



## MIT SCALE RESEARCH REPORT

The MIT Global Supply Chain and Logistics Excellence (SCALE) Network is an international alliance of leading-edge research and education centers, dedicated to the development and dissemination of global innovation in supply chain and logistics.

The Global SCALE Network allows faculty, researchers, students, and affiliated companies from all six centers around the world to pool their expertise and collaborate on projects that will create supply chain and logistics innovations with global applications.

This reprint is intended to communicate research results of innovative supply chain research completed by faculty, researchers, and students of the Global SCALE Network, thereby contributing to the greater public knowledge about supply chains.

**For more information, contact**  
MIT Global SCALE Network

**Postal Address:**

Massachusetts Institute of Technology 77  
Massachusetts Avenue, Cambridge, MA 02139 (USA)

**Location:**

Building E40, Room 267  
1 Amherst St.

**Access:**

Tel: +1 617-253-5320  
Fax: +1 617-253-4560

Email: [scale@mit.edu](mailto:scale@mit.edu)  
Website: [scale.mit.edu](http://scale.mit.edu)

**Research Report: ZLC-2014-8**  
**End-to-end supply chain performance management system**  
**Wheedong Lee and Raúl Prades**

**For Full Thesis Version Please Contact:**

**Marta Romero**

**ZLOG Director**

Zaragoza Logistics Center (ZLC) Edificio

Náyade 5, C/Bari 55 – PLAZA 50197

Zaragoza, SPAIN

Email: [mromero@zlc.edu.es](mailto:mromero@zlc.edu.es)

Telephone: +34 976 077 605

# End-to-end supply chain performance management system

By Wheedong Lee and Raúl Prades

Thesis Advisor: Prof. María Jesús Sáenz, Ph.D.

## Summary:

This thesis tackles the question of how to improve the control of the secondary distribution of a global pharmaceutical company. We developed a KPI system including the performance standards and benchmarking best practices. Then we proposed the way to consolidate the data for inter-country comparison and the governance method.



*Wheedong Lee  
Material Science  
and Engineering*

*3 years of  
experience in  
Accounting, and  
KPI system  
development at  
Samsung Cheil  
Industries*



*Raúl Prades  
Telecommunications  
Engineering*

*2 years of  
experience as SAP  
BW/BO/HANA  
Consultant*

## KEY INSIGHTS

1. Designed a best-practice logistics KPI system and performance management approach.
2. Created a consolidation method to weight KPIs in time and country dimensions by using a thresholds approach to be able to compare these KPIs among countries.
3. Established better transparency on operational logistics performance, created internal benchmarks, and proposed a governance method to incentivize performance improvements in the global network.

## Introduction

In recent years, supply chains have become more globalized. For example, some companies have merged smaller companies in order to expand their business in new

regions while other companies have become more decentralized and the management on each region is almost independent. These issues bring some important problems regarding better central management.

This thesis worked with a decentralized pharmaceutical company, focusing on the secondary distribution (in-country warehousing and transport to customers). At the moment, this secondary distribution is managed by the different country pharmaceutical organization (CPOs), which are responsible for rate negotiation and management of the 3PL relationship. Global Supply Chain Operations are responsible for the overall distribution budget, however they have only limited oversight, mainly checking and approval of contracts before signing.

However, there was no standardization of logistics such as warehouse and

transportation, KPIs, and performance management across the different 3 PLs and countries. No common operational KPIs were defined, nor operational targets; the only cross country metrics discussed are budget figures. Figure below shows the cycle proposed to solve these problems.

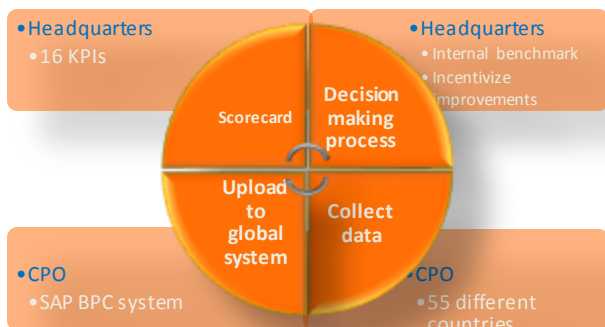


Figure 1. Continuous improvement

## Methodology

This thesis aimed at establishing a global KPI system, a reporting format, and developing a performance management approach for logistics focused on secondary distribution. The main aspects of the thesis were: Defining the KPI system, defining the reporting prototype, and defining governance.

