

MASTER THESIS

The Conception & Development of
'Visibility' in
Transportation process of mySAP SCM through
"Analytics"

For



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The Conception & Development of 'Visibility' in Transportation process of mySAP SCM through Analytics, for SAP AG

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Declaration

*"I hereby do declare in lieu of oath that I composed this work independently and without inadmissible help from outside.
The sources used are quoted in full."*

Heidelberg, 19 June, 2005

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A journey is easier when you travel together. Interdependence is certainly more valuable than independence. This thesis is the result of nine months of work whereby, I have been accompanied and supported by many people. It is a pleasant aspect that I have now the opportunity to express my gratitude for all of them.

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Abstract

Over the past decade a combination of economic, technology and market forces has compelled companies to examine and reinvent their supply chain strategies. Some of these forces include the globalization of businesses, the proliferation of product variety, increasing complexity of supply networks, and the shortening of the product life cycles. To stay competitive, enlightened companies have strived to achieve greater coordination and collaboration among supply chain partners in an approach called "supply chain integration."

Visibility in these Supply Chains means "Firms will compete Supply Chain to Supply Chain", according to new study. In an era of global supply chains, companies will effectively compete for survival with their competitors through achieving higher levels of visibility into their supply chains and the actionable information that come out of it, according to "From Visibility to Action," the 13th annual report on trends and issues in logistics and transportation issued jointly by Capgemini U.S. LLC and Dr. Karl Manrodt.

"The primary reasons for the need for visibility, are, first an extended supply chain that demands extending data collection globally in inbound and outbound movements and second, the increasing role that regulations and customer requirements play in the re-design of the technology and process of order fulfilment." Just getting it there is not sufficient. Shippers must demonstrate an infrastructure and information handling capability that is transparent to the customer as they justifiably ask: 'Where is my order?'

Companies need a view into fragmented business processes, and a way to manage numerous disparate sources of information. The challenges presented by macro-industry forces are driving the need for new visibility and event-management tools. This paper concentrates on achieving this visibility in the Transportation process of mySAP SCM (Supply Chain Management) using SAP's Advanced Planning, Event management and Analytic products. Firstly get to know the Transportation process and its role in different applications like ERP, APO-TP/VS and SCEM (Supply Chain Event Management). As well, the analyses of Key figures of this process (especially "Tendering and Re-tendering process") and the implementation of these Key figures in BW and later preparing Analytics using SAP Analytics(Visual Composer) to achieve the primary target, i.e. "Visibility".

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List of Abbreviations

APIs: Application Programming Interfaces
APO: Advanced Planning and Optimizer
BAPIs: Business Application Programming Interfaces
BW: Business Warehouse
CRM: Customer Relationship Management
CRP: Capacity Requirements Planning
DRP: Demand Requirements Planning
ERP: Enterprise Resource Planning
ESA: Enterprise Service Architecture
ETL: Extraction Transformation and Loading
GML: Generic Modeling Language
JDBC: Java Data Base Connectivity
KPIs: Key Performance Indicators
LES: Logistic Execution System
MRP: Material Requirements Planning
OLTP: Online Transactional Processing
RFCs: Remote Function Calls
RFID: Radio Frequency Identification
SAP EM: SAP Event Management
SAP: System Applications and Products (in Data Processing)
SCC: Supply Chain Council
SCEM: Supply Chain Event Management
SCM: Supply Chain Management
SCOR model: Supply Chain Operations Reference model
TP/VS: Transportation Planning / Vehicle Scheduling
TPS: Transportation Planning System
TSP: Transportation Service Provider

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1 Introduction

1.1 *The extent of the Work*

This work is done within the framework of a Master Thesis, in fulfillment of a partial requirement for the award of the degree: Master of Computer Science in Business Consulting by the University of Applied Science (Fachhochschule) Furtwangen, Germany.

It is aimed at "Conception and Development of visibility in Transportation process of mySAP SCM through Analytics", as to investigate the areas of Transportation process in Supply Chain Management where visibility can be achieved through Analytics. As to accomplish this, in which Transportation processes visibility is needed? How this visibility can be achieved? How Analytics helps in achieving visibility in these processes? And first of all why visibility is important and needed in today's Supply Chains? This work explores how this could be achieved with the available functionalities of SAP Supply Chain Event Management (SCEM), APO (TP/VS) and SAP BW (Business Information Warehouse) and at the end, using new Analytics designer tool SAP Visual Composer to develop Analytic Applications for the Transportation Process.

1.2 *Document Outline*

The documentation of the Master's Thesis is outlined in the following way: The first chapter of this work serves as an introduction to the entire work and the structure of the entire work. Afterwards, Chapter Two looks into the general concepts of 'Supply Chain Management' and visibility requirements in Supply Chain Management. Chapter Three describes the General Transportation Process in today's Supply Chains, its Modes, and Functionalities and about Transportation roles and how these roles are embedded in SAP Analytics and also integration of Analytics (Visual Composer Tool) with different SAP systems to achieve visibility. Chapter Four provides information about the different SAP Systems and Applications. Chapter Five explains the Transportation Process end to end scenario in detail and also introduces a new process "Re-tendering Process" where visibility is more needed. Chapter Six is the description of the Analysis part, it describes new KPIs and Data needed for visibility and Chapter Seven is the Implementation part description-how KPIs and Data of Transportation processes are implemented in SAP BW and finally how these are used by Analytics Applications. Conclusion and future outlook forms the final Chapter Eight.

2 Supply Chain Management

Supply chain management has been deemed as one of the useful tools for businesses to promote their competitiveness, and to build up their trust relationship with up and down stream businesses. In order to link the whole value chain, information technology (IT) application has already been essential for enterprises.

2.1 Supply Chain of businesses

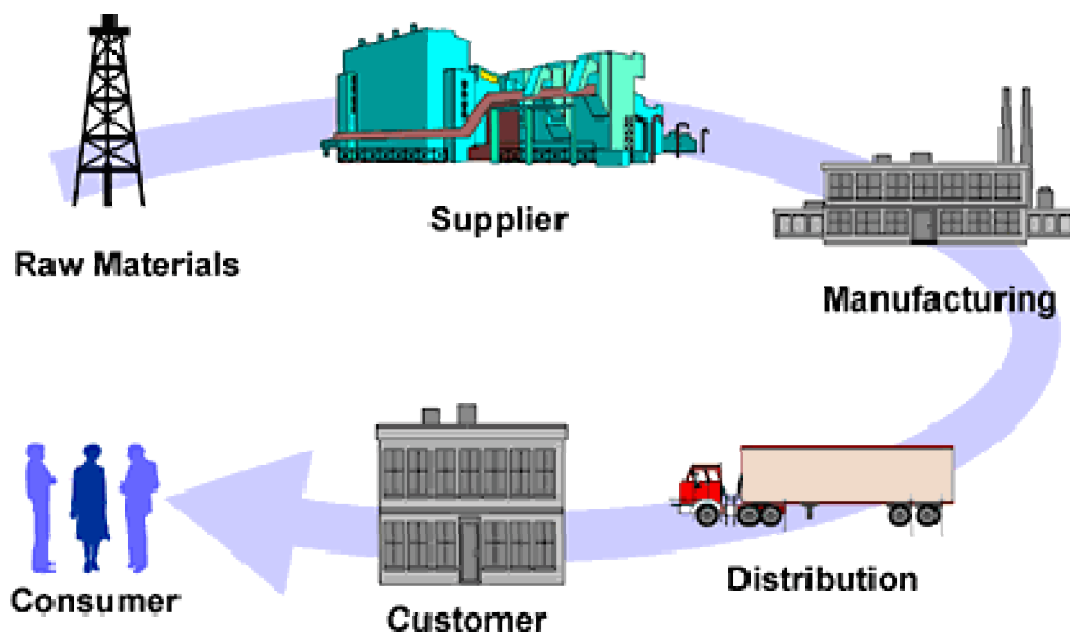


Figure 1 : Supply Chain

Source: Theprocessgroup.com White papers Logistics vs. Supply Chain

The supply chain is the series of links and shared processes that exist between Suppliers and Customers. These links and processes involve all activities from the acquisition of raw materials to the delivery of finished goods to the end consumer. Raw materials enter into a manufacturing organization via a supply system and are transformed into finished goods. The finished goods are then supplied to consumers through a distribution system. Generally, several companies are linked together in this process, each adding value to the product as it moves through the supply chain.

Some definitions of Supply chain

“A supply chain is the alignment of firms that bring products or services to market.”
[James/Lambert/Lisa 1998]

Supply Chain Management

"A supply chain consists of all stages involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers, but also transporters, warehouses, retailers, and customers themselves." [Peter 2001]

"A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers." [Ganeshan/Harrison 1995]

If this is what a supply chain is then we can define supply chain management as the things we do to influence the behaviour of the supply chain and get the results we want.

Some definitions of supply chain management

"The systemic, strategic co-ordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole." [Mentzer/DeWitt 2001 p, 18]

The integration of key business process from end user through original supplier that provides products, services and information that add value for customers and other stakeholders.[Cooper/Lambert/Pagh 1998 p, 1]

A supply chain is a system of entities that supply the next one. These entities may be independent companies, or the chain may be entirely within one firm. [Long 2003 p, 43]

"Supply chain management is the co-ordination of production, inventory, location, and transportation among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served." —My own words.

2.1.1 Basic Features

Most supply chains exhibit these basic characteristics

The supply chain includes all activities and processes to supply a product or service to a final customer. Any number of companies can be linked in the supply chain. A customer can be a supplier to another customer so the total chain can have a number of suppliers–customer relationships. While the distribution system can be direct from supplier to customer, depending on the products and markets, it can contain a number of distributors such as wholesalers, warehouses, and retailers.

Products or services usually flow from supplier to customer. Likewise, design and demand information usually flows from customer to supplier. (Physical products move "downstream", while demand information flows "upstream". [Tony 1997 p, 5]

2.1.2 Functional Components and Elements

Supply chains generally have these functional components:

Demand Planning: A planning process to predict the demand of products and services based on forecasts. Accurately forecasting customer demand improves customer service while decreasing costs by reducing demand uncertainty.

Manufacturing Planning and Scheduling: A planning process that optimally schedules manufacturing orders with production capacity. This is performed by combining material requirements planning (MRP) and capacity requirements planning (CRP) to create optimized and constrained production plans.

Supply Planning: A planning process that meets customer demand based on available inventory and transportation resources. This includes distribution requirements planning (DRP), which determines the need to replenish inventory at branch warehouses.

Transportation Planning: A planning process is to optimally schedule, load, and deliver shipments to customers while considering constraints, such as delivery date, mode of transportation, carrier, etc. [Buxmann/König 2004 p, 60]

The supply chain involves several elements: [Computer world 2004]

- **Location.** It's important to know where production facilities, stocking points and sourcing points are located; these determine the paths along which goods will flow.
- **Production.** An organization must decide what products to create at which plants, which suppliers will service those plants, which plants will supply specific distribution centres, and, sometimes, how goods will get to the final customer. These decisions have a big impact on revenue, costs and customer service.
- **Inventory.** Each link in the supply chain has to keep a certain inventory of raw materials, parts, subassemblies and other goods on hand as a buffer against uncertainties and unpredictability's. Shutting down an assembly plant because an expected part shipment didn't arrive is expensive. But inventory costs money too, so it's important to manage deployment strategies, determine efficient order quantities and reorder points, and set safety stock levels.
- **Transportation.** How do materials, parts and products get from one link in the supply chain to the next? Choosing the best way to transport goods often involves trading off the shipping cost against the indirect cost of inventory. For example, shipping by air is generally fast and reliable. Shipping by sea or rail will likely be cheaper, especially for bulky goods and large quantities, but slower and less reliable. So if you ship by sea or rail, you have to plan further in advance and keep larger inventories than you do if you ship by air. [Computer world 2004]

2.2 Visibility in the extended supply chain

2.2.1 Challenges

Once you've determined all of the elements in the supply chain, how do you manage the chain? [Computer world 2004]

There are three main paths in the process:

- Product flow includes the movement of goods from a supplier to a customer, as well as customer returns.
- Information flow involves transmitting orders and updating the status of delivery.
- Financial flow consists of credit terms, payments and payment schedules, plus consignment and title ownership.

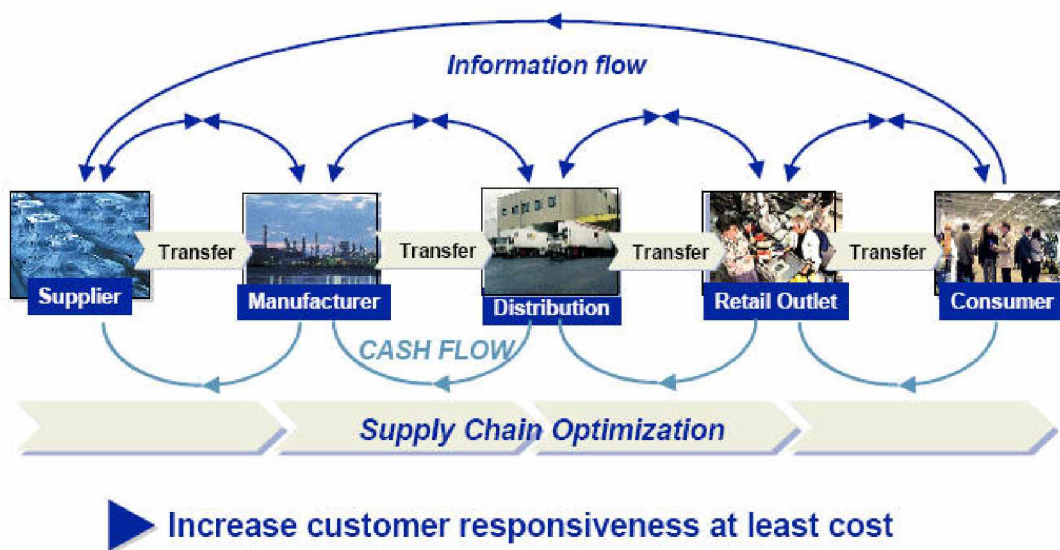


Figure 2 : Supply Chain Flow

Source: Processgroup.com

Juggling these elements involves record keeping, tracking and analysis by many departments. Supply chain software, especially large, integrated packages, combines many different technologies to give a single view of supply chain data that can be shared with others and to achieve a competitive advantage, businesses must quickly adapt to dynamic market conditions, including wide shifts in demand and supply, alternate sourcing opportunities, and lower transportation costs.

Supply Chain Management

SCM applications fall into two main categories: planning applications and execution applications. Planning applications determine the best way to route materials and the quantities of goods needed at specific points. When such applications work well, they make possible the "just-in-time" delivery of goods. Execution applications track financial data, the physical status and flow of goods, and ordering and delivery of materials. So achieving visibility in these two categories helps companies to reduce supply chain costs, optimize inventory investments, increase sales and improves overall customer service through real-time visibility, optimized supply chain planning and execution capabilities and accelerated sales and operations planning.

Tools like SAP event-management provides global visibility into real-time operations and alerts decision-makers to key supply chain events increasing the organization's ability to proactively respond to unexpected changes within the company and across its extended supply chain network.

SCM is so big that it can be difficult to plan the deployment of such a system and with visibility all detailed information of the total process is available to every required user and helps them in managing these processes effectively.

2.2.2 Potential Benefits with Visibility

Visibility in supply chain management is the key to gaining and maintaining a competitive business advantage.

Increased efficiency - removes the bottlenecks and complexity from the supply chain by providing one network environment and the framework for efficient transactions and information sharing

Greater responsiveness - enables a faster response, by all partners, to critical events at any point in the supply process

Improved Customer Service - ability to provide customers faster/better information to tracking queries

Optimised resource usage - facilitates real-time, cross network information sharing and decision making

Reduce stock-holding - allows faster movement of information and materials to the point of need, cutting lead times from an average of 8 days to around 3, reducing inventory stockpiles and improving cash-flow

Greater product availability - improved supply visibility cuts the average number of out-of-stocks by 60%

Lower logistical costs - the integrated and intelligent allocation of inbound logistics and yard management improves accuracy and efficiency and reduces costs

Simplified management - provides a unified operational environment for the disparate applications used by companies across the supply network Source: fujitsu.com

3 Transportation process

3.1 Transportation process

Transportation is the key point for any Logistic and Transport Service Provider companies' existence as it is their task to provide transport facility to other companies and a success factor for Manufacturing Companies where transportation is required for inflow and outflow of materials. These Manufacturing companies use the services of these Logistic and Transport Service Providers as they know the importance of Transportation in today's business environment. These Logistic and Service Providers fulfil the needs of Manufactures or any other Companies which need transportation and achieve success by concentrating or focussing mainly on the key needs like reducing transportation costs, increasing the efficiency of Transportation and also reducing the Transportation time by providing better service. As Cost and Time are treated as main assets of the company, controlling them can give effective and profitable results, and this is the main success point for different processes and especially for Transportation process.

3.1.1 Overview

Now a days many business infrastructures are spread all over the world like, a company has its own multiple Production units, and for them multiple Suppliers, multiple Transporting agents, and need to satisfy the Customers from different parts of the world, so and so. For this kind of infrastructure an efficient and well planned transportation process, which can optimize the transportation costs, time and which can assure availability of goods at the right time in right quantity and quality to the right person are needed. To achieve this all elements and sub-processes of the transportation process should work together and make the transportation process reliable and flexible.

The transportation process includes Inbound and Outbound shipments planning and shipment costs calculation.

As an example, an Automobile manufacturer organizes a Purchase order from the Material Management department, where a inbound delivery document is prepared with Purchase order as reference, if transportation is required for that purchase order and a shipment for this is created to transport Materials from vendors to its own plants, and later after the goods have arrived, verifying the invoice completes the inbound delivery process. Also the same manufacturer company plans to deliver the finished goods to the customer and creates a sales order, and with this as reference an outbound delivery document is created and then a shipment is created to transport goods to the customers, and finally billing process completes the outbound delivery process. See the fig. below.

A lot of information, which includes the Forwarding agent, Customer, routes, and Shipping points are needed for planning and further processing.

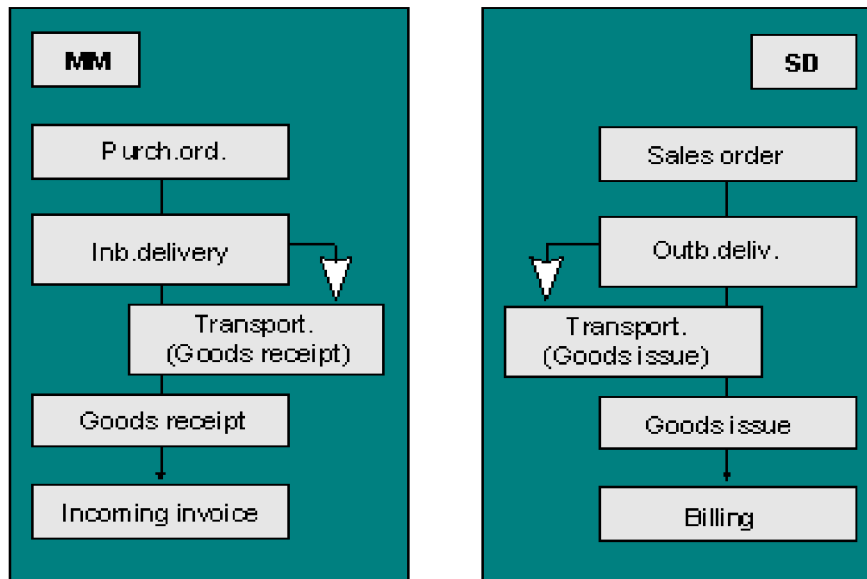


Figure 3: Inbound and Outbound delivery

Source: SAP Logistic Execution Course material

3.1.2 Planning

Before actual implementation or execution of transportation process, transportation planning is required, which acts as a foundational step for the whole process and it is the important sub-process where other sub-processes like Transportation execution, and monitoring should function as planned by this process. The primary task in Transportation planning is combining the orders to deliveries and then to prepare shipping document. Here many elements are taken into consideration like the Deliveries info, Materials info, and Suppliers info, date of shipment and Shipping point etc., to make a perfect transportation planning.

The main functions of Transportation planning process are:

Inbound and Outbound Delivery

The transportation process is same for both inbound and outbound delivery, but receiver and sender are different. Normally transportation process starts when someone prepared a shipment which may be a combination of inbound delivery document, prepared with reference to purchaser order and an outbound delivery document, prepared with reference to sales order. How well a transportation process is optimized is dependent on the planner, who combines these inbound and outbound deliveries to create a shipment. This shipment is the indication for the start of Transportation process.

There is another kind of transportation between the plants of same company, which mainly concentrates on stock transfer and also to transfer semi finished goods between the plants.

Carrier Selection

After having a perfect planned shipment (combination of similar kind of deliveries), transportation route and stages are planned and then Carriers should be selected appropriate for that route, stages and products, like in which way goods must be sent, thru trucks, ships, train or thru airways etc., carriers must be selected by analysing which one will be the most beneficial for the transportation process.

Shipment costs calculation

After carrier selection, where everything needed for the transportation is selected and planned, and then comes the shipment costs calculation process, it is not payment after transportation, but like estimating or deciding the transportation costs before the transportation starts. These resulting costs are then transferred into customer billing documents, and thus include the costs of transportation in the invoice to the customer. Later settlement is completed with service agents through the payment of the invoice or creation of a credit memo.

3.1.3 Execution

Transportation execution is a sub-process where actual preparation of shipment documents and movement of materials take place.

This process starts with the creation of shipment document. The shipment document is the central document that is used to model shipments in the R/3 System. It contains all information necessary for organizing and carrying out a shipment.

The Execution process has following functions: [SAP601 LES]

- Combining inbound deliveries to form inbound shipments
- Combining outbound deliveries to form outbound shipments
- Assigning service agents, modes of transport, shipment types, and so on
- Planning and monitoring deadlines
- Specifying shipment stages
- Cross-delivery packing and creation of handling units
- Creating output and shipping papers
- Recording shipment-relevant texts
- Recording partner information
- Freight cost estimating
- Shipment tendering

Note: Actually Transportation planning and Transportation execution processes have almost the same functions, but these functions are planned in the planning process and the same functions are executed in the execution process.

3.1.4 Monitoring

After the goods have moved from the warehouse of the sender, then it should reach the right receiver at the planned date and time, with the exact material. And if this is not achieved then it is a problem or interruption for the transportation process, and here transportation process should be monitored and see that these problems or interruptions are rectified and make the process run as planned. For this kind of situations reaction time should be much faster, as the goods should reach the receiver as planned, and see that the transportation process completes successfully may be with some delay in these kinds of situations. Responding quickly, notifying the required processes, planning alternatives, taking decisions quickly are required in order to achieve the targets.

Transportation monitoring also happens during planning and execution processes too, this monitoring process is like a supportive process to every other processes, but the task of this process is same in all processes, i.e. to monitor and help them in achieving their targets.

3.1.5 Warehouse management

The starting point of actual execution of transportation process or goods movement is done at sender's warehouse, or any intermediate junction warehouses where activities like picking, packing and loading goods to the trucks or to any other carrier are carried out. This process repeats every time there is a change of transport or carrier in between the whole transportation process.

The final destination of the goods are at receiver's warehouse, and this is the end of the actual execution of transportation process or goods movement, but after successfully managing the transportation process warehouse management is required, which is an important process that takes care of inventory (the storage of goods before delivering them to other parties or before sending them to the production department) in the warehouse.

Using the concepts of "Cross Docking", inventory in the warehouse can be reduced, but also with perfect transportation planning it can be reduced. So basically Warehouse management is not necessary when transportation process is carried out considering the inventory in the warehouse. If it is planned so, the goods from the supplier goes directly to the production department without any necessity for storage.

3.2 Visibility in Transportation Process

When it comes to international movement of goods, customers are looking for visibility into the movement of freight because there is a lot of risk in it," [Gaurav]. In a shipment from China to US, for example, the chain of custody may extend through a dozen "hands" between a supplier's docks to final destination. "But every company needs visibility because it has an impact on their inventory levels and also an impact on stock outs.

Visibility questions like, “where are my goods presently?”, “Will my goods arrive on time?”, and “What are the alternative ways to get my goods safely (in case of accidents) etc. can be answered. These are applicable for both domestic and international transports.

Transportation visibility covers transportation and customs issues for inbound and outbound processes. Different kinds of transportation or different mode of transports are considered including International Sea Shipment.

The following business goals and objectives can be achieved through the implementation of visibility:

- Improving Customer Service
- Complaint management and tracking
- Better service levels
- Increasing Revenue
- Reduce time-to-market & volume
- Reducing Operating Costs & Increasing Efficiency
- Lower logistics costs
- Improve inventory visibility

Transportation Tracking & Monitoring: Transportation visibility monitors and controls the transportation process from the creation of the delivery to the delivery receipt at the customer site, including arrival, loading respectively unloading and unloading events as well as customs related entries.

Alerts & Follow-Up for Transportation: Provides alerts to the business partners involved along the transportation process.

