given in Figure 13. This hierarchy scheme is created for the inbound, outbound, warehouse and other processes. All can be found in appendix Q.

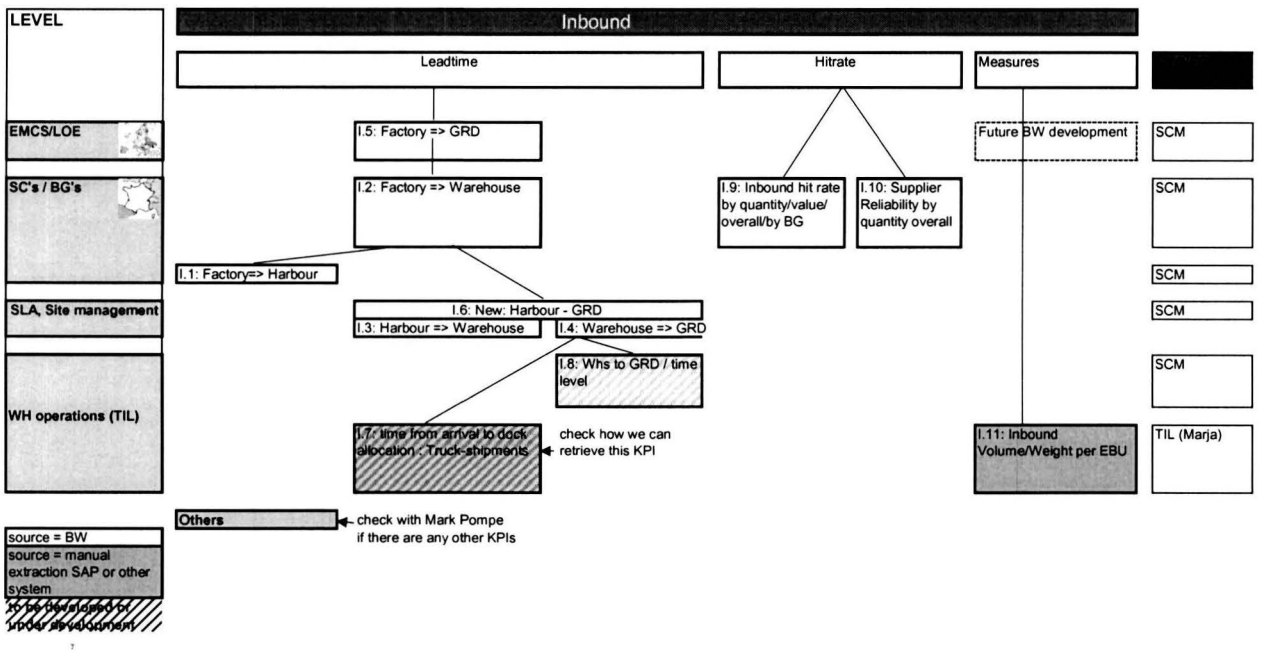



**Figure 13: Hierarchy of indicators at different levels, inbound processes**

# 8 Using the Performance Measurement System

## 8.1 Introduction

Once the Performance Measurement System has been developed it needs to be put into use. This chapter first presents the products that are the result of this project, to get a clear view of what is present and what is possible. Second the monitoring process is presented that can be used by the managers. This will explain the steps that have to be taken each week to keep track of performance. The action plan presented in the following paragraph discusses the next steps that need to be taken to come to an implemented and used Operational Performance Measurement System. Next to weekly monitoring performance, it is important to review the entire performance measurement system on a regular basis, such as twice a year. Actions that need to be taken during that review are described in the action plan as well. The developed Performance Measurement System is evaluated in the final paragraph of this chapter

## 8.2 Presentation of Project Products

This project has several different deliverables (see Figure 14) in the form of documents and in the form of the design of an Operational Performance Measurement System. The first document presents the indicators and analysis information that has been selected for each of the departments of CAV and for the General Manager of CAV. The second document provides all definitions, calculations, sources of data and other related information for each of the selected performance indicators as well as the selected analysis information. This document can be consulted whenever questions arise regarding the exact definition of the indicator, during the development or the use of the system. The third and final document gives an overview of all indicators and owners of these indicators at the different logistical levels of the organisation, together with more details about these indicators.

The above-mentioned three documents are used during the development and building of the Operational Performance Measurement System, the tool. In this tool all data needed to create the indicators is imported in the form of data tables. This data is used to create department specific reports, which contain specific indicators as selected and presented in the first document. Next to the operational performance indicators the reports provides the possibility to add a comment to a graph, whenever this is needed. It also provides the possibility to add information on actions that have been taken to improve performance. Another important feature of the report is the links that are present. These links provide the connection to the analysis information as has been selected, as well as to information on other logistics levels relating to the indicators in this report. An overview of the project products and the relations between the products are shown in Figure 14.

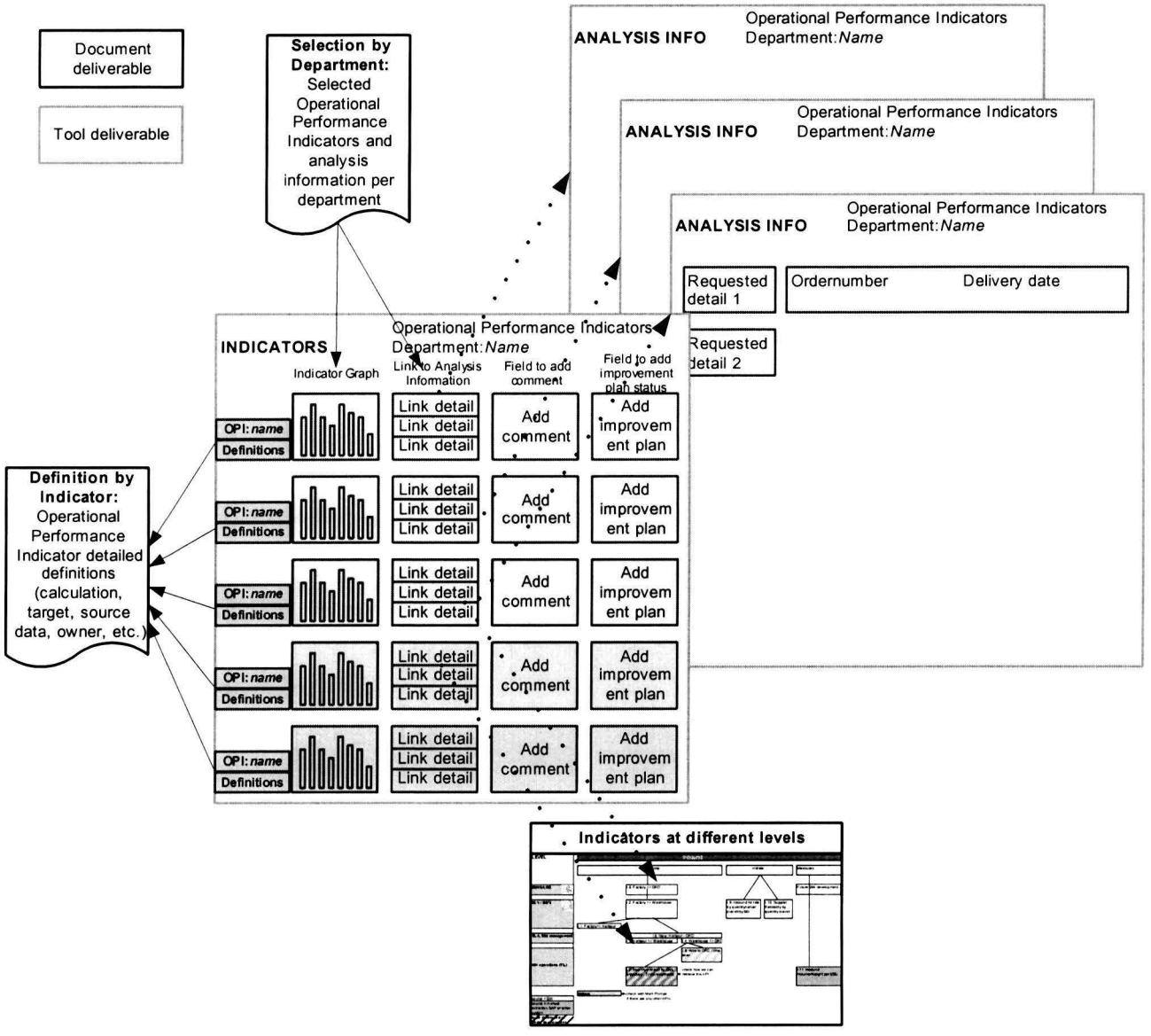



**Figure 14: Schematic of project products**

## 8.3 Weekly Monitoring Process

The monitoring process as presented in Figure 15 explains how the performance measurement system can be used to weekly examine performance in a structured way. When the designed performance monitoring process is compared to the management circle from literature as presented in chapter 5, it may be noticed that the collection of data and the editing of data to create performance indicators is not included. The reason for this is that in the designed Operational Performance Measurement system this is not part of the task of the user of the system. It is tried to import the data into the Microsoft Access tables automatically for as much as possible. Whenever it is not possible to automatically upload the information to Access, the owner of the Operational Performance Measurement System will download the data from the data source and manually import it into Microsoft Access. This will make it easy for the user to review his performance indicators.

Weekly performance monitoring process

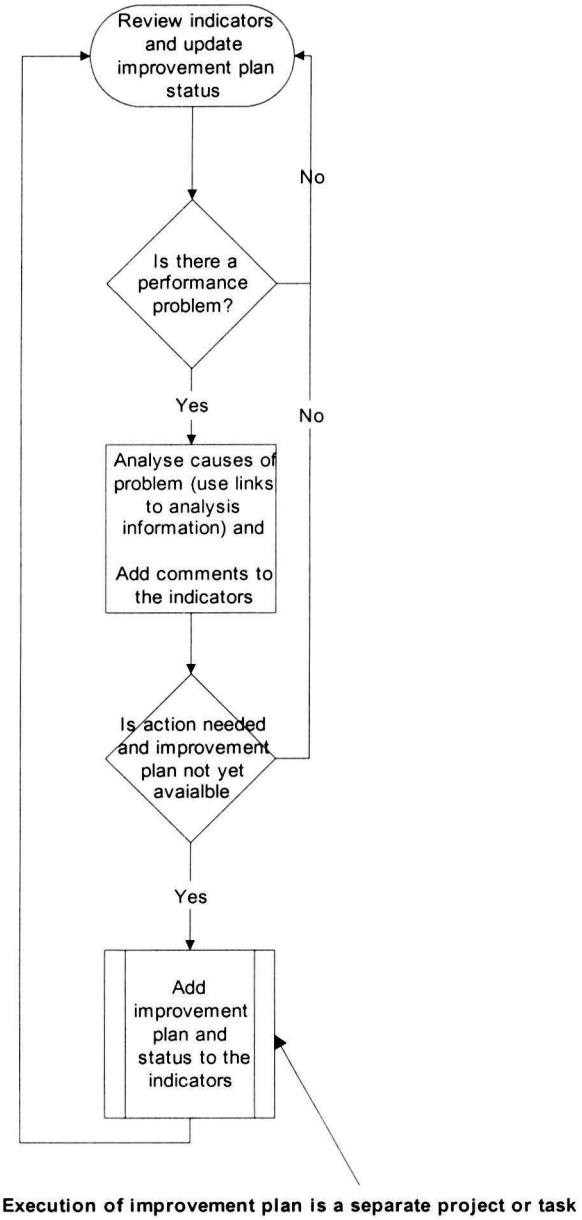



**Figure 15: Weekly performance monitoring process**

## 8.4 Action Plan Operational Performance Measurement System

The operational performance measurement system now needs to be implemented. The action plan described below, presents the status of all performance indicators including the analysis information and gives the status of development. After the indicators have been discussed, status and actions that need to be taken for the creation of the reports for the different departments is presented. Once the system has been implemented it needs to be used and reviewed as discussed in paragraphs 8.4.2 and 8.4.3.

## 8.4.1 Implementation

a. Indicators

| Indicator name and number | Status of indicator | Status of task and/or due date | | | | | |
|---|---|---|---|---|---|---|---|
| | | Definition of indicator | Definition of analysis info. | Source data available | Indicator (& calculation methods) available manually | Indicator in Access | Analysis information in Access |
| Productivity | Data on man-hours available from security and will be available more detailed from Hours and Efficiency. Volumes or other units needed for productivity available from SAP PWD, currently investigated if data can be uploaded automatically | 100% | 100% | Yes, for inbound and outbound, not for all departments | Yes, for inbound and outbound, not for all departments | Due beginning of March | Due date to be set |
| 1. Lead-times | Investigate if data from SAP PWD can be uploaded to Access automatically | 100% | 80% | Yes | Yes, published on a general level. Detailed information is available. | Due beginning of March | Due date to be set |
| 2. Stock status and integrity | Check if data from PWD can be extracted frequently and/or uploaded automatically | 100% | 100% | Not extracted | No | Due date to be set | Due date to be set |
| 3. Stock count frequency and accuracy results | Check if data from PWD can be extracted frequently and/or uploaded automatically | 100% | 100% | Not extracted | No | Due date to be set | Due date to be set |
| 4. Damage and Missing | | 100% | 80% | Not extracted | Due date to be set | Due date to be set | Due date to be set |
| 5. Storage utilisation (capacity usage report) | Created by operations support | 100% | 100% | Yes | Yes | Due date to be set | Due date to be set |
| 6. Accuracy of Pre-planning | Definitions and calculations to be | 50% | 0% | Only actual volumes | No | Due date to be set | Due date to be set |

| Indicator name and number | Status of indicator | Status of task and/or due date | | | | | |
|---|---|---|---|---|---|---|---|
| | | Definition of indicator | Definition of analysis info. | Source data available | Indicator (& calculation methods) available manually | Indicator in Access | Analysis information in Access |
| or outbound production (volumes) actual versus plan | created and necessity of analysis info to be checked | | | available, most information unavailable | | | |
| 7. Expected versus actual truck arrival and departure | It is preferred to get data from one system only, so yms OR sap | 100% | 80% | Not extracted | No | Due date to be set | Due date to be set |
| 8. Planned Goods Issue – versus – Actual | PGI vs AGI in hours to be replaced by expected versus actual truck departure | 100% | 100% | Yes | Yes, measured in days | Due date to be set | Due date to be set |
| 9. Delivery changes (instead of picking accuracy) | | 100% | 100% | Yes, for the indicator, not for the analysis info | Yes | Due beginning of March | Due date to be set |
| 10. Disputes versus deliveries | Analysis information with value not yet available | 100% | 100% | Yes, indicator is created, and some elements of analysis info | Yes | Due beginning of March | Due date to be set |
| 11. Carrier transport lead-time | Data from Infodis. For questions contact Karsten, Koen or Arjan | 100% | 100% | Yes. Indicator created by LOE | Yes | Due date to be set | Due date to be set |
| 12. Complexity of operation (background information) | Definition not yet available. Needs to be set up in | 0% | 0% | Not defined | No | Due date to be set | Due date to be set |
| 13. Disputes lead-time | Indicator and analysis information are being created weekly | 100% | 100% | Yes, indicator and analysis info | Yes | Due beginning of March | Due date to be set |
| 14. Returns Classification | Created manually in the returns centre. Information and | 100% | 100% | Yes | Yes | Due date to be set | Due date to be set |

| Indicator name and number | Status of indicator | Status of task and/or due date | | | | | |
|---|---|---|---|---|---|---|---|
| | | Definition of indicator | Definition of analysis info. | Source data available | Indicator (& calculation methods) available manually | Indicator in Access | Analysis information in Access |
| | calculation for sample size to be added | | | | | | |

b. Reports

| Department | Separate report needed / designed | Created in Access | Location to view requested data |
|---|---|---|---|
| General management | Yes / yes | First report due mid-March | Data Access page on CAV network drive (G/Mgt/OPI) or on own desktop |
| Operations support | No, equal to general management? / ? | First report due mid-March | Data Access page on CAV network drive (G/Mgt/OPI) or on own desktop |
| Warehouse operations (including shift managers) | Yes / yes | First report due mid-March | Data Access page on CAV network drive (G/Mgt/OPI) or on own desktop |
| Planning & Services | Yes / yes | First report due mid-March | Data Access page on CAV network drive (G/Mgt/OPI) or on own desktop |
| Logistics Support | Yes / yes | First report due mid-March | Data Access page on CAV network drive (G/Mgt/OPI) or on own desktop |
| Quality Centre | Yes / yes | First report due mid-March | Data Access page on CAV network drive (G/Mgt/OPI) or on own desktop |
| Customer Relations | Yes / yes | First report due mid-March | Data Access page on CAV network drive (G/Mgt/OPI) or on own desktop |
| Returns | Yes / yes | Internal ERC report exists / CAV performance measurement system report to be created. First report due mid-March | Data Access page on CAV network drive (G/Mgt/OPI) or on own desktop |
| All CAV employees | Yes / no | First report due mid- | Plasma screens near |

| | | | |
|---|---|---|---|
| | | March, elements to be selected | CAV coffee corners |
| All SLE employees | Yes, only general level indicators without analysis information / no | Interim solution for reporting already available, first report due mid-March | CAV intranet |

### 8.4.2 Recurring (frequent)

a. Weekly monitoring process by all (department) managers
b. Suggested to discuss performance during managers meetings (bi-weekly)
c. Weekly importing data files into Microsoft Access (Allow / arrange automatic uploading as much as possible)

### 8.4.3 Recurring (infrequent)

a. Reviewing performance indicator system twice a year (or when processes change) to keep the system up-to-date
    i. Relevance of indicators / identify new relevant indicators
    ii. Correctness of definitions
    iii. Correctness of reports and calculation methods
    iv. Whenever targets are reached, new more challenging targets should be set

## 8.5 Evaluation of Operational Performance Measurement System

After the evaluation of the selected indicators in paragraph 6.7 the operational performance measurement system is evaluated. It can be said that with the Information Guide (see the separate appendix) containing the definitions, calculation methods and many other relevant aspects of an indicator, the indicators are well documented. Providing these clear definitions makes the indicators unambiguous and avoids misinterpretation.

Providing the users of the system with the reports containing the indicators relevant for their part of the operation makes it easy to monitor performance. The indication of the target included in the report graphs shows the performance at a glance. At the same time, no more time gets lost in finding the information or looking at irrelevant indicators. Information will be available with a constant frequency, being once a week. The weekly monitoring process can be used to review performance in a structured way. In the report the links to other information, such as the defined analysis information and the information available on the other logistic levels of the organisation facilitates the analysis of performance and the identification of root causes.

# 9 Conclusions & Recommendations

## 9.1 Introduction

This chapter presents the conclusions and recommendations relating to this project. First the conclusions are presented for all research phases. Second, the recommendations are presented that are not only presented for all research phases, but also are of a more general nature.

## 9.2 Conclusions

This paragraph presents the conclusions of the entire project. The conclusions are grouped by the research phases as discussed in chapter 2. The research goals are repeated to make it easy to validate if the goals have been achieved. As a validation of the achievement of the goals of this process, it can be checked whether the research questions asked in the first chapter are answered.

For both parts of the project, designing the Operational Performance Measurement System and harmonising the indicators at the different logistic levels, the following structure will be followed. First the goal of the project will be repeated and it is explained which deliverables of the project indicate that the goal is achieved. Following, the covering research question for the part of the project being discussed is repeated and again the deliverables are mentioned that contain the answers to the question. The last elements discussed for each part of the project are the related research phases and the conclusions that can be drawn from executing.

## 9.3 Conclusions on Designing the Operational Performance Measurement System, Part A

**Goal of Part A**
Designing an operational performance measurement system, that includes the weekly process performance information (indicators) for management of the operational level of the CAV division, that is required to control and improve the processes, including defining what tool can be used for reporting and presenting this information

The designed operational performance measurement system consists of the following items, which have been designed and presented in the previous chapters:

- The indicators selected on general level and by department
- The indicators definitions, source data and targets (identification sheets), the Information Guide
- The infrastructure for data availability and the creation of information
- The infrastructure for publishing

The performance measurement system that has been designed enables structured and frequent reporting. The reporting is structured, because all information is in one system and it is easy to find the information. Reporting can be frequent by weekly (automatically) uploading the data needed to create indicators.

The covering research question of part A of the project is:

Part A) Which performance indicators are needed for the operational level of Consumer Audio and Video to gain insight into the weekly performance-situation of the processes at Consumer Audio and Video and to locate bottlenecks – and – how should this information be measured, reported and presented?