### **KPI system**

The KPI system was developed through the following steps:

1. Collecting company's needs and requirements in order to tailor KPIs selected to them. The KPI selection was focused on a simple KPI system around core operational performance dimensions.
2. Screening and review of best practices approaches (such as Warehouse Education and Research Council (WERC), benchmarking forecasting practices in the

pharmaceutical industry, Dechert Hampe Consulting Customer Service Benchmarking study or Reverse Logistics Executive Council) were conducted based on project experience/cases, benchmarking and literature.

3. Detailing KPI definitions and data sources for global dashboard KPIs preparing and communicating to relevant organizations.
4. Finally, testing the KPI system and refining with selected CPOs through conferences with the different region leaders.

### **Reporting Prototype**

The reporting prototype development went through the following steps:

1. Reporting logic was developed focused on comparing KPIs among different countries, consolidating data and reporting changes over time.
2. The excel prototype of the KPI dashboards was prepared including different views and drilldowns.
3. The initial prototype was handed over to IT, which was used to clarify questions as needed regarding BPC and the final scoreboard.
4. Finally, after consolidation, performance indexes were developed in order to be able to compare among the different countries.

### **Governance**

The key elements of governance are as follows:

- Process, timeline and roles and responsibilities (R&R) to collect KPI data

- Performance dialogue approach based on the KPI dashboard of internal benchmarking and incentivizing performance improvement.
- Approach for involvement of and data sharing with 3PLs

In order to achieve these key elements the steps followed were:

1. Propose a schedule for each CPO to upload the data at the same date.
2. Propose a procedure to act quickly when alarms are triggered.
3. Propose an awards system to incentivize performance improvements among the countries.

## Results

The KPI system was used to deliver a best practices document. Best practices can be defined in its simplest form as a way or method of accomplishing a business function or process that is considered to be superior to all other known methods. A business' primary goal is to be profitable and so it is reasonable to expect only the adoption of practices that enhance profitability, or at least business continuity. Identifying the stakeholders - parties who work with, share resources and are affected by transport - helps identify the perceptions and impacts transport has, and the system types that can have best practice objectives built into them.

After making the provisional list of KPIs, we had in-depth discussions with the company in order to select the final KPIs that will be actually used. In order to have a clean, understandable and reliable scorecard, the number of KPIs was restricted to 15. Two KPIs (Invoice Accuracy and Inventory

Accuracy) were mandatory for the company and the other 13 were chosen from our list, considering the business needs. Finally, Invoice Accuracy is present in both reports (distribution and warehousing) and 16 KPIs were confirmed by the company.

Each KPI was explained using 4 different parts:

- Definition
- Thresholds
- Future performance
- Best practices

In order to show the approach used, a short description of each KPI is showed below.

### Warehousing KPIs

#### ✓ Inventory Accuracy

- Shows the accuracy of the physical inventory compared to the reported inventory.

<b>Color coding</b>	Inventory accuracy $\geq$ 99.8%
	Inventory accuracy $\geq$ 98.5%
	Rest

(In the case of B&W printing, Green color corresponds to top threshold.)

#### ✓ Invoice Accuracy

- Shows the percent of invoice line items without errors.

<b>Color coding</b>	Invoice accuracy $\geq$ 99%
	Invoice accuracy $\geq$ 97.4%
	Rest

#### ✓ Picking Accuracy

- Shows the accuracy of the orders picking process where errors may be caught prior to shipment such as during packaging.

<b>Color coding</b>	Picking accuracy $\geq$ 99.9%
	Picking accuracy $\geq$ 99.5%
	Rest

#### ✓ Defect rate

- Shows the amount of breakage & deterioration of all inventories relative to total inventory.

<b>Color coding</b>	Defect rate $\leq$ 0.05%
	Defect rate $\leq$ 0.2%
	Rest

- ✓ Fill rate
  - Shows the percent of orders filled according to customer request.

<b>Color coding</b>	Fill rate $\geq$ 99.8%
	Fill rate $\geq$ 98%
	Rest

- ✓ Return rate
  - Shows the rate of items that are returned after they have been shipped.

<b>Color coding</b>	Return rate $\leq$ 1%
	Return rate $\leq$ 2.59%
	Rest

- ✓ Average Inventory Level
  - Shows the monthly average of amount of pallets found in the facility.

<b>Color coding</b>	Inventory level for DII $\leq$ 90
	Inventory level for DII $\leq$ 165
	Rest

- ✓ Order throughput time
  - Shows the time from the moment an order is placed to the warehouse and to the moment it is shipped.