Transportation Analytics: Provides input for analyzing the adherence to the planned duration of the entire shipment, including the duration of customs processing and arrival of customs documentation.

In this thesis paper, it is clearly described how visibility can be achieved in Transportation process through Analytics. The Analysis part and Implementation part are explained in detail in the coming chapters.

3.3 Transportation Process Roles

There are many sub-processes in Transportation process, and to maintain all these processes, there should be one or many responsible persons according to the complexity and area of scope in these processes.

Actually Transportation process is taken care by Transportation Planner Role, and he has some supportive Roles helping him in achieving his targets successfully. Depending on the Company infrastructure, Transportation process can also have more Roles to maintain the processes though everybody works for the same goal.

Here are some Roles which are important for the Transportation process maintenance. A company may have every Role described here or only some Roles depending on their infrastructure.

Transportation Manager

Definition: is a role that supervises the total transportation process and this role is also called as owner of the process.

Description: This role takes care of the total Transportation process. All other roles should report to this role, long term decisions and Management level decisions are taken by this role like contracting the Forwarding agents, determining the business share for the respective Forwarding agent, business share for the company in this current year, Transportation process flow, and so on. This role makes the process run effectively by assigning tasks to other roles and by monitoring them.

Why: A good owner is required to run any process effectively, and in these business environment, the role should save the time, budget and should also provide customer satisfaction, so this role acts as a head of the total Transportation process and helps its subordinate roles to take up the challenges and run the process smoothly satisfying all the requirements.

Responsibility: This role is responsible for the total Transportation process.

Areas: This role focuses mainly on all working areas related to Transportation:

- Analytics
- Collaboration
- Processing / Execution
- Master Data Maintenance
- Monitoring (Management Level)
- Monitoring (Execution Level)
- Planning (Execution Level)
- Planning (Management Level)
- Tendering / FProc (Contracting)
- Tendering / FProc (Operational)
- Freight costing inquiry
- Freight costing Processing
- Reporting
- Self service
- Supervision

Tasks:

- Monitoring the total Transportation process
- Management level planning like Transportation process flow
- Taking Management level decisions like Contracts with the Forwarding agents

- Leading the Transportation process team
- Reporting to the High level Management about the progress in the process

Transportation Planner

Definition: is a role that analyzes, forecasts, plans, process, and monitors the Transportation planning process in an organization.

Description: This role initiates the Transportation process. All deliveries which need transportation are taken up by this role, this role combines all the similar deliveries, creates shipment documents, selects Forwarding agents, mode of transport and Carriers, determines the route and shipment stages and estimates the Freight costs. These tasks can be done by the role manually or by using TPS or any other automated systems.

Why: There are so many tasks involved in the Transportation process, and each and every task should be conducted systematical and effectively within the Time frame. Also in today's Customer centric business environment, Companies products should be available to the customer as early as possible and Companies should be quick in taking the decisions related to Transportation process, so there should be a role which takes care of these things.

Responsibility: This role is responsible for the total Transportation planning process.

Areas: This role focuses mainly on these working areas:

- Analytics
- Collaboration
- Processing / Execution
- Master Data Maintenance
- Monitoring (Execution Level)
- Planning (Execution Level)
- Tendering / FProc (Operational)
- Freight costing inquiry
- Reporting
- Self service

Tasks:

- Combining inbound deliveries to form inbound shipments
- Combining outbound deliveries to form outbound shipments
- Selecting service agents / Forwarding Agents, modes of transport, shipment types, and so on
- Planning and monitoring deadlines
- Specifying route and shipment stages
- Cross-delivery packing and creation of handling units
- Creating output and shipping papers
- Freight cost estimating and shipment tendering etc...

Transportation Controller

Definition: is a role that executes, process, monitors and controls the Transportation process after the Transportation planning stage in an organization.

Description: This role executes the Transportation planning process which is planned by the Transportation planner role and sees that everything happens in the exact way it is planned by the planner i.e., his main task is to compare the Actual vs. Planned. If the actual process does not meet the planned process or when there is an interruption in the process, this role should take the required measurement steps to make the process run as close to the planned process. So this role should also be ready to take up the situations like rescheduling, re-tendering etc...

Why: This role can be neglected in small companies because here the Transportation planner role itself can take up the tasks of Transportation controller role by doing both planning and execution. But in many large companies we need this role, as it removes the burden from Transportation planner and the total process runs effectively and quickly which is the main aim of any organization.

Responsibility: This role is responsible for the execution of Transportation planning process including alert handling, rescheduling and re-tendering process.

Areas: This role focuses mainly on these working areas:

- Analytics
- Collaboration
- Processing / Execution
- Master Data Maintenance
- Monitoring (Execution Level)
- Tendering / FProc (Operational)
- Freight costing inquiry
- Reporting
- Self service

Tasks:

- Executing the Transportation planning process
- Responding to the Alerts and handling them effectively
- Notifying respective roles and persons about the alert or interruption in the process
- Checking whether the Carriers deliver the right products in correct quantities at right location
- Rescheduling for the missed products or misplaced products
- Re-tendering process
- Assigning Special Journeys or Express deliveries to make the process run quicker

Transportation Analyst

Definition: is a role that collects data during and after the completion of the total Transportation process, analyzes the data and provides updated and reliable information to other roles at required time.

Description: This role comes into action at both starting and completion of a Transportation process. This role helps all other roles by providing necessary info. at required time, ex. he helps the Planner at the time of tendering process and Controller at the time of re-tendering process by providing reports on Forwarding agents efficiency and provides reports on the total Transportation process efficiency to the Manager. He collects all the data after the completion of the process and prepares reports about it and also calculates the total transportation costs, penalties and so on.

Why: There is so much of data that should be analyzed and compared with previous data to see the status of the current process and to make the process run more effectively in future, and also to take decisions quickly, we need updated and reliable information in a clear structure, and this role satisfies the requirements of collecting, analyzing and providing information. This role is really needed at the time of alerts, rescheduling, and re-tendering processes, as time is really important at these situations.

Responsibility: This role is responsible for collecting, analyzing and providing information to other roles at required time.

Areas: This role focuses mainly on these working areas:

- Analytics
- Master Data Maintenance
- Planning (Management Level)
- Tendering / FProc (Contracting)
- Reporting
- Self service

Tasks:

- Collecting all the required Information / Data
- Analyzing the Information / Data
- Preparing the information in a clear structural form
- Calculating fines for Forwarding agents or for plant depending on the situation
- Providing the information
- Maintaining the Master Data
- Providing help in Management Level planning, like Contracting Forwarding agents
- Alert the respective members when some drastic changes are identified.

Transportation Specialist:

Is a role that performs the same tasks of a Transportation Planner, except Shipment costs inquiry or calculation or tasks related to Freight costs etc. He is specialist in Planning.

Tendering Clerk:

Is a role that performs the actual Tendering Process, Transportation planner only plans the Tendering process and asks Tendering Clerk to tender to these selected Forwarding Agents, or The Tendering Clerk himself can select the Forwarding Agent and do Tendering process in some cases and he will also deal in Freight costs inquiry with Forwarding Agents and help the Planner and Controller in estimating the total shipments costs and so on.

Carrier / Forwarder:

Carrier is a role, which takes transport requests from Transportation planner/ Tendering Clerk / Forwarding Agent and does the actual transportation of goods from Shipping point to destination point. He needs to only check whether he can deliver the goods with in the time frame mentioned the transport request and adjust his schedule according to it or propose new time.

Forwarder role is a combination of Carrier and Transportation Planner, he acts as a carrier when he receives the transport requests from Transportation Planner / Tendering Clerk, adjust his time slots or propose new time etc... and after receiving the Transport request from them, he acts as a Transportation planner and contacts the Carrier who can deliver the goods and forwards this Transport request to them and plans accordingly to meet the requirements.

3.4 SAP Analytics

The SAP Analytics application enables the business to gain credible, clear, and comprehensive business insights. The application leverages SAP Business Intelligence to unify and integrate disparate data from SAP, third-party and custom corporate applications, legacy systems, as well as externally syndicated information sources. Giving businesspeople the comprehensive views they need to take actions that are appropriate, guided by strategy and in concert with their colleagues and the value network. [SAP Analytics]

SAP Analytics delivers insights across the extended value network, spanning multiple business functions, departments, and even organizations. Plus, the application is designed for businesspeople. So it's easy to use, modify, and extend. Businesspeople can quickly deploy ready-to-use analytic applications that encapsulate best business practices. As business conditions change, businesspeople can also use an intuitive, code-free design environment to extend functionality or even create their own analytic applications. Source: sap.com

The below diagram explains, how Analytics acts as a mediator between people productivity and other Applications and Platforms in the Enterprise Service Architecture.

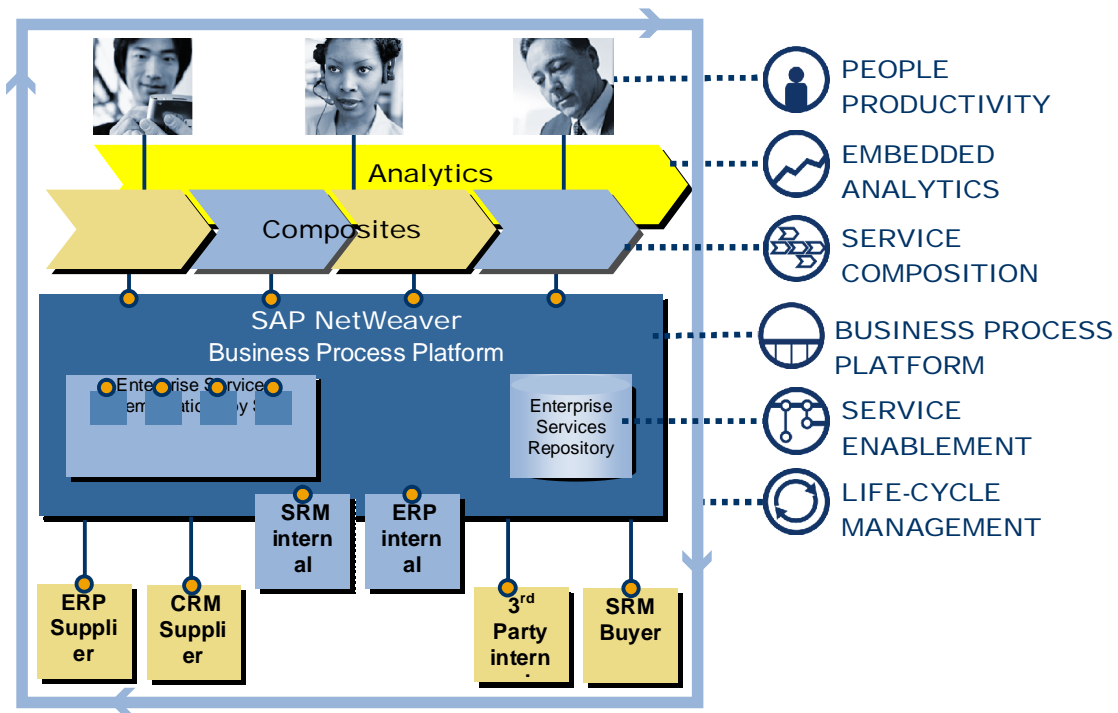


Figure 4: Enterprise Service Architecture: Key Building Block Analytics

Source: SAP Analytics Documentation

3.4.1 Visual Composer

SAP NetWeaver Visual Composer is a powerful design tool that facilitates the creation of portal content for SAP Enterprise Portal 6.0 and NetWeaver '04, using a visual user interface rather than manually writing code. It provides sophisticated, yet simple-to-use tools for creating portal iViews that process data from back-end systems. Visual Composer operates on top of the portal, utilizing the portal's connector-framework interfaces to allow users to access a range of data sources, including SAP and third-party enterprise systems. Special connectors are also supported, such as that used for accessing data services from Siebel systems. Because Visual Composer is a fully Web-based application, business consultants can interact with business users (content experts) to build or customize pages and iViews as needed, accessing the software from any machine.

SAP NetWeaver Visual Composer can produce iViews that run on both SAP Enterprise Portal 6.0 SP2 (Patch 4 and above) as well as SAP NetWeaver '04 SP Stack 05 and above.

Features

From the Visual Composer client – the Storyboard – one can design models that include hierarchy of pages and their required iViews. All aspects of the iViews can be constructed, including:

Data Service Layer

Visual Composer provides a tool that allows connection to back-end applications defined in the system landscape. This connection enables users to import into their Visual Composer model, the relevant Remote Function Calls (RFCs), Business APIs (BAPIs) and other data sources on which users want to base their iViews.

User Interface (UI) Logic

The UI logic defines which UI components are presented to the user at runtime, how the user may interact with the components, and what the underlying data queries are. Users construct the UI logic by dragging and dropping icons that represent the elements of their iView, such as the forms it displays at runtime. As they construct the UI logic, Visual Composer writes the underlying code.

UI Layout

The layout defines all the visual aspects of the iView. The Storyboard provides wysiwyg tools for customizing the iView layout.

The model build with Visual Composer is automatically coded in the proprietary Generic Modeling Language (GML). When designing Visual Composer model is complete, users use the Visual Composer compiler to convert the GML code into a format supported by the portal. They can also export their model to another Visual Composer, and import other models as well. [VC user guide, 2005]

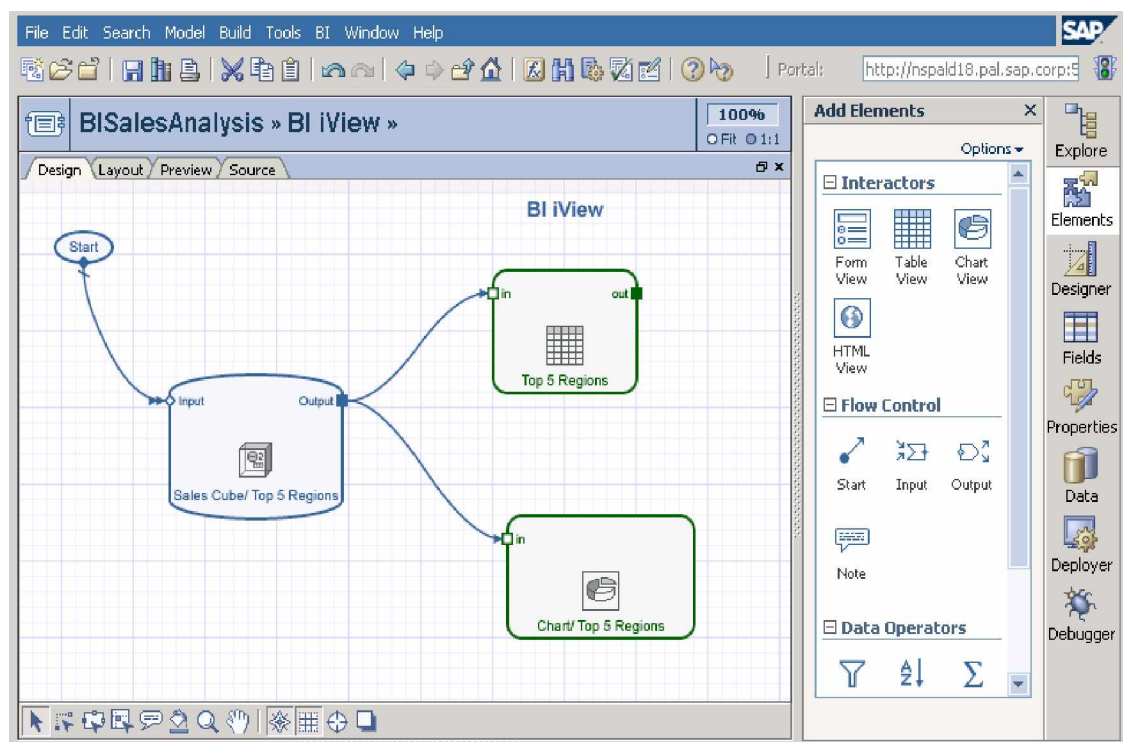


Figure 5: Creating Analytic Applications

The above picture is a screenshot of Visual Composer design time; here the selection of Queries or BAPIs, arrangement of different Charts, tables and forms takes place.

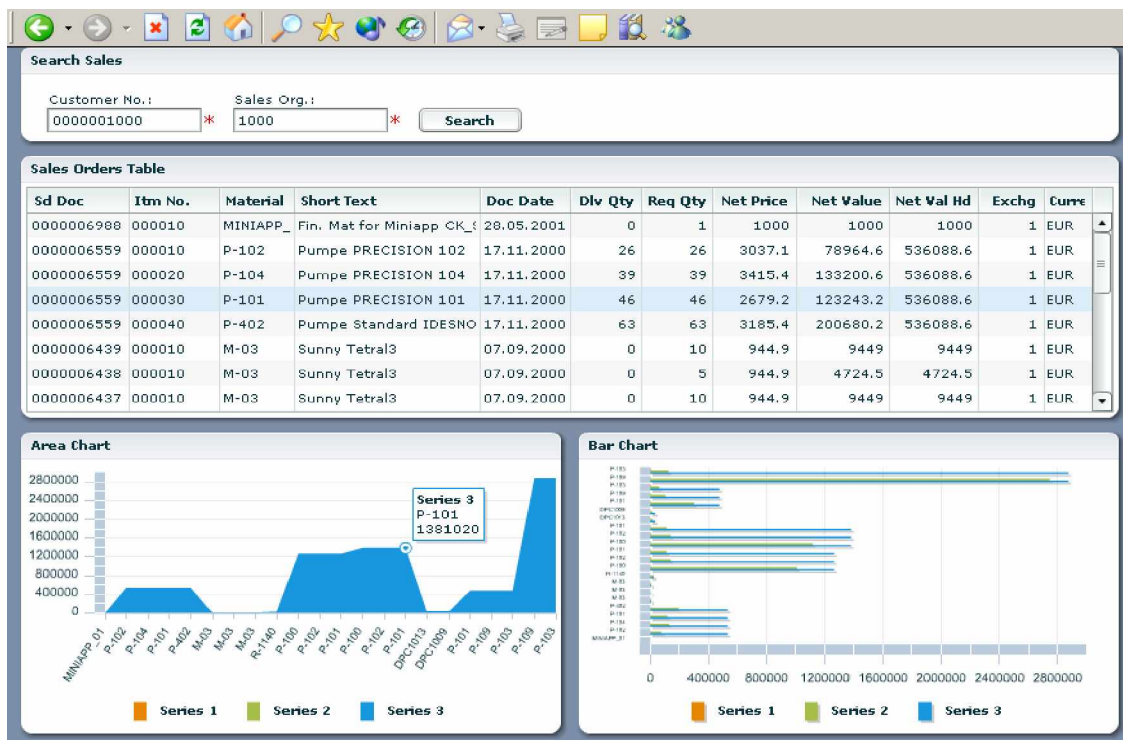


Figure 6: Sample Analytic Application

The above picture is a screenshot of Visual Composer run time; here the output of the iView can be seen. Dynamic interaction between these charts and tables are also possible.

3.4.2 Integration of Visual Composer with different backend systems

Visual Composer directly connects to different BW and R/3 systems through interfaces. So the Key figures, which are needed, should come from one of the data services.

“You have access to backend systems like SAP R/3, mySAP ERP, and mySAP CRM with connectivity based on Web services. And you can connect to those services via SAP Enterprise Portal. Visual Composer allows business users to compose an iView that accesses data from various data sources (e.g., BAPIs from SAP backend systems such as CRM) without actually writing code. You are in a pure modelling environment, one that not only lets you model the layout of the user interface, but also the flow of control between different user interface elements, as well as the access to backend data and the binding of data to UI elements.” [SAP insider]

Identification of the data sources:

- BW: Identify the queries, query views
- R/3: BAPIs for data access

Connectivity:

SAP ERP: BAPI/RFC from 3.1 onwards

BI: Info Cubes all BW releases

Third party:

- Any Third party product where a connector is available for the portal connector framework
- Database - Any JDBC compliant database by using the JDBC connector supplied by the portal

SAP NetWeaver Visual Composer Architecture

The Visual Composer compiler generates business packages that can be deployed to any portal using the standard deploy procedure. Once deployed, the pages and iViews created by Visual Composer can retrieve data from the SAP Enterprise Portal runtime connectivity framework and display this information just like any other hand-coded portal pages and iViews. [VC user guide, 2005]

The following figure depicts the general architecture of the Visual Composer system

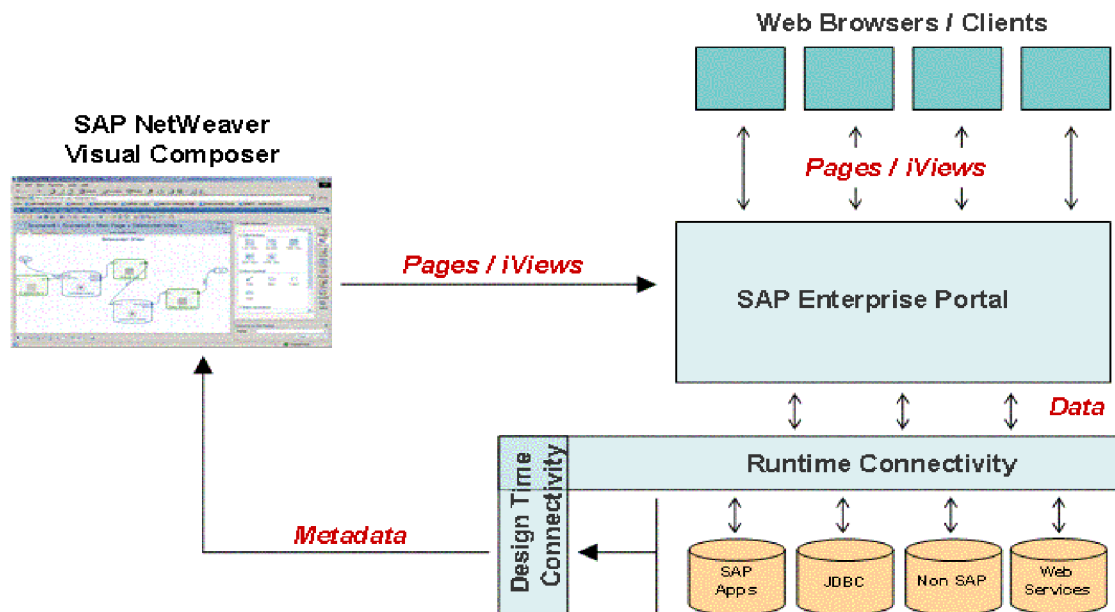


Figure 7: Visual Composer architecture

Source: SAP Visual Composer Documentation

Note: Now recently in 2005 SAPHIRE in Copenhagen and Boston, SAP announced the partnership with Macromedia Flash. With Flash, the models or iViews become more attractive, more users friendly and there will be more dynamic interaction between the charts tables and forms having great animation effects.

4 Systems and Applications related to Transportation Process

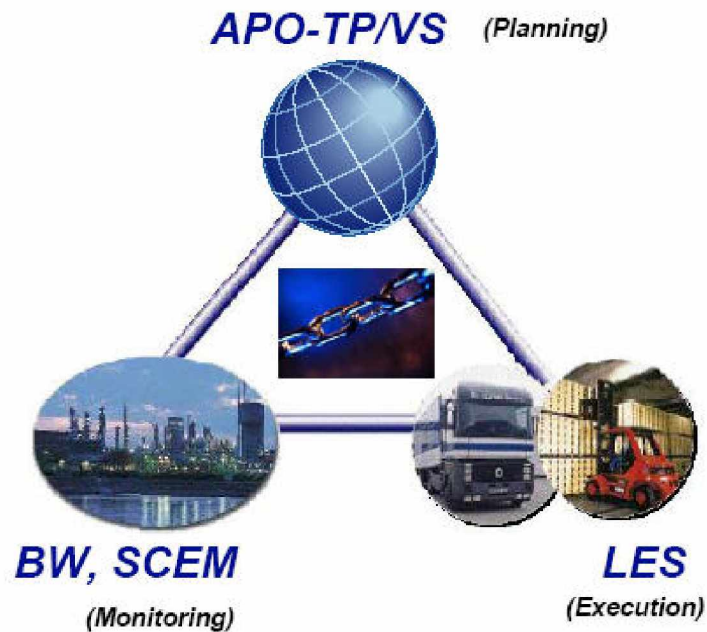


Figure 8: Transportation Management Systems

Source: SAP SCM612-APO/TPVS (Course material)

4.1 Managing processes

Together TP/VS, LES, BW and Supply Chain Event Management (SCEM) deliver a comprehensive solution for Transportation Management with in Supply Chain Management.

Features:

- Closed feedback loop between Planning, Execution and Monitoring
- Fast and simple information exchange
- Monitoring of all processes
- Short and long term decision support

4.1.1 APO

Advanced Planner and Optimizer (APO) is a set of software applications from SAP Company for supply chain management. According to SAP literature, Advanced Planner and Optimizer are designed to help a company improve production planning, pricing, scheduling, and product shipping. APO works by getting updates about customer demand from different sources like Retailers etc... These updates are used to create APO "demand triggers" that take into account many complex variables, such as the delivery schedule of raw materials and productions cycles, to forecast the right amount of product mix the company will need to meet future customer demands. APO can be integrated with the SAP R/3 and legacy enterprise resource planning (ERP) systems.