Answers to the covering research question of part A can be found by looking at the following deliverables:

- Overview of selected indicators by department
- Operational Performance Indicator Information Guide
- Design for the Operational Performance Measurement System (Access tool)

### 9.3.1 Conclusions on research phases 1-3: Orientation and analysis phase

An overview and explanation of the different processes and the information sources is presented in the first chapters. This information shows that the processes are complex and the use of management information such as performance indicators facilitates the monitoring, control and improvement of performance.

The information that is being created at the start of this project is mostly not documented and no clear definitions are present, thus allowing miscommunication when people interpret information in a different way. Part of the available information cannot be used because the information is unreliable. Next to that managers' requests indicate that not all information that is needed is present. The information that is available is not sufficient to manage and improve the operation. Not al information available is actually used, because people who are interested in information do not always know that information is available. Information is not available from one person, but is created by multiple people and stored on many different locations and not created with a fixed frequency. In some cases more people are creating the same information separately. This results in a duplicate of effort and the possibility of miscommunication if indicators are not clearly defined. The fact that information is scattered indicates that it is not supplied in a structured way. The creation of information is often depending on the presence of one person. This means that information is not created once that person is not in the office because of illness or holidays.

Summarising it can be said that there is a mixture of information, with some elements that can be seen as performance indicators. Indicators have not been clearly defined and many different people create the information. This causes duplicate of efforts and thus wasted time, as well as a lot of work finding information. Whenever two people are creating the same or similar information communication problems can arise when definitions are not clear and measurements are taken slightly different. This all has negative effects on an efficient and effective performance control process.

Managers have presented their wishes that should be used as a basis for a new operational performance measurement system. Next to that, the warehouse analysis can be used as a reference when creating performance indicators. It may be concluded that the process is to complex to measure without having tools like a performance measurement system available.

### 9.3.2 Conclusions on research phases 4-5: Designing indicators and Information Guide

The indicators that have been selected for the different departments contain the information that is needed to control that specific department. This selection has been made together with the department managers to ensure acceptance and to fulfil management requirements. Next to the selected indicators, analysis information is defined in most cases, which can be used for analysing performance when needed. The analysis information sometimes contains information that can possibly be part of the Operational Control Framework. During the review of the Operational Control Framework a link will be made between this framework and the selected performance indicators. Whenever it is felt that analysis information of the performance measurement system should be part of the Operational Control Framework or vice versa, changes will be made. The selection of indicators

for each department has been reviewed after the 15 main areas of performance had been selected. This resulted in some extra requests for information, because it was seen that information was available (part of the 15 areas of performance). It is watched for that not an unmanageable overflow of information is presented to the managers.

The Information Guide that is created provides clear descriptions of each indicator and each element of the analysis information and ensures an unambiguous definition. In the Information Guide all indicators are described and the data sources are registered. For most indicators the information is present, although it is not always currently being extracted from the system.

The tool that is designed to calculate and report the performance indicators provides structure, because all data is in one database and all users have the same data source for their information making the information comparable and compatible. The reports from the performance measurement system will be update each week, creating frequent reporting and making it possible to review performance on a weekly basis. The reports will contain specific information relevant for each department and will be easily available from a fixed location. The information will be presented in a Data Access Page, on the Plasma Screens in the CAV warehouse and on the SLE intranet. The location and tool as well as the information presented depends on the user.

## 9.4 Conclusions on Harmonising the Indicators at the different Logistic Levels, Part B

**Goal of Part B**
Harmonising the logistics performance indicators (definitions) at the different logistic organisational levels and providing the links between the different indicators, that will make it possible to drilldown to get more detailed information such as the underlying causes of performance

An overview of the indicators and the links between them will shows how the indicators at the different levels relate to each other. Also the links in the Access reports will enable the drilldown in information. The definitions are the responsibility of the owners of the indicators. During the meetings held duplicate indicators were removed and owners of the indicators assigned.

This leads to the following covering question:

Part B) What needs to be done to harmonise and link the information at the logistic organisational levels?

The first step in harmonising the indicators is made by creating an overview of all indicators at all levels of the organisation. This list is then discussed during meetings with people from all these levels present. During these meetings duplicate indicators were removed and owners of the indicators assigned. The overview of indicators, including the comments of the meetings, is then drawn as a flowchart, showing all relations between indicators. This overview can be used to link the indicators in the Access tool that is being developed as the Operational Performance Measurement System.

### 9.4.1 Conclusions on research phases 6-7: Harmonising performance indicators

Many indicators are present throughout the different logistic levels. The existence of certain information created at one level is not always know at other level. There are indicators that are equal of similar that are created by different people at different levels of the organisation. Especially when indicators are similar, confusion can originate because of measurement differences. The different levels of logistics performance information and the indicators at these levels have been analysed and

an overview of all indicators is created. In this overview all comments made during meetings with all logistic levels are used and duplicates are no longer present. The flowchart overview as presented in appendix Q shows the relation between all indicators at the different logistic levels. In the overview of all indicators duplicates have been removed and definition issues highlighted.

By removing duplicate indicators on the different levels of the Sony organisation and making links between the levels that can be used in the Access tool, the harmonisation and links have been provided. Owners of indicators are assigned that are responsible for their definitions.

## 9.5 Recommendations

The recommendations are presented grouped by the research phases. Recommendations that are not directly related to a research phase are presented in the last paragraph.

### 9.5.1 Recommendations from phases 1-3: Orientation and analysis phase

It is concluded that there is a need for a structured supply of performance information. Therefore it is recommended to design and implement a system of performance indicators. In this system performance indicators should be included that represent the entire Consumer Audio & Video operation, giving information to the department managers. This information should be the information they need to manage and improve their processes. Clear definitions that prevent misinterpretation should be part of the system of performance indicators. The system should enable reporting at a fixed frequency.

### 9.5.2 Recommendations from phases 4-5: Designing indicators and Information Guide

It is recommended to use the selected performance indicators and analysis information for each department as a basis for the reports. These reports can be created with the Data Access Page functionality of Microsoft Access. For the building and implementation of this system, as well as during the use of this system, the Information Guide can be used as a reference. The Information Guide presents all definitions, calculations, source data, units of measure, etc. The overview of all indicators at the different logistic levels, presented as a flowchart, can be used as a reference when adding the links to the reports in the Operational Performance Measurement System.

Once the system has been fully developed and implemented, it is recommended to use the designed weekly monitoring process for weekly monitoring performance. The Information Guide can be used whenever questions arise about definitions, calculations, or other items related to the performance indicator. Twice a year, or when significant changes occur, the system should be reviewed to keep it up-to-date. Reports and the Information Guide should be updated accordingly. It is also recommended to keep a clear distinction between performance indicators and information that can be used for analysis purposes. The distinction is recommended to avoid an information overload.

### 9.5.3 Recommendations from phases 6-7: Harmonising performance indicators

In order to keep indicators on different levels in line it is recommended to communicate changes that are made to one of the indicators. This can be done by organising review meetings to keep indicators and definitions harmonised. It is also recommended to let the owners of the indicators review all definitions and discuss these during a meeting with all indicator owners. Another meeting can review if indicators that are being created are still relevant, measured correctly, clearly defined and measured at the correct level in the organisation. It should also be checked if there are no more duplicates.

### 9.5.4 Other recommendations

At the moment the focus of performance measurement is internal. It is recommended to extend this focus and include the external environment. Questions that can be asked are "how is the performance of the competitors and can benchmarking be applied?". A possibility might be to benchmark with other SLE warehouses such as Playstation or Recording Media and Energy. Another recommendation relates to the nature of indicators. This project is focussed on operational, non-financial measures. As a next step it is recommended to link the indicators defined to financial measures that are being used.

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# Appendices



Separate appendix: Operational Performance Indicators Information Guide, containing all definitions and calculation methods etc. This appendix is not available in the library.

# A. Organisational charts

SONY

Sony Logistics Europe

## CAV Organigram

**2 shift 12th January 2004**

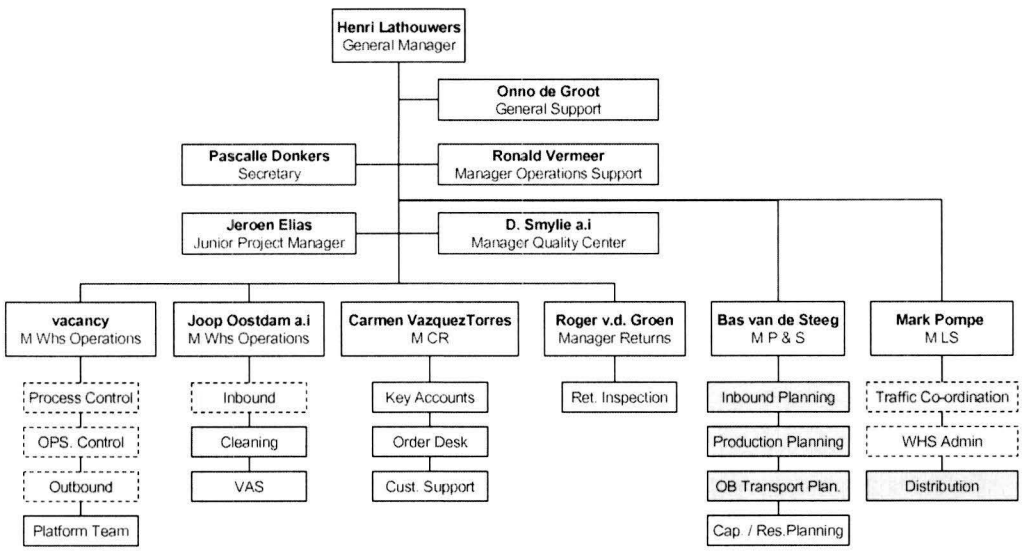
maandag 2 februari
2004

Slide 1

SONY

Sony Logistics Europe

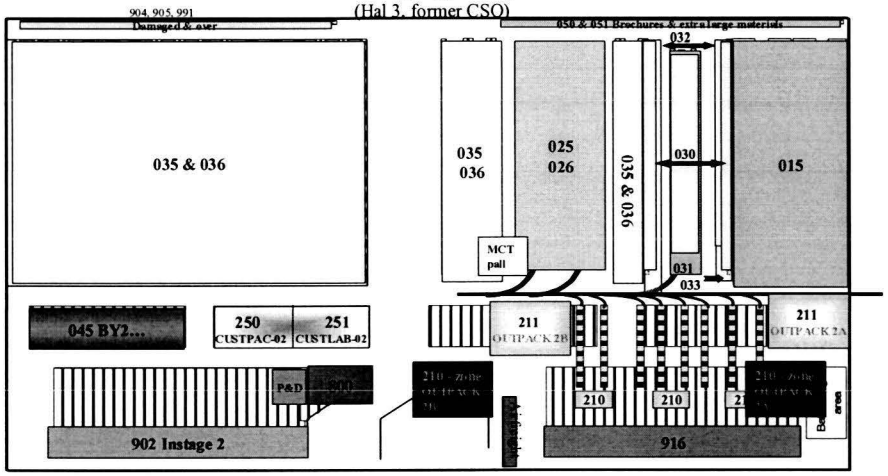
## EDC CAV organization 2 shift as per 12th January 2004




Slide 2

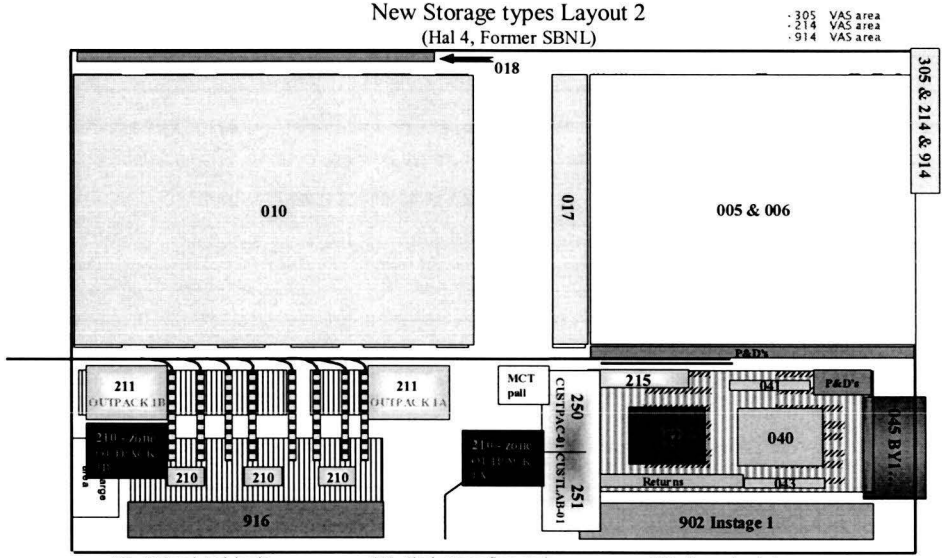
# B. Warehouse Layout

New Storage types Layout 1
(Hal 3, former CSO)




- 035 Reach truck rack High levels
- 036 Reach truck rack pick face
- 045 Bypass
- 800 Cross dock area
- 902 Goods Receipt area
- 904 Damaged at Receipt
- 905 Over at Receipt
- 025 Pick to belt High levels
- 026 Pick to belt pick face
- 015 Block storage Drive-in rack
- P&D Pick and Drop area
- 916 Goods Issue area
- 991 Damaged at Warehouse
- 050 Rack for brochures and oversized materials
- 051 Rack for brochures and oversized materials
- 030 High value rack High levels
- 031 High value rack pick face
- 032 High value pick face heavy
- 033 High value shelves
- 210 Wrapping area
- 211 FP labeling area
- 251 customisation (with ship labels)
- 250 customisation (no ship labels)

New Storage types Layout 2
(Hal 4, Former SBNL)




- 005 VNA rack High levels
- 006 VNA rack pick face
- 045 Bypass
- 211 FP labeling area
- 902 Goods Receipt area
- 250 customisation (no box labels)
- 010 Block storage floor stack
- 017 Broken pallet picks heavy
- 018 Broken pallet picks light
- P&D Pick and Drop area
- 916 Goods Issue area
- 251 customisation (with ship labels)
- 040 Mezzanine shelves
- 041 Mezzanine pallets
- 042 Mezzanine Flowrack
- 043 Mezzanine Pick to Belt
- 210 Wrapping area
- 215 Mezzanine BMC handling

# C. Process overview: input-output-resources

CAV IB-P-10 Plan and Prepare arriving shipment
- Receive and process pre-arrival information (LS)
- Plan shipment and assign time slots (PS)
- Register planning and inform Vendor/ carrier/ agent/ (LS)

CAV IB-P-20 Receive and check incoming truck
- Check Truck at Gate (TC)
- Check and process documents at Sat office (LS)
- Break seal at dock (WH)

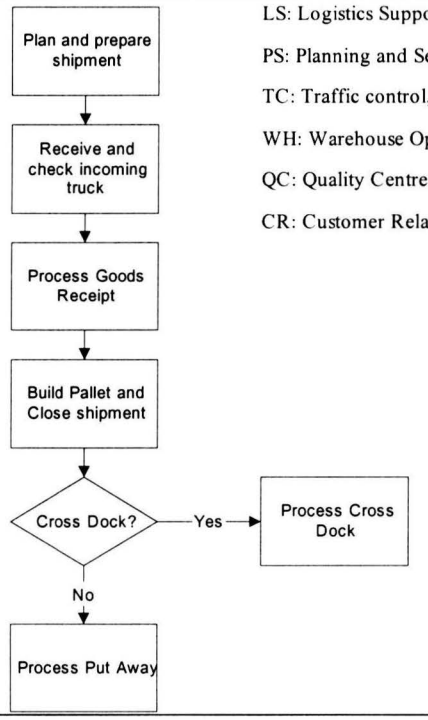
CAV IB-P-30 Process Goods Receipt
- Unload & Check (WH)
- Register and process irregularities (LS)
- Sign transport documents (LS)
- Post Goods Receipt (WH)

CAV IB-P-40 Build pallet & Close shipment
- Build pallets (WH)
- Test and register new material (QC)
- Register irregularities and close shipment (LS)

Decide if shipment is cross dock (LS)

Cross Dock according to Cross Dock procedure (LS & WH)

Move Goods to identified location (WH)




LS: Logistics Support

PS: Planning and Services

TC: Traffic control, logistics service departmen

WH: Warehouse Operations

QC: Quality Centre

CR: Customer Relations

CAV OB-P-10 Create & Release shipments (PS)
- Process deliveries
- Plan deliveries in shipments
- Review & Release shipments

Arrange transportation and handle changes (LS)

CAV OB-P-30 Create & Release wave
- Create wave by combining shipments including shutes and docks (PS)
- Discuss and adapt waves (PS)
- Release wave, incl. stock allocation, replen. TO's and pick TO's (WH)

Deplenish and replenish storage locations based on Transfer Orders (WH)

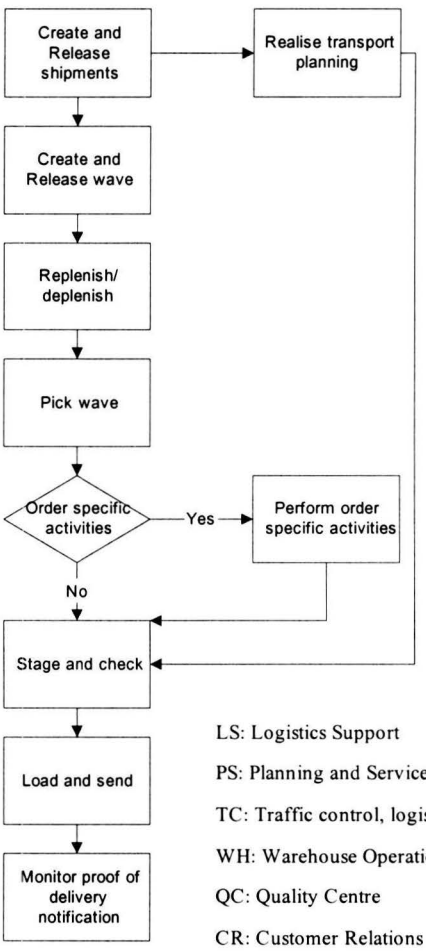
CAV OB-P-50 Pick wave (WH)
- Pallet pick
- MC pick
- Broken MC/ mezzanine
- Pick to Belt

CAV-OB-P-60 Perform order specific activities (WH)
In case applicable:
- Customise
- Sort
- Pack

CAV OB-P-70 Stage & Check
- Stage (WH)
- Prepare check (LS/WH)
- Check (WH)

CAV OB-P-80 Load & Send
- Prepare loading (LS)
- Load (WH)
- Check loading (system) (LS)
- Arrange transport docs and update systems (LS)
- Close seal (LS)
- Put shipment on departed (TC)

CAV OB-P-90 Monitor proof of delivery notification
- Monitor Proof of Delivery information (CR/LS?)
- Research deviations (CR/LS?)
- Follow-up (CR)