<b>Color coding</b>	Order throughput time $\leq$ 3 h
	Order throughput time $\leq$ 13 h
	Rest

- ✓ Warehouse Utilization
  - Shows the percentage of space utilized in warehouse.

<b>Color coding</b>	Warehouse utilization $\geq$ 91%
	warehouse utilization $\geq$ 85%
	Rest

- ✓ Goods receiving
  - Average process time on goods received, from arrival to put away and stock booked into the WMS.

<b>Color coding</b>	Goods receiving $\leq$ 2 hours
	Goods receiving $\leq$ 6 hours
	Rest

## Transportation KPIs

- ✓ Average shipment lead time
  - Shows the average time required to complete shipments from warehouse to customers.

<b>Color coding</b>	TOP 20% per country
	TOP 50% per country
	Rest

- ✓ Lead time variability
  - Shows the average of the absolute percentage differences (APD) between the forecasted lead time and the actual lead time for each shipment.

<b>Color coding</b>	Lead time variability $\leq$ 25%
	Lead time variability $\leq$ 34%
	Rest

- ✓ Distribution cost per shipment
  - Shows the average cost per shipment. It should be calculated by type (standard or expedite) and by mode (ambient or cold).

<b>Color coding</b>	TOP 20% per country
	TOP 50% per country
	Rest

- ✓ Shipping accuracy
  - Shows the percentage of lines that were shipped without error out of all lines or SKUs shipped during the month.

<b>Color coding</b>	Shipping accuracy $\geq$ 99.5%
	Shipping accuracy $\geq$ 98%
	Rest

- ✓ Damage rate
  - Shows the percentage of orders with damaged products during the transportation.

<b>Color coding</b>	Damage rate $\leq$ 0.5%
	Damage rate $\leq$ 1.25%
	Rest

After all the KPIs were defined, the next step was to decide the reporting tool in order to be useful for decision-making. The final decision on the tool to be used was SAP-BPC. The main reasons for selecting this tool were:

- Every country has access to it already
- SAP-BPC is an Excel-based method for data entry so it is easy for employees to understand
- It is possible to consolidate the data in time and in country dimensions

CPO users will input the data in an Excel format monthly. Then, the data will be consolidated and updated in the database. Final users will be able to access this data and to filter them by date and by organization. The final prototype and the different KPIS are shown in the table below.

	MONTH
	YEAR
	EUR
<b>Total Average KPI</b>	
<b>Total Average KPI Warehouse</b>	
KPL_0001 Inventory Accuracy (CPO Inventory)	
KPL_0002 Invoice Accuracy (3PL W&D invoices)	
KPL_0003 Picking Accuracy (in)	
KPL_0004 Defect rate	
KPL_0005 Order Fill Rate	
KPL_0006 Return Rate	
KPL_0007 Average Inventory Capacity Utilization	
KPL_0008 Goods Receipt	
KPL_0009 Order Throughput Time	
KPL_0010 Average inventory level	
<b>Total Distribution KPI</b>	
KPL_0011 Shipping Accuracy (in %)	
KPL_0012 Damage Rate (in %)	
KPL_0013 Average Shipment Lead Time	
KPL_0014 Lead Time Variability	
KPL_0015 Distribution Cost per Shipment	

Table 1. Reporting prototype

Finally, we proposed a schedule to allow the data to be updated at the same time from each country. Also, a procedure was proposed to act quickly when alarms are triggered. Finally, an awards system was used to incentivize performance.

## Conclusions

This thesis has achieved a two-pronged contribution:

- Design a best-practice logistics KPI system and performance

management approach based on cross industry logistics best practice.

-Through the research performed, the KPI system is robust and tailored to the pharmaceutical industry and the company needs.

-Thresholds proposed for each KPI are based on extensive benchmark research.

- Best practices approach will help to act quickly when the performance of a KPI is below yellow threshold (lowest level)

- Governance proposed a calendar to be followed by each CPO to have every KPI aligned in the time dimension.

- Establish better transparency on operational logistics performance, create internal benchmarks, and incentivize performance improvements in the global network.

-Headquarters will have full vision of the 3PL performance in the different countries.

-CPOs will be able to collaborate in order to share their best practices for every KPI. This will lead to an improvement of KPI performance.

-Weighted consolidation allows comparison among the different countries and 3PL.

-Governance will help Headquarters to act quickly when measured KPIs are not accurate

-Prizing schema will encourage CPOs for continuous improvement.