SAP has introduced the Supply Chain Management solution to meet the challenges of managing the entire supply chain from end to end. The SAP Advanced Planner and Optimizer (SAP APO) is an important part. With SAP APO, SAP has combined the ERP execution power of the SAP R/3 System with advanced data analysis and supply chain management tools. [SAP SCM612]

Overview of SAP Advanced Planner & Optimizer

The SAP Advanced Planner and Optimizer builds on the SAP Business Framework to improve information flow by incorporating real-time collaborative decision support, advanced planning, and optimization into the SAP R/3 System. SAP APO uses a powerful memory resident analytical engine and highly specialized, highly configurable data objects that offer major new Components.

APO consists of eight application levels: network design, demand planning, supply network planning, production planning and detailed scheduling, global availability, transportation planning and vehicle scheduling, and supply chain collaboration. [Supply Chain Solutions, 2004]

APO Includes planning functions for the strategic, tactical and operational planning of logistics chains, integrated APO modules cover the entire field of planning. APO provided with several integrated modules, which have access to a joint data basis. [Gerhard/Tamara 2002 p, 280]

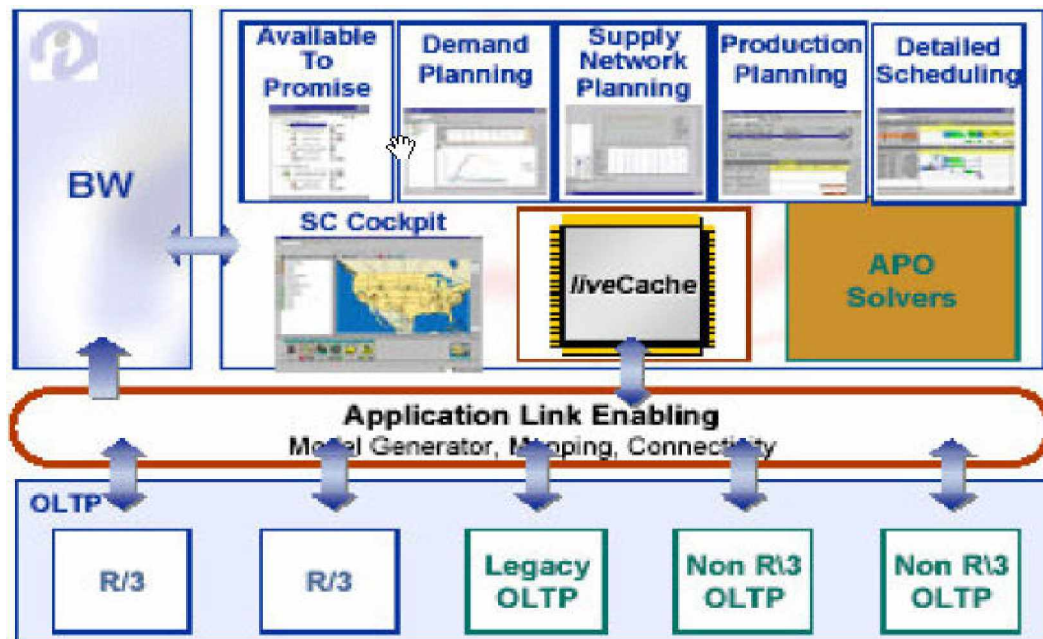


Figure 9: APO Architecture

Source: SAP APO Course Material

Benefits of SAP Advanced Planner & Optimizer

SAP APO provides a number of benefits, including the following:

Completeness:

SAP APO supports all of the key supply chain planning and optimization functions and processes traditionally found in stand-alone advanced planning and scheduling solutions.

Performance:

The SAP *live* Cache memory resident computing technology enables forecasting, planning, and optimization functions to be executed in real time.

Independence:

SAP APO performs planning functions and processes outside of the OLTP system, ensuring greater flexibility and high availability of the SAP APO server.

Openness:

SAP built SAP APO to function in heterogeneous environments. It inter-operates with SAP R/3, third party, and legacy OLTP systems.

Integration:

SAP APO is seamlessly integrated with the R/3 System so you can integrate all the links in your supply chain. A robust and sophisticated integration layer facilitates the use of SAP APO with additional optimization and forecasting algorithms.

4.1.2 Transportation Planning/Vehicle Scheduling (TP/VS)

The component Transportation Planning/Vehicle Scheduling (TP/VS) is used to plan and optimize shipments for orders (sales orders, purchase orders, returns, and stock transport orders) and deliveries. To do this the Planner should assign the orders and deliveries for which he plans shipments to vehicles. He can take various restrictions into account, for example, requested delivery dates or transportation capacities when assigning the vehicles. The result of TP/VS planning is the creation of planned shipments. TP/VS support various processes such as outbound delivery, inbound delivery, and cross-docking. TP/VS is part of transportation management.

Integration

Task	System
Create orders and deliveries for the shipments that you want to plan	SAP R/3
Execute the shipments	SAP R/3 component Logistics Execution (LE)
Backorder processing	SAP APO component Global Availability Check (GATP)
Evaluate the transportation management process	SAP Business Information Warehouse (SAP BW)
Monitor transportation execution	SAP Event Management (SAP EM)

Features

Interactive planning

You use interactive planning to plan shipments for your orders and deliveries and to process them manually. You can use the planning view with its various planning boards for interactive planning.

Optimization

You use optimization to optimize the planning of shipments on the basis of costs and to determine optimal delivery sequences and transportation dates/times. You can also start optimization from interactive planning or schedule it in the background. You can continue to process optimization results in interactive planning.

Transportation service provider selection (TSP selection)

You use the TSP selection to assign transportation service providers to your planned shipments, either manually or automatically. In the case of automatic assignment, the system assigns the transportation service providers on the basis of a transportation service provider profile, in which you define criteria for the assignment, for example, costs or priority. You can either trigger the automatic TSP selection automatically or schedule it in the background.

Releasing planned shipments

You use the release to fix your planned shipments after you have finished planning. You cannot change released planned shipments manually or in optimization. The release is also a prerequisite for transportation tendering.

Transportation tendering (collaborative transportation planning)

You use transportation tendering to tender your planned shipments to external transportation service providers using EDI or the Internet. The transportation service provider can react to the tender in various ways: accept the offer, reject the offer, or suggest a deadline change.

Monitoring exceptional situations

If problems occur during planning, TSP selection, or transportation tendering, you can display and rectify them using interactive planning. [SAP Help Portal]

4.2 Supply Chain Event Management (SCEM)

Monitoring the processes is an important issue in today's Business infrastructures, the goals or the targets can be achieved only when they are monitored or controlled effectively. In Transportation process also monitoring and controlling the whole process is a must in order to make the process run as planned.

In mySAP SCM (Supply Chain Management) there is an application, which is used to monitor the transportation process and see that every thing functions well, and if something happens in between, it will automatically takes care of respective alternatives and solves the issues efficiently according to the user defined rules and that is SCEM (Supply Chain Event Management), this application is used not only for transportation process but also used for production malfunction, fulfilment process, procurement and outbound delivery. It provides visibility in these processes.

Supply Chain Event Management (SCEM) is an application that supports control processes for managing events within and between companies. It consists of a set of integrated software functionality that supports five business processes: monitor, notify, simulate, control and measure supply chain activities.

Systems and Applications related to Transportation Process

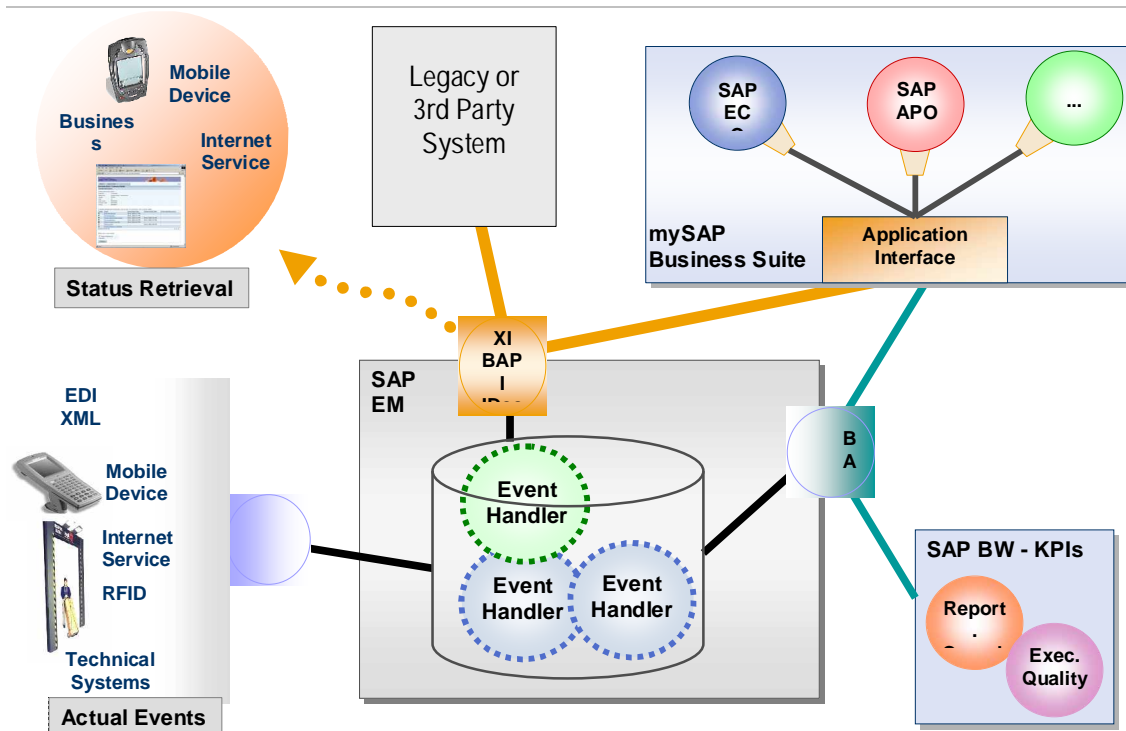


Figure 10: SAP Event Management – Architectural Landscape

Source: SAP SCEM Documentation

SCEM can be integrated with SAP system or any Legacy or 3rd Party System. It consist event handlers which take events from the tracking systems and alerts respective system and finally these events information and messages from tracking systems which are generated in the process run are then uploaded to SAP BW (Business Warehouse) for analysis purpose, here KPIs (Key Performance Indicators), related to this application are developed. These KPIs are useful in analysing and improving the business processes and these KPIs are based on Visibility Scenarios available in SCEM. [SAP SCEM]

4.2.1 Visibility Scenario

The Transportation visibility process covers transportation and customs issues for inbound and outbound processes. This means that the definition is rather generic and can be used for both types of processes. Since international sea shipments play a large role, the visibility process concentrates mainly on transportation chains for the sea process and on collective shipment roads.

The Transportation visibility process demonstrates the following functions:

- Monitor and control the transportation process
- Actively track the delivery (customer)
- Report events, both within the company and also by business partners
- Notify the business partners involved in the process
- Trigger follow-up activities
- Analyze the business processes in the SAP Business Information Warehouse

Two sub-processes are considered in the visibility process

- International Road Shipment and
- International Sea Shipment

Although these are independent from one another, they can be combined. While the road shipment is based upon a single shipment, the sea shipment is mapped using transportation chain that consists of a preliminary leg, a main leg, and a subsequent leg. If on the other hand you work with the sea shipment, you should consider both processes.

In the following section, both sub-processes will be described in greater detail from the business perspective.

International Road Shipment

The international road shipment describes a collective shipment. In many cases it consists of several inbound or outbound deliveries that are to be collected from or delivered to various locations. The following graphic shows this.



Figure 11: Route diagram from Location 1 to Location 3

Source: SAP TP/VS Course material

International Sea Shipment

The international sea shipment describes a transportation chain that consists of at least three legs. The following graphic shows a transportation chain with

- 2 preliminary legs that transport the deliveries to the port of departure (road).
- A main leg that transports the deliveries by sea
- 3 subsequent legs that transport the deliveries from the destination harbour to the respective recipients (road)

Each leg contains several deliveries. The road shipments that have already been mentioned are used to map the preliminary and subsequent legs. The advantage of this is that you can reuse the processes that you have already defined in the road shipment for the transportation chain. Road shipments, preliminary legs, and subsequent legs only differ in their shipment type.

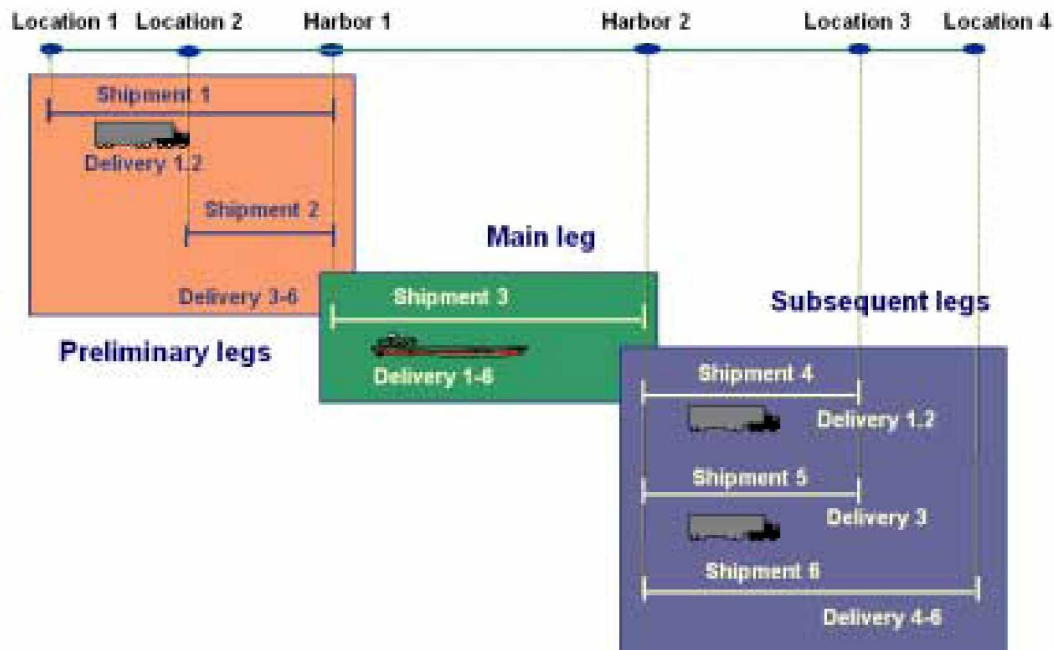


Figure 12: Flow of Shipment between different Transportation legs

Source: SAP TP/VS Course material

4.2.2 Analyzing the Scenario in SAP BW

SAP EM contains an interface to SAP BW as part of analytical SCEM. Data that is collected from various sources within operational SCEM is transferred from SAP EM to SAP BW after the business process has been completed. This information can then be used to evaluate Key Performance Indicators (KPIs) and/or indicators that measure collaboration between partners (CPIs).

In the case of the Transportation visibility process, the sea shipment is used as an example of analyzing data in SAP BW. The following evaluations are available in BW Content:

- Adherence to the planned duration of the entire shipment (transportation chain)
- Adherence to the planned durations for preliminary, main, and subsequent legs
- Duration of customs processing
- Arrival of customs documents [SAP SCEM]

4.3 BW (Business Information Warehouse)

The SAP BW Meta Data Services components provide both an integrated Meta Data Repository where all Meta data is stored and a Meta Data Manager that handles all requests for retrieving, adding, changing, or deleting Meta data. The Meta Data Repository is integrated into the Administrator Workbench, with a list of all Meta data objects available there. Figure 13 shows the layered architectural structure and components of SAP BW. The SAP BW architecture can be divided into five main layers.

- Administration
- Extraction, Loading and transformation services
- Data Storage and Management
- Analysis and Access Services
- Presentation

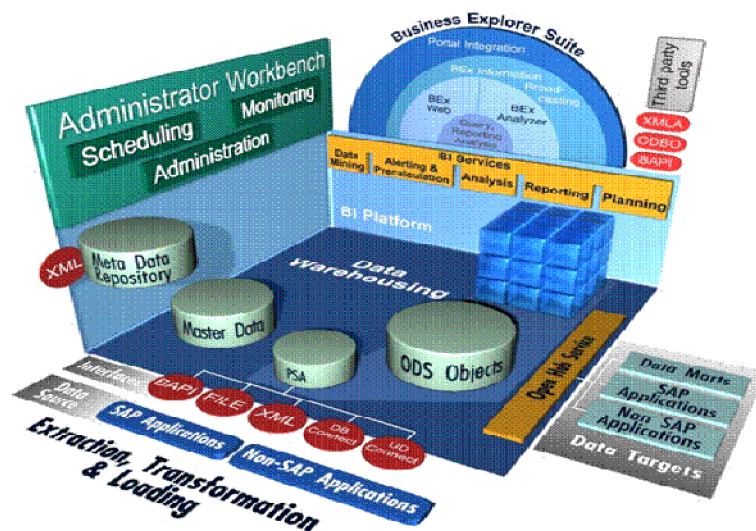


Figure 13: SAP BW Architecture

Source: SAP Help Portal, 2005

As BW is a vast subject, here only selected sub-topics which are related to the implementation of this Thesis are discussed here.

4.3.1 Extraction, Transformation and Loading Services

The extraction, transformation, and loading (ETL) services layer of the SAP BW architecture includes services for data extraction, data transformation, and loading of data and serves as a staging area for intermediate data storage for quality assurance purposes. [McDonald et al]. The core part of the ETL services of SAP BW is the staging Engine, which manages the staging process for all the data received from several types of source systems and is supported by the Data Source Manager. The Data Source Manager manages the definitions of the different sources of data known to the SAP BW system and supports five different types of interface which include BAPI, File Interface, XML interface, DB connect interface and UD connect interface.

Systems and Applications related to Transportation Process

Depending on the source systems and the type of data basis, the process of loading data into the SAP BW is technically supported in different ways. In the conception phase, the system firstly needs to detect the different data sources in order to be able to transform the data with the suitable tool afterwards. [BW310 2005] The following figure 14 gives a brief overview of the ETL process in SAP BW.

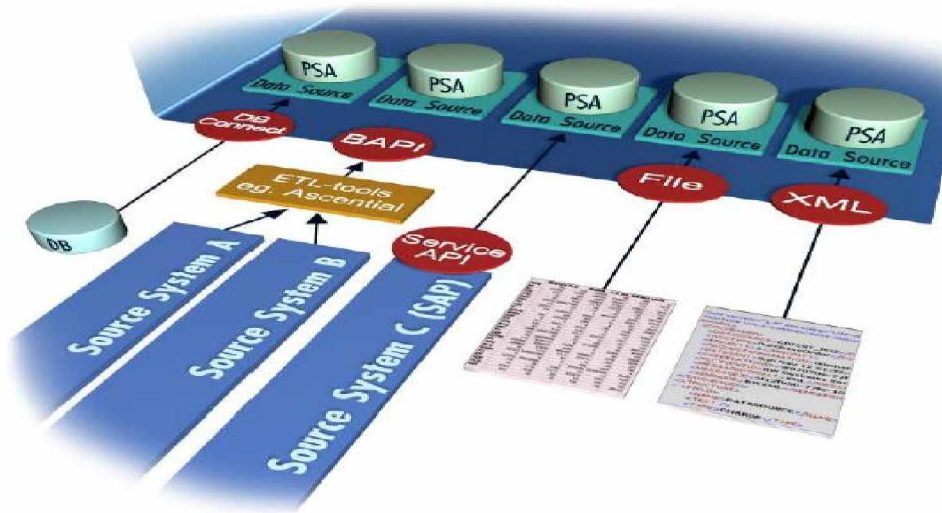


Figure 14: ETL: Extraction, Transformation and Loading in SAP BW

Source: SAPCOURSE, BW310

4.3.2 Data Storage and Management

Data storage is based on an intelligent combination of InfoCubes (information data models) and master data that enriches the depth of knowledge available while ensuring high performance. Master data comprises non-volatile information on typical attributes for customers, companies, suppliers, etc. This can mean addresses, Regions or categories. Often this is drawn directly from R/3 applications, cutting down on maintenance and providing a perspective many other data warehouses simply cannot emulate. InfoCubes are the basis for multidimensional views. They comprise dimensions such as time, geographic region or product type, and key figures, i.e. actual volumes or quantities. A large number of prefabricated Info- Cubes are provided with the BW, allowing to begin exploring data immediately without having to spend time building InfoCubes. In addition, the InfoCubes can be modified or defined, as new needs arise.

Info Cubes provide a flexible means of aggregating data in accordance with one's needs. Many InfoCubes are pre-defined, reducing the time required to set up your warehouse. Aggregation mechanism is completely transparent to the end-user, and is designed to ensure high performance and zero down-time. Hierarchies are external to the InfoCubes, and therefore extremely flexible. Changes to the structure of your business are easy to model, and you can view data according to new or old structures without having to completely re-align that data. [McDonald et al.]

Systems and Applications related to Transportation Process

4.3.3 Presentation Services

As a top layer in the SAP BW architecture, the Business Explorer (BEx) serves as the reporting environment for the end users. It consists of the BEx Analyzer, BEx Query Designer, BEx Web Application Designer, BEx Browser, BEx Formatted Reporting etc. The Presentation Layer includes all components required to present information available on the SAP BW server in the traditional Microsoft Excel-based business Explorer Analyzer (BEx Analyzer), in the BEx Web environment, or third party applications.

The Business Explorer allows a large spectrum of user's access to the information in SAP BW. Using the Enterprise Portal (for example, through an iView that can call up alongside the applications from which the data is extracted), using the Internet (Web Application Design) or using mobile devices (WAP or iMode-enabled mobile telephones, Personal Digital Assistants). [BW305] The Business Explorer (BEx) component provides users with extensive analysis options.

The SAP BW presents information in a user-friendly, easy-to-understand fashion. It comes complete with a wide variety of standard reports that can be accessed with the click of a mouse; allowing knowledge workers to utilize the facts and figures stored in BW from the word go. Standard reports are supplied for the needs of particular departments, such as human resources, of particular industries, such as manufacturing, and even for individual roles, such as account managers, product managers, regional managers or financial controllers. Reports can also be adapted or custom-designed, or used to initiate ad-hoc queries with new parameters. Figure 15 shows the Web Application Framework in SAP BW Presentation Layer.

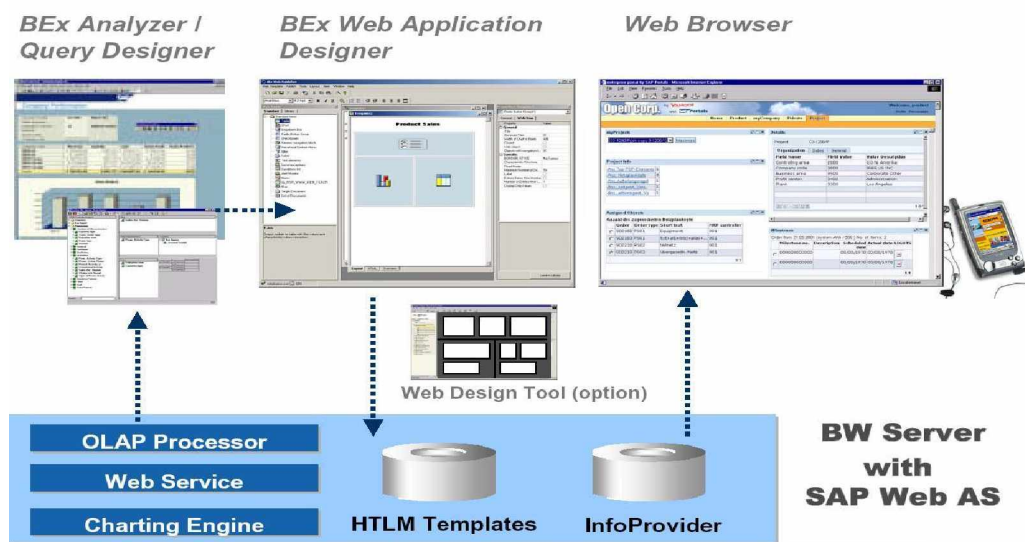


Figure 15: Web Application Framework

Source: SAP Help Portal, 2005

4.4 SCOR model

The Supply-Chain Operations Reference-model (SCOR) is the product of the Supply-Chain Council (SCC), an independent, not-for-profit, global corporation with membership open to all companies and organizations interested in applying and advancing the state-of-the-art in supply-chain management systems and practices. The SCOR-model captures the Council's consensus view of supply chain management. While much of the underlying content of the Model has been used by practitioners for many years, the SCOR-model provides a unique framework that links business process, metrics, best practices and technology features into a unified structure to support communication among supply chain partners and to improve the effectiveness of supply chain management and related supply chain improvement activities. [Supply-Chain 2005]

The SCOR-model has been developed to describe the business activities associated with all phases of satisfying a customer's demand. The Model itself contains several sections and is organized around the five primary management processes of Plan, Source, Make, Deliver, and Return. By describing supply chains using these process building blocks, the Model can be used to describe supply chains that are very simple or very complex using a common set of definitions. As a result, disparate industries can be linked to describe the depth and breadth of virtually any supply chain.