LS: Logistics Support

PS: Planning and Services

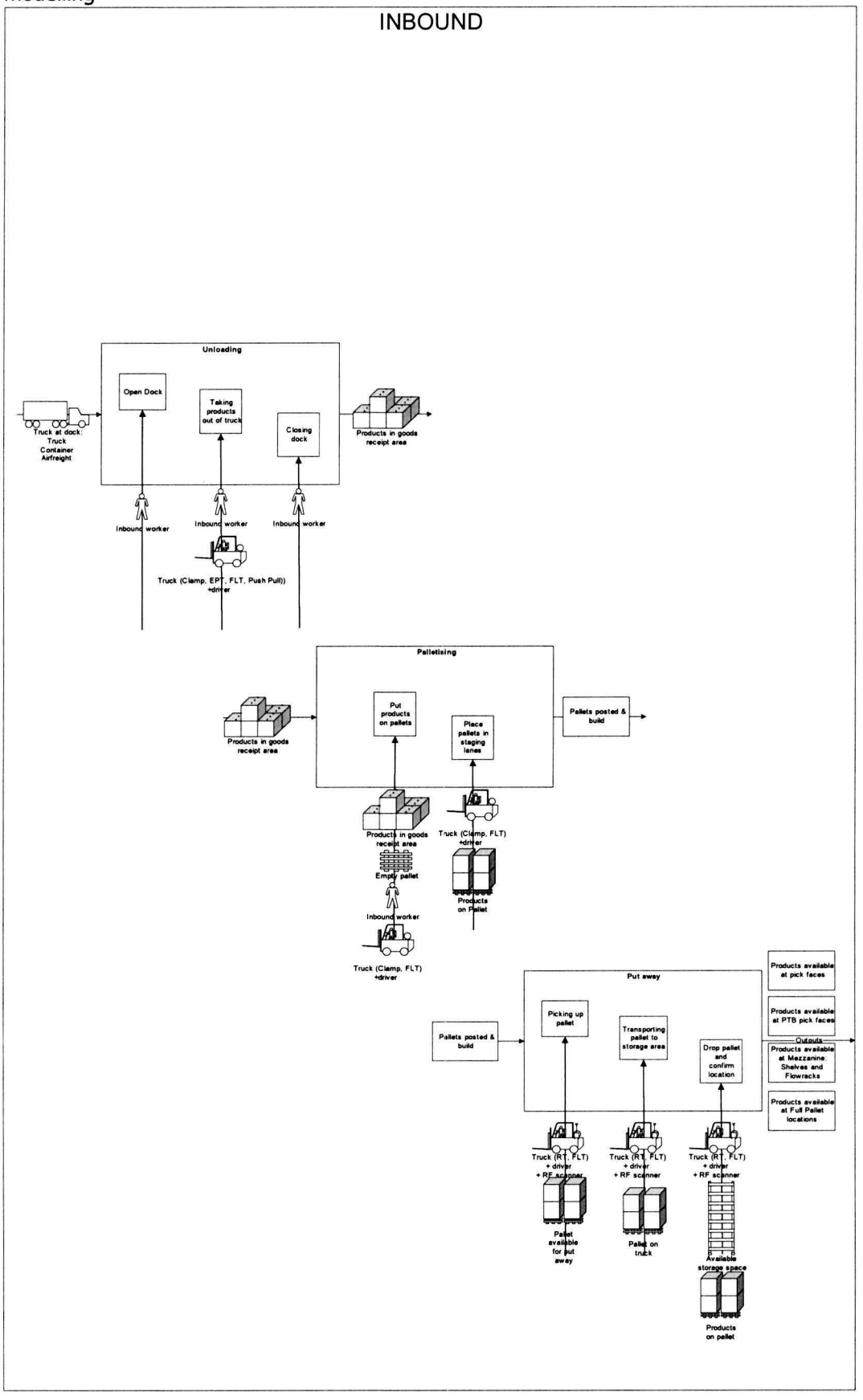
TC: Traffic control, logistics service departmen

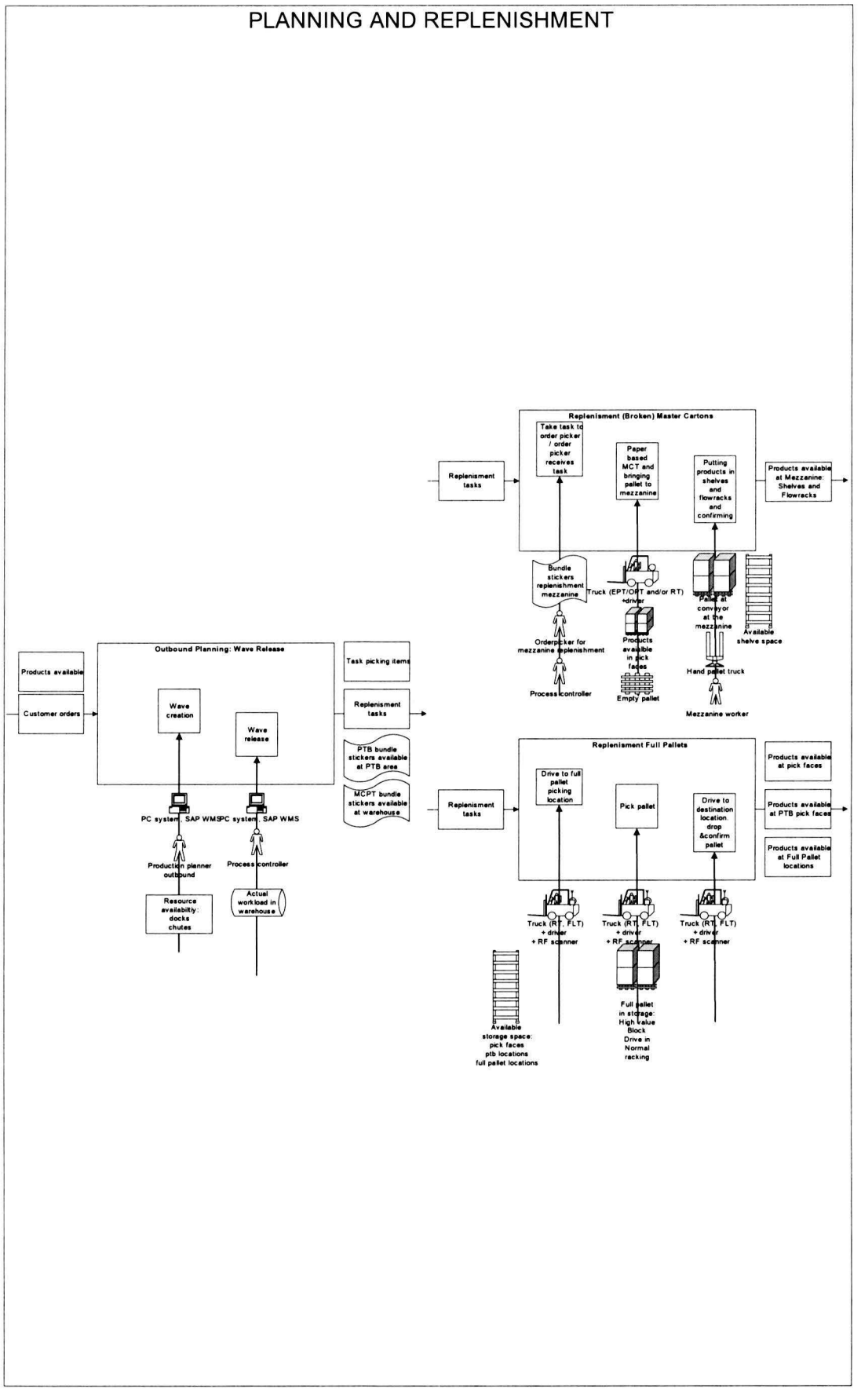
WH: Warehouse Operations

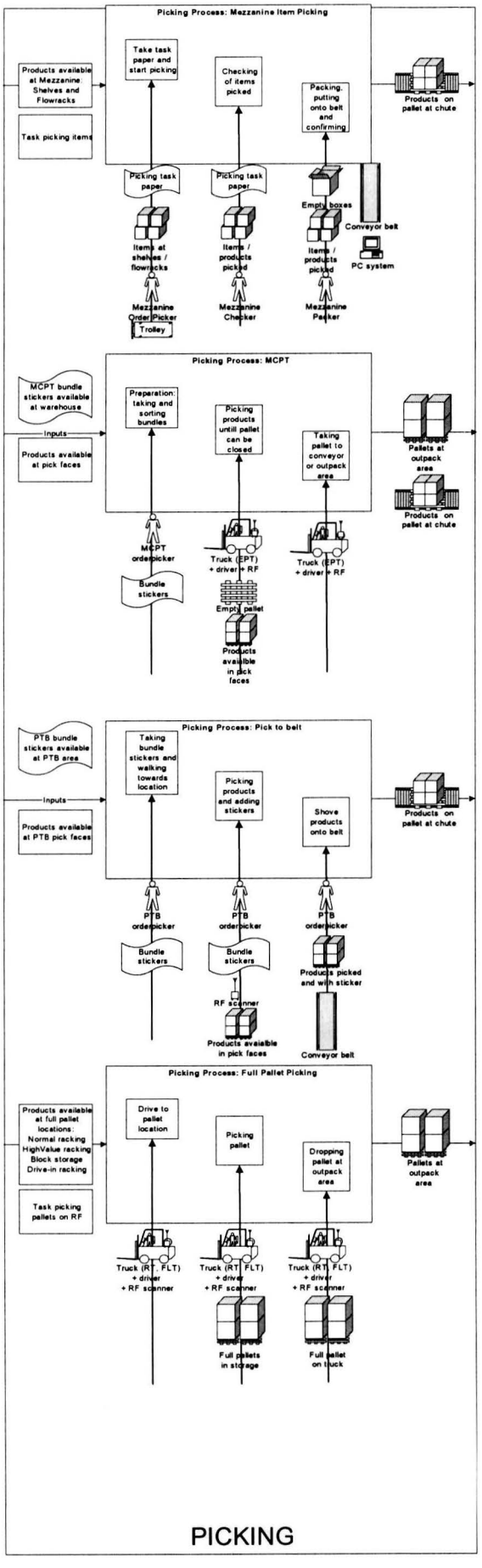
QC: Quality Centre

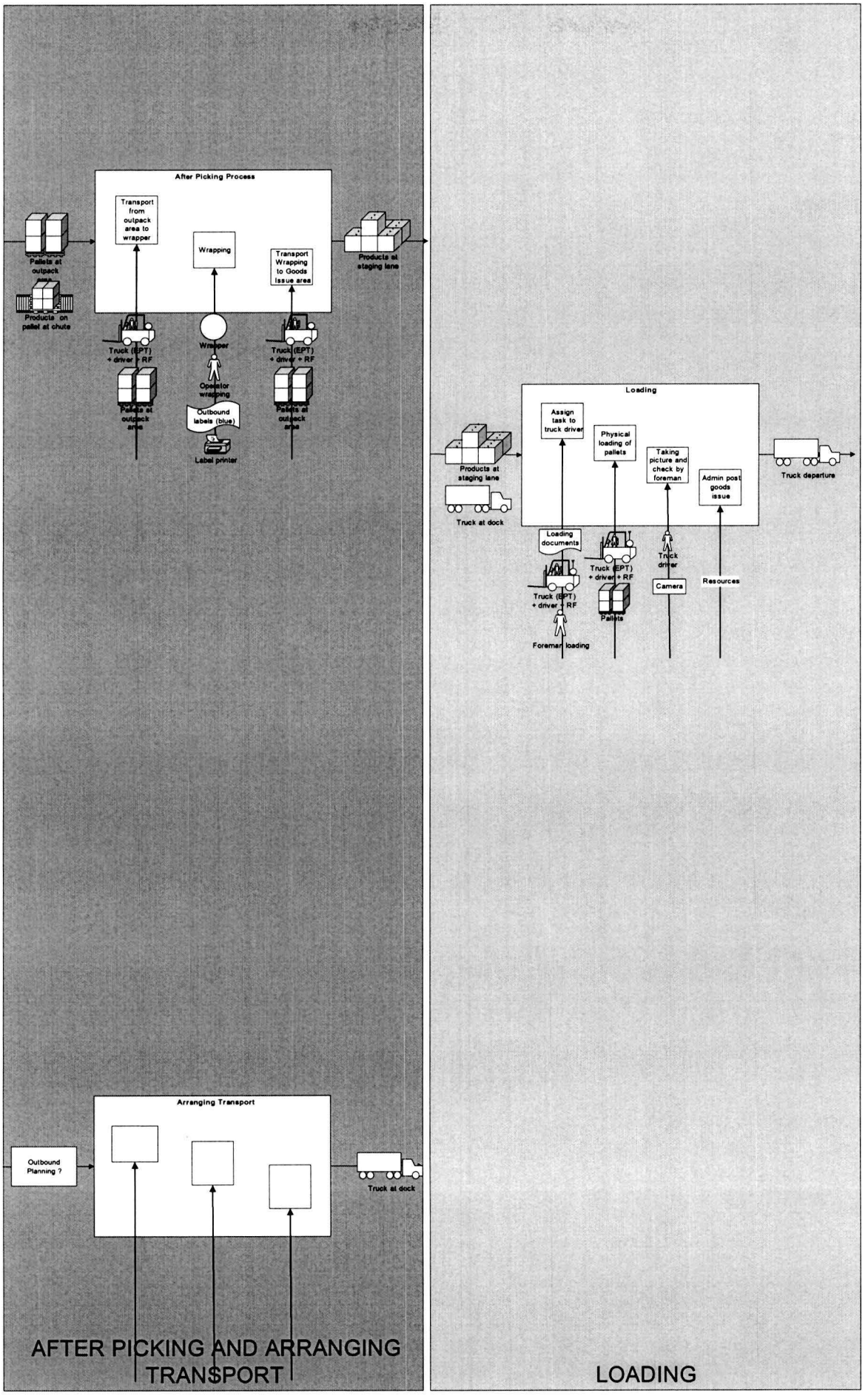
CR: Customer Relations

Technique from: J.P. Briffaut and G. Saccone: Business performance sustainability through process modelling




PLANNING AND REPLENISHMENT
Replenishment (Broken) Master Cartons
Take task to order picker / order picker receives task
Paper based MCT and bringing pallet to mezzanine
Putting products in shelves and flowracks and confirming
Replenishment tasks
Products available at Mezzanine: Shelves and Flowracks
Bundle stickers replenishment mezzanine
Truck (EPT/OPT and/or RT) +driver
Pallet at conveyor at the mezzanine
Available shelve space
Orderpicker for mezzanine replenishment
Products available in pick faces
Hand pallet truck
Process controller
Empty pallet
Mezzanine worker
Outbound Planning: Wave Release
Products available
Customer orders
Wave creation
Wave release
Task picking items
Replenishment tasks
PTB bundle stickers available at PTB area
MCPT bundle stickers available at warehouse
PC system: SAP WMS
PC system: SAP WMS
Production planner outbound
Process controller
Resource availability: docks chutes
Actual workload in warehouse
Replenishment Full Pallets
Drive to full pallet picking location
Pick pallet
Drive to destination location drop &confirm pallet
Replenishment tasks
Products available at pick faces
Products available at PTB pick faces
Products available at Full Pallet locations
Truck (RT, FLT) + driver + RF scanner
Truck (RT, FLT) + driver + RF scanner
Truck (RT, FLT) + driver + RF scanner
Available storage space: pick faces ptb locations full pallet locations
Full pallet in storage: High Value Block Drive in Normal racking


Picking Process: Mezzanine Item Picking
Products available at Mezzanine Shelves and Flowracks
Task picking items
Take task paper and start picking
Checking of items picked
Packing, putting onto belt and confirming
Products on pallet at chute
Picking task paper
Picking task paper
Empty boxes
Conveyor belt
PC system
Items at shelves / flowracks
Items / products picked
Items / products picked
Mezzanine Order Picker
Trolley
Mezzanine Checker
Mezzanine Packer
Picking Process: MCPT
MCPT bundle stickers available at warehouse
Inputs
Products available at pick faces
Preparation: taking and sorting bundles
Picking products until pallet can be closed
Taking pallet to conveyor or outpack area
Pallets at outpack area
Products on pallet at chute
MCPT orderpicker
Truck (EPT) + driver + RF
Truck (EPT) + driver + RF
Bundle stickers
Empty pallet
Products available in pick faces
Picking Process: Pick to belt
PTB bundle stickers available at PTB area
Inputs
Products available at PTB pick faces
Taking bundle stickers and walking towards location
Picking products and adding stickers
Shove products onto belt
Products on pallet at chute
PTB orderpicker
PTB orderpicker
PTB orderpicker
Bundle stickers
Bundle stickers
Products picked and with sticker
RF scanner
Products available in pick faces
Conveyor belt
Picking Process: Full Pallet Picking
Products available at full pallet locations: Normal racking HighValue racking Block storage Drive-in racking
Task picking pallets on RF
Drive to pallet location
Picking pallet
Dropping pallet at outpack area
Pallets at outpack area
Truck (RT, FLT) + driver + RF scanner
Truck (RT, FLT) + driver + RF scanner
Truck (RT, FLT) + driver + RF scanner
Full pallets in storage
Full pallet on truck
PICKING


After Picking Process
Transport from outpack area to wrapper
Wrapping
Transport Wrapping to Goods Issue area
Pallets at outpack area
Products on pallet at chute
Products at staging lane
Truck (EPT) + driver + RF
Wrapper
Operator wrapping
Outbound labels (blue)
Label printer
Pallets at outpack area
Truck (EPT) + driver + RF
Pallets at outpack area
Loading
Assign task to truck driver
Physical loading of pallets
Taking picture and check by foreman
Admin post goods issue
Products at staging lane
Truck at dock
Truck departure
Loading documents
Truck (EPT) + driver + RF
Truck (EPT) + driver + RF
Pallets
Truck driver
Camera
Resources
Foreman loading
Arranging Transport
Outbound Planning ?
Truck at dock
AFTER PICKING AND ARRANGING TRANSPORT
LOADING

# D. List of available operational performance reports / indicators for the Consumer Audio & Video warehouse

| ID | Name / report | Status |
|---|---|---|
| ERC1 | ERC1:<br>Goods Receipt Performance:<br>All incoming deliveries must be logged in Phoenix within 24 hours | Available |
| ERC2 | ERC2:<br>Stock accuracy:<br>Percentage of counted items without differences between systems and physical number of quantity | Available |
| ERC3 | ERC3:<br>Quality inspection verification:<br>Number of QV classifications of which result is according to guidelines divided by total number of tested QV classifications | Available |
| ERC4 | ERC4:<br>Quality verification leadtime:<br>Number of pieces (unit with WWI reference number) registered with correct QV status in (WWI) system within 5 days after truck registration in security logbook/ divided by total arrived pieces in QV | Available |
| ERC6 | ERC6:<br>Miss Shipments:<br>Number of delivery-lines with deviations vs. Total number of delivery-lines on STO's and material documents (Miss shipments are corrected before sending) | Available |
| ERC7 | ERC7:<br>Outbound Performance:<br>Outbound deliveries departed in time vs. Total number of outbound deliveries | Available |
| ERC8 | ERC8:<br>Performance Shuttle of sellable stock:<br>Number of pieces arrived new sellable must be shipped next day | Available |
| ERC9 | ERC9:<br>Interface Performance:<br>Number of daily errors found in interface communication in relation to the daily total send IDOC's | Available |
| ERC10 | ERC10:<br>Reporting Performance:<br>Number of correct delivered reports (accurate and in time), divided by total agreed on reports | Available |
| | | |
| Monthly Logistics Operational Data and KPI reporting | Storage volume and weight | Available, only used as input for reporting by Logistic Operations Europe |
| Monthly Logistics Operational Data and KPI reporting | Number of pallets stored in warehouse | Available, only used as input for reporting by Logistic Operations Europe |
| Monthly Logistics Operational Data and KPI reporting | Number of delivery notes | Available, only used as input for reporting by Logistic Operations Europe |

| ID | Name / report | Status |
|---|---|---|
| Monthly Logistics Operational Data and KPI reporting | Number of delivery notes smaller than 10 kg | Available, only used as input for reporting by Logistic Operations Europe |
| Monthly Logistics Operational Data and KPI reporting | Number of delivery line items | Available, only used as input for reporting by Logistic Operations Europe |
| Monthly Logistics Operational Data and KPI reporting | Number of pieces goods issued | Available, only used as input for reporting by Logistic Operations Europe |
| Monthly Logistics Operational Data and KPI reporting | Outbound volume and weight | Available, only used as input for reporting by Logistic Operations Europe |
| Monthly Logistics Operational Data and KPI reporting | Inbound volume and weight | Available, only used as input for reporting by Logistic Operations Europe |
| Monthly Logistics Operational Data and KPI reporting | Storage capacity in number of pallet places | Available, only used as input for reporting by Logistic Operations Europe |
| Monthly Logistics Operational Data and KPI reporting | Available M2 | Available, only used as input for reporting by Logistic Operations Europe |
| Monthly Logistics Operational Data and KPI reporting | Number of hours worked in warehouse. currently NA | Available, only used as input for reporting by Logistic Operations Europe |
| | | |
| Monthly logistics operational data 1 | Storage volume and weight | Available, only used as input for financial reporting |
| Monthly logistics operational data 2 | Number of pieces "goods issued" BENELUX | Available, only used as input for financial reporting |
| Monthly logistics operational data 3 | Outbound volume and weight BENELUX | Available, only used as input for financial reporting |
| Monthly logistics operational data 4 | Inbound volume and weight | Available, only used as input for financial reporting |
| Monthly logistics operational data 5 | Storage capacity in number of pallet places, warehouse utilization | Available, only used as input for financial reporting |
| | | |
| Reporting for invoicing Consumer Audio and Video 1 | 2a) Outbound volume per EBU, onderverdeeld naar FP (full pallets),<br>MC (master carton) en BMC (broken master carton) | Available, only used as input for financial reporting |
| Reporting for invoicing Consumer Audio and Video 2 | 2b) Inbound volume per EBU | Available, only used as input for financial reporting |
| Reporting for invoicing Consumer Audio and Video 3 | 2c) Storage volume per EBU | Available, only used as input for financial reporting |