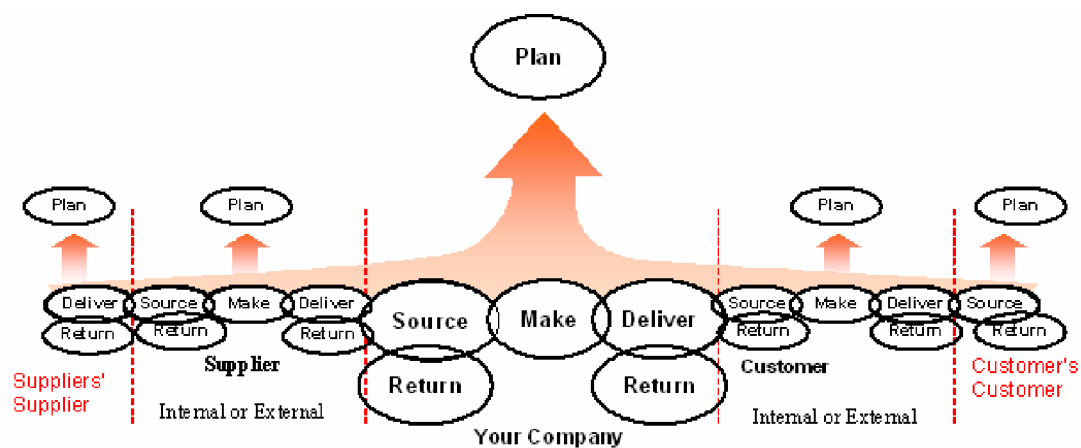


Figure 16: SCOR Model

Source: Supply Chain Council

It will also be worthy of note that the SAP SCM have satisfied many KPIs as stipulated in SCOR requirement as regards 'Performance Management', amongst others.

In this Thesis Paper, some KPIs of SCOR model which are not present in SAP SCM are used and added to the Business Content of SCM. The details of these KPIs are mentioned in the coming Chapters.

5 Transportation process end to end Scenario

The end to end scenario of Transportation process is explained using Aris diagrams, because everybody can clearly understand the flow of the process, triggering events, final events and also systems and applications helping the process to flow smoothly. These diagrams explain how the Transportation process is carried out using SAP systems and applications.

5.1 Processes

The different processes of Transportation process are:

Inbound and Outbound delivery

As said before in the Transportation process overview, Transportation process starts with creation of shipments, and these shipments are based on inbound and outbound deliveries.

In the Figure 17: Inbound and Outbound delivery Aris diagram below, Inbound delivery is created with reference to purchase order, which is created in MM (Materials Management) system, and outbound delivery is created with reference to sales order, which is created in SD (Sales and Distribution) system. Then shipment processing takes place in LE (Logistics execution) system, the main task is to combine inbound and outbound deliveries and sort it for shipment creation. When deliveries may be inbound or outbound are relevant for shipment, then creation of shipments and other transportation planning and execution things are carried through Transportation process (details about Transportation process are explained below). Then shipment costs settlement takes place after the shipments are planned and later invoice verification for inbound delivery or billing for outbound delivery ends the total Transportation process.

Transportation process

As explained above, deliveries (inbound or outbound) which are relevant for shipment are combined together and then transportation planning process takes care of these deliveries. (See Figure 18: Transportation process Aris diagram below) Shipments are created first and later planned how the execution of transportation process should take place. Then Transportation execution process takes place, here the actual movement of goods from sender to the destination point are carried out. Transportation Monitoring and Controlling process acts like a supportive process or as a monitoring process for Transportation planning and Transportation Execution processes, this process will not start before or after planning and execution processes but starts along with them, helps them in performing their duties effectively and also sometimes suggests for re-planning too (Transportation planning and Transportation monitoring and controlling processes are explained below). Later Shipment costs settlement takes place either by billing (for outbound) or by invoice verification (for inbound).

Transportation Process end to end Scenario

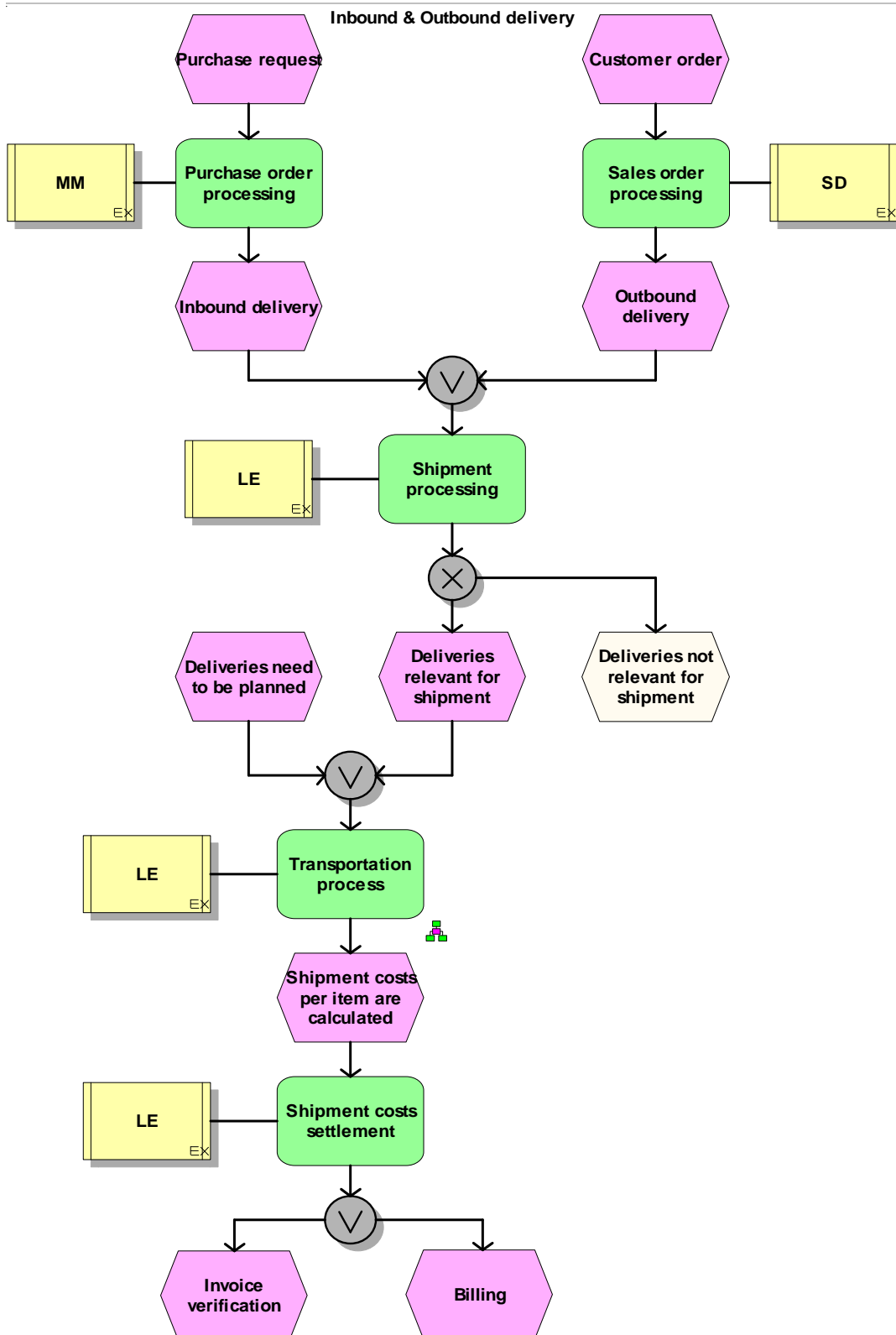


Figure 17: “Inbound and Outbound delivery “Aris diagram

Transportation Process end to end Scenario

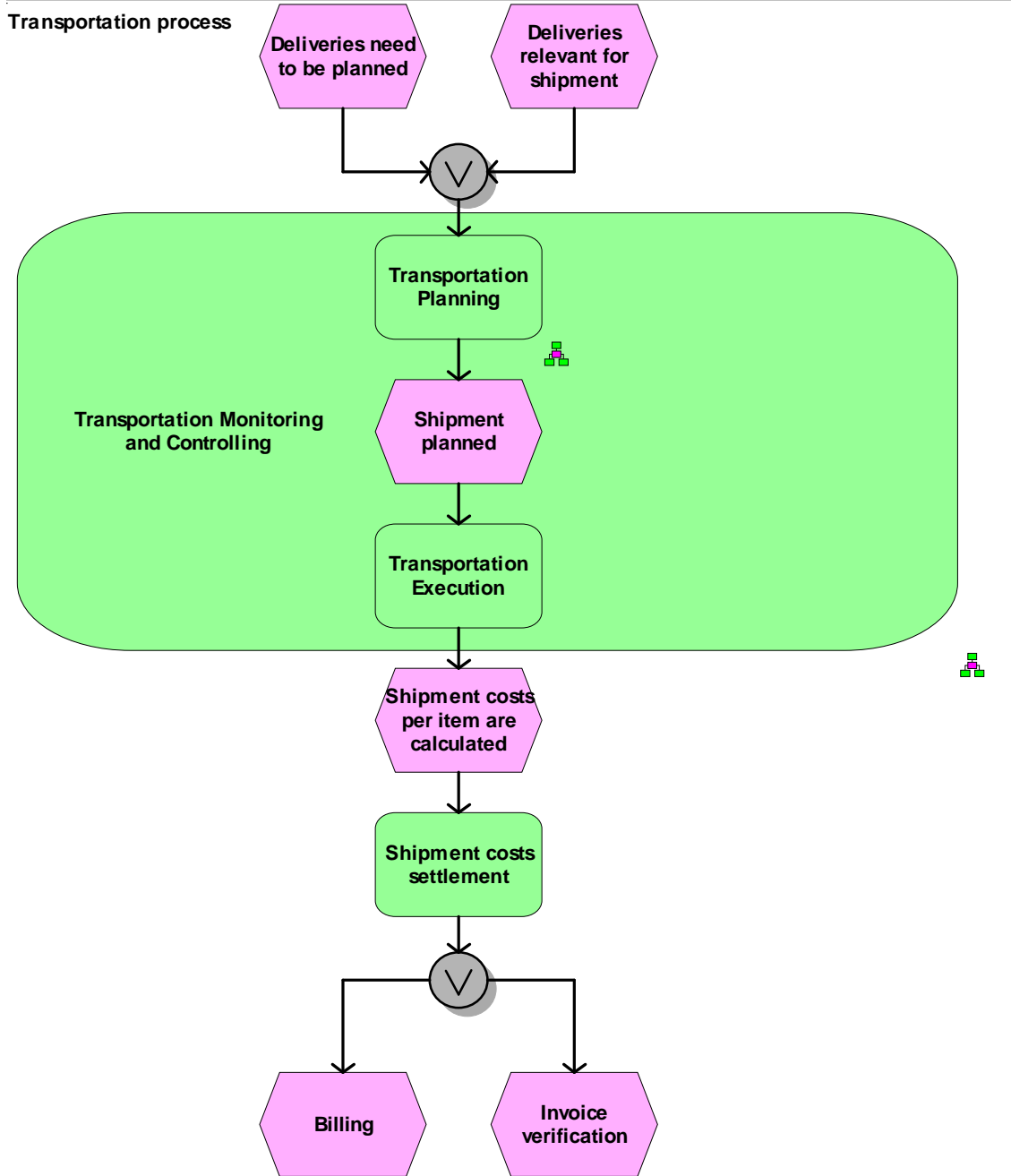


Figure 18: "Transportation Process "Aris diagram

Transportation Process end to end Scenario

Transportation planning process:

Transportation planning process has many functions, and all these functions must be carried out efficiently to make the process run smoothly (See the Figure 19: Transportation planning functionalities Aris diagram). Some of the important functions are Grouping of inbound and outbound deliveries, Carrier Selection, Leg determination, Freight costs estimation and Shipment tendering.

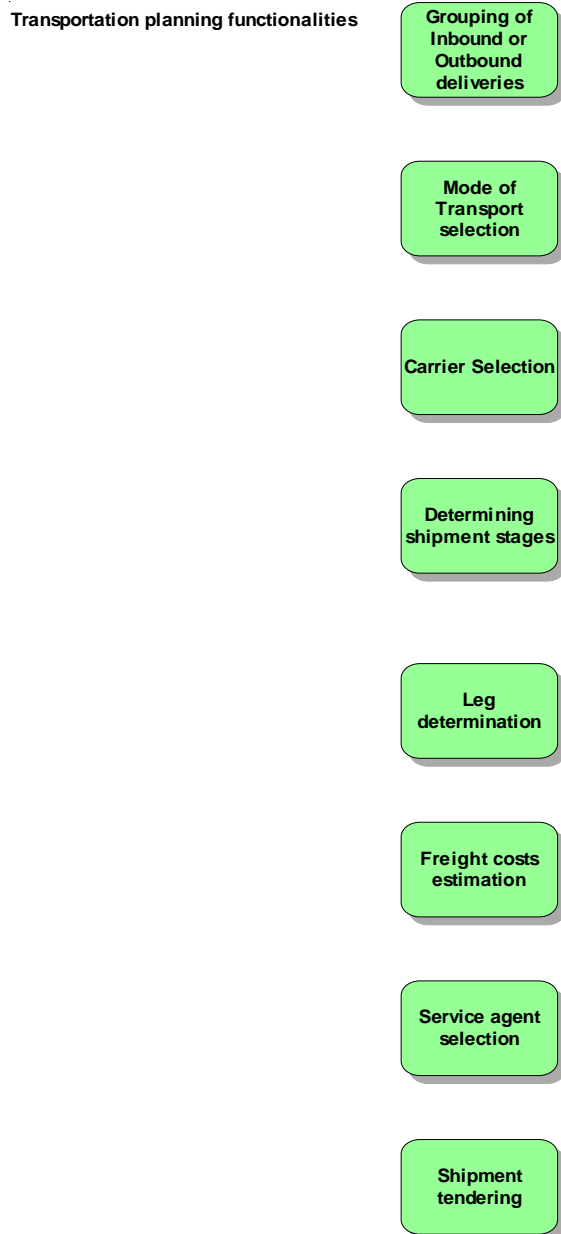


Figure 19: “Transportation Planning Functionalities “Aris diagram

Transportation Process end to end Scenario

Transportation Monitoring and controlling process:

As explained above, this process acts as a supportive process for planning and execution processes and has following functions (see figure 20: Transportation Monitoring and Controlling Process Aris diagram). Its main task is to monitor the shipment process, see that all shipments are planned efficiently, if not propose for re-planning and also monitor and control shipment tendering process. Controlling shipment is the main important function which is explained in detail through Aris diagrams later.

After the completion of the total Transportation process, the information which is generated during the process is collected and used for analyzing the process, and this helps in taking effective planning methods and decisions in the future.

Transportation monitoring and controlling functionalities

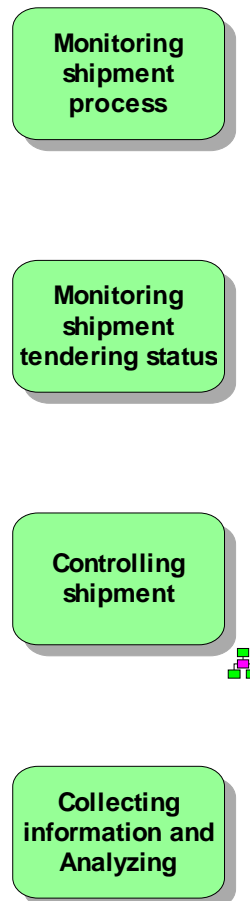


Figure 20: “Transportation Monitoring and Controlling Process” Aris diagram

Controlling Shipment:

This is the main important function in Transportation monitoring and controlling process and has many sub-functions, here the Figure 21: Controlling Shipment Aris diagram (part 1) and Figure 22: Controlling Shipment Aris diagram (part 2) explains a scenario covering all these sub-functions of controlling shipment function.

The scenario starts with alerts received (may be goods missing or damaged or Truck delay) from various sources like Internet, mobile devices etc... (See Figure 21) and these alerts are handled by the Transportation Controller role (see Transportation roles chapter for description) in Supply Chain Event Management (SCEM) system. According to the alerts he can forward these alerts to the respective departments or trigger some follow up activities or he can reschedule the Transportation process (in this scenario this option is considered), so he reschedules the process and here he can figure it out, whether the goods are already available in the plant warehouse, where he can use for production for time being or else he need to arrange a special/express delivery to get those goods from the supplier. If special/express delivery is required then he needs to create first the order and try to mix it with other orders, create a shipment and do shipment planning once again. This shipment planning can be taken by Transportation Planner role or by Transportation Controller role or may be by both, and this process is carried out in Transportation planning system. Here once again all the Transportation planning functions are carried out and Carrier Selection is one of the functions where a selection for Forwarding agent/Transport agent is carried out. In this process (See Figure 22) the same Transport agent who has carried the transport can accept or supplier itself arranges a Transport agent or a new Transport agent is required (in this scenario this option is considered). In this case a Re-tendering process (This process is explained in detail later) is required to select the new Transport agent/Forwarding agent, and this ends the Transportation planning process and later Transportation execution process is carried out by Transportation execution team and goods received by the plant and shipment cost settlement completes the whole scenario.

This whole scenario and these sub-functions in this controlling shipment function may not occur regularly. If the Transportation planning process is carried out efficiently then these kind of situations can be reduced, but sometimes some exceptional cases like Truck accidents, Goods damaged during transport, Truck delays etc... may occur and this function with the whole scenario is very much useful. This function uses the latest systems and applications to manage these things efficiently.

This function also points out some things that should be taken care in the initial stages itself, like planning for good packaging material may stop the exceptional cases like "Goods damaged during transport" etc..., like this, this function is also very useful to analyze the situation and try to overcome them in the future.

Transportation Process end to end Scenario

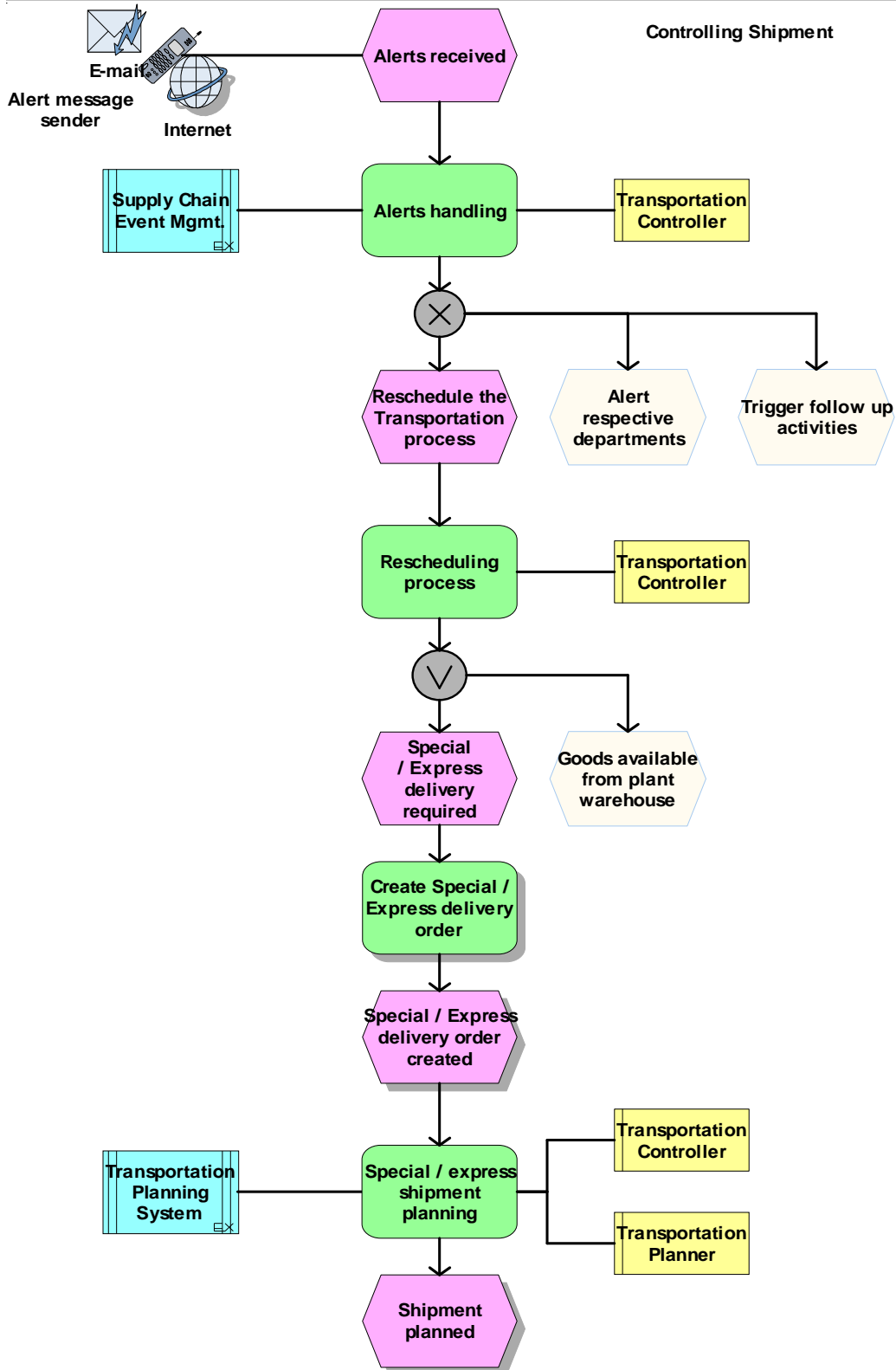


Figure 21: “Controlling Shipment” Aris diagram (Part 1)

Transportation Process end to end Scenario

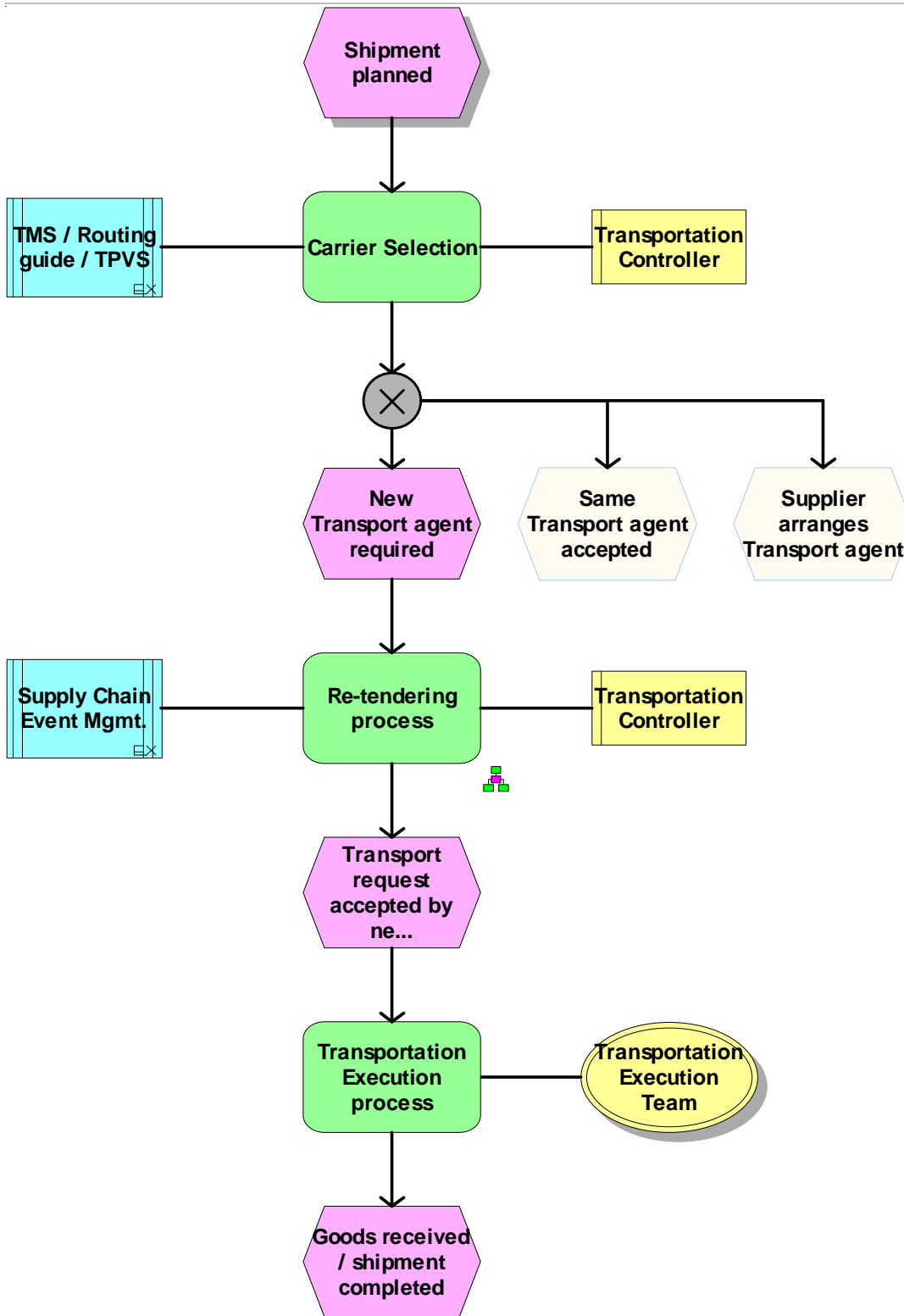


Figure 22: "Controlling Shipment" Aris diagram (Part 2)

5.2 Re-tendering process

As explained above, Re-tendering process is one of the sub-functions of controlling shipment function, where tendering for Transport agent/ Forwarding agent take place.

In the below figure 23: Re-Tendering process Aris diagram, this process starts when there is once again a requirement of Forwarding agent (This process can also be used for normal Tendering process). Then selection of best forwarding agent is carried out, this function selects the best forwarding agent, who can take up this task efficiently by analyzing his previous experience with the company (Details of selection process is explained below). After selecting the best forwarding agent, the actual tendering process starts in this case re-tendering process, here a transport request is sent to the selected best forwarding agent by Transportation Controller using SCEM system. From here a new dynamic process is introduced to reduce the time taken by sending the requests and receiving the acknowledgments from the forwarding agent.

According to this dynamic process, the transport request acceptance time of each forwarding agent is noted before sending the request itself, i.e. time taken by the forwarding agent to accept a transport request sent by the planner or controller (Detailed description of acceptance time is explained later). This acceptance time is also one of the criteria to select the best forwarding agent. Then the transport request is sent to the selected best forwarding agent, here when the agent rejects the request or the time allotted to accept the request expires then this transport request is automatically sent to the next best forwarding agent. This kind of automatic re-send to the next forwarding agent takes place for 2-3 times, if one of them has accepted then the shipment responsibility is given to him, but if no body has accepted then finally the transport request is automatically broadcasted to the remaining all forwarding agents, then there will be a chance that at least one of the forwarding agent accepts the request. Then an acknowledgement is sent to the remaining forwarding agents to intimate the acceptance of this transport request by so and so forwarding agent, only to terminate the re-tendering process with other agents. Once the transport request has been accepted by the agent, the normal transportation execution process takes place followed by Shipment costs settlement.

In this way the new dynamic re-tendering process functions, basically this is the best way when there are more forwarding agents that to be considered and when the contact time is less. With this dynamic automatic process, lot of time invested in the tendering process is reduced and used for the actual transportation process.

This process is usually more useful for the re-tendering process then normal tendering process because re-tendering process occurs only in emergency and special cases and in these cases the transportation time is short, so the planner or controller should be quick in selecting and confirming the forwarding agent, and this dynamic re-tendering process fits best to the needs of them.

Note: This process is not yet implemented in the SCEM system, but through this thesis I propose the process to be implemented in near future.

Transportation Process end to end Scenario

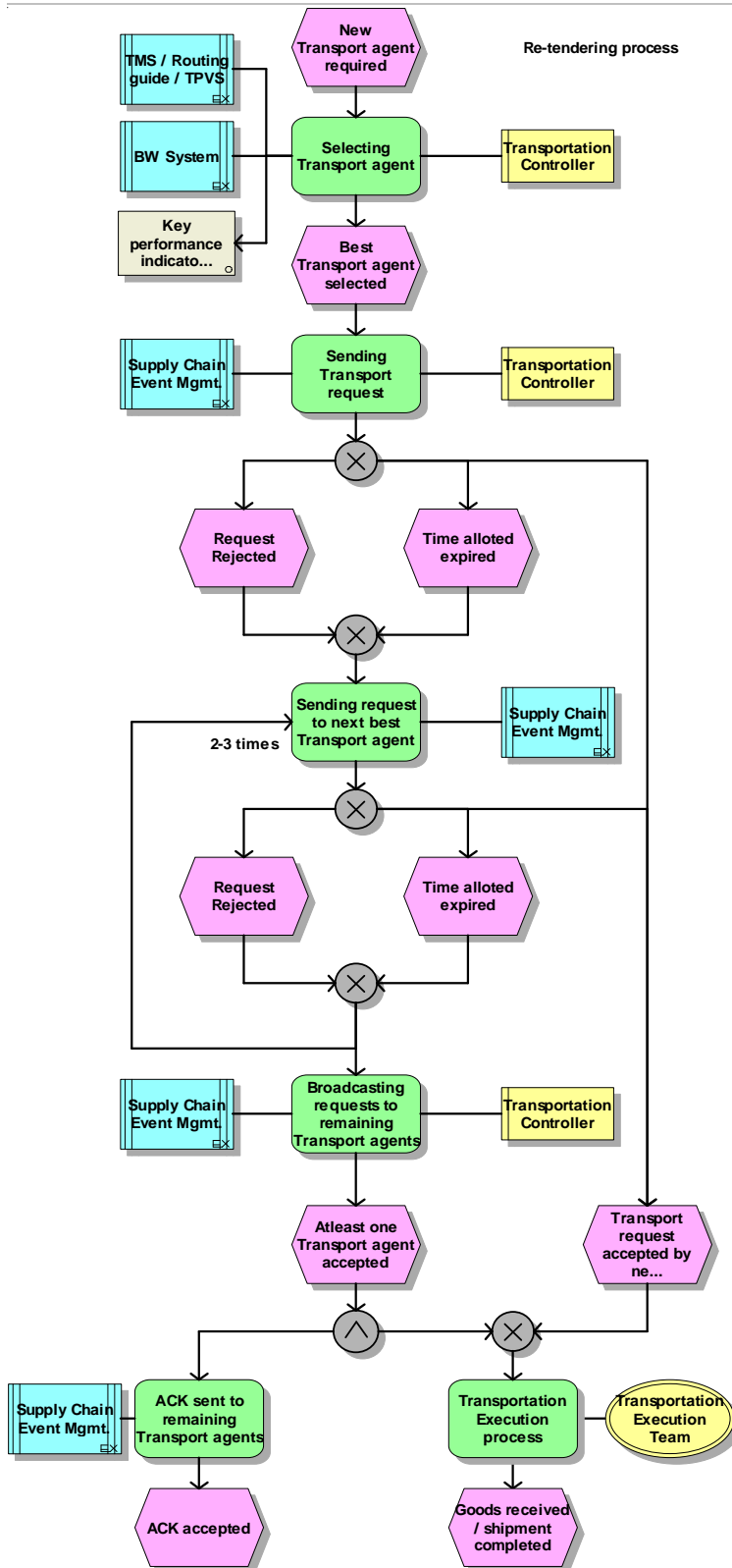


Figure 23: "Re-Tendering Process" Aris diagram

5.3 Requirements

The re-tendering process functions effectively only when the planner or controller identify the best forwarding agent quickly and see that there are fewer automatic re-sent. Then the transport request confirmation process takes less time, and this saved time is utilized to send the material quickly to the destination point. In order to identify the best forwarding agent planner or controller should check the previous experience data of the agent and also the data present in the agent's contract. This data of the forwarding agent needs to be in a structured and sorted way, and then only they can take up the decisions quickly. Also all the information should be categorized into different performance indicators and depending on these indicators selection process is done. These indicators are generally termed as KPIs (Key Performance Indicators) and it is easier for the planner or controller to judge the agent and select him depending on these indicators.

Different KPIs which tell the performance of the agent, relationship with the company, budget etc... are needed for the selection process. Here in the above scenario, the Controller has to judge different forwarding agents based on his requirements, he need to get answers to the questions like-

- Which forwarding agent accepts the tender quickly?
- Which forwarding agent is accepting more tenders?
- How many times the tender request has been re-sent to different agents?
- Which forwarding agent has more Business Share in this period?
- Which forwarding agent is rejecting the tenders more frequently?
- Which forwarding agent can deliver the goods to the destination point quickly and more efficiently, especially damage free delivery?
- Which forwarding agent has taken up more shipments in this period?
- What is the total budget for transportation in this period?
- How many shipments are being delivered in this period?
- What is the average difference between planned and actual transportation time?
- Who is the most expensive agent and why?
- How are the freight costs in this period?
- What is the average difference between the planned and actual budget?

To answer these questions, the controller needs the KPIs which give information on all these things, and these KPIs should be arranged in a systematic and sorted way, so that it is easier for him to get the answers from them.

Requirements form SAP point of view

These KPIs are systematically arranged in InfoCubes, through interfaces data is uploaded to these InfoCubes i.e. to the KPIs and Characteristics. Based on the InfoCubes, Queries are defined and the view of the KPIs depends on how these queries are defined. By this a single KPI can be viewed into different dimensions and into different categories, and also used to compare with other KPIs. The output of these queries can also be viewed on Web and here i.e. at the run time of the query too, KPIs can be re-organized, to view them into different dimensions and categories and finally take decisions.

6 Analysis

In this Analysis phase, the KPIs and Characteristics are identified, selected, defined and arrangements for development are made.

Note: In Oct 2005, SAP is releasing the product "SAP Analytics" i.e. the Visual Composer tool and with the help of SAP Analytics these KPIs can be arranged more systematically and the information can be obtained dynamically, because the data not only comes from the BW (Historical data) but also from other SAP systems and other backend systems too where present data is present (See the detail explanation of SAP Analytics and Visual Composer in 3.4 chapter).

6.1 KPIs

As explained above KPIs which measure the performance of the forwarding agent are needed to get answers for the above mentioned questions, and to organize these KPIs, Characteristics (See below for explanation of Characteristics) are needed, because a KPI alone will not exist, it need to have a relationship with a Characteristic. From SAP point of View these KPIs and Characteristics are present in BW, if some of the needed KPIs and Characteristics are not present in BW, then they should be identified, developed and assigned to InfoCubes, later with the help of interfaces data is uploaded to them.

According to the Re-tendering process, at the time of Selection process, KPIs related to the performance of Forwarding agent is required, so the KPIs which satisfy these requirements are identified and searched in latest version of BW to check whether all the required KPIs are present in BW.

6.1.1 KPIs present in BW

The KPIs which are related to the Transportation process are categorized into different sub-processes (See the Appendix A to view all the KPIs of Transportation process as of BW 3.5 Business Content).

After a long searching and selection process, these Transportation process related KPIs are identified, but still some KPIs related to the Forwarding agent selection process are not present in BW 3.5 (latest version of 2005) Business Content. So they need to be developed in BW and later if needed (or approved by the officials) should be added to the next release of BW Business Content version.

Note: All KPIs and Characteristics which satisfy the requirements of different processes, which are commonly used by different business people are identified and developed in BW. These common KPIs and Characteristics are then later shipped to the SAP BW customers as Business Content, the customers may use these KPIs and Characteristics onto their business processes or they can define their own, based on these.

6.1.2 Newly proposed key figures:

According to the requirements mentioned above KPIs are identified, and after going through the Business Content of BW, the KPIs already present in BW are not satisfying most of the requirements, so there is a need for new KPIs. First the new KPIs should be defined and later development should take place. At the end these KPIs together with already present KPIs in BW, should be combined and used for analysis purpose.

These are the newly proposed KPIs (Key figures), which are needed to satisfy the requirements of the forwarding agent selection process

- % of Qualified Suppliers / Transport Agents which Meet Defined Requirements (Requirements Analysis)
- Planned Business Share (%)
- Actual Business Share (%)
- No. of Tenders
- Tender Acceptance Rate (%)
- Tender Acceptance Time
- No. of Iterations per Shipment
- Freight costs Index (%)
- Transport Time Efficiency (%)
- Damage Free Goods (%)
- Mode of Transport Efficiency (%) (Ex. Truck)

These are the KPIs which are useful to select the best forwarding agent and according to the above mentioned scenario of Re-tendering process, these KPIs satisfies the needs of the selection process along with the KPIs already existing in BW.

Here only Selection process of Forwarding agent is considered to generate these new KPIs, because this process occurs frequently in a Transportation process. First in the normal tendering process, where the planner should select a forwarding agent for the carrier, and next when there is a delay, or in emergency cases, the planner or controller should once again select a forwarding agent and do the tendering stuff (here it is called Re-tendering process), and it may also happen that the goods arrived are found damaged, and a special journey is planned to get these goods, and here also selection process of Forwarding agent is required to select the best forwarding agent who has experience in carrying these special or emergency journeys.

So considering all these things, the thesis paper is concentrated only on this process of the Transportation process.

These are the definitions and descriptions of each newly proposed KPI for this Re-tendering process.

KPI: % of Qualified Forwarding Agents which Meet Defined Requirements (Requirements Analysis)

Definition: The number of qualified Forwarding Agents who meet defined requirements divided by the total number of qualified Forwarding Agents used as sources in the measurement period.

Formula: Calculated based on grades, given to each requirement KPI.

Dimension: Products, Region (Location), Shipping point, Route, Mode of Transport, and Time dimensions.

Description: This KPI or Query measures the total performance of a Forwarding Agent and sorts them in ascending order like best Forwarding agent first (for this grades are given to each requirement, so that it is calculated automatically, customers can change these grades according to their company requirements by customizing. Grades are also based on agreed upon rules and contracts mostly for the new Forwarding agents where they don't have previous experience with the company but are selected because of the agreement).

Explanation:

Why: In order to get goods at required time and with competitive price, we need to contact the right Forwarding Agent who can provide the respective goods in the right quantity, right quality, and right time and with affordable price. So this KPI provides the chance to choose the right and best Forwarding Agent who can meet all the requirements defined by the company.

Where: Mostly it is used at the time of Tendering Process, where we need to choose the best Forwarding Agent in the Transportation planning process. But it is more useful at the time of Re-tendering process where the available time to contact the Forwarding Agent is less and we need the information of the best immediately.

Useful to: Transportation Analyst while analyzing the Performances
Transportation Planner while doing the Tendering Process
Transportation Controller while doing the Re-tendering process
Transportation Manager in decision making

Actions taken:

Planner and Controller: According to the value given by this KPI or Query, contact the best Forwarding agent first and when it is not possible with him then contact the next best one.

Manager: To continue the contract or to give warning message to them or to issue penalties or finally cancel the contract when the Forwarding Agent Performance is continuously worse.

KPI: Mode of Transport Efficiency (%) (Ex. Truck)

Definition: The average efficiency of a Truck carrying Weight and Volume (Compared to maximum capacity of a Truck), divided by the total no. of Trucks used as sources in the measurement period.

Formula: Actual capacity of a truck / Maximum Capacity of a truck.

Dimension: Region (Location), Shipment no., Time dimensions, Supplier, Transport agent, Shipping Point, and Route.

Description: This KPI can be treated as one of the requirements in Selecting Forwarding Agents. (As an example, Truck no. "HD J1234" which is part of this shipment no. "S0234", which came through this Forwarding agent "Mueller KG" and which has goods like "Truck engines" from these Suppliers traveled to these centers of this particular plant, carried 762 kg and 5,6 m³ weight and volume, compared to the max. Weight 900 kg and volume 8 m³ of a Truck gives the % of efficiency as 84% of this truck, when only weight is compared). Comparison of capacities are dependent on the Planner, he can consider Weight or Volume or both.

Explanation:

Why: Analyzing the history is an important process, which is useful for the future decision making process. So to know the efficiency of planning and controlling and to know the efficiency of the total transportation process (here about the Truck), this KPI is useful. Sometimes it happens that Truck's volume is not full, but it reached its maximum weight capacity and it may happen in the other way also, so this Volume and weight efficiency makes the planner to choose the right Truck, and goods for that specific Truck.

Where: Mostly it is used at the time of Carrier Selection and Tendering Process, because this also tells the efficiency of Forwarding Agents like, this particular Forwarding agent used the mode of transport efficiently and this one not as expected. And also while selecting the type of truck for these kinds of goods.

Useful to: Transportation Analyst while analyzing the efficiency
Transportation Planner while doing the Tendering Process and Carrier Selection
Transportation Controller while doing the Re-tendering process
Transportation Manager in decision making

Actions taken:

Planner and Controller: According to the value given by this KPI, contact the best Forwarding agent first and when it is not possible with him then contact the next best one. To choose an appropriate Truck, that can accommodate the goods more efficiently.

Manager: To continue the contract or to give warning message to them or to issue penalties or finally cancel the contract when their efficiency is continuously worse.

KPI: Transport Time Efficiency (%)

Definition: The average efficiency of delivering the Goods in time by the Forwarding Agent (Compared with the Planned Transport time) used as sources in the measurement period.

Formula: Actual total transportation time / Planned total transportation time.

Dimension: Region (Location), Shipment no., Time dimensions, Shipping point, Route, Transport Mode and Forwarding Agent.

Description: This KPI gathers the fundamental information of Total Transport time i.e. Time taken by a Forwarding agent to deliver the goods to the destination point including the waiting time and then comparing it with the Total Planned Transport time. Before the actual Transportation process, the Transport time is planned, and after the Transportation process, this Planned Transport Time is compared with Actual Transport Time.

Explanation:

Why: Analyzing the history is an important Process, by which we can improve the Process in the future. So to know the Transport time efficiency, we need this KPI. This KPI is useful to observe the Time taken by the Forwarding Agents in delivering the Goods and according to the value given by this KPI select only the one's who can deliver the Goods more efficiently.

Where: Mostly it is used at the time of Tendering Process and Carrier Selection process, where we need to choose the best Forwarding Agent in the Transportation planning process. But it is more useful at the time of Re-tendering process where the available time to contact the Forwarding Agent is less and we need the information of the best immediately.

Useful to: Transportation Analyst while analyzing the efficiency
Transportation Planner while doing the Tendering Process and Carrier Selection
Transportation Controller while doing the Re-tendering process
Transportation Manager in decision making

Actions taken:

Analyst: Analyze the KPI, and submit the report to the respective Planner and Controller and also to the Manager. Alert the respective members when some drastic changes are identified.

Planner and Controller: According to the value given by this KPI, select the Forwarding Agent who can deliver the Goods in time.

Manager: To continue the contract or to give warning message to them or to issue penalties or finally cancel the contract when their efficiency is continuously worse.

KPI: Tender Acceptance Time

Definition: The average time taken by a Forwarding Agent to accept a Transport Tender divided by the total no. of Forwarding Agents accepting time used as sources in the measurement period.

Formula: Difference of Tender sent time and Tender response received time.

Dimension: Shipment no., Time dimensions, Shipping Point, Region, Route, Transport Mode and Forwarding Agent.

Description: Used at the time of Tendering and mainly at Re-Tendering process, to check the availability of a Forwarding agent who can accept the Tender quickly and to check whether his acceptance time is within our available time for selecting a Forwarding Agent. The Tendering process and mainly the Re-tendering process can be automated with the availability of this KPI.

Explanation:

Why: In the process of selecting Forwarding agents, this KPI is very much useful which saves time. As the Planner knows the time taken by a Forwarding Agent before itself, he will not waste time waiting for his reply, whether he replies or not, that Tender is sent automatically to another Forwarding Agent when the time allotted (which is know from this KPI) for the first Forwarding agent expires and then this process continues until that Tender is accepted by one of the best Forwarding Agents. If none has accepted and the time for selecting a Forwarding Agent is less, then the Planner broadcasts this Tender to the remaining all Forwarding Agents and selects one out of them.

Where: Mostly it is used at the time of Tendering Process, where there is a need to choose a best Forwarding Agent who can also accept the Tenders within the time. But it is more useful at the time of Re-tendering process where the available time to contact the Forwarding Agent and settle the contract with him is less. So this information is needed to be more reactive and quick to the situation.

Useful to: Transportation Analyst in analyzing the time durations after collecting data from respective Tendering clerk
Transportation Planner while doing the Tendering Process
Transportation Controller while doing the Re-tendering process
Transportation Manager in decision making

Actions taken:

Planner and Controller: According to the value given by this KPI, contact the Forwarding agent who's time slot to accept the Tender is less and see that another Tender is generated automatically to another Forwarding Agent when the time slot of the first is about to expire and finally broadcast the Tenders to remaining Agents.

Manager: To continue the contract when his acceptance time and performance is better and cancel the contract when it is continuously worse.

KPI: Damage Free Goods (%)

Definition: Average of Undamaged goods that are transferred by a Forwarding Agent divided by total number of goods transferred by them used as sources in the measurement period.

Formula: No. of undamaged goods / Total no. of goods.

Dimension: Shipment no., Time dimensions, Transport Mode, Shipping Point, Route and Type of Goods.

Description: This KPI is useful in order to measure the performance of a Forwarding Agent, and also Goods / Products. This KPI tells the percentage of particular product delivered undamaged by a Forwarding agent using particular Transport Mode. And also the total percentage of all products delivered undamaged by this particular Forwarding Agent.

Explanation:

Why: Supply Chain follows the motto "Right Goods to Right Person in Right time", and there is add up to this motto "in Right quality and quantity". As quality and quantity are also important in today's Supply Chain, this KPI helps in measuring these criteria's. Ex. This KPI explains that these kinds of goods are found damaged using this Transport Mode, and then the Planner plans to send them through different Transport Mode, like wise this also tells whether this Forwarding Agent is taking precautionary measures in packaging or in delivering goods

Where: Mostly it is used at the time of Tendering process, but it is more useful at the time of Transport Mode, Packaging material and handling units' selection.

Useful to: Transportation Analyst in analyzing the Performances of Forwarding Agents and Goods
 Transportation Planner while doing the Tendering Process and Transport Mode, packaging material and handling units selection
 Transportation Controller while doing the Re-tendering process
 Transportation Manager in decision making

Actions taken:

Analyst: Analyze the KPI, and submit the report to the respective Planner and Controller and also to the Manager. Alert the respective members when some drastic changes are identified.

Planner and Controller: According to the value given by this KPI, contact the best Forwarding agent who can deliver the Goods with right quality and quantity. Plan for best packaging material and handling units and select appropriate Transport Mode required for these Goods.

Manager: To continue the contract or to give warning message to them or to issue penalties or finally cancel the contract. Take decisions on Packaging material and handling units for different kinds of goods with the support of Analyst and Planner.

KPI: Planned Business Share (%)

Definition: The average Business Share for each Forwarding Agent planned by the Transportation Planner for a particular time period divided by the Total no. of Forwarding Agents.

Formula: No. of Shipments a Forwarding agent can accept for a particular time period. The value comes directly from the APO system.

Dimension: Time dimensions, Region, Transport Mode, Shipping Point, Route.

Description: The Transportation Planner estimates the previous records of the Forwarding Agent acceptance rate and the total Business Share for this period and then assigns Business share accordingly. This Business Share is nothing but the no. of shipments, the planner can assign to this Forwarding Agent in this particular time period.

Explanation:

Why: With this KPI the Planner can easily estimate the acceptance rate of a Forwarding Agent, this act as a comparison KPI for Business Share along with Actual Business Share KPI.

Where: Mostly it is used to compare with the Actual Business Share KPI, at the time of planning the Business Share of a Forwarding Agent for a particular time period and also at the time of Tendering process, to select only the Forwarding Agent who still needs to fulfill his assigned Business Share.

Useful to: Transportation Analyst in analyzing the Total Business Share and individual Business Share per Forwarding Agent
 Transportation Planner while assigning Business Share and while doing Tendering process
 Transportation Controller while doing Re-tendering process and while adjusting the individual Business Share
 Transportation Manager while assigning the Total Business Share for a particular time period

Actions taken:

Analyst: Analyze the KPI, and submit the report to the respective Planner and Controller and also to the Manager. Alert the respective members when some drastic changes are identified.

Planner and Controller: Compare this KPI with the Actual Business Share KPI and assign new Business Share or adjust the Business Share of a Forwarding Agent for a particular time period. Also when one Forwarding Agent is not fulfilling his assigned Business Share, then allot his Business Share to another one who can accept more shipments for the same period.

Manager: To take decisions on Total Business Share for a particular time period.

KPI: Actual Business Share (%)

Definition: The average Business Share, actually fulfilled by each Forwarding Agent for a particular time period divided by the Total no. of Forwarding Agents.

Formula: Actual no. of shipments accepted / planned no. of shipments.

Dimension: Time dimensions, Region, Transport Mode, Shipping Point, Route.

Description: The Transportation Planner assigns the Business Share for each Forwarding Agent according to his previous acceptance rate and the Forwarding Agent may fulfill this Business Share or not depending upon his own schedule. This Actual Business Share is nothing but the no. of shipments, the Forwarding Agent has accepted from the Transportation planner in this particular time period.

Explanation:

Why: With this KPI the Planner can easily estimate the acceptance rate of a Forwarding Agent, this act as a comparison KPI for Business Share along with Planned Business Share KPI.

Where: Mostly it is used to compare with the Planned Business Share KPI, at the time of planning the Business Share of a Forwarding Agent for a particular time period and also at the time of Tendering process, to select only the Forwarding Agent who still needs to fulfill his assigned Business Share.