| ID | Name / report | Status |
|---|---|---|
| Reporting for invoicing Consumer Audio and Video 4 | 2d) Inbound VAS per EBU | Available, only used as input for financial reporting |
| Reporting for invoicing Consumer Audio and Video 5 | 2e) Outbound VAS per EBU | Available, only used as input for financial reporting |
| Reporting for invoicing Consumer Audio and Video 6 | 2f) Storage volume pand Dongenseweg Tilburg | Available, only used as input for financial reporting |
| | | |
| WHS capacity usage 1 | a) "chart; overview full-empty":<br>This chart shows the total no of empty and used storage space. | Available |
| WHS capacity usage 2 | b) "chart; detail racking and block":<br>This chart shows the total empty and used storage space seperated for block and racking. | Available |
| WHS capacity usage 3 | c) "chart; per storage area in time":<br>This chart shows per storage area the empty storage space (in pallets). | Available |
| WHS capacity usage 4 | d) "chart; capacity per area":<br>This chart shows the present capacity per storage area (in pallets). | Available |
| | | |
| Impr.Proj 28: 1 | Productivity increase MC pick area:<br>Reduction Duration of Putaway Pallet | Temporary |
| Impr.Proj 28: 2 | Productivity increase FP pick area:<br>Reduction Duration of Putaway Pallet | Temporary |
| Impr.Proj 28: 3 | Better spread of pallets accross storage types:<br>Difference in max-min usage per storage type | Temporary |
| Impr.Proj 28: 4 | No more pallets kept at barge, because in a specific area SLE has no capacity left:<br>no of pallets kept at barge not due to specific capacity problems is minimal | Temporary |
| Impr.Proj 28: 5 | The use of the PTB will be maximised:<br>No of boxes via the sorter should increase.<br>no of picks via the sorter should increase | Temporary |
| Impr.Proj 28: 6 | Have less MC area replenishments related to a wave:<br>No of capacity based replens should increase | Temporary |
| Impr.Proj 28: 7 | Products are stored based on their strategy:<br>Certain percentage of quants are correctly stored. | Temporary |
| Impr.Proj 28: 8 | Productivity increase MC pick area:<br>Reduction Duration of Putaway Pallet | Temporary |
| Impr.Proj 28: 9 | Productivity increase FP pick area:<br>Reduction Duration of Putaway Pallet | Temporary |
| Impr.Proj 28: 10 | Make sure capacity HEAVY pickface is no bottleneck anymore:<br>Increase capacity HEAVY pickface | Temporary |
| Project 40 | Claims and disputes backlog | available |
| Project 40 | Time to treat claims and backlog | available |
| Project 021 | Inbound leadtime truck air and container | available |
| | | |
| | | |
| ARMI 1 | Inbound lead time (kpi1_1) | Accuracy uncertain |
| ARMI 2 | Inbound lead time performance (kpi1_2) | Accuracy uncertain |
| ARMI 3 | Supplier information performance (days) (kpi1_3) | Accuracy uncertain |

| ID | Name / report | Status |
|---|---|---|
| ARMI 4 | Suppliers information performance (deliveries) (kpi1_4) | Accuracy uncertain |
| ARMI 5 | Outbound performance (kpi2) | Accuracy uncertain |
| ARMI 6 | Forwarders performance (infodis) (kpi9) | Accuracy uncertain |
| ARMI 7 | Irregularities flow inbound value (kpi3_1) | Accuracy uncertain |
| ARMI 8 | Irregularities flow inbound quantity (kpi3_2) | Accuracy uncertain |
| ARMI 9 | Irregularities flow outbound quantity (kpi3_3) | Accuracy uncertain |
| ARMI 10 | Irregularities flow outbound value (kpi3_4) | Accuracy uncertain |
| ARMI 11 | Irregularities level inbound quantity (kpi6_1) | Accuracy uncertain |
| ARMI 12 | Irregularities level inbound value (kpi6_1) | Accuracy uncertain |
| ARMI 13 | Irregularities level outbound quantity (kpi6_2) | Accuracy uncertain |
| ARMI 14 | Irregularities level outbound value (kpi6_1) | Accuracy uncertain |
| ARMI 15 | Irregularities level total quantity (kpi6_3) | Accuracy uncertain |
| ARMI 16 | Irregularities level total value (kpi6_3) | Accuracy uncertain |
| ARMI 17 | Movement ratio quantity (kpi4_1) | Accuracy uncertain |
| ARMI 18 | Movement ratio value (kpi4_2) | Accuracy uncertain |
| ARMI 19 | Pick accuracy in percentages (kpi5_1) | Accuracy uncertain |
| ARMI 20 | Pick accuracy quantity (kpi5_2) | Accuracy uncertain |
| ARMI 21 | Pick accuracy value (kpi5_3) | Accuracy uncertain |
| ARMI 22 | Storage occupancy (kpi7_1) | Accuracy uncertain |
| ARMI 23 | Storage occupancy per storage location (kpi7_2) | Accuracy uncertain |
| ARMI 24 | Storage rotation in calendar days / product hierarchy 1-3 (kpi8_1) | Accuracy uncertain |
| ARMI 25 | Storage rotation in calendar days / top 10 SKU (kpi8_2) | Accuracy uncertain |
| | | |
| Other OPI 1 | Shipment duration | Recently added, available but format can be changed |
| Other OPI 2 | Productivity full pallets, master cartons | Temporary by time study and manual extraction |
| Other OPI 3 | Leadtime goods receipt until put away | Recently added, available but format can be changed |
| Other OPI 4 | Planned Goods Issue vs actual goods issue | Recently added, available |
| Other OPI 5 | Number of changes in delivery items vs total number of delivery items | Recently added, available |

# E. List of available operational performance reports / indicators for all logistic levels

| ID | Name / report | Responsibility |
|---|---|---|
| I.1 | Leadtime Factory to harbour | SCE |
| I.2 | Leadtime Factory to warehouse | SCE |
| I.3 | Leadtime harbour to warehouse | SCE |
| I.4 | Leadtime warehouse to goods receipt | SCE |
| I.5 | Leadtime factory to goods receipt | SCE |
| I.6 | Leadtime harbour to goods receipt | SCE |
| I.6 | Leadtime harbour-GR Container shipments (SLA 1.3) | LOE SLA |
| I.6 | Leadtime Airport-GR Airfreight on airfreight pallets (SLA 1.4) | LOE SLA |
| I.7 | time to dock allocation : Truck-shipments (SLA 1.1) | LOE SLA |
| I.8 | Unloading + put-away time: All truck shipments (SLA1.2) | LOE SLA |
| 1,9 | Inbound hit rate by quantity overall | SCE |
| 1,9 | Inbound hit rate by quantity by sales companies | SCE |
| 1,9 | Inbound hit rate by quantity by product group | SCE |
| I.10 | Supplier Reliability by quantity overall | SCE |
| I.10 | Supplier Reliability by quantity by business group | SCE |
| I.11 | Inbound Volume (Cubic meters) per EBU | LOE |
| I.11 | Inbound Weight (KG) per EBU | LOE |
| W.1 | Movements per delivery: Movement ratio quantity (ARMI 4_1) | SLE |
| W.1 | Movements per delivery: Movement ratio value (ARMI 4_2) | SLE |
| W.2 | storage occupancy: Utilization (pallets) | LOE |
| W.3 | Space utilization: Utilization (Cubic meters) | LOE |
| W.4 | Days-supply (stock turn) | LOE |
| W.5 | Storage Volume (Cubic meters) per EBU | LOE |
| W.6 | Storage Weight (KG) per EBU | LOE |
| W.2 | Number of pallets in storage (per storage type) | LOE |

| ID | Name / report | Responsibility |
|---|---|---|
| W.2 | Storage capacity (number of pallets) | LOE |
| W.7 | Central Stock Storage Volumes | LOE |
| W.8 | Damage / Loss / Missing / Theft VALUE (SLA 3.1) | SLE / LOE SLA |
| W.9 | Stock accuracy (SLA3.2) | SLE / LOE SLA |
| W.10 | Productivity (cubic meters / manhour) | LOE |
| O.1 | Dealer Hit Rate: Overall by value | SCE |
| O.1 | Dealer Hit Rate: Overall by quantity | SCE |
| O.1 | Dealer Hit Rate: Business groups by value | SCE |
| O.1 | Dealer Hit Rate: Business groups by quantity | SCE |
| O.1 | Dealer Hit Rate: Sales companies by value | SCE |
| O.1 | Dealer Hit Rate: Sales companies by quantity | SCE |
| O.1 | Dealer hit rate | LOE |
| O.2 | On Time delivery (SLA 2.2) | LOE SLA |
| O.3 | Delivery reliability (Synthetics) (SLA2.3) | LOE SLA |
| | Planned Goods Issue vs Actual goods issue | SLE |
| O.4 | Number of changes on deliveries vs total number of deliveries | SLE |
| | Impr. Project 28: The use of the PTB will be maximised: | |
| | No of boxes via the sorter should increase. | |
| | no of picks via the sorter should increase | SLE |
| | Picking productivity Full pallets and master cartons (pick tour) | SLE |
| O.5 | Outbound Volume (Cubic meters) per EBU | LOE |
| O.5 | Outbound Weight (KG) per EBU | LOE |
| O.6 | Number of delivery notes | LOE |
| O.7 | Small shipment ratio | LOE |
| O.10 | Delivery Losses / Losses on customer distribution (SLA 2.1) | LOE SLA |
| O.11 | Outbound-Budget comparison | LOE |
| O.12 | FP/MC/BMC ratio | LOE |
| O.8 | Speed & Accuracy: Lead time: delivery creation to delivery | LOE |
| O.9 | Speed & Accuracy: Lead time within warehouse | LOE |
| | Shipment duration | SLE |

| ID | Name / report | Responsibility |
|---|---|---|
| O.14 | Shipment/Delivery Profile | LOE |
| R.1 | all returns | LOE |
| R.2 | logistic returns | LOE |
| R.3 | Returns lead time to Returns Centre (SLA 4.2) | LOE / LOE SLA |
| | ERC1:<br>Goods Receipt Performance: | SLE ERC |
| | ERC2:<br>Stock accuracy: | SLE ERC |
| | ERC3:<br>Quality inspection verification: | SLE ERC |
| | ERC4:<br>Quality verification leadtime: | SLE ERC |
| | ERC6:<br>Miss Shipments: | SLE ERC |
| | ERC7:<br>Outbound Performance: | SLE ERC |
| | ERC8:<br>Performance Shuttle of sellable stock: | SLE ERC |
| | ERC9:<br>Interface Performance: | SLE ERC |
| | ERC10:<br>Reporting Performance: | SLE ERC |
| D.1 | Dispute Settlement (SLA 4.1) | LOE SLA |
| S.1 | Product availability by business groups for A and B materials | SCE |
| S.1 | Product availability by sales companies for A and B materials | SCE |
| S.2 | Forecast accuracy Forecast accuracy in value by business group | SCE |
| S.2 | Forecast accuracy Forecast accuracy in value by sales company | SCE |
| F.1 | Logistics expense (Distribution Expense Ratio) | LOE |
| F.2 | Costs per cubic meter | LOE |
| F.3 | Sales value/cubic meter | LOE |
| X.1 | Inbound vs Outbound | LOE |
| X.2 | Forecast vs Actual | LOE |

# F. Time study Project Document

## Project Document: Time Measurements

### Background

For several projects time measurements are needed. Therefore, the times are measured in a way that they can be used for all different projects. These projects concern:

- Simulation tool (Wolfgang Schönfeld)
- Wave planning tool; workload warehouse (Kayihan Noyan)
- Capacity & Resource Planning tool (Marjolijn 't Mannetje)
- Performance indicators (Anouk Hesen)

### Project result

**Objective**

The objective of the time measurements is to get information regarding the time needed per handling unit for the several parts of the process.

**Result**

Time measurements for all operational processes (inbound, outbound, internal replenishment) for the CAV operation of Sony Logistics Europe in Tilburg.

**Project scope**

The project scope concerns time measurements for the operational activities (inbound, production, outbound and internal replenishment) in the Consumer Audio Video operation in the distribution centre of Sony Logistics Europe in Tilburg, the Netherlands.

### Methods

The flows that are going to be measured are:
Inbound flow (unloading, pallet building and put away)
Outbound flows:

- Full Pallet flows
- Master Carton flows
- Broken Master Carton flows
- Internal replenishment flows

The following processes are measured in detail:

- Master Carton Pick Tour
- Pick-to-belt replenishment
- Mezzanine replenishment

These processes are measured in detail for different reasons. Master carton Pick tour is measured in detail for the reason that a low productivity was concluded. Pick-to-belt replenishment is a critical process and time constraint. The mezzanine replenishment flow is seen as an issue by Germany.
For every step in the process the required number of measurements will be performed to achieve a 95% level of confidence.

# G. Time Study Results

**Time study times**

The actual results (average time per unit, average man-hours per unit and units per man-hour) are removed because of confidentiality.

| | | | | | | | | | | Number of measurements |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | **Inbound** | | | | | | | | | ***Pallets*** |
| IN11 | Time (minutes) to | unload | one pallet | | | | MCC flow | | | 88 |
| | Time (minutes) to | build | one pallet | | | | special (MCC, airfreight, loose loading, slipsheets) | | | 167 |
| | Time (minutes) to | build | one pallet | | | | **system activity** | | | 158 |
| | | | | | | | | | | |
| IN12 | Time (minutes) to | unload | one pallet | | | | Loose loading flow | | | 27 |
| | Time (minutes) to | build | one pallet | | | | special (MCC, airfreight, loose loading, slipsheets) | | | 167 |
| | Time (minutes) to | build | one pallet | | | | **system activity** | | | 158 |
| | | | | | | | | | | |
| IN13 | Time (minutes) to | unload | one pallet | | *Use pallet time as per palletised inbound* | | returns flow | | | 56 |
| | Time (minutes) to | build | one pallet | | | | standard (pallets, returns, slipsheets) | | | 56 |
| | Time (minutes) to | build | one pallet | | | | **system activity** | | | 158 |
| | | | | | | | | | | |
| IN15 | Time (minutes) to | unload | one pallet | | | | pallet flow | with a | FLT | 56 |
| | Time (minutes) to | build | one pallet | | | | standard (pallets, returns, slipsheets) | | | 56 |

| | | | | | | | | | | Number of measurements |
|---|---|---|---|---|---|---|---|---|---|---|
| | Time (minutes) to | build | one pallet | | | | **system activity** | | | 158 |
| | | | | | | | | | | |
| IN14 | Time (minutes) to | unload | one pallet | | | | airfreight flow | | | 18 |
| | Time (minutes) to | build | one pallet | | | | special (MCC, airfreight, loose loading, slipsheets) | | | 167 |
| | Time (minutes) to | build | one pallet | | | | **system activity** | | | 158 |
| | | | | | | | | | | |
| IN16 | Time (minutes) to | unload | one pallet | | | | slipsheet flow | with a | CT | 120 |
| | Time (minutes) to | build | one pallet | | | | special (MCC, airfreight, loose loading, slipsheets) | | | 167 |
| | Time (minutes) to | build | one pallet | | | | system activity | | | 158 |
| | | | | | | | | | | |
| | Time (minutes) to | unload | one pallet | | | | slipsheet flow | with a | PPT | 39 |
| | Time (minutes) to | build | one pallet | | | | standard (pallets, returns, slipsheets) | | | 56 |
| | Time (minutes) to | build | one pallet | | | | **system activity** | | | 158 |
| | | | | | | | | | | |
| | Time (minutes) to | put away | one pallet | | | to | High value | with a | RT | 8 |
| | Time (minutes) to | put away | one pallet | | | to | Standard rack | with a | RT | 49 |
| | Time (minutes) to | put away | one pallet | | | to | Block storage | with a | FLT | 16 |
| | Time (minutes) to | put away | one pallet | | | to | Drive-in rack | with a | RT | 25 |
| | Time (minutes) to | put away | one pallet | | | to | Mezzanine | with a | RT | 9 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | **Replenishment** | | | | | | | | | ***Pallet*** |
| OUT26 | Time (minutes) to | pick and transport | one pallet | from | standard rack | to | pick to belt area | with a | RT | 1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | **Number of measurements** |
| | | | | the | | | mezzanine (on conveyor) | | | |
| | | | | | | | | | | ***Pallets*** |
| OUT34A | Time (seconds) to | replenish one pallet location | one replenishment pallet | from the | roller conveyor mezzanine | to | pick to belt area mezzanine | | | 1 |
| | | | | | | | | | | |
| | | | | | | | | | | ***MC's*** |
| OUT32 | Time (minutes) to | pick and transport | one replenishment MC | from the | standard rack (high level) | to | Pick & Drop area mezzanine | with an | OPT | 303 |
| | | | | | | | | | | ***pallets*** |
| OUT33 | Time (minutes) to | pick and transport | one replenishment pallet | from the | Pick & Drop area mezzanine | to | the mezzanine | with a | RT | 6 |
| | | | | | | | | | | ***MC's*** |
| OUT34 | Time (minutes) to | handle (put in flow racks) | the boxes on one replen pallet | at the | mezzanine | | | | | 105 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| OUT29 | Time (minutes) to | pick and transport | one pallet | from the | standard rack (high level) | to | standard rack (pick face) | with a | RT | 10 |
| | Time (minutes) to | pick and transport | one pallet | from the | standard rack | to | pick to belt ground floor | with a | RT | 9 |
| OUT30 | Time (minutes) to | pick and transport | one pallet | from the | high value (high level) | to | high value (pick face) | with a | RT | 5 |
| OUT31 | Time (minutes) to | pick and transport | one pallet | from the | block storage 010 | to | block storage 018 (pick face light) | with a | FLT | 1 |
| OUT36 | Time (minutes) to | pick and transport | one pallet | from the | block storage 010 | to | block storage 017 (pick face heavy) | with a | RT | 6 |

| | | | | | | | | | | Number of measurements |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | Time (minutes) to | pick and transport | one pallet | from the | drive in 015 | to | block storage 018 (pick face light) | with a | RT | 2 |
| | Time (minutes) to | pick and transport | one pallet | from the | drive in 015 | to | block storage 017 (pick face heavy) | with a | RT | 3 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | **Picking Full Pallets** | | | | | | | | | ***Pallets*** |
| OUT12 | Time (minutes) to | transport | one pallet | from the | standard rack | to | Outpack zone 210/211/custom. Area/vas | with a | RT | 37 |
| OUT13 | Time (minutes) to | transport | one pallet | from the | drive-in rack | to | Outpack zone 210/211/custom. Area/vas | with a | RT | 26 |
| OUT14 | Time (minutes) to | transport | one pallet | from the | high value storage | to | Outpack zone 210/211/custom. Area/vas | with a | RT | 2 |
| OUT15 | Time (minutes) to | transport | one pallet | from the | block storage | to | Outpack zone 210/211/custom. Area/vas | with a | FLT | 38 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | **Mezzanine** | | | | | | | | | ***Broken MC's*** |
| OUT17 | Time (minutes) to | pick | one broken mc | at the | mezzanine | | | | | 25 |
| OUT17AZ | Time (seconds) to | check&scan | one broken mc | at the | mezzanine | | | | | 38 |
| OUT18 | Time (minutes) to | pack | one broken mc | at the | mezzanine | | | | | 88 |
| | | | | | | | | | | |
| | **Picking master cartons : Pick-to-belt ; Including** | | | | | | | | | ***MC's*** |