Useful to: Transportation Analyst in analyzing the Total Business Share and individual Business Share per Forwarding Agent
Transportation Planner while assigning Business Share and while doing Tendering process
Transportation Controller while doing Re-tendering process and while adjusting the individual Business Share
Transportation Manager while assigning the Total Business Share for a particular time period

Actions taken:

Analyst: Analyze the KPI, and submit the report to the respective Planner and Controller and also to the Manager. Alert the respective members when some drastic changes are identified.

Planner and Controller: Compare this KPI with the Planned Business Share KPI and assign new Business Share or adjust the Business Share of a Forwarding Agent for a particular time period. Also when one Forwarding Agent is not fulfilling his assigned Business Share, then allot his Business Share to another one who can accept more shipments for the same period.

Manager: To take decisions on Total Business Share for a particular time period.

KPI: No. of Tenders

Definition: Sum of Tenders placed by the Transportation Planner or Transportation Controller to the Forwarding Agents during Tendering process.

Formula: Value coming directly from APO system.

Dimension: Time dimensions, Region, Transport Mode, Shipping Point, Route, Responsible persons- Transportation Planner and Forwarding Agent.

Description: At the time of tendering process, the Planner or Controller places the Transport request (Tender) for selected Forwarding Agent. This Tender contains the details of Transportation (Time period, Route, Shipping point etc...), and depending upon the availability, the Forwarding Agent may accept this Tender or not, if not, this Tender is forwarded to another Forwarding Agent.

Explanation:

Why: This KPI helps in determining the acceptance rate of a Forwarding Agent, and this acts as a basic KPI on which Business Share, Acceptance rate, No. of Iterations per shipment can be calculated. Comparison of this KPI with No. of Shipments gives the acceptance rate and No. of Iterations per shipment of Forwarding Agents (See the descriptions below to know more about these calculated KPIs), based on this Business Share is calculated and assigned.

Where: Mostly it is used to compare with the No. of Shipments KPI, at the time of planning the Business Share of a Forwarding Agent for a particular time period and also at the time of Tendering process, to select the Forwarding Agent who can accept more No. of Tenders.

Useful to: Transportation Analyst in analyzing the Total Business Share and individual Business Share per Forwarding Agent
Transportation Planner while assigning Business Share and while doing Tendering process
Transportation Controller while doing Re-tendering process and while adjusting the individual Business Share
Transportation Manager while assigning the Total Business Share for a particular time period

Actions taken:

Analyst: Analyze the KPI, and submit the report to the respective Planner and Controller and also to the Manager. Alert the respective members when some drastic changes are identified.

Planner and Controller: Compare this KPI with the No. of shipments KPI and calculate Acceptance rate and assign new Business Share or adjust the Business Share of a Forwarding Agent for a particular time period. Also when one Forwarding Agent is not fulfilling his assigned Business Share, then allot his Business Share to another one who can accept more shipments for the same period.

Manager: To take decisions on Total Business Share for a particular time period

KPI: Tender Acceptance Rate (%)

Definition: Average of Tenders placed by the Transportation Planner or Transportation Controller to the Forwarding Agent and Tenders accepted by this Forwarding Agent during tendering process.

Formula: $(\text{No. of shipments} / \text{No. of Tenders}) * 100$.

Dimension: Time dimensions, Region, Transport Mode, Shipping Point, Route.

Description: At the time of tendering process, the Planner or Controller places the Transport request (Tender) for selected Forwarding Agent and depending upon his availability, the Forwarding Agent may accept this Tender or not, and this gives the Tender Acceptance Rate of this Forwarding Agent.

Explanation:

Why: This KPI helps the planner to know how often the Forwarding Agent is accepting the Transport request (Tender) and ultimately helps in assigning the Business Share for Forwarding Agents. This KPI saves lot of time for the planner, he can directly contact the Forwarding Agent with most Tender Acceptance Rate first, instead of contacting them randomly.

Where: Mostly it is used to calculate the Business Share of Forwarding Agents for the coming period and also at the time of Tendering process, to select the Forwarding Agent who can accept more No. of Tenders i.e. high Tender Acceptance Rate.

Useful to: Transportation Analyst in analyzing the Total Business Share and individual Business Share per Forwarding Agent
Transportation Planner while assigning Business Share and while doing Tendering process
Transportation Controller while doing Re-tendering process and while adjusting the individual Business Share
Transportation Manager while assigning the Total Business Share for a particular time period

Actions taken:

Analyst: Analyze the KPI, and submit the report to the respective Planner and Controller and also to the Manager. Alert the respective members when some drastic changes are identified.

Planner and Controller: According to the Acceptance rate value assign new Business Share or adjust the Business Share of a Forwarding Agent for a particular time period. Also when one Forwarding Agent is not fulfilling his assigned Business Share or his Tender Acceptance Rate is decreasing then allots his Business Share to another one who can accept more shipments for the same period.

Manager: To take decisions on Total Business Share for a particular time period

KPI: No. of Iterations per Shipment

Definition: The average difference between Tenders placed by the Transportation Planner or Transportation Controller to the Forwarding Agent and Tenders accepted by this Forwarding Agent during tendering process.

Formula: No. of Tenders / No. of Shipments.

Dimension: Time dimensions, Region, Transport Mode, Shipping Point, Route.

Description: At the time of tendering process, the Forwarding Agent may accept the Tender or not, if not, this Tender is forwarded to another Forwarding Agent, and so on until it is accepted by one, and this no. of forwarding of this Tender (= shipments when accepted) from one Agent to another is nothing but No. of Iterations per Shipment i.e. the journey of Shipment from one agent to another.

Explanation:

Why: This KPI explains the journey of Tender (= shipments when accepted). The planner can know easily how many Forwarding Agents have rejected this Tender before it reached the accepted one. The planner should focus in reducing this No. of Iterations per shipment, so that he can limit the tendering process time and can allot sufficient time for the actual transportation process, or else he need to go for Express delivery when there is not enough time for normal delivery.

Where: This is also same as Acceptance rate but from shipment point of view, but it is also used to calculate the Business Share of Forwarding Agents for the coming period and also at the time of Tendering process.

Useful to: Transportation Analyst in analyzing the Total Business Share and individual Business Share per Forwarding Agent
Transportation Planner while assigning Business Share and while doing Tendering process
Transportation Controller while doing Re-tendering process and while adjusting the individual Business Share
Transportation Manager while assigning the Total Business Share for a particular time period

Actions taken:

Analyst: Analyze the KPI, and submit the report to the respective Planner and Controller and also to the Manager. Alert the respective members when some drastic changes are identified.

Planner and Controller: According to the No. of Iterations per shipment value assign new Business Share or adjust the Business Share of a Forwarding Agent for a particular time period. Also when the Forwarding Agent is responsible for increase in No. of Iterations per shipment then ignore him and select the one who is accepting more at the first attempt itself.

Manager: To take decisions on Total Business Share for a particular time period

KPI: Freight Costs Index (%)

Definition: The average difference between Freight costs and the Unit costs (cost of the Materials/Containers are calculated based on Purchase order or Sales order).

Formula: Freight costs / value of goods (Unit costs).

Dimension: Time dimensions, Region, Transport Mode, Shipping Point, Route and Materials/Goods/Products/Containers.

Description: At the time of transportation process, the planner estimates Freight costs of this shipment, in this process he compares this with the Unit costs (Value of the goods) that is being transported and this comparison gives the value of Freight Costs Index.

Explanation:

Why: This KPI helps the planner in estimating the Freight costs of the shipments, the planner verifies whether he is spending more money on cheaper materials or on expensive or dangerous materials. If he knows it is expensive material or dangerous material, he plans for good packaging material, and split the shipment into two, though it increases the Freight costs, as quality and safety is also important.

Where: This is mostly used at the time of estimating shipment costs i.e. Freight costs and also at Packaging material, handling unit and Transport Mode selection process.

Useful to: Transportation Analyst in analyzing the Freight Costs and Unit Costs
Transportation Planner while estimating Freight costs and while selecting Packaging material, handling units and Transport Mode
Transportation Controller while doing Monitoring process and while adjusting the Freight costs
Transportation Manager in decision making

Actions taken:

Analyst: Analyze the KPI, and submit the report to the respective Planner and Controller and also to the Manager. Alert the respective members when some drastic changes are identified.

Planner and Controller: According to the Freight costs index value estimate the Freight costs, take precautionary measures in transporting expensive and dangerous materials though it increases the budget and control spending money on cheaper materials, see alternative solutions for controlling the budget. Also select only appropriate Packaging material, handling units and Transport mode. Insist the Forwarding Agent to follow precautionary measures when transporting expensive and dangerous materials.

Manager: To take decisions on Packaging material, handling units, Transport Mode and on Transportation budget.

6.2 Characteristics

According to the Re-tendering process scenario, the Characteristics (Ex. Forwarding Agent Nr., -Name, Route and Mode of Transport) which are required for the selection process are also identified. Most of the required Characteristics are already present in BW 3.5 Business Content, but still some Characteristics are needed in order to view the KPIs in different dimensions and categories (Check Appendix B for the list of Characteristics which are already present in BW and also which Characteristics need to be developed in future for making the selection process more efficient).

Note: In this thesis paper only the Characteristics existing in BW 3.5 business content are used for the Implementation process.

7 Implementation

As mentioned in the Analysis phase, these selected Characteristics and KPIs should be developed in BW, and with the help of Visual Composer make them usable for analysis purpose. This implementation phase describes about this development process with the help of screenshots.

7.1 Characteristics and KPIs in BW

The newly approved KPIs need to be created in the BW first i.e. adding business content of APO system into BW (this new KPIs information should be present somehow in the source system, then only its possible to develop new KPIs in BW). After creating the KPIs (according to the scenario only KPIs development is required), these KPIs along with Characteristics are arranged in an InfoCube. Later Info Source, Transfer Rules, Update Rules are created and then the data is uploaded to this new Cube through Flat file upload Technology.

The following screenshots explain the creation of Business content in BW.

Figure 24 below, shows the list of KPIs created in BW.

- Actual Business Share
- Planned Business Share
- Average damage free goods
- Carrier acceptance lead time
- No. of Tenders
- Actual Budget
- Planned Budget

Note: Remaining mentioned KPIs can be created based on these KPIs, in BW terminology they are termed as Calculated Key figures.

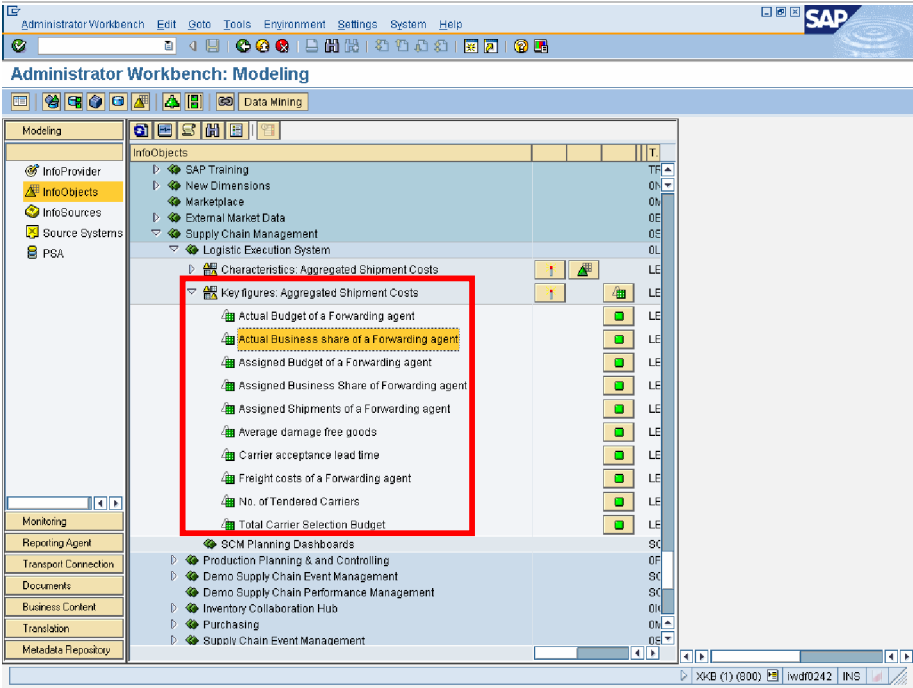


Figure 24: Creation of new Info Objects (Key Figures) in BW

Figure 25 shows the InfoCube (Aggregated Carrier selection costs) which has been created to hold these KPIs and Characteristics.

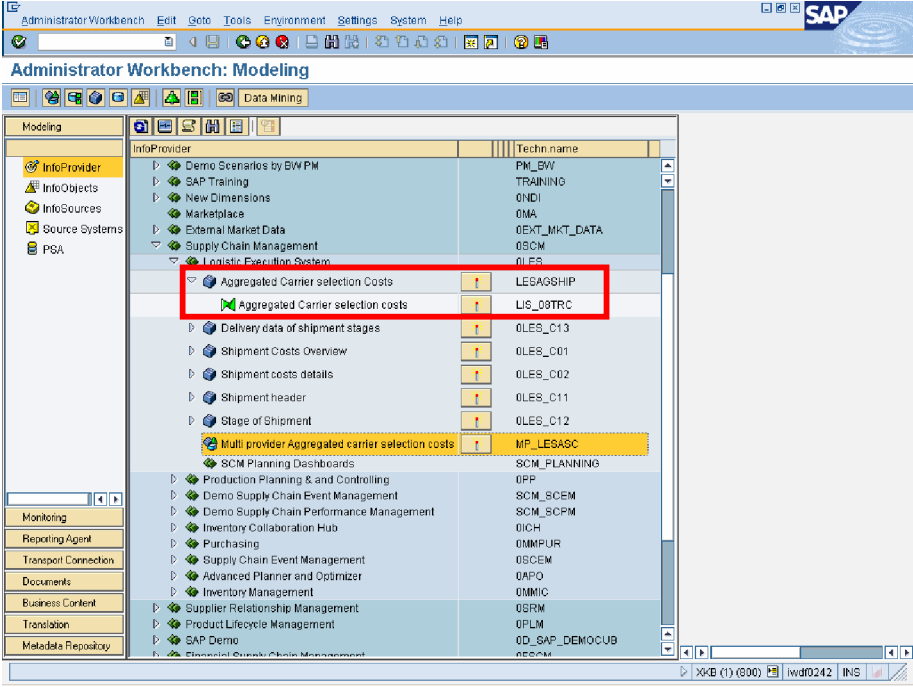


Figure 25: Creation of new Info Cube in BW

Figure 26 below shows the list of Characteristics present in the InfoCube.

Forwarding agent – 0FORWAGENT
 Route- 0ROUTE
 Mode of Transport- 0TRALEVEL
 Transportation planning point-0TRAPPOINT

These characteristics are assigned to Partners and Transportation Control dimensions.

- Forwarding agent to Partners dimension.
- Route, Mode of Transport and Transportation planning point to Transportation Control dimension.

As mentioned earlier these characteristics are already present in the Business content of BW. They are just activated and used in this InfoCube.

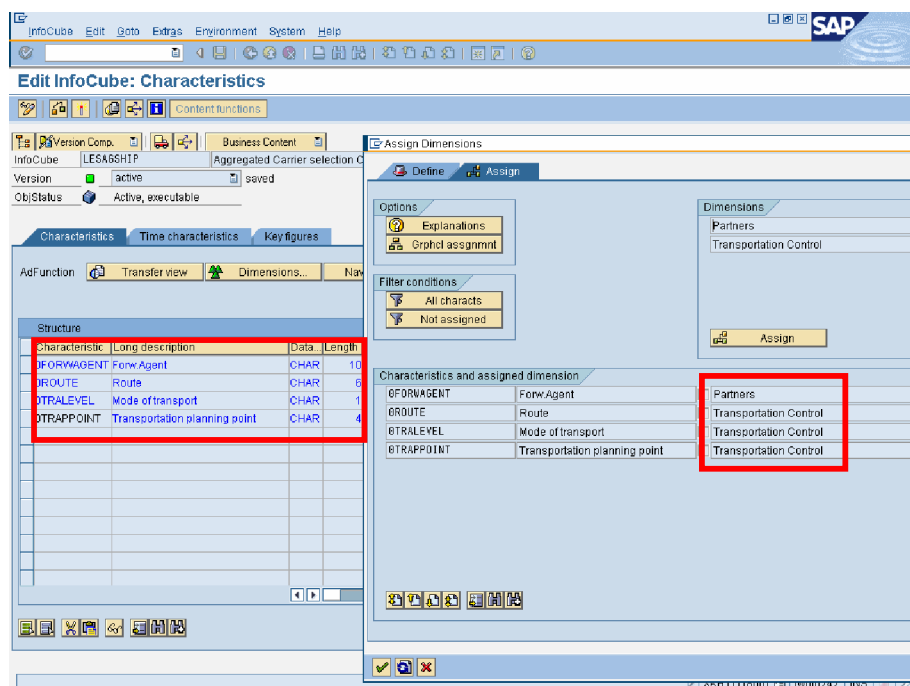


Figure 26: Assigning Characteristics to its Dimensions for the New Cube in BW

Figure 27 below shows the list of KPIs present in the InfoCube.

- Net value of shipment costs-0FCNETVALUE
- Planned transportation time-0DUR_EFF_PL
- Actual transportation time-0DUR_EFFECT
- Planned waiting time-0DUR_WAIT_PL
- Actual waiting time-0DUR_WAITACT
- Penalty costs-0APO_NDLN_CSTS

The above mentioned KPIs are already present in BW.

NOTE: KPIs or Characteristics names starting with "0" are from Business Content of BW.

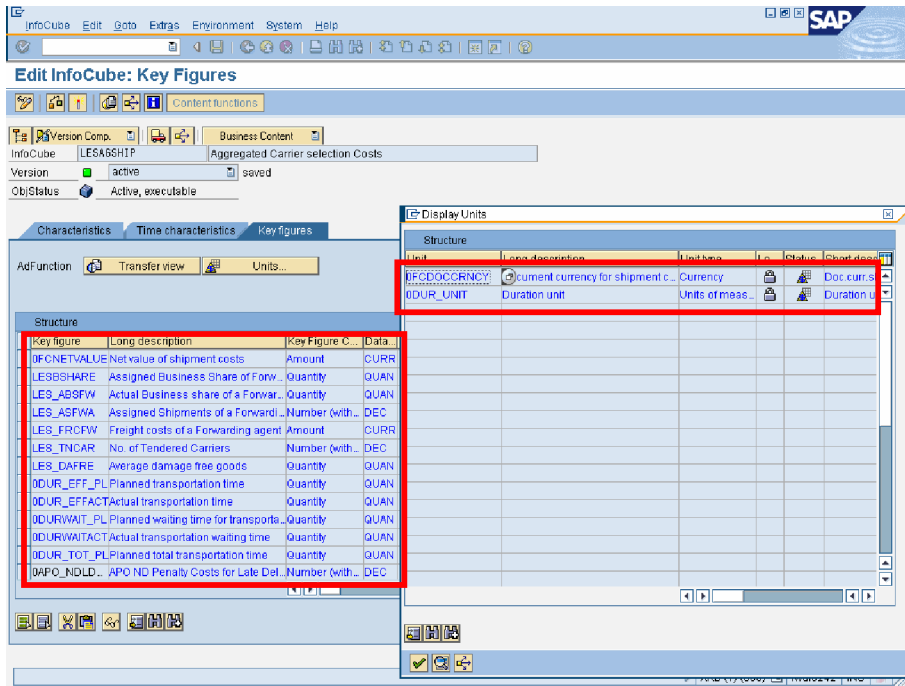


Figure 27: Assigning Key Figures and its Units to the New Cube in BW

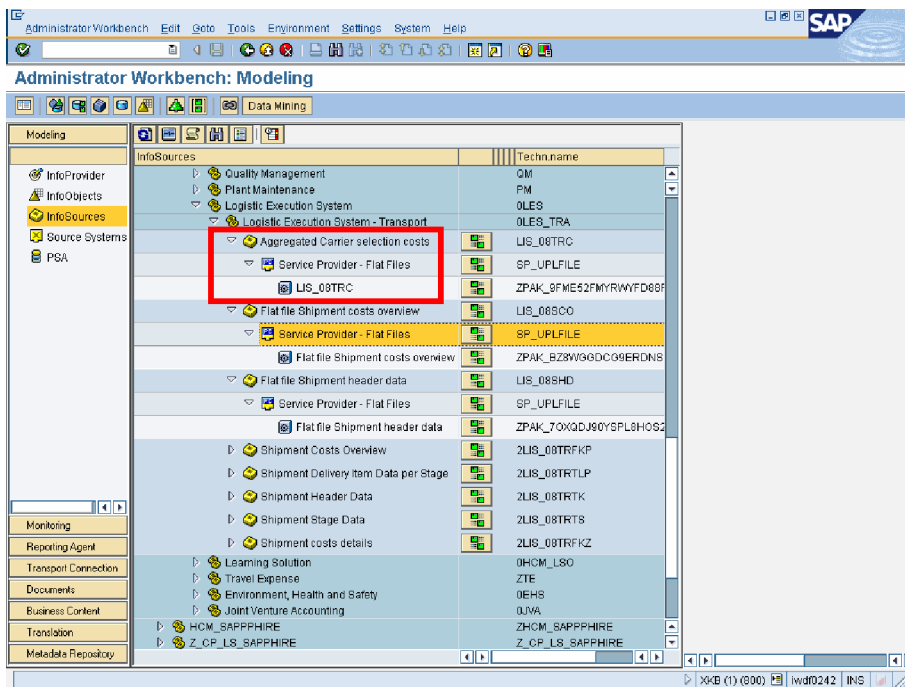


Figure 28: Creating Info Source for the New Cube in BW

Figure 28 above shows the InfoSource (Aggregated carrier selection costs) created to upload the data to the InfoCube from the Source system.

In the InfoSource itself Transfer rules (See Figure 29 below) are created to optimize the data transfer from the source systems.

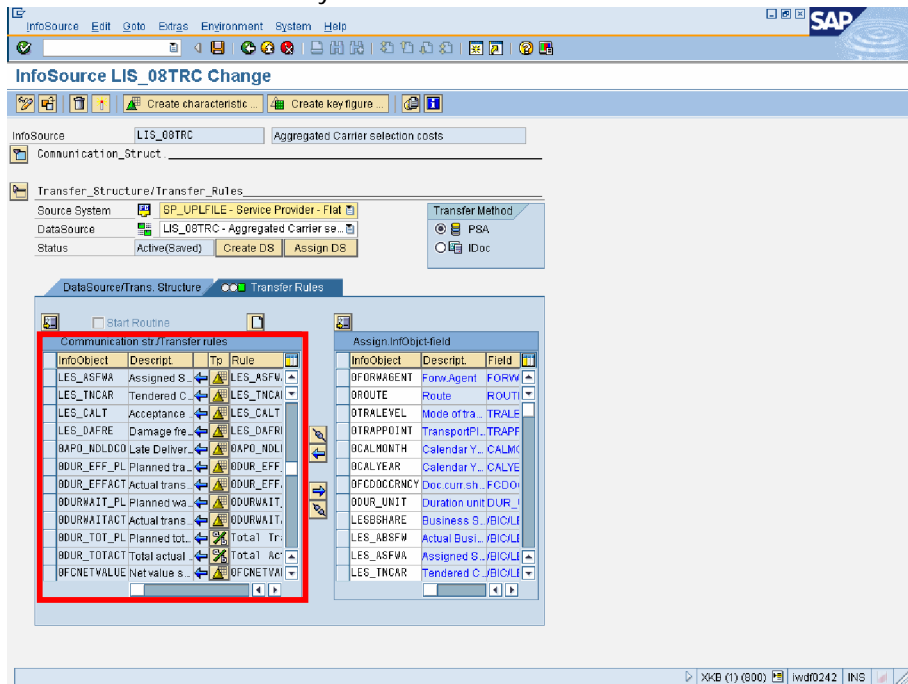


Figure 29: Creating Transfer Rules for the New Cube in BW

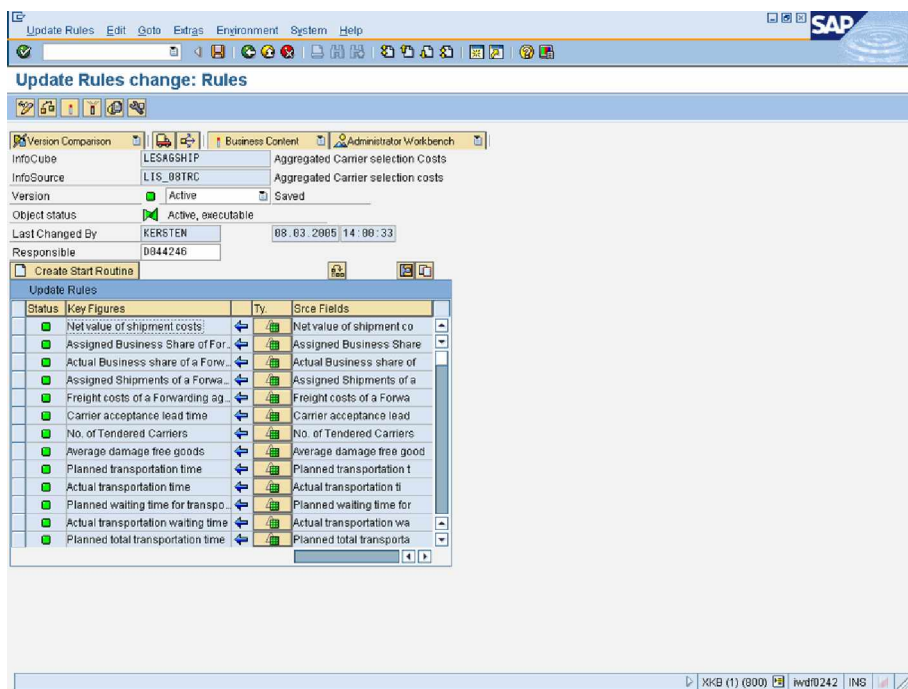


Figure 30: Creating Update Rules for the New Cube in BW

After activating the Transfer rules, update rules (See figure 30 above) for the InfoCube are created to optimize the updating process of data from InfoSource.

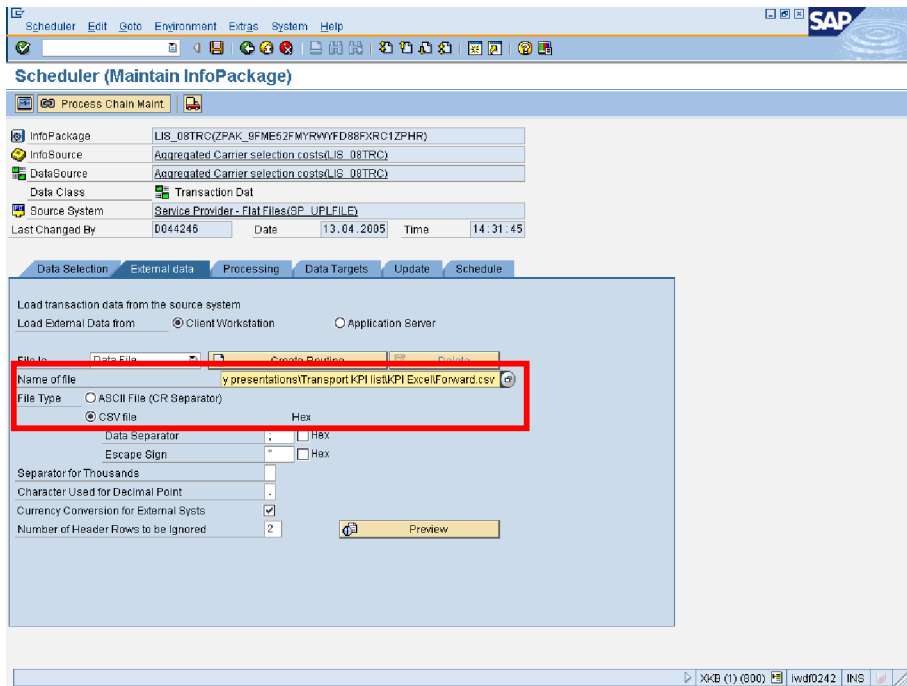


Figure 31: Uploading data to the New Cube in BW

Figure 31 above shows the screen of Scheduler, where the Flat file upload technology takes place. Here before uploading the data, the data first need to be created in a spreadsheet and saved as CSV file or ASCII file (Here CSV file is taken). This CSV file containing data is uploaded using the functionalities of Scheduler in SAP BW.

In normal cases instead of Flat file, a source system is directly connected to BW and with the help of interfaces data is retrieved from source systems and uploaded to BW with the help of this Scheduler.

Figure 32 below shows the screen of the uploaded data in the cube itself, after the scheduling the upload process, the data directly goes from the DataSource to the Data target i.e. InfoCube through InfoSource. The Transfer rules and Update rules optimize the data loading and updating process.

This is the final step in the creation of Business Content in BW and all these activities are done using the concepts of Administrative workbench (See the chapter of BW for explanation on Administrative workbench).

Data tgt. browser: "LESAGSHIP", List output

Forw Agent	Route	OTRALEVEL	OTRAPPOINT	OCALMONTH	OCALYEAR	Duration unit	DFCDOCCRNC	DAPO_NDLDC	ODURWAITAC	ODURWAIT_P	ODUR_EFFAC	ODUR_EFF_P
0000001000	R1	1	TRP1	200412	2004	TAG	EUR	4.000.000	2,000	1,000	14,000	12,000
0000001000	R2	1	TRP1	200412	2004	TAG	EUR	5.000.000	3,000	2,000	14,000	13,000
0000001000	R3	5	TRP1	200412	2004	TAG	EUR	3.500.000	3,000	2,000	10,000	9,000
0000001000	R3	6	TRP1	200412	2004	TAG	EUR	5.500.000	1,000	1,000	8,000	6,000
0000001000	R3	1	TRP1	200412	2004	TAG	EUR	5.000.000	3,000	2,000	14,000	13,000
0000001000	R4	5	TRP1	200412	2004	TAG	EUR	5.000.000	3,000	2,000	12,000	11,000
0000001000	R4	6	TRP1	200412	2004	TAG	EUR	5.000.000	3,000	2,000	12,000	11,000
0000001000	R5	5	TRP1	200412	2004	TAG	EUR	5.000.000	3,000	2,000	12,000	11,000
0000001001	R1	7	TRP2	200412	2004	TAG	EUR	4.000.000	2,000	1,000	14,000	12,000
0000001001	R2	7	TRP2	200412	2004	TAG	EUR	3.000.000	2,000	2,000	8,000	8,000
0000001001	R3	5	TRP2	200412	2004	TAG	EUR	4.000.000	2,000	1,000	14,000	12,000
0000001001	R3	6	TRP2	200412	2004	TAG	EUR	3.000.000	2,000	2,000	8,000	8,000
0000001001	R4	5	TRP2	200412	2004	TAG	EUR	4.000.000	2,000	2,000	11,000	10,000
0000001001	R4	6	TRP2	200412	2004	TAG	EUR	2.000.000	1,000	1,000	9,000	8,000
0000001001	R5	5	TRP2	200412	2004	TAG	EUR	4.500.000	3,000	2,000	9,000	8,000
0000001002	R1	1	TRP1	200412	2004	TAG	EUR	2.000.000	1,000	1,000	9,000	8,000
0000001002	R2	1	TRP1	200412	2004	TAG	EUR	3.000.000	2,000	2,000	8,000	8,000
0000001002	R3	5	TRP1	200412	2004	TAG	EUR	2.500.000	2,000	1,000	7,000	6,000
0000001002	R3	6	TRP1	200412	2004	TAG	EUR	4.500.000	3,000	2,000	8,000	8,000
0000001002	R3	1	TRP1	200412	2004	TAG	EUR	3.000.000	2,000	2,000	8,000	8,000
0000001002	R4	5	TRP1	200412	2004	TAG	EUR	2.500.000	2,000	2,000	12,000	12,000
0000001002	R4	6	TRP1	200412	2004	TAG	EUR	2.500.000	2,000	2,000	12,000	12,000
0000001002	R5	5	TRP1	200412	2004	TAG	EUR	2.500.000	2,000	2,000	12,000	12,000
0000001003	R1	1	TRP1	200412	2004	TAG	EUR	6.000.000	2,000	1,000	7,000	5,000
0000001003	R2	1	TRP1	200412	2004	TAG	EUR	4.000.000	2,000	2,000	11,000	10,000
0000001003	R3	5	TRP1	200412	2004	TAG	EUR	4.000.000	1,000	1,000	5,000	4,000
0000001003	R3	6	TRP1	200412	2004	TAG	EUR	5.000.000	3,000	2,000	12,000	11,000
0000001003	R3	1	TRP1	200412	2004	TAG	EUR	4.000.000	2,000	2,000	11,000	10,000
0000001003	R4	5	TRP1	200412	2004	TAG	EUR	3.000.000	2,000	2,000	11,000	10,000

Figure 32: Uploaded data in the New Cube

Figure 33 shows the overview screen of the total development process of Creating an InfoCube, InfoSource, Data package and uploading data from a Flat file. After this, the queries should be created based on this InfoCube using Query Designer.

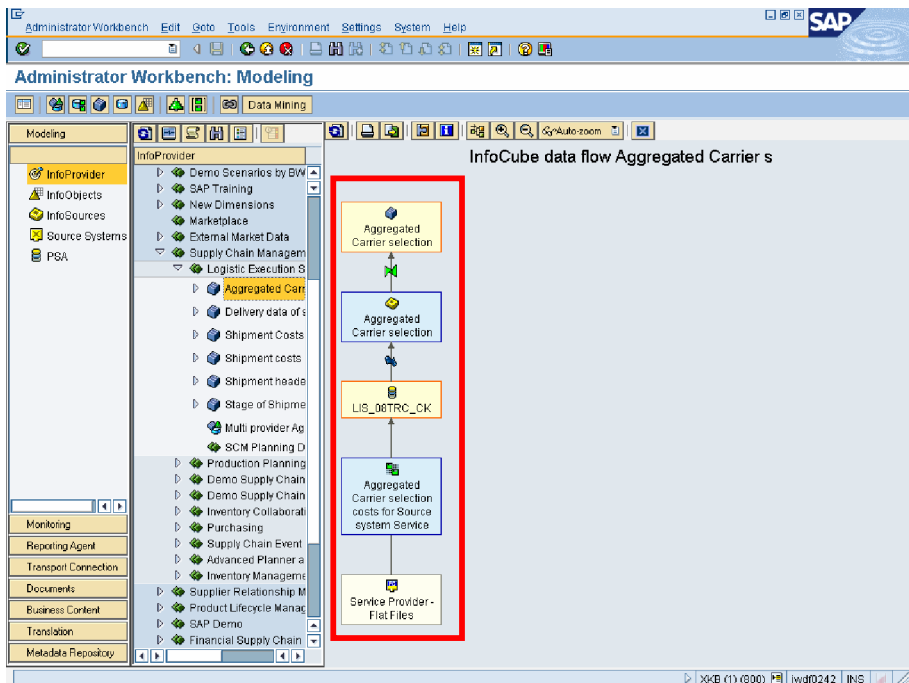


Figure 33: Data flow of the New Cube in BW

7.2 Creation of Queries using Query designer

After the data is uploaded to the InfoCube, now queries can be made to analyze the uploaded data. Query Designer is used to create new queries based on this InfoCube. Figure 34 shows the list of queries created in Query Designer based on this InfoCube

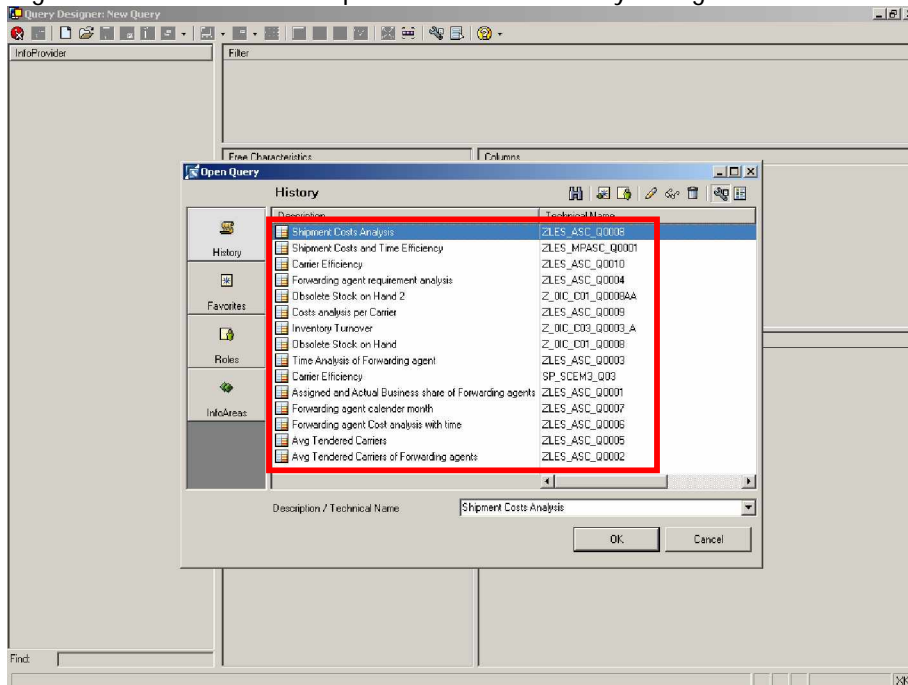


Figure 34: Creation of Queries in Query Designer

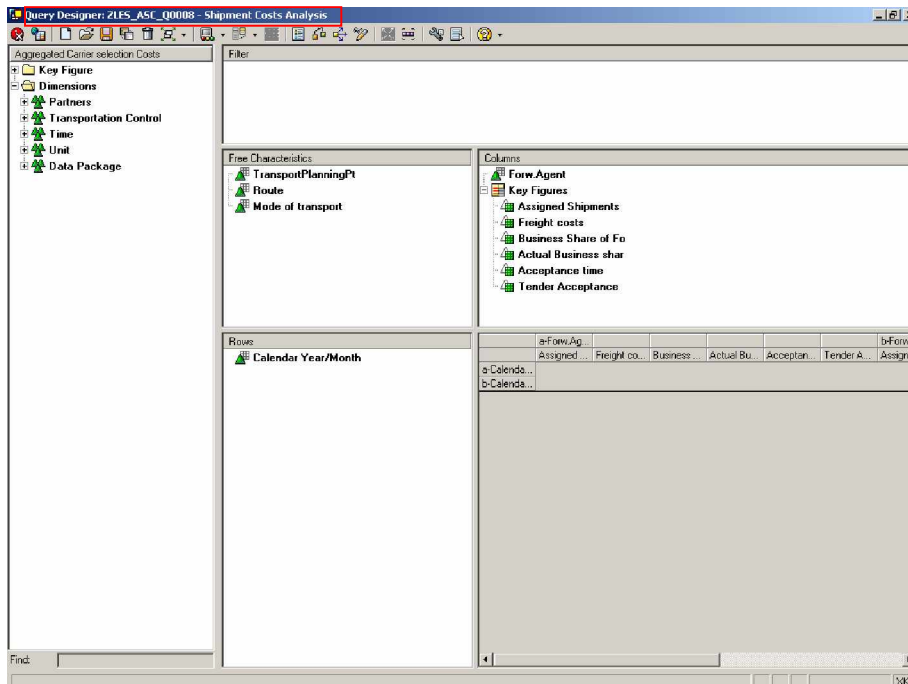


Figure 35: Creation of ZLES_ASC_Q0008 Query in Query Designer

Implementation

Above Figure 35, shows the definition of a Query (ZLES_ASC_Q0008), here the Characteristics are placed under rows tab and Free Characteristics tab and the KPIs under Columns tab.

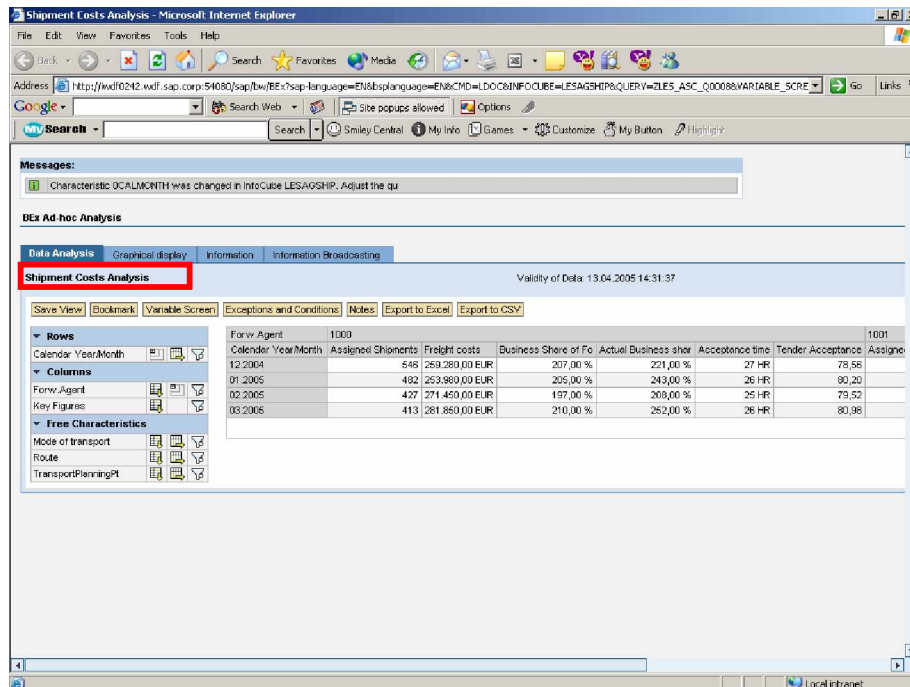


Figure 36: Output of ZLES_ASC_Q0008 Query in Query Designer

The above Figure 36, shows the output of the query, this screen is also termed as runtime of the Query Designer. Here the output can be viewed in different dimensions and categories, the characteristics can be filtered and also drill down option is available to view the KPI in much more detail.

Later these views of the query can also be saved and viewed for later analysis purpose and this ends the creation of queries phase, now these queries can be used by Visual Composer to develop SAP Analytics

7.3 SAP Analytics development using Visual Composer

SAP Analytics is a new concept from SAP, here Visual Composer tool is used to develop analytics (See chapter on SAP Analytics for detailed description).

Below Figure 37 shows the design time screen of Visual Composer, here SAP Analytics models are created. In the figure the red mark portion shows different models created by the Solution Managers of different Solution service departments like CRM, SCM etc...

ANALYTICS_SCM_D044246 model is considered for this Thesis paper.

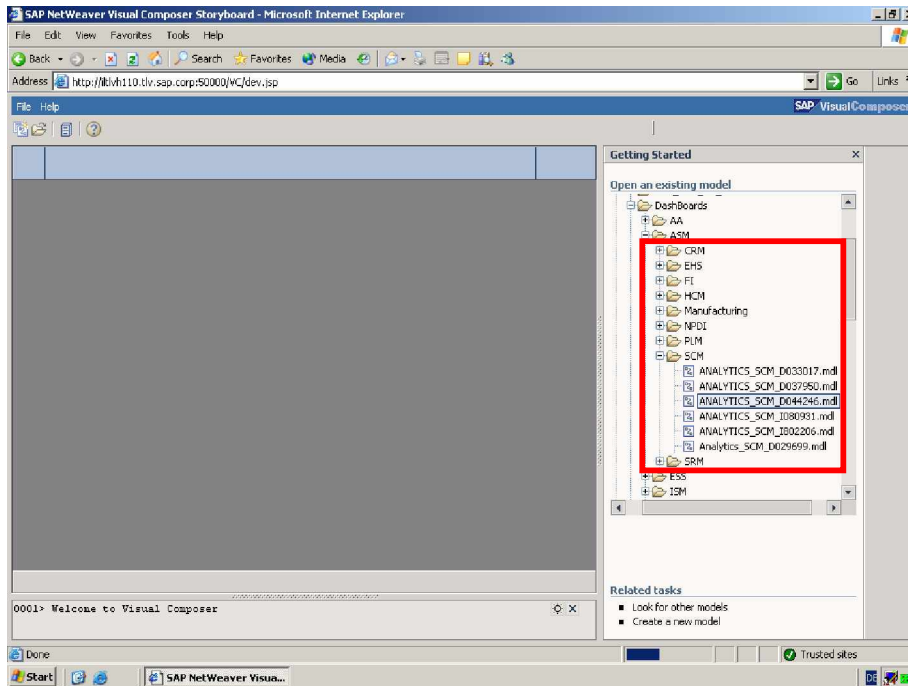


Figure 37: Creation of Analytics model in Visual Composer

Below Figure 38 shows different packages created inside the model

NOTE: The Forwarding agent analysis (SAPPHIRE) package is used to exhibit the SAP Analytics of SCM at SAPPHIRE Copenhagen and Boston in 2005

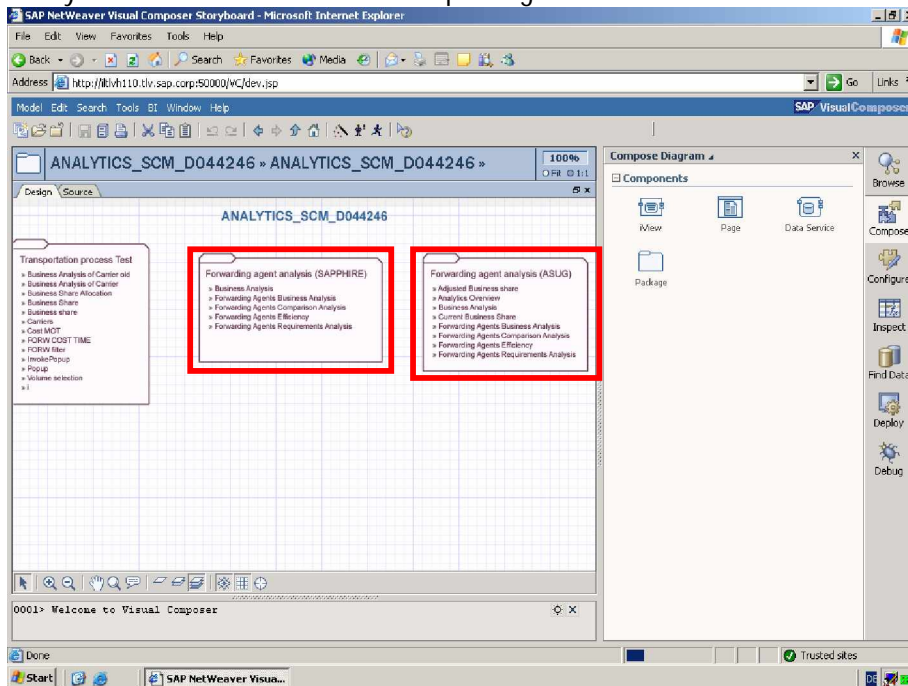


Figure 38: Creation of Packages for the Model in Visual Composer

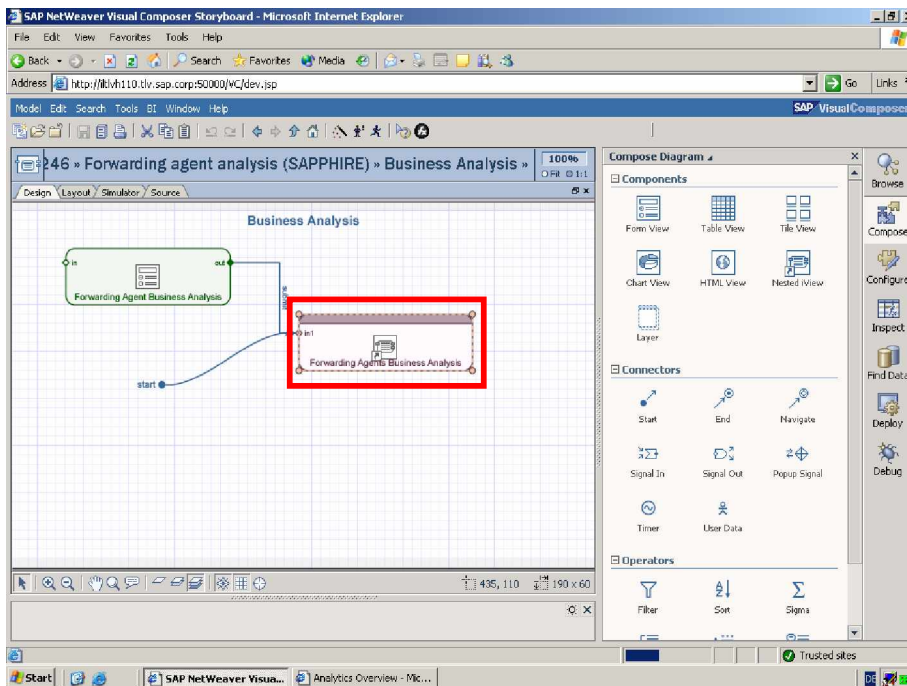


Figure 39: Creation of iView in Visual Composer

Above Figure 39 shows the Business Analysis iView inside the SAPHIRE package. Here the iViews are created just by dragging it from the Configure tool tab to the design editor.