| | | | | | | | | | | Number of measurements |
|---|---|---|---|---|---|---|---|---|---|---|
| | **measurements where >1 person work at a TO** | | | | | | | | | |
| **OUT19** | **Time (minutes) to** | **pick and put** | **one master carton** | **on the** | **high value belt** | | | | | **329** |
| | Time (minutes) to | pick | one master carton | for | high value belt | | | | | 239 |
| | | | | | | | | | | ***Locations*** |
| | Time (minutes) to | transport | between | the | storage (pick face) | and | high value belt | | | 17 |
| | | | | | | | | | | ***MC's*** |
| **OUT25** | **Time (minutes) to** | **pick, customise and put** | **one master carton** | **on the** | **high value belt** | | | | | **332** |
| | Time (minutes) to | pick | one master carton | for | high value belt | | | including customisation | | 91 |
| | | | | | | | | | | ***Locations*** |
| | Time (minutes) to | transport | between | the | storage (pick face) | and | high value belt | including customisation | | 3 |
| | | | | | | | | | | ***MC's*** |
| **OUT20** | **Time (minutes) to** | **pick and put** | **one master carton** | **on the** | **ground floor belt** | | | | | **539** |
| | Time (minutes) to | pick | one master carton | for | ground floor belt | | | | | 539 |
| | | | | | | | | | | ***Locations*** |
| | Time (minutes) to | transport | between | the | storage (pick face) | and | ground floor belt | | | 28 |
| | | | | | | | | | | ***MC's*** |
| **OUT21** | **Time (minutes) to** | **pick and put** | **one master carton** | **on the** | **mezzanine belt** | | | | | **14** |
| | | | | | | | | | | |
| | **Picking master cartons : Pick-to-belt ; Only measurements where one person is working on a TO** | | | | | | | | | ***MC's*** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | **Number of measurements** |
| **OUT19** | **Time (minutes) to** | **pick and put** | **one master carton** | **on the** | **high value belt** | | | | | **379** |
| | Time (minutes) to | pick | one master carton | for | high value belt | | | | | 289 |
| | | | | | | | | | | ***Locations*** |
| | Time (minutes) to | transport | between | the | storage (pick face) | and | high value belt | | | 18 |
| | | | | | | | | | | ***MC's*** |
| **OUT25** | **Time (minutes) to** | **pick, customise and put** | **one master carton** | **on the** | **high value belt** | | | | | **182** |
| | Time (minutes) to | pick | one master carton | for | high value belt | | | including customisation | | 91 |
| | | | | | | | | | | ***Locations*** |
| | Time (minutes) to | transport | between | the | storage (pick face) | and | high value belt | including customisation | | 3 |
| | | | | | | | | | | ***MC's*** |
| **OUT20** | **Time (minutes) to** | **pick and put** | **one master carton** | **on the** | **ground floor belt** | | | | | **482** |
| | Time (minutes) to | pick | one master carton | for | ground floor belt | | | | | 482 |
| | | | | | | | | | | ***Locations*** |
| | Time (minutes) to | transport | between | the | storage (pick face) | and | ground floor belt | | | 25 |
| | | | | | | | | | | ***MC's*** |
| **OUT21** | **Time (minutes) to** | **pick and put** | **one master carton** | **on the** | **mezzanine belt** | | | | | **7** |
| | | | | | | | | | | |
| | **Picking master cartons : Master Carton Pick Tour** | | | | | | | | | ***MC's*** |
| | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | **Number of measurements** |
| **OUT22** | **Time (minutes) to** | **pick and transport** | **one master carton** | **from the** | **standard rack** | **to** | **chute (outpack 210) pallet building** | **with an** | **OPT** | **204** |
| | Time (minutes) to | pick | one master carton | from the | standard rack | | | | | 204 |
| | | | | | | | | | | ***Locations*** |
| | Time (minutes) to | transport | between | the | standard rack | and | standard rack | | | 40 |
| | | | | | | | | | | ***MCPT*** |
| | Time (minutes) for | preparation/other | for | the | standard rack | | | | | 5 |
| | | | | | | | | | | ***MC's*** |
| **OUT23** | **Time (minutes) to** | **pick and transport** | **one master carton** | **from the** | **block storage** | **to** | **chute (outpack 210) pallet building** | **with an** | **OPT** | **2** |
| | Time (minutes) to | pick | one master carton | from the | block storage | | | | | 2 |
| | | | | | | | | | | ***Locations*** |
| | Time (minutes) to | transport | between | the | block storage | and | block storage | | | 2 |
| | | | | | | | | | | ***MCPT*** |
| | Time (minutes) for | preparation/other | for | the | block storage | | | | | 0 |
| | | | | | | | | | | ***MC's*** |
| **OUT24** | **Time (minutes) to** | **pick and transport** | **one master carton** | **from the** | **high value** | **to** | **chute (outpack 210) pallet building** | **with an** | **EPT** | 287 |
| | Time (minutes) to | pick | one master carton | from the | high value | | | | | 137 |
| | | | | | | | | | | ***Locations*** |
| | Time (minutes) to | transport | between | the | high value | and | high value | | | 9 |
| | | | | | | | | | | ***MCPT*** |
| | Time (minutes) for | customisation | for | the | high value | | | | | 53 |
| | | | | | | | | | | ***MC's*** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | **Number of measurements** |
| **OUT35** | **Time (minutes) to** | **pick and transport** | **one master carton** | **from the** | **block storage Heavy** | **to** | **chute (outpack 210) pallet building** | **with an** | **OPT** | **120** |
| | Time (minutes) to | pick | one master carton | from the | block storage Heavy | | | | | 120 |
| | | | | | | | | | | ***Locations*** |
| | Time (minutes) to | transport | between | the | block storage Heavy | and | block storage Heavy | | | 36 |
| | | | | | | | | | | ***MCPT*** |
| | Time (minutes) for | preparation/other | for | the | block storage Heavy MCPT | | | | | 4 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | **Customisation** | | | | | | | | | |
| OUT10 | Time (minutes) to | customise | one pallet | at the | customisation area | | | | | 111 |
| | | | | | | | | | | |
| | **Transport after customisation** | | | | | | | | | |
| OUT08 | Time (minutes) to | transport | one pallet | from the | customisation area | to | outpack zone 210 | with a | FLT | 47 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | **Labelling** | | | | | | | | | ***MC's*** |
| OUT16 | Time (minutes) to | label | a master carton on a full platform pallet | at the | outpack zone 211 | | | | | 196 |
| | | | | | | | | | | |
| | **Pallet Build** | | | | | | | | | ***MC's*** |

| | | | | | | | | | | Number of measurements |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Outbound** | | | | | | | | | |
| OUT11 | Time (minutes) to | put | one MC | on a | pallet | at the | chute (outpack 210) | | | 229 |
| OUT11 | Time (minutes) to | put | one MC | on a | pallet | at the | chute (outpack 210) | | Only scanning times | 107 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | **Transport to wrapper (only one of the two types of equipment used)** | | | | | | | | | |
| OUT02 | Time (minutes) to | transport | one pallet | from the | outpack zone 210 / pallet building at chute | to | wrapping and labelling | with a | FLT | 15 |
| OUT03 | Time (minutes) to | transport | one pallet | from the | outpack zone 210 / pallet building at chute | to | wrapping and labelling | with an | EPT | 21 |
| | | | | | | | | | | |
| | **Wrapping** | | | | | | | | | ***Pallets*** |
| GEN12 | Time (minutes) to | wrap | one pallet | | | | | | | 23 |
| | | | | | | | | | | |
| | **Transport to dock and truck** | | | | | | | | | |
| OUT04 | Time (minutes) to | transport | one pallet | from the | wrapping and labelling | to | goods issue area | with a | FLT | 68 |
| | Time (minutes) to | check | one pallet | at the | dock | before | loading | | | 448 |

| | | | | | | | | | | Number of measurements |
|---|---|---|---|---|---|---|---|---|---|---|
| OUT06 | Time (minutes) to | transport | one pallet | from the | goods issue area | into | truck | with a | FLT | 183 |

**SAP times**

Actual times are excluded because of confidentiality.

| | | Data | | |
|---|---|---|---|---|
| Movement type | Pick type change | Sum of #Bins | Sum of # Boxes | Average of Processing time 2 |
| Full Pallets | FP | | | |
| Master Carton Tour | MCT | | | |
| Putaway | Putaway | | | |

| | | Data | | | |
|---|---|---|---|---|---|
| Pick type | Typ | Sum of #Bins | Sum of # Boxes | Average of Processing times per bin | Average of Processing time per box |
| Pick to Belt | 26 | | | | |
| | 31 | | | | |
| | 43 | | | | |
| PtB Total | | | | | |
| Grand Total | | | | | |

**Agreed performance at the moment**

On the 9th of December 2003 a meeting will be held to discuss the found productivity figures. The result of the meeting will be an overview of the current productivity that is agreed by all meeting attendees.

# H. Operational Performance Indicators Development plan

Names have been abbreviated for privacy reasons.

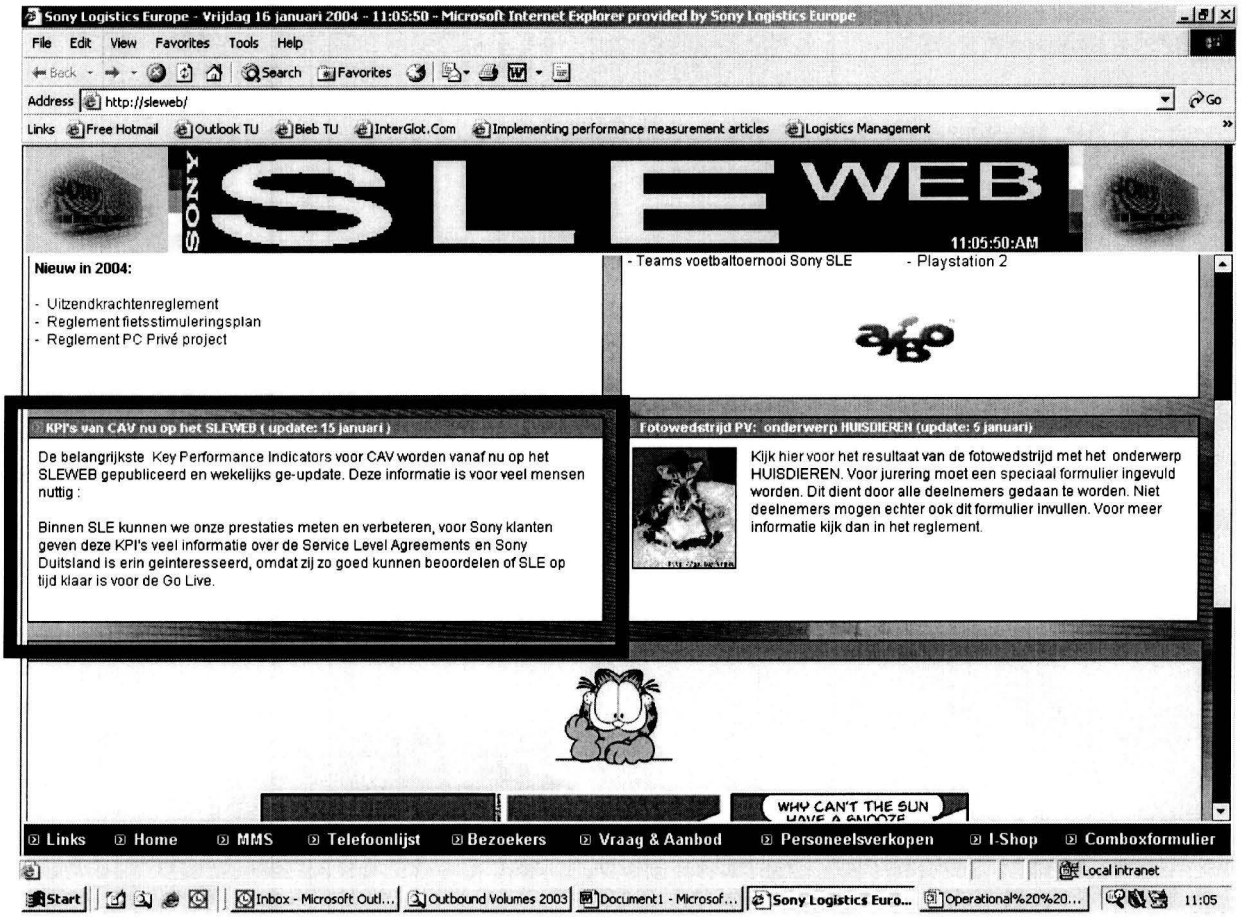
| Operational Performance Indicator development plan | Due Date | Who |
|---|---|---|
| **Status mid-December** | **15-12-2003** | |
| • Overview of possible performance indicators for the CAV operation Indicators based on managers' and other people's wishes | | AH |
| • Prioritisation added to list with possible indicators for CAV based on impact on cost, speed and delivery reliability and on priority give by managers. This resulted in a suggested selection on the highest operational level (14 Operational Performance Indicators) | | PO, RM, AH, SM, managers |
| • Selection on highest operational level validated and approved during meeting on the 15th (15 Operational Performance Indicators): | | HL, (OG), RM, PO,MW, EB, SM |
| 1. Productivity<br>a. Inbound; unloading & Put away<br>b. Outbound; picking per area & loading<br>First step: Calculate total number of required hours based on real volume (use workload per area) and detailed productivity targets. Compare the calculated required hours to the real hours worked to give an indication of detailed productivity<br>Second step: Use the Task and Resource Management system (TRM) to extract actual hours worked on detailed processes. This will be available in April. | **January 2004** | First step: AH (develop) SM (report) |
| 2. Lead-time<br>a. Inbound; GR –pallet build- pick up pallet –put away<br>b. Outbound; Wave start – to creation – to confirmation – start loading – end loading – start goods Issue- print documents – print CMR<br>Manually available at the moment (15-12-2003). Data to be presented on a high level, but detailed information should be available for analysis purposes in case of bad performance. | **Available on high level**<br><br>Detail to be developed (Development status available 30-1-2004) | SM (report)<br><br>AH, RMr |
| 3. Stock accuracy<br>Number of bins/pieces counted versus number of bins/pieces with differences | (Development status available 30-1-2004) | AH |
| 4. Stock count frequency and progress<br>How often should stock count be executed and how often is it actually executed | (Development status available 30-1-2004) | AH |
| 5. Damage and Missing<br>Indicator on a weekly basis is under development in SAP BW. This information is not as detailed as the information | (Development status available 30- | AH |

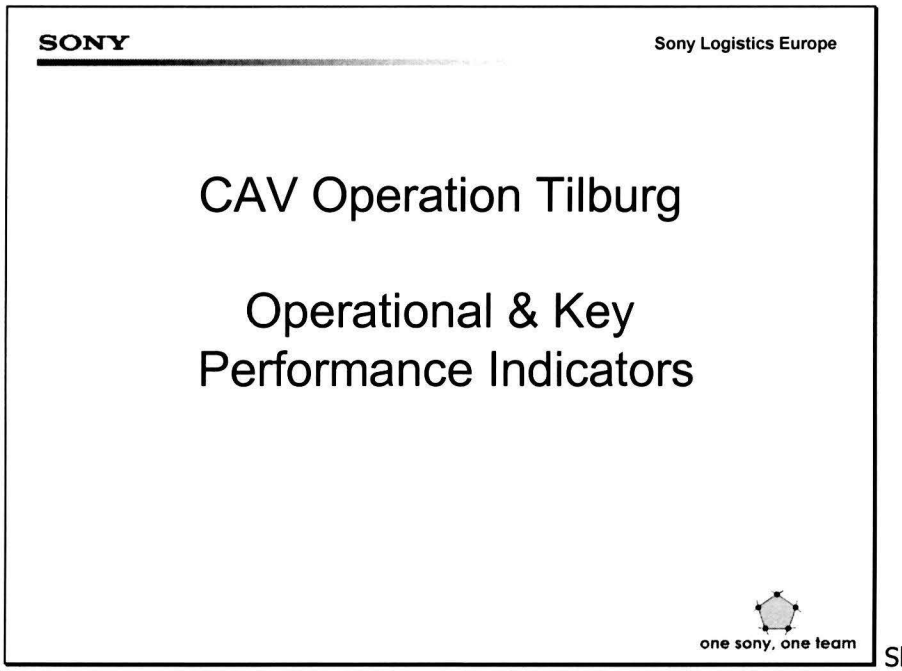
| Operational Performance Indicator development plan | Due Date | Who |
|---|---|---|
| that could be available from the WMS system (PWD). Absolute number of TO's / quantity, TO-items versus total number of TO's etc. | 1-2004) | |
| 6. Storage utilisation (capacity usage report)<br>Report in place. Mezzanine not included because it is not critical (enough spaces available). The definition of utilisation will be redefined by Jeroen Elias. | **Available** | MH (create *and report*)<br>SM (report) |
| 7. Accuracy of Pre-planning or outbound production (volumes) actual versus plan<br>This indicator is still wanted, but will not be measured at the moment. Before measuring this indicator the planning project should be finished and the results of the project should be in place.<br>As an interim solution the quality of the input for the planning will be measured being: forecast accuracy of the sales companies (EU20 plant and including SR that does not go through the CAV warehouse) | (Development status available 30-1-2004) | AH |
| 8. Expected versus actual truck arrival and departure<br>Information from Yard Management System | (Development status available 30-1-2004) | AH |
| 9. Planned Goods Issue – versus – Actual<br>Remark: this is PRC data and somewhat less accurate than PWD data. (Difference about 10%) | **Available** | EB (create),<br>SM(report) |
| 10. Delivery changes (instead of picking accuracy)<br>Picking accuracy not available because this is mostly manually corrected. Delivery changes are manually available | (Development status available 30-1-2004) | AH |
| 11. Disputes versus deliveries | **Available** | SM (report) |
| 12. Carrier transport lead-time<br>Available from INFODIS but definition needs to be checked | (Development status available 30-1-2004) | AH |
| 13. Complexity of operation (background information)<br>a. Nature of inbound (slipsheets, loose loading, pallets, etc.)<br>b. Inbound profile (truck, air, container)<br>c. Delivery profile (% of directs, platform and replenishments)<br>d. Nature of outbound (cubic meter per TO)<br>e. Volumes versus limits in SLA<br>Indicator needs more work to provide the right information. Idea is to make a proposal for a weighted measure of complexity and a separate measure and decide on what's best afterwards. | (Development status available 30-1-2004) | AH (to make proposal) |
| 14. Disputes lead-time | **Available** | SM (report) |
| 15. Returns Classification | (Development | Anouk Hesen |

| Operational Performance Indicator development plan | Due Date | Who |
|---|---|---|
| (check on accurate classification by WWI of returned products)<br>At the moment sample size not included and needs to be added | status available 30-1-2004) | |
| **→Currently Operational Performance Indicator selection on highest operational level finished. Validation to be formalised** | **23-12-2003 / 12-1-2004** | HL, OG, RM, PO, MW, EB, SM, LD |
| **Creating Operational Performance Indicators per department**<br>Operational Performance Indicators will be developed per department based on and linked to the selected Operational Performance Indicators. | **29-12-2003** | **AH (validate with managers)** |
| **Indicator Information Guide development**<br>For all Operational Performance Indicators an identification sheet will be created containing things like definition, source data, data owner, target, etc. This file will need to be maintained and can change over time. The intention is to have the first version ready for review on the given due date. | **31-12-2003** | **AH** |
| The identification of the source data might take more time, therefore the due date is set on a later time for this item | **9-1-2004** | AH |
| **Reporting tool development**<br>To be able to retrieve the data in a structured way and make it independent of one person a way to report or extract the data will be developed. | | |
| 1. First it will be checked if indicators are already available from BW | **9-1-2004** | AH, RM, (PB) |
| 2. Second it will be checked if indicators that are not (yet) available in BW can be created with data available in BW, or can be developed in BW | **9-1-2004** | AH, RM, (PB) |
| 3. Last, other data extraction methods will be reviewed for all data that cannot come from BW | **23-1-2004** | AH |
| When it is known for all (or most) indicators what development needs to be done to get the data extracted in a structured way, a development plan for reporting will be created. | **30-1-2004** | AH |
| **Publishing tool development**<br>Regarding publishing there are several things that need to be decided on:<br>1. First, the tool used to publish the information needs to be selected<br>2. Second, it will need to be decided who will be receiving information and what the information is they need to receive<br>3. Third, how can the information be sent to the people? This can be e-mail, a location on the network or intranet, the plasma-screens (or a selection of (all) of the above.) | **12-1-2004** | **SM,AH** |
| For the publishing a development plan will be created when all information mentioned above is available | **15-1-2004** | AH |

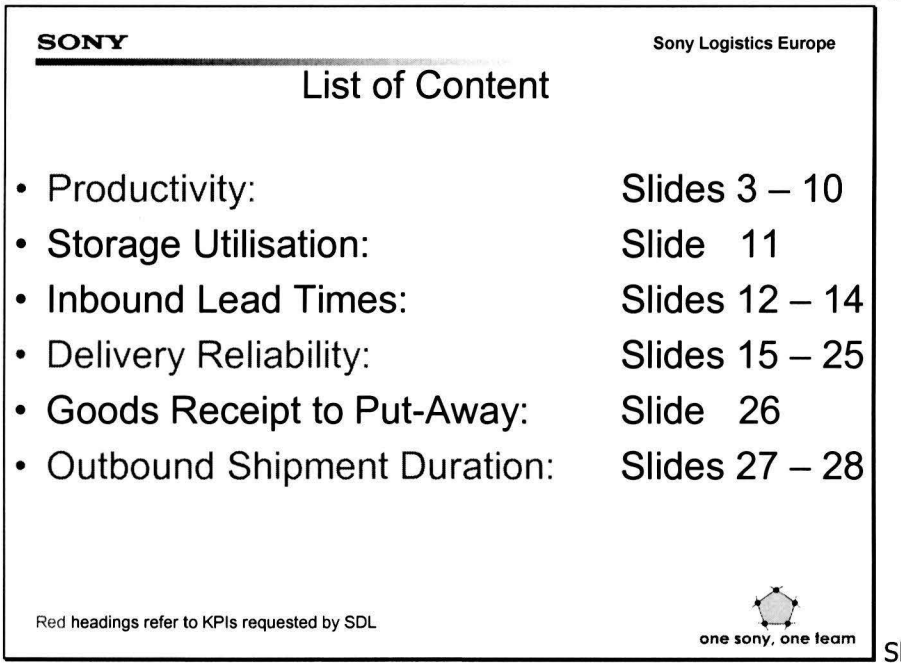
| Operational Performance Indicator development plan | Due Date | Who |
|---|---|---|
| **Creating Implementation and Communication plan** | **28-1-2004** | **AH** |
| Keeping future users aware of progress | **Continuous** | AH |
| Tools available | (Development status available 15-1-2004) | |
| Organise meeting to present tools and instruction (including monitoring process) to start first use | **Depends on availability of tools** | Organised by AH (invited: users) |
| First use to review entire system | **Period of 2 weeks after presentation meeting** | All users |
| Review meeting (validate publishing: who is receiving information, what is the information they receive, when is it received and how to receive) | **After review period** | Organised by AH (invited: users) |
| First update | **Depends on the changes needed** | AH |
| Continuous use and keeping system up-to-date | **After first update** | All |

# I. Publication of Operational Performance Indicators "interim solution" on the SLE intranet on 15-1-2004






Slide 1




Slide 2

Presentation slides containing information on actual performance are excluded because of confidentiality.