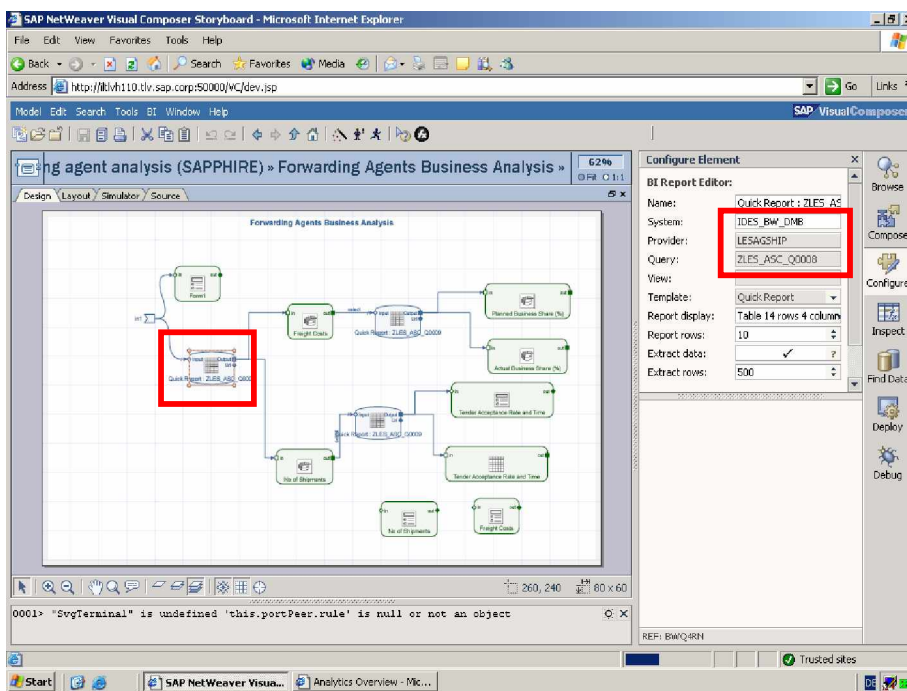


Figure 40: Assigning BW Query (ZLES_ASC_Q008) to Visual Composer

Implementation

The above Figure 40 shows the screen of the design editor, here in the editor the red mark portion shows the query that has been downloaded from the BW. In the Configure element tool tab, the properties of the query are displayed like-

- The system name-IDES_BW_DMB (The same BW system, where InfoObjects and InfoCube has been created earlier)
- Provider-LESAGSHP (The same InfoCube, where all KPIs and Characteristics are arranged and data is uploaded)
- Query-ZLES_ASC_Q0008 (The same Query, where the definition of the KPIs are designed in Query Designer)

With this it is clearly visible that Visual Composer tool is directly based on the BW system, and the queries created there can be used directly without any interfaces or without any modifications. That is the advantage of Visual Composer and also this tool directly gets the data from systems like SAP R/3, SAP SCM, SAP CRM, other party systems and Databases.

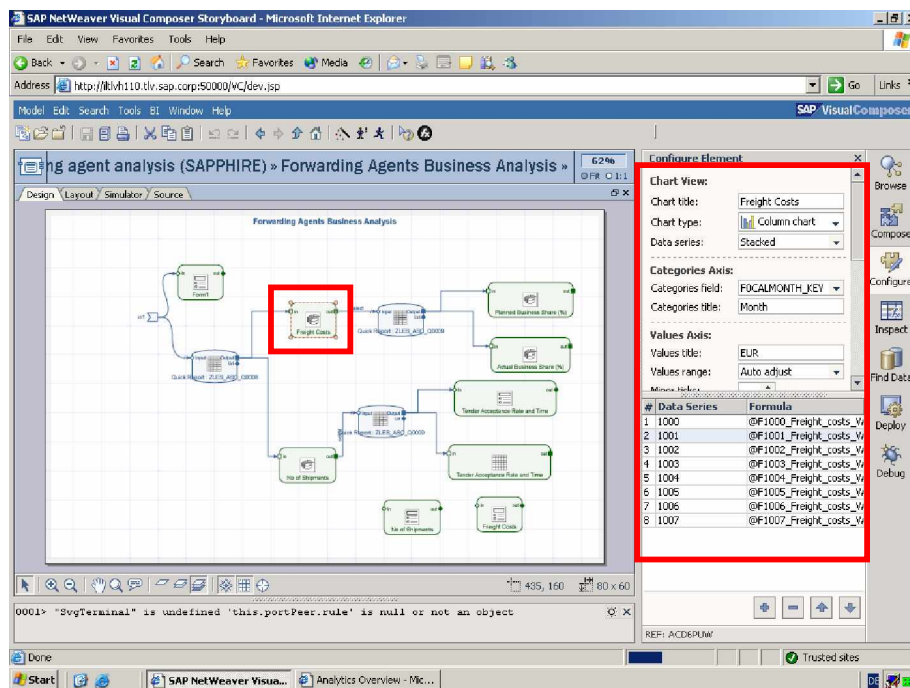


Figure 41: Creation of different Charts in Visual Composer

In the Figure 41 above, the properties of a chart are displayed. It is very easy to create different kind of charts, forms and tables in Visual Composer. Here in the red mark portion of the properties tool tab different chart options are displayed like-

Chart title, Chart type (column chart, pie chart etc...), Data series, Categories title and field, Values title and range, and also animation options are available to generate a more user friendly and nice interactive analytics.

Implementation

Figure 42 below shows the output of the Business Analysis iView and here run time interactivity is also possible (Ex. The pie chart changes, when somebody clicks the bar chart)

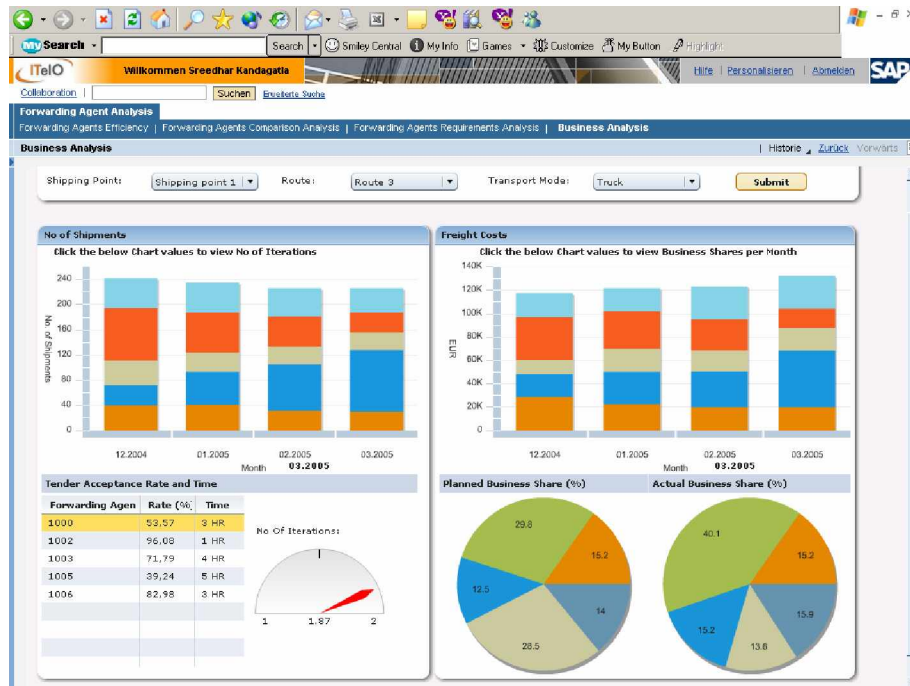


Figure 42: Output of the Business Analysis iView in the Portal

The below Figure 43 is the output of the Forwarding Agents efficiency iView.

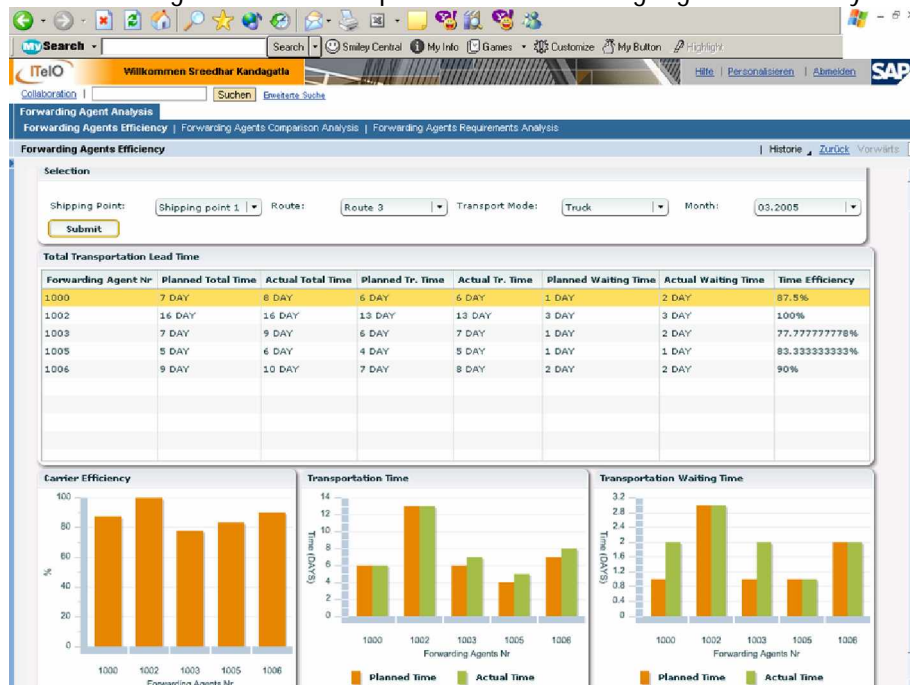


Figure 43: Output of the Efficiency iView in the Portal

Figure 44 is the output of the Forwarding Agents Comparison analysis iView.

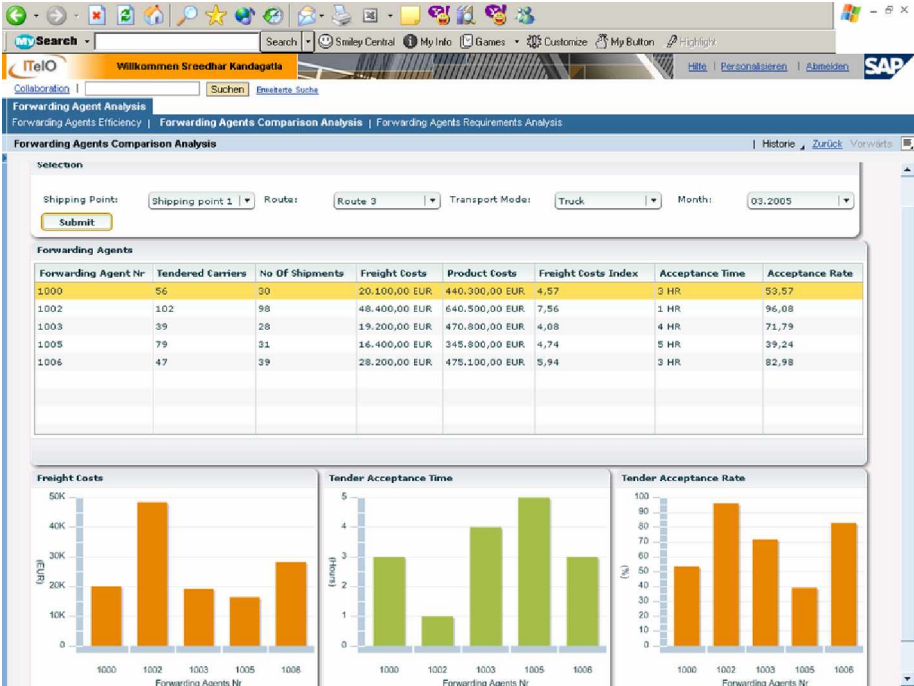


Figure 44: Output of the Comparison Analysis iView in the Portal

Figure 45 is the output of the last iView of the SAPHIRE package i.e. Forwarding Agents requirements analysis iView.

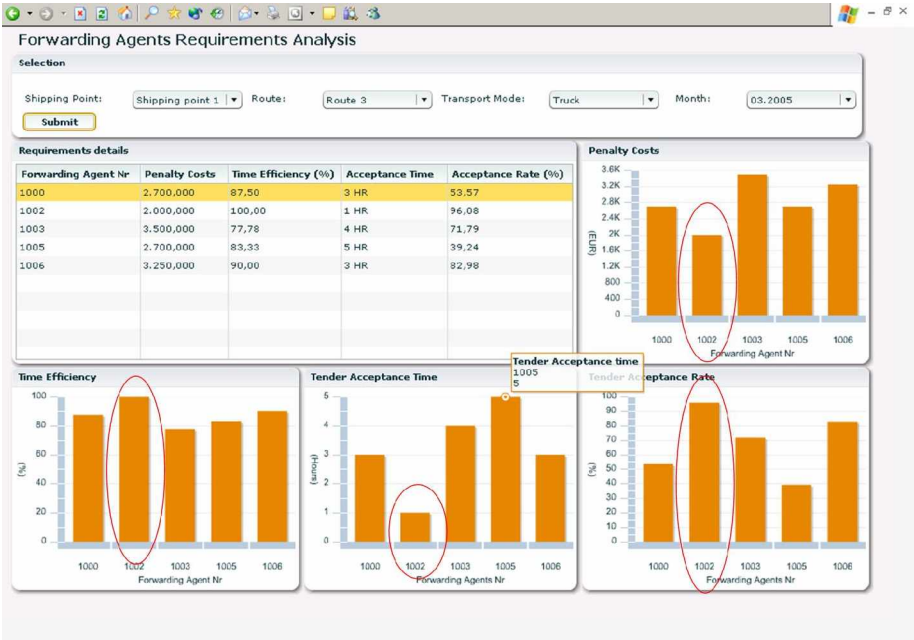


Figure 45: Output of the Requirements Analysis iView in the Portal

Here (Figure 45), in the output of Requirements Analysis iView the table shows all the KPIs required for requirement analysis in detail and each graph shows individual KPI as an overview. The Transportation planner, with the help of this analysis selects the Forwarding Agent who satisfies most of his requirements.

From this analysis, the planner figures it out that 1002 Forwarding Agent is the best, as he has greater Time efficiency, Quick Tender acceptance time, more Tender Acceptance rate and also less penalty costs (see the red mark portions in the Figure 45). Seeing all these qualifications, transportation planner allocates the shipments to this 1002 numbered Forwarding Agent for this period.

This analysis is based on the data from BW but actually it is also possible to directly retrieve data from the APO system itself, with this the analysis will be more accurate and dynamic. The transportation planner or controller according to the historic data (from BW) and present data (from APO) selects the best Forwarding Agent during Tendering and Re-tendering processes in the future too. These analytics updates themselves automatically whenever new data is uploaded to BW or APO systems, they show the most recent data of the systems.

The analytics are also much easier to build, even the business man or the end user who do not have the programming knowledge like coding etc. can build their own analytics by themselves, because this Visual Composer is a model driven code free tool. So depending upon the requirements the planner or controller can build their own analytics based on the data available in BW and APO system (according to this Re-tendering process scenario). They can easily have visibility in the system using SAP Analytics, as now they have the chance to view the historic and present data in different dimensions and categories in the same screen, they can compare it, they can drill down into the details, view the data in different angles, and at the end they can be accurate in their decisions.

But in order to achieve the visibility, the required KPIs for the process should present in the system first, as SAP Analytics shows only the data that is present in the systems, so before creating the analytics, the KPIs should be identified and developed in the systems.

8 Conclusion and Future Outlook

Supply chain management is all about having the right products, at the right time, to the right customers at minimal cost. In order for an organization to reach the helm of industry leadership, the organization should start thinking radically and the leaders of the organization should be willing and determined to shift to the new paradigm. Information technology is an important and essential component and the organization should make the best use of its Potential. The experiences of global leaders who have reached the helm, suggests that achieving Visibility in supply chain is not easy, but it is worth putting so much effort in terms of the global benefits that can result from it. Visibility plays a key role in various supply chain functions such as demand generation and planning, order execution, capacity planning, transportation planning, purchasing, etc.

This Thesis Paper serves as a guideline for increasing the visibility in any business process (but in particular Transportation process). It has explained how to identify and define the KPIs required for the process, how to implement or develop these KPIs in BW and at the end how to use these KPIs for creating Analytics with the help of Visual Composer tool. Visibility can only be achieved when every process works together, i.e. in this paper, when BW or APO systems interact with SAP Analytics, when required KPIs are present in BW etc. The Analytics containing the required KPIs increases the visibility in Transportation process, this, in turn, allows the planner or controller to refine their planning efforts. And it's doing it in real time, which means they can react quickly and take advantage of those trends rather than finding out about them after the fact. These Analytics can be used for all different processes or sections of a company. It clearly increases the efficiency in identifying a problem and taking appropriate decisions according to the requirements and especially increases the "Visibility" in the process.

According to a survey conducted at Georgia Southern "The survey responses indicate that the benefits of visibility are better availability of goods on the shelf, better fill rates for the retailer and better turns for the supplier," said Dr. Karl Manrodt, associate professor of logistics. "This should translate into greater value to the customer; it is effectively competing supply chain to supply chain."

Visibility: the quest continues. After Analytics, RFID promises to provide visibility to everyone in the supply chain at the item level, but that data could overwhelm and paralyze most organizations. Integration of supply chain solutions is what provides value, not the solution itself. A model must be built that takes into account functions/operations; decision-support; visibility; supply chain event management; agents/automated response; data collection; data synchronization; metrics & reporting; and people, process & technology. The language of actionable information is metrics. Supply chains, and individual firms, should measure time and cost through three key metrics: integrated cash-to-cash metric, total order cycle time metric, and the perfect order.

9 Bibliography

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10 Appendix A: KPIs (Key Figures)

Supply Chain Design key figures (KPIs)

- APO ND handling costs during goods issue
- APO ND handling costs during goods receipt
- APO ND penalty costs for non-allowed location products
- APO ND maximum transportation duration
- APO ND transportation costs
- APO ND late delivery penalty costs
- APO ND transportation duration
- APO ND shipment quantity
- APO ND shipment quantity (in aggregation unit)

Procurement key figures (KPIs)

- Average delivery time
- Average weighted delivery time
- Average delivery time
- Average weighted delivery time
- Number of deliveries
- Fulfillment rate - deliveries
- Proportion delivery date variance 1
- Proportion delivery date variance 2
- Proportion delivery date variance 3
- Proportion delivery date variance 4
- Delivery date variance 1
- Proportion delivery date variance 5
- Delivery date variance 2
- Delivery date variance 3
- Delivery date variance 4
- Delivery date variance 5
- % Received On Time to Demand Requirement (Number)
- % Received On Time to Commitment (Number)
- % Received On Time to Commitment (Value)
- Calendar year/month
- % Received On Time to Demand Requirement (Value)
- % Received Complete (Number)
- % Received Complete (Value)
- Backlog in days
- Backlog within one day

- Backlog within seven days
- Backlog within 30 days
- Backlog greater than 30 days

Order Fulfillment key figures (KPIs)

- Net amount of shipment costs
- Net amount of shipment costs
- Planned transportation time
- Planned waiting time
- Planned total time
- Actual transportation time
- Actual transportation waiting time
- Total actual transportation time
- Distance
- Actual Transportation time (dy)
- Material cost share
- Sales volume cost
- Gross weight of deliveries
- Gross weight of returns deliveries
- Volume of deliveries
- Delivery volume
- Gross weight of delivery
- Gross weight of returns delivery
- Delivery gross weight
- Delivery quantity
- Delivery net weight
- Delivery volume
- Number of delivery items
- Delivery quantity
- Delivery returns quantity
- Average delay between confirmed and actual delivery date
- Average delay between requested delivery date and actual delivery date
- Average difference between requested and confirmed delivery date
- Correctly delivered quantity
- Quantity delivered too early
- Quantity delivered too late
- Average traveling time to customer
- Difference between loading and goods issue
- Difference between material availability date and loading date
- Difference between loading and arrival of goods at customer
- Difference between planned goods issue and actual goods issue
- Delivery Performance to Customer Request Date (Quantities)

Appendix A: KPIs (Key Figures)

- Delivery Performance to Customer Request Date (Value)
- Delivery Performance to Scheduled Commit Date (Quantities)
- Delivery Performance to Scheduled Commit Date (Value)
- Quantities delivered complete (Quantities)
- Quantities delivered complete (Value)
- Delivery Performance to Customer Request Date (Number)
- Delivery Performance to Customer Request Date (Value)
- Delivery Performance to Scheduled Commit Date (Number)
- Delivery Performance to Scheduled Commit Date (Value)
- Items Delivered Complete (Number)
- Items Delivered Complete (Value)
- Delivery Performance to Customer Request Date (Number)
- Delivery Performance to Customer Request Date (Value)
- Delivery Performance to Scheduled Commit Date (Number)
- Delivery Performance to Scheduled Commit Date (Value)
- Orders Delivered Complete (Number)
- Orders Delivered Complete (Value)
- Actual duration transport
- Planned duration transport
- Event delay
- Event message delay
- Number of transports delayed 12-24 hrs.
- Number of transports delayed 24-36 hrs
- Number of transports delayed 36-48 hrs.
- Number of transports delayed 48-96 hrs.
- Number of transports delayed 0-12 hrs.
- Number of transports delayed > 96 Hrs.
- Number of events delayed 12-24 hrs.
- Number of events delayed 24-36 hrs.
- Number of events delayed 36-48 hrs.
- Number of events delayed 48-96 hrs.
- Transport duration delay
- Number of events delayed 0-12 hrs.
- Number of events delayed > 96 hrs.
- Number of event messages delayed 12-24 hrs.
- Number of event messages delayed 24-36 hrs.
- Number of event messages delayed 36-48 hrs.
- Number of event messages delayed 48-96 hrs.
- Number of event messages delayed 0-12 hrs.
- Number of event messages delayed > 96 hrs.
- Number of carrier arrivals
- Number of arrivals at customer
- Number of delayed transports

- Number of delayed events
- Number of events with status reason "Carrier late"
- Number of departures from plant
- Number of events with status reason "Accident"
- Number of delayed event messages
- Number of events with status reason "Door occupied"
- Number of events with status reason "Mechanical"
- Number of events without a status reason
- Number of events with status reason "Weather"
- Number of events with status reason "Picking late"

11 Appendix B: Characteristics

Characteristics present in BW

- Total shipments of a Transport agent (Number of shipments --0NUMSHPMENT)
- Shipment Nr (# of Shipments--TPM_SHIPM)
- Shipment type (Shipment Type—0SHTYP)
- Shipment leg Nr.
- Transport agent Nr (Forwarding Agent—0FORWAGENT)
- Transport agent Region (Region (State, Province, County)-- 0REGION)
- Supplier Nr (Supplier--US_SUPPLR)
- Supplier Region (Region (State, Province, County)-- 0REGION)
- Customer Nr (Customer number--0CUSTOMER)
- Customer name (Name of customer--0CUSTOMER_T)
- Customer Region (Region (State, Province, County)-- 0REGION)
- Plant (Plant—0PLANT)
- Segment (Division--0DIVISION)
- Product Nr / Good Nr / Material Nr (--0MAT, —0MATERIAL, --0PRODUCT)
- Product type / Material type (0MATL_TYPE, Product Category--0PROD_CATEG)
- Damage goods Nr (external-0DEFQTY_EXT, internal--0DEFQTY_INT)
- Mode of Transport type (Mode of transport--0TRALEVEL)
- Carrier info (Truck, Rail, Ship, Plane info) (Carrier—0CARRIER)
- Unit price (Price Unit—0COND_PR_UN)
- Penalty costs for a Transport agent (for Late Delivery --0APO_NDLDCO, for non-allowed Location Products--0APO_NDPECO, not Delivering --0APO_NDNDCO)
- Assigned Budget for a Transport agent (Forwarding agent) (Budget --0BUDGET)
- Assigned shipments for a Transport agent (Number of Shipments --0NR_TRANSP)
- Duration of travel for a shipment (Actual transportation time--0DUR_EFFACT, Actual shipment duration—0EVT_ACTDUR)
- Duration of travel(Planned Duration of Main Leg --0PLN_DUR_M, Preliminary Leg--0PLN_DUR_P, Subsequent Leg--0PLN_DUR_S)
- Distance covered for a shipment

- Distance covered for a shipment leg
- Max volume of a Carrier (0MAX_VOL)
- Max weight of a Carrier (Maximum gross weight of all stages of a shipment -- 0MAX_GRS_WT, Maximum net weight --0MAX_NET_WT)
- Unloading point of the ship- to party (0UNLD_PT_WE)
- Unloading point (0UNLOAD_PT)
- Loading point (Loading point—0LOAD_PT)
- Loading date (Loading date—0LOAD_DATE)
- Loading time (Loading Time--0APO_LOATIM)
- Date (Date—0SO_CR_DTE)
- Month (Calendar month--0CALMONTH2, Calendar Year/Month--0CALMONTH)
- Year (Calendar Year--0CALYEAR)
- Calendar week (Calendar Year/Week--0CALWEEK)

Characteristics to be developed in BW

- Center
- Container type
- Container Nr
- Cost per Carrier
- Transportation tariff for one shipment
- Transportation tariff for one shipment leg
- Payment type (Plant or Supplier)
- Business share of a Transport agent
- Distance covered by a Transport agent
- Volume per carrier (Actual)
- Weight per carrier (Actual)
- Efficiency (Carrier, Transport agent & Unloading and loading)
- Unloading tariff
- Unloading time
- No. of suppliers for a shipment (supplier Nr respective shipment Nr)
- Advance journey no.
- Special journey / Express delivery no.
- Special journeys / Express delivery costs
- Empty return journey Nr
- Time taken to accept the request by a Transport agent