# J. Agreed productivity levels

The agreed productivity levels are not presented because of confidentiality.

| Process |
|---|
| ***Inbound*** |
| unloading pallets (use same time for returns) |
| unloading slip sheets (PPT) good quality |
| unloading slip sheets poor quality (CT) |
| unloading MCC |
| unloading loose loading |
| unloading Air Freight palettised |
| unloading Air Freight loose |
| goods receipt (pallet build system activity) |
| put away (high value) |
| put away (standard racking) |
| put away (block storage) |
| put away (drive-in racking) |
| put away (mezzanine) |
| |
| ***Outbound*** |
| Full pallet pick (rack) |
| Full pallet pick (block) |
| Full pallet pick (drive in) |
| Full pallet pick (high value) |
| PTB (pick & transport) one person |
| PTB (mezzanine) |
| PTB (high value) |
| |
| MC pick-tour (standard rack) |
| Heavy item pick |
| Security area (MCT) |
| Item picking (mezzanine) |
| Full pallet handling (labelling of pallet platform) |
| Customisation |
| Palletizing at chute (only scanning and placing on pallet) |
| Wrapping |
| Checking |
| Loading (including photo, etc) |
| |
| ***Internal*** |
| Replenishment to PTB |
| Replenishment in rack (avg block drive-in and rack) |

# K. Requests from the German operation

| List of requested Key Performance Indicators: | Status | Result |
|---|---|---|
| **Outbound Performance:** | | |
| Steady output of > 1.000 m3/shift | Data available (extracted weekly) on daily basis from outboundvolumeswk.. file (P:\SWITCH\00 Post Go-Live Improvement Program\Project Documentation\020 Resolve Bottleneck in Whs\029 Closing Wave & Lane management\Outbound volumes) | Volumes can be reported weekly |
| # orderlines outbound | Data of number of TO's and TO items is available | Number of TO's and TO items can be reported weekly |
| # broken master ol per hour | | Currently not available, (needs TRM module) |
| # broken master orders per hour | | Currently not available, (needs TRM module) |
| Productivity Outbound > 2,25 m3/man hour (in line with original design) | Outbound productivity reported on a weekly basis (OPI productivity report) | Productivity can be weekly reported on a high level. Also an estimate can be made of detailed productivity (under development) |
| **Shipment duration < 6 hours** | | |
| wave lenght in hours | Shipment duration available on a weekly basis (G:\cav\mgt\OPI) file outbound OPI | Shipment duration can be reported weekly |
| ratio of waves finished in time or before daily > 97,5% | Planned goods issue versus actual available from BW | PGI vs AGI can be reported weekly |
| no of deliveries per day in time (per day and per wave) | Planned goods issue versus actual available from BW | PGI vs AGI can be reported weekly |
| no of deliveries in % being shipped in time or before time (planned GI vs. act GI) | Planned goods issue versus actual available from BW | PGI vs AGI can be reported weekly |
| cut deliveries vs no of deliveries > 99,5% | That's number of GIed deliveries Vs adjusted Deliveries (G:\cav\mgt\OPI) delivery changes | Number of changed deliveries can be reported weekly |
| **Zero picks number** | | |
| zero picks vs no of order lines < 0,5% | | See number of changed deliveries |
| **Disputes number:** | | |
| no of dispuites vs no deliveries | Existing in temporary OPI report | Can be reported weekly |
| mispicks (vs disputes) | Not available | Not available (and difficult to create) |
| returns reasons (damage ratio/ late delivery/refusals) | Available from BW | Details to be checked, probably possible to report |

| | | |
|---|---|---|
| | | monthly (Eduard Brantjes) |
| **Service Levels:** | | |
| 96% delivery performance on standard orders | What is available:<br>• Infodis forwarder performance<br>• Planned GI vs Actual Goods Issue<br>• Disputes | Available weekly:<br>• Infodis forwarder performance<br>• Planned GI vs Actual Goods Issue<br>• Disputes |
| 98% delivery performance on rush orders based on deliveries | - | Not available |
| **Back log:** | | |
| next day or crisis (channel managed to clear it up) | Aged delivery report (M. 't Mannetje) | Available on a daily basis |
| **EDI transmissions per truck:** | | |
| being in time (at platform before truck arrives) >99% | Currently not available | Currently not available |
| accuracy (no of cartons missing vs EDi should be) >99% | Currently not available | Currently not available |
| result of complete end2end test with real labels /real data in CTE resulting in real scanning and printing at platform site | Part of the integration testing, not a KPI issue | |

First report (send 12-1-2004) to contain:

- November
- December
- 1st week of January

After that

Weekly reporting

# L. Ranking of possible indicators resulting in a list of 14 suggested indicators on general level

| Business Process Group | Name / report | expressed in: units of measure | IMPACT RATING sum | PRIORITY RATING sum | Average of priority and impact |
|---|---|---|---|---|---|
| Outbound | Outbound productivity | M3 per manhour | 8 | 9 | 9 |
| Housekeeping | Stock accuracy | % | 8 | 9 | 9 |
| Inbound | Inbound leadtime Internal | time (hrs) | 6 | 9 | 8 |
| Inbound | Productivity | M3 per manhour | 8 | 6 | 7 |
| Outbound | Outbound leadtime per shipment (Shipment duration) | time (hrs) | 7 | 6 | 7 |
| Outbound | Picking profile, workload per area | manhours and time per area | 8 | 5 | 7 |
| Inbound | Damage and missing on inbound | Qty | 5,5 | 7 | 6 |
| Outbound | Planned goods issue versus actual goods issue | time (hrs) | 6,5 | 6 | 6 |
| Planning and Services | Accuracy of pre-planning: pre-planning versus actual figures | % | | 6 | 6 |
| Quality Centre | Stock count: Accuracy of stock count (status) | | | 6 | 6 |
| Inbound | Inbound leadtime External | time (hrs) | 5,5 | 6 | 6 |
| Outbound | Picking accuracy | % | 6,5 | 5 | 6 |
| Outbound | Damage and missing on outbound | Qty and or % | 5,5 | 6 | 6 |
| Inbound | Inbound leadtime Internal Truck | time (hrs) | 5 | 6 | 6 |
| Inbound | Inbound leadtime Internal Container | time (hrs) | 5 | 6 | 6 |
| Inbound | Inbound leadtime Internal Air | time (hrs) | 5 | 6 | 6 |
| Inbound | Waiting times in interim areas (between unloading and put away) | time (hrs) | 7 | 4 | 6 |
| Outbound | Productivity full pallet picking | units per manhour | 8 | 3 | 6 |
| Outbound | Productivity master carton picking (Pick to belt) | units per manhour | 8 | 3 | 6 |
| Outbound | Productivity master carton picking (Pick tour) | units per manhour | 8 | 3 | 6 |
| Outbound | Outbound performance production (volume) actual versus plan) | units per manhour | 8 | 3 | 6 |
| Outbound | Picking leadtime per area (mezzanine, pick tour, picking full pallets, etc) | time (hrs) | 7 | 3 | 5 |
| Outbound | Outbound Admin leadtime: difference between time needed from 916 into truck versus 916 up to and including goods issue | time (hrs) | 7 | 3 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| Housekeeping | Storage utilisation per storage area | % | 6 | 4 | 5 |
| Logistic Support | Inbound: Expected time of arrival at SLE versus Actual, truck, container and air | | | 5 | 5 |
| Logistic Support | Outbound: Expected time of arrival (driver notification) versus actual | | | 5 | 5 |
| Logistic Support | Outbound: Expected time of departure truck at gate versus actual | | | 5 | 5 |
| Inbound | Dock Utilisation | % | 7 | 2 | 5 |
| Outbound | Number of scan errors at chute | Qty and or % | 6 | 3 | 5 |
| Outbound | Number of boxes that go through the sorter / sorter utilisation | Qty and or % | 7 | 2 | 5 |
| Inbound | Inbound leadtime External Truck | time (hrs) | 5 | 3 | 4 |
| Inbound | Inbound leadtime External Container | time (hrs) | 5 | 3 | 4 |
| Inbound | Inbound leadtime External Air | time (hrs) | 5 | 3 | 4 |
| Outbound | *Delivery profile, proportion of platform, direct, and replenishment shipments (measure for cause of performance)* | % | 6 | 2 | 4 |
| Logistic Support | Accuracy: All data correctly entered in Yard Management System (no empty fields) | | | 4 | 4 |
| Outbound | Number of shipments with materials scattered over multiple pallets | Qty and or % | 4 | 3 | 4 |
| Housekeeping | Average storage time (time a product spends in warehouse storage) | Time | 4 | 3 | 4 |
| Housekeeping | Days supply per EBU | number of days | 5 | 2 | 4 |
| Housekeeping | *Number of inbound trucks, proportion to destination: bulk, drive - in, etc.(measure for cause of performance)* | % | 4 | 3 | 4 |
| Outbound | Loading leadtime per shipment (check complete untill start loading) | time (hrs) | | 3 | 3 |
| Housekeeping / planning | Inbound volume versus outbound volume | qty | 3 | 3 | 3 |
| Returns | 3 QV deviation (number of checked classifications that failed / total amount of checked classifications) | % | | 3 | 3 |
| Customer Relations | Disputes lead-time | time (hrs) | 4 | 2 | 3 |
| Quality Centre | Green testing leadtime (on status green in external database) | | | 3 | 3 |
| Quality Centre | Leadtime new material in material master data from goods receipt until put away (dock to stock) | | | 3 | 3 |
| Quality Centre | Inbound not processed: Stock age of products not processed on inbound | | | 3 | 3 |
| Logistic Support | Accuracy: All items on transport plan are ordered | | | 3 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| Logistic Support | Inbound lead-time: Time products spent in NL0X (before put away) | | | 3 | 3 |
| Logistic Support | Outbound: Expected time of arrival at customer versus actual | | | 3 | 3 |
| Logistic Support | Outbound lead-time: Time between end loading and goods issue (status 5 -/- status 4) | | | 3 | 3 |
| General | Absence due to sickness | | | 3 | 3 |
| Transport / Yard | Planned truck arrival vs actual truck arrival | time | | 2 | 2 |
| Transport / Yard | planned truck departure vs actual truck departure | time | | 2 | 2 |
| Planning and Services | Lead-time: Outbound express deliveries: duration for requests to be added to plan (target: as soon as possible, within 1 hour) | time hours | | 2 | 2 |
| Planning and Services | Forecast: Pre-planning (expected volumes and needed resources per area) finished before deadline | % per time block | | 2 | 2 |
| Planning and Services | Accuracy: Workload planning: planned workload versus actual workload (per wave) | % | | 2 | 2 |
| Planning and Services | Accuracy: Long term planning versus actual | % | | 2 | 2 |
| Quality Centre | Damages frequency: Amount of products damaged per week, per material | | | 2 | 2 |
| Quality Centre | Clearing (result of stock count): Write on and write offs per day (in quantity or value) | | | 2 | 2 |
| Quality Centre | Stock count: Frequency of stock count | | | 2 | 2 |
| Quality Centre | Damage at goods receipt: Stock age of items in storage type 904, by material and qty | | | 2 | 2 |
| Quality Centre | Missing at goods receipt: Stock age of items in storage type 903, by material and qty | | | 2 | 2 |
| Quality Centre | Picking errors: Stock age of products in storage location NLPT, indicates products missing or over when delivering to the customer (customer claims), by material and qty | | | 2 | 2 |
| Logistic Support | Accuracy: All data for shipment statuses correctly entered in SAP | | | 2 | 2 |
| Transport / Yard | Time waiting until dock is allocated | time | | 1 | 1 |
| Planning and Services | Lead-time: Planning for next day finished before deadline (inbound and outbound have separate fixed times) | % | | 1 | 1 |
| Planning and Services | Accuracy: Percentage of deliveries forgotten (not added to plan) | % | | 1 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| Planning and Services | Accuracy: Percentage of shipments deliberately put into a wave that is released later than what would be required to meet the deadline (according to Service Level Agreement) | % | | 1 | 1 |
| Planning and Services | Accuracy: Percentage of inbound shipments planned within norm from Service Level Agreement (already produced) | % | | 1 | 1 |
| Planning and Services | Lead-time: Long term planning (for three months) finished before deadline (monthly) | % | | 1 | 1 |
| Quality Centre | Damages shipped: Amount of damages shipped to the returns centre, per material | | | 1 | 1 |
| Quality Centre | Damages administrative, accuracy: Status of stock transport orders, indicates whether the products that are shipped are correctly processed in the system | | | 1 | 1 |
| Logistic Support | Inbound lead-time: Cross-dock lead-time | | | 1 | 1 |
| Inbound | Damaged and missing at arrival | Qty | | 0 | 0 |
| Inbound | Damaged and missing during unloading | Qty | | 0 | 0 |
| Inbound | Performance: Amount received versus standard amount received | % | | 0 | 0 |
| Inbound | Unloading productivity | units per manhour | | 0 | 0 |
| Inbound | Palletising productivity | units per manhour | | 0 | 0 |
| Inbound | Put away productivity | units per manhour | | 0 | 0 |
| Outbound | Picking leadtime per shipment | time (hrs) | | 0 | 0 |
| Outbound | After picking leadtime per shipment | time (hrs) | | 0 | 0 |
| Outbound | Picking leadtime full pallets | time (hrs) | | 0 | 0 |
| Outbound | Picking leadtime master cartons (pick tour) | time (hrs) | | 0 | 0 |
| Outbound | Picking leadtime master cartons (pick to belt) | time (hrs) | | 0 | 0 |
| Outbound | Picking leadtime item picking | time (hrs) | | 0 | 0 |
| Outbound | Productivity item picking | | | 0 | 0 |
| Housekeeping | Days supply per area | number of days | | 0 | 0 |
| Returns | 1 Goods receipt performance; % of deliveries logged in Phoenix within 24 hours ( WWI nr of credited return deliveries / SAP nr of credited return deliveries) | % | | 0 | 0 |
| Returns | 2 Stock accuracy | % | | 0 | 0 |
| Returns | 4 QV lead time | time (hrs) | | 0 | 0 |
| Returns | 6 Miss shipments on outbound (no of order lines with deviations / total no of orderlines ) | % | | 0 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| Returns | 7 outbound performance | % | | 0 | 0 |
| Returns | 8 performance shuttle of sellable stock | % | | 0 | 0 |
| Returns | 9 interface performance | % | | 0 | 0 |
| Returns | 10 reporting performance | % | | 0 | 0 |
| Customer Relations | lead- time of open disputes per month | time (hrs) | | 0 | 0 |
| Customer Relations | lead- time of closed disputes | time (hrs) | | 0 | 0 |
| Customer Relations | number of disputes with a backlog | Qty and or % | | 0 | 0 |
| Customer Relations | Net value of Outstanding disputes | Value | | 0 | 0 |
| Customer Relations | Total outbound deliveries versus disputes | % | | 0 | 0 |
| Customer Relations | Order reasons | % | | 0 | 0 |
| Customer Relations | NL and BE route | overview | | 0 | 0 |
| Customer Relations | Net value Top 10 customers | Value | | 0 | 0 |
| Customer Relations | Issue list of non dispute complaints or questions | overview | | 0 | 0 |
| Customer Relations | Total number of disputes closed per month | Qty and or % | | 0 | 0 |
| Outbound / Planning | Standard hours needed from calculation planning tool / real hours worked | % | | 0 | 0 |
| Outbound / Planning | Calculated productivity vs achieved productivity | % | | 0 | 0 |

**Suggestions based on priority**

1. Productivity
    c. Inbound; unloading & Put away
    d. Outbound; picking per area & loading
2. Leadtime
    e. Inbound; GR –pallet build- pick up pallet –put away
    f. Outbound; Wave start – to creation – to confirmation – start loading – end loading – start goods Issue- print documents – print CMR
3. Stock (count) accuracy
4. Picking profile (workload per area)
5. Damage and Missing
6. Planned Goods Issue – versus – Actual
7. Accuracy of Pre-planning or outbound production (volumes) actual versus plan
8. Picking accuracy
9. Storage utilisation

10. Expected versus actual truck arrival and departure
11. *Disputes and Complaints (leadtime/backlog/qty)*
12. *Returns Classification*
13. *Information accuracy (YMS and SAP status)*
14. *Complexity of operation (background information)*

# M. Comments made during meeting selecting general level indicators

1. Productivity
   - Inbound; unloading & put away
   - Outbound; picking per area & loading
     First step: Calculate total number of required hours based on real volume (use workload per area) and detailed productivity targets. Compare the calculated required hours to the real hours worked to give an indication of detailed productivity
     Second step: Use the Task and Resource Management system (TRM) to extract actual hours worked on detailed processes. This will be available in April.
2. Lead-time
   - Inbound; goods receipt – pallet build - pick up pallet – put away
   - Outbound; wave start – to creation – to confirmation – start loading – end loading – start goods issue- print documents – print CMR
     Manually available at 15-12-2003. Data to be presented on a high level, but detailed information should be available for analysis purposes in case of bad performance. Detailed indicator can be developed.
3. Stock accuracy
   Number of bins/pieces counted versus number of bins/pieces with differences.
4. Stock count frequency and progress
   How often should stock count be executed and how often is it actually executed.
5. Damage and Missing
   Indicator on a weekly basis is under development in SAP BW. This information is not as detailed as the information that could be available from the WMS system (PWD). Absolute number of TO's / quantity, TO-items versus total number of TO's etc.
6. Storage utilisation (capacity usage report)
   This report is in place. The mezzanine is not included because it is not critical (enough spaces available). The definition of utilisation will be redefined by Jeroen Elias.
7. Accuracy of planning or outbound production (volumes) actual versus plan
   This indicator is still wanted, but will not be measured at the moment. Before measuring this indicator the "planning-project" should be finished and the results of the project should be in place. As an interim solution the quality of the input for the planning will be measured being: forecast accuracy of the sales companies (EU20 plant and including SR that does not go through the CAV warehouse)
8. Expected versus actual truck arrival and departure
   Information from Yard Management System.
9. Planned Goods Issue – versus – Actual
   Remark: this is PRC data and somewhat less accurate than PWD data. (Difference about 10%).
10. Delivery changes
    (instead of picking accuracy) Picking accuracy not available because this is mostly manually corrected. Delivery changes are available by manual data extractions and calculation.
11. Disputes versus deliveries
12. Carrier transport lead-time
    Available from INFODIS but definition needs to be checked.
13. Complexity of operation
    (background information)
    - Nature of inbound (slip sheets, loose loading, pallets, etc.)
    - Inbound profile (truck, air, container)

- Delivery profile (% of directs, platform and replenishments)
- Nature of outbound (cubic meter per TO)
- Volumes versus limits in SLA
  Indicator needs more work to provide the right information. Idea is to make a proposal for a weighted measure of complexity and a separate measure and decide on what's best afterwards.

14. Disputes lead-time.
15. Returns Classification
    Check on accurate classification by Walsh Western International of returned products. At the moment the sample size and the confidence interval is not included and this needs to be added.

# N. Performance indicators used in a warehouse and distribution environment (from literature)

On level D as mentioned by van Damme (2000), the following performance indicators are suggested for transport function. Here distribution is seen as a special form of transport. A distinction is made between internal and external performance indicators. Internal performance indicators are about indications of cost and/or quality of the transport process, that are relevant for the people responsible for this process. External performance indicators are about the end result of the execution of the transport process, that can be noticed by and is relevant for the customer of the transport service.

**Internal Performance Indicators**

| | |
|---|---|
| Loading (Operational) | Lead-times loading |
| | Number of loaded vehicles per man-hour |
| | Man-hours per loaded unit respectively order/order line |
| | Volume handled per man-hour |
| Loading (Financial) | Cost per loaded unit respectively order/order line |
| | Cost of labour per loaded unit respectively order/order line |
| Driving (Operational) | Lead times driving |
| | Number of kilometres per litre fuel |
| | Number of man hours per driven unit respectively order/order line |
| | Handled volume per man-hour |
| | Number of accidents per ton kilometre |
| | Number of offences per driven ton kilometre |
| Driving (Financial) | Costs per driven unit respectively order/order line |
| | Cost of labour per driven unit respectively order/order line |
| Unloading/waiting (Operational) | Lead times unloading |
| | Man-hours per unloaded unit respectively order/order line |
| | Handled volume per man-hour |
| | Number of trucks unloaded per man-hour |
| Unloading/waiting (Financial) | Costs per unloaded unit respectively order/order line |

(Van Damme, 2000)

**External Performance Indicators**

| | |
|---|---|
| Loading (Operational) | Number of goods loaded correctly per unit of time |
| | Number of orders or order lines correctly (on time and complete) handled / total number of orders or order lines |
| Driving (Operational | Number of kilometres driven per driver hour |
| | Number of orders or order lines correctly delivered to the customer / total number of orders or order lines |
| Unloading/waiting (Operational) | Number of goods correctly unloaded per unit of time |
| | Number of orderliness correctly handled / total number of orderliness |

(Van Damme, 2000)

**Critical elements of the logistics process (Caplice, 1994)**

Time, distance and money are still the basis of all logistics management.

| Common effectiveness metrics used to track availability and timeliness | |
|---|---|
| **Measure** | **Description** |
| Order Fill Rates | Orders filled / orders requested |
| Line item fill rates | Total line items not filled / shipped in time per period<br>Line items not filled/shipped in time per order<br>Incorrect units shipped |
| Damage rates | Orders with no damaged line items<br>Line items damaged per order |
| Order cycle time | Elapsed time between receiving request and delivering order<br>Elapsed time between receiving request and readying order for shipment<br>Elapsed time between receiving request and picking order |
| Deliver / transit time | Elapsed time between readying order for shipment and delivering order |
| On-time | Orders shipped on time<br>Orders received by customer on-time |
| Perfect deliveries | Orders received by customer with no logistics service fullness |

**Table 19: Common effectiveness metrics used to track availability and timeliness (Caplice, 1994)**

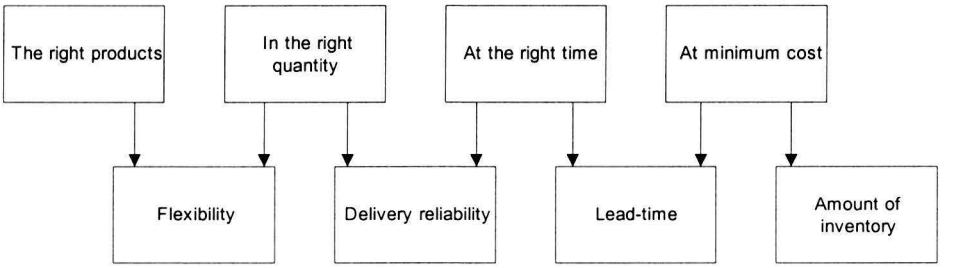



Figure 16: Hierarchy of goals (Nevem werkgroep, 1989)

# O. Selected indicators by department

| General Management | | | | |
|---|---|---|---|---|
| Dimension of performance | Nr. | Indicator type | Indicator on first level | Indicator detailed level / analysis information |
| Velocity | 1 | Productivity | Total warehouse productivity per department | Inbound productivity (cubic meters per manhour per shift) |
| | | | | Outbound productivity (cubic meters per manhour per shift) |
| | | | absence through illness | Inbound productivity (TO lines per manhour per shift) |
| | | | Staff turnover | Outbound productivity TO lines per manhour per shift) |
| | | | Link to warehouse monitor | MCT bins per hour per person |
| | | | | FP bins per hour per person |
| | 2 | Lead-times | Inbound lead-time per mode (air, truck, container) | Inbound lead-time per mode (air, truck, container) per activity (unloading and put away)<br>Inbound lead-time (time in NL0X) per mode (air, truck, container) vs target |
| | | | Outbound lead-time per delivery type (direct, platform, replenishment) | Waiting time interim areas |
| | | | Cross dock lead-time | Outbound lead-time checking finished to start loading to end-loading to goods issue (start check - check finished - loading documents ready - start loading Bas Wouters) |
| | | | New material Master data update: time between goods issue and MD update | Outbound lead-time per wave |
| | | | Green Program: Stock age of products in storage type 917 (per bin type: test, cage, QI area, QI BHD, QI PSC, QI Checked) | Outbound lead-time per picking area |
| | | | | ERC 1: Goods Receipt Performance<br>ERC 4: Quality Verification Lead-time<br>ERC 8: Shuttle performance |

| General Management | | | | |
|---|---|---|---|---|
| Dimension of performance | Nr. | Indicator type | Indicator on first level | Indicator detailed level / analysis information |
| Inventory status | 3 | Stock accuracy | | Percentage of products in storage types (903, 904, 905, 906, 991, 997, 999, 917) without q-block or s-block |
| | | | Stock age of products in storage types (903, 904, 905, 906, 991, 997, 999, 917) | Items with stock age in storage types (903, 904, 905, 906, 991, 997, 999(> 2 days), 917) longer than 6 weeks |
| | 4 | Stock count frequency and progress | Stock counts results per storage area: % of difference between physical qty and information system (PWD) | Percentage of products without a cycle count indicator (not included in cycle count) |
| | | | | List of products by cycle count indicator including last change of indicator |
| | | | Stock counts per time period | Stock count status |
| | | | | ERC 2: Stock Accuracy |
| | 5 | Damage and missing | Inbound irregularities: damages and missing on receipt | Stock age of products in storage types 991, 903, 904, 905, 906 |
| | | | Warehouse irrregularities: damage and missing in warehouse | Damage and missing in warehouse per source storage type in qty |
| | | | | Total number of occurences of damage and missing per week on inbound per source storage type |
| | | | | Total number of occurences of damage and missing per week on outbound per source storage type |
| | | | Amount of products damaged and missing per week , per material shipped to the returns centre | Status of stock transport orders (indicates whether the products that are shipped are correctly processed in the system) |
| | | | | Write on and write offs per day (in quantity or value) |
| | 6 | Storage utilisation | Storage utilisation in number of pallet places, | per area |
| Planning | 7 | Planning accuracy | Planned versus actual outbound volumes | Planned versus actual outbound volumes per area |
| | | | Planned versus actual outbound pallets | Percentage of deliveries forgotten (not added to plan)(manual) |
| | | | Planned versus actual transport need | Long term planning man-hours and volumes planned versus actual (Excel) |
| | | | Planned versus actual inbound volumes | |
| | | | | Actual quantity handled in ERC versus forecast |
| | 8 | Expected versus actual truck arrival and departure | Inbound planned versus actual truck arrival | Inbound planned versus actual truck arrival per mode |
| | | | Outbound planned versus actual truck arrival | Outbound planned versus actual truck arrival per mode |
| | | | Outbound planned versus actual truck departure | Outbound planned versus actual truck departure per mode |
| | | | | Performance on YMS and SAP (data correctly entered in system) |
| | | | Percentage of shipments planned in wave that cannot meet the deadline according to SLA / percentage of shipments planned within norm of SLA (wave start versus planned loading start à lead-time | Inbound and outbound planning / long-term planning finished before deadline (date and time in e-mail) |
| | | | | Outbound express deliveries added to plan within target lead-time (TX shipments in SAP) |

| General Management | | | | |
|---|---|---|---|---|
| Dimension of performance | Nr. | Indicator type | Indicator on first level | Indicator detailed level / analysis information |
| Delivery reliability | 9 | Planned goods issue versus actual | Difference in hours (days) between planned and actual goods issue | ERC 7: Outbound Performance |
| | 10 | Delivery changes | Number of changes on delivery items (quantity) versus total number of delivery items (quantity) | Data on delivery: customer and route<br>ERC 6: Miss Shipments |
| | 11 | Disputes versus deliveries | Number of disputes versus number of deliveries | Stock age of products in storage location NLPT, indicates products missing or over when delivering to the customer (customer claims), by material and qty<br>Number of disputes<br>Disputes value versus invoice value<br>Frequency distribution of order reasons<br>Costs of a dispute (versus claim value): costs of unsatisified customer, and all hours spent on solving a dispute (If possible) |
| | 12 | Carrier transport lead-time | Carrier transport lead-time<br>Expected time of arrival at customer versus actual | All items for transport plan are ordered |
| | 13 | Complexity of operation | Overall indicator of complexity of operation | Detailed indicators of complexity of operation<br>Number of T1 shipments<br>Number of shipments inbound and outbound<br>Number of cross docks |
| | | | ERC operation classification (inbound, QV and outbound) | Delivery profile<br>ERC 9: Interface Performance |
| | 14 | Disputes lead-time | Disputes closing lead-time | Disputes backlog |
| | 15 | Returns classification audit | Returns classification audit | Frequency distribution order reasons<br>Returns versus deliveries<br>Returns value (credited to customer) versus invoice value<br>ERC 3: Quality Verification Deviation |

| Warehouse Operations | | | | |
|---|---|---|---|---|
| Dimension of performance | Nr. | Indicator type | Indicator on first level | Indicator detailed level / analysis information |
| Velocity | 1 | Productivity | Inbound productivity (TO lines per manhour per shift) | Inbound productivity (cubic meters per manhour per shift) |
| | | | Outbound productivity TO lines per manhour per shift) | Outbound productivity (cubic meters per manhour per shift) |
| | | | Warehouse productivity | MCT bins per hour per person<br>FP bins per hour per person |
| | 2 | Lead-times | Inbound lead-time per mode (air, truck, container) | Inbound lead-time per mode (air, truck, container) per activity (unloading and put away) |
| | | | Outbound shipment lead-time per delivery type (direct, platform, replenishment) | Outbound lead-time per wave<br>Outbound lead-time per picking area<br>Outbound lead-time checking finished to start loading to end-loading to goods issue (start check - check finished - loading documents ready - start loading Bas Wouters) |

| Warehouse Operations | | | | |
|---|---|---|---|---|
| Dimension of performance | Nr. | Indicator type | Indicator on first level | Indicator detailed level / analysis information |
| Inventory status | 3 | Stock accuracy | | |
| | 4 | Stock count frequency and progress | Stock counts results per storage area: % of difference between physical qty and information system (PWD) | |
| | 5 | Damage and missing | Total number of occurences of damage and missing per week on inbound | Total number of occurences of damage and missing per week on inbound per source storage type |
| | | | Total number of occurences of damage and missing per week on outbound | Total number of occurences of damage and missing per week on outbound per source storage type |
| | | | Total number of occurences of damage and missing per week on receipt | |
| | 6 | Storage utilisation | Storage utilisation in % of pallet places, per area | |
| Planning | 7 | Planning accuracy | Actual versus planned workload per area (inbound and outbound) | |
| | 8 | Expected versus actual truck arrival and departure | Inbound expected versus actual truck arrival per mode | |
| | | | Outbound expected versus actual truck arrival per mode | |
| | | | Outbound expected versus actual truck departure per mode | |
| Delivery reliability | 9 | Planned goods issue versus actual | Difference in hours (days) between planned and actual goods issue | Outbound lead-times |
| | 10 | Delivery changes | Number of changes on delivery items (quantity) versus total number of delivery items (quantity) (Process control) | |
| | 11 | Disputes versus deliveries | Number of disputes versus number of deliveries (Year to date) per reason code | |
| | 12 | Carrier transport lead-time | | |
| | 13 | Complexity of operation | Overall indicator of complexity of operation | Detailed indicators of complexity of operation |
| | 14 | Disputes lead-time | | |
| | 15 | Returns classification audit | | |

| Quality Centre | | | | |
|---|---|---|---|---|
| Dimension of performance | Nr. | Indicator type | Indicator on first level | Indicator detailed level / analysis information |
| Velocity | 1 | Productivity | ... per manhour QC | |
| | 2 | Lead-times | Inbound lead-time per mode (air, truck, container) vs target | |
| | | | Master data update: time between goods issue and MD update | |
| | | | Green Program: Stock age of products in storage type 917 (per bin type: test, cage, QI area, QI BHD, QI PSC, QI Checked) | |
| Inventory status | 3 | Stock accuracy | Percentage of products in storage types (903, 904, 905, 906, 991, 997, 999, 917) without q-block or s-block | Items with stock age in storage types (903, 904, 905, 906, 991, 997, 999(> 2 days), 917) longer than 6 weeks |
| | | | Stock age of products in storage types (903, 904, 905, 906, 991, 997, 999, 917) | |
| | 4 | Stock count frequency and progress | Percentage of products without a cycle count indicator (not included in cycle count) | List of products by cycle count indicator including last change of indicator |
| | | | Cycle count results: percentage of differences between physical qty and PWD | Overview of stock count documents and document number per status (activated, printed, counted and cleared) |
| | 5 | Damage and missing | Amount of products damaged and missing per week , per material, per storage type | Amount of products damaged and missing per week , per material shipped to the returns centre |
| | | | Stock age of products in storage types 991, 903, 904, 905, 906 | Status of stock transport orders (indicates whether the products that are shipped are correctly processed in the system) |
| | | | | Write on and write offs per day (in quantity or value) |
| | 6 | Storage utilisation | Storage utilisation in % of pallet places, per area | |

| Quality Centre | | | | |
|---|---|---|---|---|
| Dimension of performance | Nr. | Indicator type | Indicator on first level | Indicator detailed level / analysis information |
| Planning | 7 | Planning accuracy | | |
| | 8 | Expected versus actual truck arrival and departure | | |
| Delivery reliability | 9 | Planned goods issue versus actual | | |
| | 10 | Delivery changes | Number of changes on delivery items versus total number of delivery items | |
| | 11 | Disputes versus deliveries | Stock age of products in storage location NLPT, indicates products missing or over when delivering to the customer (customer claims), by material and qty | |
| | 12 | Carrier transport lead-time | | |
| | 13 | Complexity of operation | | |
| | 14 | Disputes lead-time | | |
| | 15 | Returns classification audit | | |

| Planning and Services | | | | |
|---|---|---|---|---|
| Dimension of performance | Nr. | Indicator type | Indicator on first level | Indicator detailed level / analysis information |
| Velocity | 1 | Productivity | ... per manhour P&S | Detailed productivity |
| | | | Total warehouse productivity | Inbound productivity versus target (rating, % of target) per activity (unloading, palletising and put away) |
| | | | Inbound productivity versus target (rating, % of target) | Outbound productivity versus target (rating, % of target) per activity (picking per area, loading) |
| | | | Outbound productivity versus target (rating, % of target) | |
| | 2 | Lead-times | Inbound lead-time per mode (air, truck, container) vs target | Inbound lead-time per mode (air, truck, container) vs target per activity (unloading and put away) |
| | | | Outbound lead-time per wave versus target (per delivery type) | Outbound lead-time per shipment versus target |
| | | | | Outbound lead-time checking finished to start loading to end-loading to goods issue |
| Inventory status | 3 | Stock accuracy | | |
| | 4 | Stock count frequency and progress | | |
| | 5 | Damage and missing | | |
| | 6 | Storage utilisation | Storage utilisation in % of pallet places, per area | |
| Planning | 7 | Planning accuracy | Actual versus planned workload per area (inbound and outbound | Percentage of deliveries forgotten (not added to plan)(manual) |
| | | | Actual versus planned transport need | Long term planning man-hours and volumes planned versus actual (Excel) |
| | | | Actual versus planned loading end | |
| | | | Actual versus planned departure | |
| | | | Actual versus planned volumes (Excel) | |
| | 8 | Expected versus actual truck arrival and departure | | Inbound and outbound planning / long-term planning finished before deadline (date and time in e-mail) |
| | | | | Outbound express deliveries added to plan within target lead-time (TX shipments in SAP) |
| | | | | Percentage of shipments planned in wave that cannot meet the deadline according to SLA / percentage of shipments planned within norm of SLA (wave start versus planned loading start à lead-time |
| Delivery reliability | 9 | Planned goods issue versus actual | | |
| | 10 | Delivery changes | Number of changes on delivery items versus total number of delivery items | |
| | 11 | Disputes versus deliveries | | |
| | 12 | Carrier transport lead-time | | |
| | 13 | Complexity of operation | Overall indicator of complexity of operation | Detailed indicator of complexity of operation, per complexity element |
| | 14 | Disputes lead-time | | |
| | 15 | Returns classification audit | | |

| Logistics Support | | | | |
|---|---|---|---|---|
| Dimension of performance | Nr. | Indicator type | Indicator on first level | Indicator detailed level / analysis information |
| Velocity | 1 | Productivity | Number of shipments per manhour LS | |
| | 2 | Lead-times | Inbound lead-time (time in NL0X) per mode (air, truck, container) vs target | Inbound leadtimes from SLA until warehouse (NL0X) |
| | | | Time between end loading and goods issue | |
| | | | All statuses correctly entered in SAP (accuracy) | |
| | | | All data correctly entered in YMS (accuracy) | |
| | | | Cross dock lead-time | |
| Inventory status | 3 | Stock accuracy | | |
| | 4 | Stock count frequency and progress | | |
| | 5 | Damage and missing | | |
| | 6 | Storage utilisation | | |
| Planning | 7 | Planning accuracy | Number of pallets per shipment actual versus planned | |
| | 8 | Expected versus actual truck arrival and departure | Inbound expected versus actual truck arrival per mode | All statuses correctly entered in SAP (accuracy) |
| | | | Outbound expected versus actual truck arrival per mode | All data correctly entered in YMS (accuracy) |
| | | | Outbound expected versus actual truck departure per mode | |
| Delivery reliability | 9 | Planned goods issue versus actual | Difference in hours planned versus actual goods issue | Time between end loading and goods issue<br>Outbound lead-times picking, loading |
| | 10 | Delivery changes | | |
| | 11 | Disputes versus deliveries | | |
| | 12 | Carrier transport lead-time | Carrier transport lead-time versus target (in hours or time stamps) | All items for transport plan are ordered |
| | | | Expected time of arrival at customer versus actual | |
| | 13 | Complexity of operation | Number of T1 shipments | |
| | | | Number of shipments inbound and outbound | |
| | | | Number of cross docks | |
| | | | Delivery profile | |
| | 14 | Disputes lead-time | | |
| | 15 | Returns classification audit | | |

| Customer relations | | | | |
|---|---|---|---|---|
| Dimension of performance | Nr. | Indicator type | Indicator on first level | Indicator detailed level / analysis information |
| Velocity | 1 | Productivity | … per manhour CR | |
| | | | Link to warehouse monitor | |
| | 2 | Lead-times | Outbound lead-time versus target per delivery type (platform, direct, replenishment)(Shipment duration) | |
| Inventory status | 3 | Stock accuracy | Stock accuracy percentage per picking area / storage type (product type NPP (brochures etc, type 050/051) | |
| | 4 | Stock count frequency and progress | | |
| | 5 | Damage and missing | | |
| | 6 | Storage utilisation | | |
| Planning | 7 | Planning accuracy | | |
| | 8 | Expected versus actual truck arrival and departure | | Inbound expected versus actual truck arrival |
| | | | | Outbound expected versus actual truck arrival |
| | | | | Outbound expected versus actual truck departure |

| Customer relations | | | | |
|---|---|---|---|---|
| Dimension of performance | Nr. | Indicator type | Indicator on first level | Indicator detailed level / analysis information |
| Delivery reliability | 9 | Planned goods issue versus actual | Difference in hours planned versus actual goods issue (currently only available in days | |
| | 10 | Delivery changes | Number of changes on delivery items versus total number of delivery items | Data on delivery: customer and route |
| | 11 | Disputes versus deliveries | Number of disputes versus number of deliveries (Year to date)<br>Number of disputes<br>Disputes value versus invoice value<br>Frequency distribution of order reasons | Costs of a dispute (versus claim value): costs of unsatisified customer, and all hours spent on solving a dispute (If possible) |
| | 12 | Carrier transport lead-time | Carrier transport lead-time versus target | On time delivery at customer |
| | 13 | Complexity of operation | Overall indicator of complexity of operation | Detailed indicator of complexity of operation, per complexity element |
| | 14 | Disputes lead-time | Disputes lead-time versus target | Disputes backlog |
| | 15 | Returns classification audit | Frequency distribution order reasons<br>Returns versus deliveries<br>Returns value (credited to customer) versus invoice value | |

| Returns | | | | |
|---|---|---|---|---|
| Dimension of performance | Nr. | Indicator type | Indicator on first level | Indicator detailed level / analysis information |
| Velocity | 1 | Productivity | ... per manhour (WWI and ERC) | |
| | 2 | Lead-times | ERC 1: Goods Receipt Performance<br>ERC 4: Quality Verification Lead-time<br>ERC 8: Shuttle performance | |
| Inventory status | 3 | Stock accuracy | ERC 2: Stock Accuracy | |
| | 4 | Stock count frequency and progress | | |
| | 5 | Damage and missing | | |
| | 6 | Storage utilisation | | |
| Planning | 7 | Planning accuracy | Actual quantity handled in ERC versus forecast | |
| | 8 | Expected versus actual truck arrival and departure | | |
| Delivery reliability | 9 | Planned goods issue versus actual | ERC 7: Outbound Performance | |
| | 10 | Delivery changes | ERC 6: Miss Shipments | |
| | 11 | Disputes versus deliveries | | |
| | 12 | Carrier transport lead-time | | |
| | 13 | Complexity of operation | ERC 9: Interface Performance<br>ERC operation classification (inbound, QV and outbound) | |
| | 14 | Disputes lead-time | | |
| | 15 | Returns classification audit | ERC 3: Quality Verification Deviation | |

# P. Operational Performance Measurement System Development Plan

| Development process steps | Due date | Who |
|---|---|---|
| 1. Defining parameters | 26-1-2004 | Serge Maiquez, Anouk Hesen |
| 2. Defining source of parameters | 26-1-2004 | RV, Anouk Hesen |
| 3. Importing data files into Access (first manually, later automatically) | 28-2-2004 | Serge Maiquez, Anouk Hesen |
| 4. Calculating Operational Performance Indicators (creating queries) | 4-2-2004 | Serge Maiquez, Anouk Hesen |
| 5. Creating and validating format of graphs | 11-2-2004 | Serge Maiquez, Anouk Hesen |
| 6. Programming graphs in Access | 16-2-2004 | Serge Maiquez, Anouk Hesen |
| 7. Creating reports per department | 16-2-2004 | Serge Maiquez, Anouk Hesen |
| 8. Creating interface (Menu structure / web-like) | 23-2-2004 | Serge Maiquez, Anouk Hesen |
| 9. Test (phase 1: Serge Maiquez, Anouk Hesen; phase 2: All) | 23-2-2004 | All |
| 10. Use | 24-2-2004 | All |

**Table 20: Access Operational Performance Indicators tool development process steps**

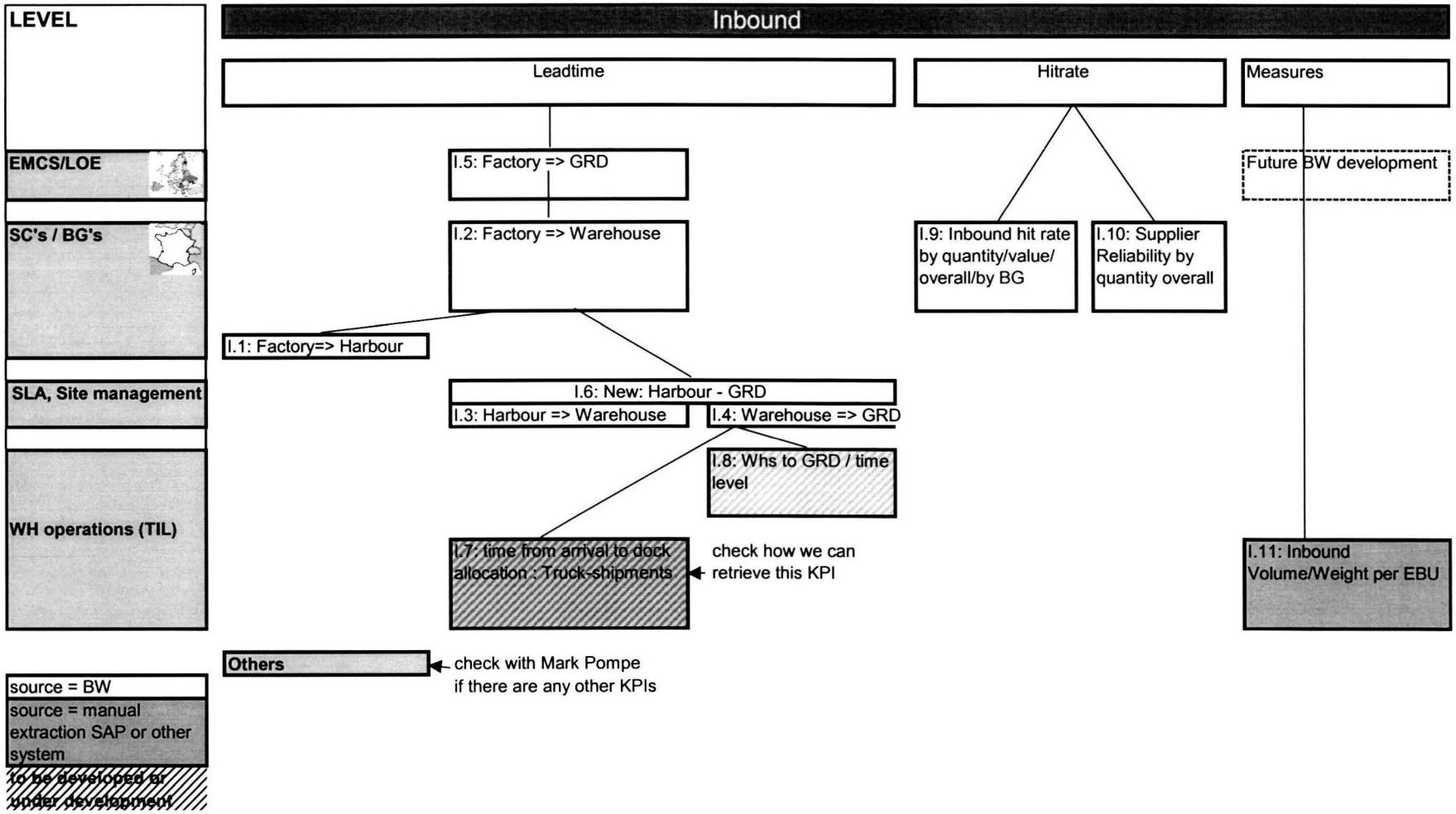
Ad 1:
Data structure (tables), list of required data that should be uploaded every week/day

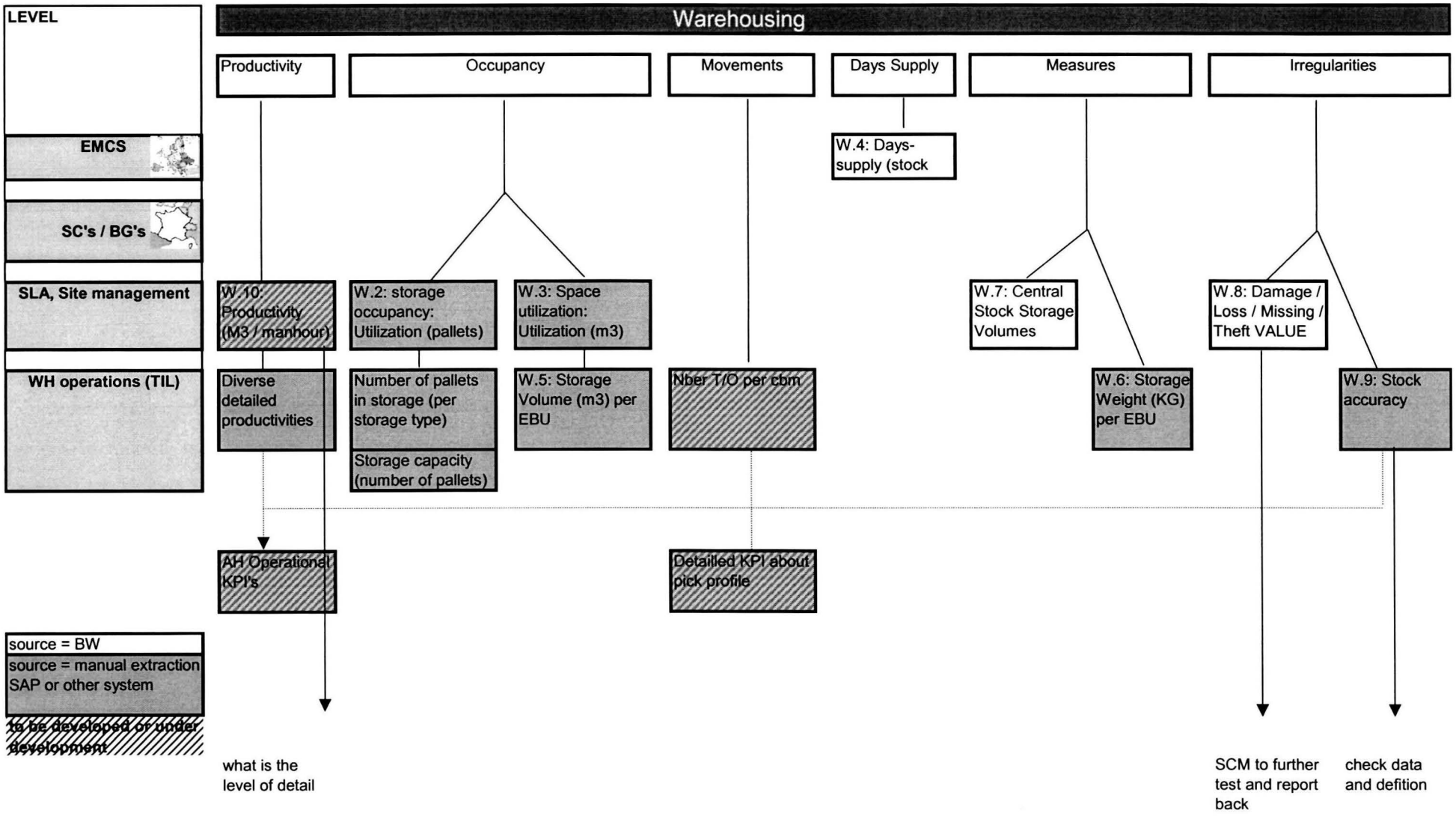
- Disputes
- Volumes
- Man-hours
- Transfer Orders (TO's)
- TO items
- Number of deliveries
- Number of pieces on deliveries
- Number of pieces requested
- Etc.

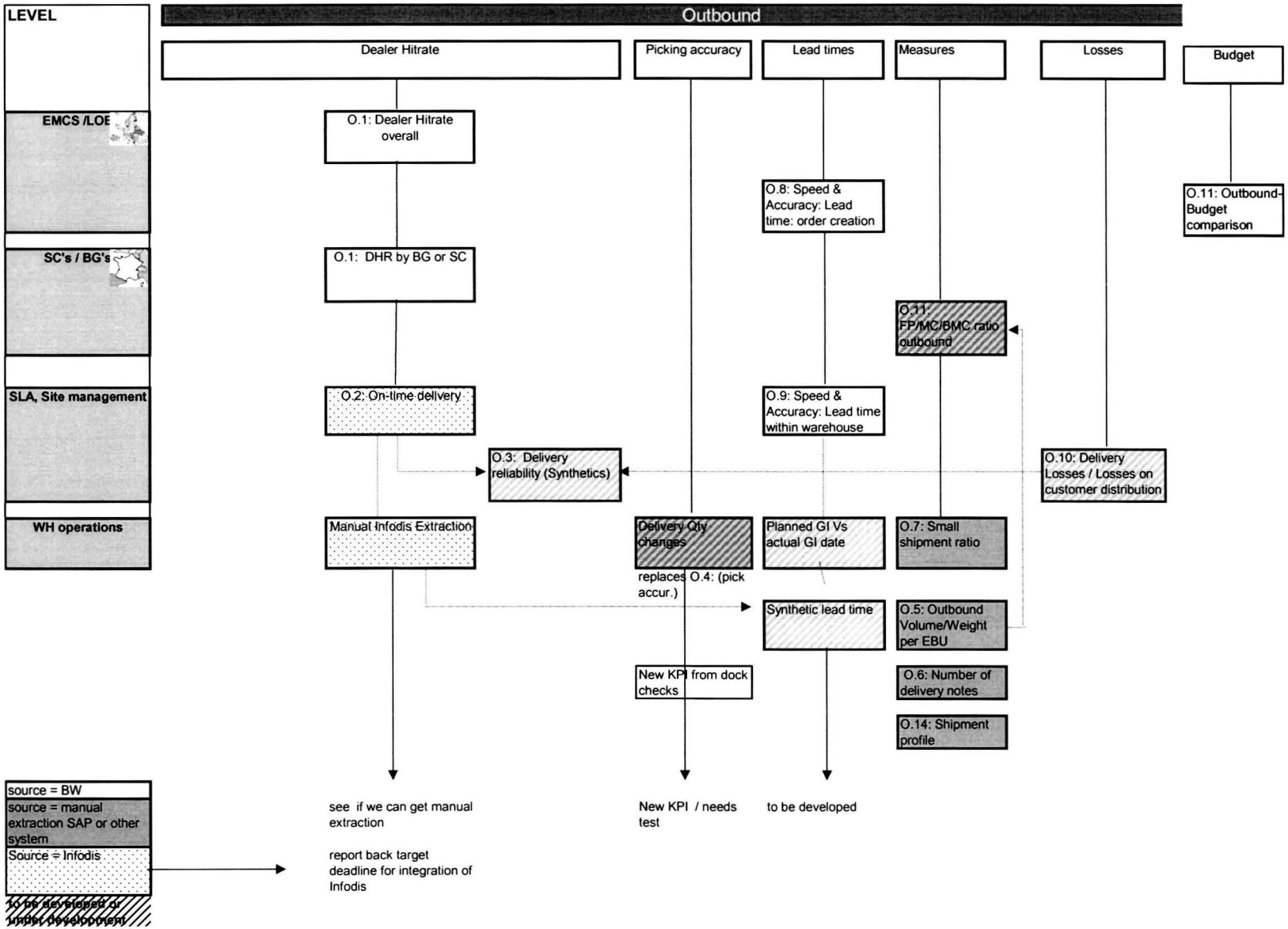
Ad 8.
Layout and options in Operational Performance Measurement System

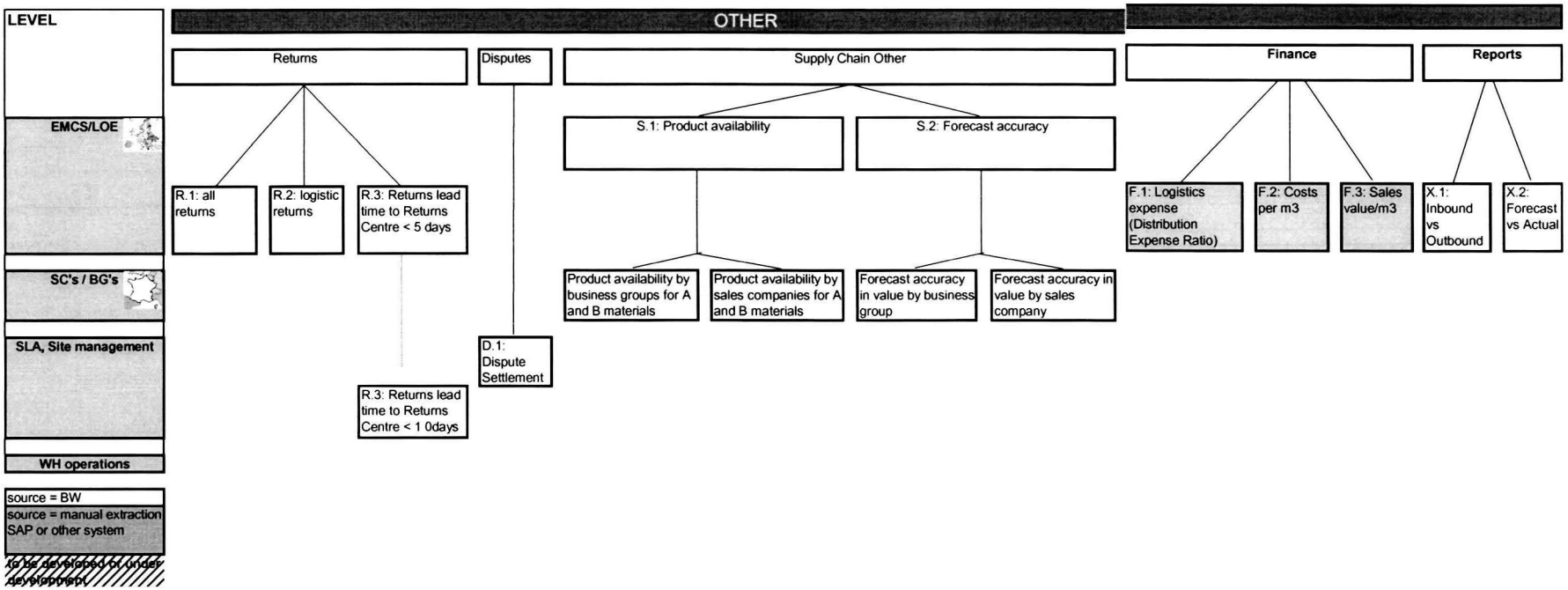
- Interface
- Adding comments
- Adding actions
- Linking indicators

# Q. Hierarchy Schemes of Indicators at Different Organisational Levels




LEVEL
Warehousing
Productivity
Occupancy
Movements
Days Supply
Measures
Irregularities
EMCS
SC's / BG's
SLA, Site management
WH operations (TIL)
W.4: Days-supply (stock
W.10: Productivity (M3 / manhour)
W.2: storage occupancy: Utilization (pallets)
W.3: Space utilization: Utilization (m3)
W.7: Central Stock Storage Volumes
W.8: Damage / Loss / Missing / Theft VALUE
Diverse detailed productivities
Number of pallets in storage (per storage type)
Storage capacity (number of pallets)
W.5: Storage Volume (m3) per EBU
Nber T/O per cbm
W.6: Storage Weight (KG) per EBU
W.9: Stock accuracy
AH Operational KPI's
Detailled KPI about pick profile
source = BW
source = manual extraction SAP or other system
to be developed or under development
what is the level of detail
SCM to further test and report back
check data and defition


LEVEL
EMCS /LOE
SC's / BG's
SLA, Site management
WH operations
Outbound
Dealer Hitrate
Picking accuracy
Lead times
Measures
Losses
Budget
O.1: Dealer Hitrate overall
O.1: DHR by BG or SC
O.2: On-time delivery
O.3: Delivery reliability (Synthetics)
Manual Infodis Extraction
O.8: Speed & Accuracy: Lead time: order creation
O.9: Speed & Accuracy: Lead time within warehouse
Planned GI Vs actual GI date
Synthetic lead time
O.11: FP/MC/BMC ratio outbound
O.7: Small shipment ratio
O.5: Outbound Volume/Weight per EBU
O.6: Number of delivery notes
O.14: Shipment profile
O.10: Delivery Losses / Losses on customer distribution
O.11: Outbound-Budget comparison
Delivery Qty changes
replaces O.4: (pick accur.)
New KPI from dock checks
source = BW
source = manual extraction SAP or other system
Source = Infodis
To be developed or under development
see if we can get manual extraction
report back target deadline for integration of Infodis
New KPI / needs test
to be developed


LEVEL
EMCS/LOE
SC's / BG's
SLA, Site management
WH operations
source = BW
source = manual extraction SAP or other system
to be developed or under development
OTHER
Returns
Disputes
Supply Chain Other
Finance
Reports
R.1: all returns
R.2: logistic returns
R.3: Returns lead time to Returns Centre < 5 days
R.3: Returns lead time to Returns Centre < 1 0days
D.1: Dispute Settlement
S.1: Product availability
S.2: Forecast accuracy
Product availability by business groups for A and B materials
Product availability by sales companies for A and B materials
Forecast accuracy in value by business group
Forecast accuracy in value by sales company
F.1: Logistics expense (Distribution Expense Ratio)
F.2: Costs per m3
F.3: Sales value/m3
X.1: Inbound vs Outbound
X.2: Forecast vs Actual