TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

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# MODELLING A WEB SHOP USING SAP R/3 AS BACKEND SYSTEM

Master of Science Thesis

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Examiner and topic approved in the Faculty of Computing and Electrical Engineering Council meeting on 9th January 2013

# TIIVISTELMÄ

TAMPEREEN TEKNILLINEN YLIOPISTO
Tietotekniikan koulutusohjelma
**YRJÖLÄ, TUOMAS**: Verkkokaupparatkaisun mallintaminen käyttäen SAP R/3 järjestelmää taustajärjestelmänä
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Web-pohjaisten sovellusten suosio on kasvanut vuosi vuodelta. Isot organisaatiot etsivät tapoja hyödyntää tietojärjestelmiensä dataa. Yksi tapa olisi tarjota tämä paikallisten tietojärjestelmien data web-pohjaisella sovelluksella, joka pääsee käsiksi samaan dataan jota paikalliset tietojärjestelmät hyödyntävät.

Tässä diplomityössä mallinnetaan web-pohjainen verkkokaupparatkaisu, joka integroituu Metson SAP R/3 tietojärjestelmään. Verkkokaupparatkaisun kokonaisvaltaisesti mallintavaa dokumentaatiota ei ole tällä hetkellä olemassa. Tässä diplomityössä esitellään verkkokaupparatkaisun peruskäsitteitä, arkkitehtuuria ja sitä miten se integroituu SAP R/3 järjestelmään. Verkkokaupparatkaisu on tuote, jonka nimi on Internet Sales. Verkkokaupparatkaisuun on saatavilla myös lisäosa nimeltään IPC, jonka vaikutusta verkkokaupparatkaisun arkkitehtuuriin tutkitaan myös. Verkkokaupparatkaisun rooli Metson liiketoimintaympäristössä kuvataan myös tässä diplomityössä.

Diplomityön tavoitteena on rakentaa kokonaisvaltainen malli verkkokaupparatkaisun eri komponenteista. Tässä tavoitteessa on onnistuttu. Verkkokaupparatkaisua tutkitaan työssä erilaisista näkökulmista: prosessi-, käsite-, sekä arkkitehtuurisella tasolla.

# ABSTRACT

TAMPERE UNIVERSITY OF TECHNOLOGY
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The use and popularity of web based applications has increased year by year. Large organizations have information systems and they are seeking ways to utilize data within different information systems with web based applications. One way would be to provide the data within local information systems with a web application which has access to the same data used by the local information systems.

This thesis describes a web shop application which integrates with Metso´s SAP R/3 system. Currently there is no specification of the overall architecture of Metso´s Internet Sales implementation and the aim of this thesis is to provide that information. This thesis presents the overall architecture of the web shop application and its integration with Metso´s SAP R/3 system. Also the key concepts of the web shop application are described. The web shop application is a product called Internet Sales. There is an add-in available for the web shop application called IPC, and its effect on the web shop architecture is also investigated. The web shop application´s role in Metso´s business environment is also explored.

A goal of this thesis is to create an overall model of the web shop application and its components. This goal has been achieved successfully. The web shop application is investigated at the process, concept, and architectural level.

## PREFACE

Writing this thesis has been an interesting journey into the world of web technologies and ERP systems. I would like to thank Professor Tommi Mikkonen and Esko Harjama for offering me the possibility to write this thesis and for their valuable input in the writing and design process.

Last but not least, I would like to thank my family and friends for supporting me during my studies. The writing of this thesis has been a fantastic and mind broadening experience.

Tampere, 9th April 2013

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# CONTENTS

# ABBREVATIONS

| | |
|---|---|
| **ABAP** | Advanced Business Application Programming. A programming language. |
| **AJAX** | Asynchronous Javascript and XML. |
| **API** | Application Programming Interface. |
| **B2B** | Business-to-business. |
| **B2C** | Business-to-consumer. |
| **CRM** | Customer Relationship Management. |
| **ERP** | Enterprise Resource Planning system. |
| **FTP** | File Transfer Protocol. |
| **GUI** | Graphical User Interface. |
| **HTTP** | Hypertext Transfer Protocol. |
| **Internet Sales** | SAP AG´s web shop product. |
| **IPC** | Internet Pricing and Configurator. A product which is part of Internet Sales. |
| **J2EE** | Java 2 Platform Enterprise Edition. |
| **JCo** | Same as SAP JCo. |
| **JSF** | JavaServer Faces. |
| **JSP** | JavaServer Pages. |
| **LDAP** | Lightweight Directory Access Protocol. |
| **Material** | SAP uses term material for product. In this thesis material is considered the same as product. |
| **Metso** | In this thesis term Metso refers to Metso Minerals Ltd. |
| **RFC** | Remote Function Call. |
| **SAP AG** | A company which has developed SAP R/3 system. |
| **SAP ECC** | SAP ERP Central Component. In this thesis it is considered as SAP R/3. |
| **SAP JCo** | SAP Java Connector. |
| **SAP R/3** | An ERP system. |
| **SAP WebAS** | Web application server. Also known as SAP NetWeaver Application Server or WebAS. |
| **TREx** | Text Retrieval and Information EXtraction. A search engine. |
| **UI** | User Interface. |
| **UME** | User Management Engine. |
| **Web shop** | A tool for online shopping. In this thesis web shop is the same as Internet Sales. |
| **WCEM** | Web Channel Experience Management. SAP AG´s web shop product. |

# 1 INTRODUCTION

Large organizations try to utilize their data as effectively as possible. One way to manage the data is to centralize the data in Enterprise Resource Planning (ERP) systems. Integration between ERP systems and web applications is a complex issue and requires the use of different kinds of APIs in different systems.

ERP systems can be used with a graphical user interface, which is offered usually as a desktop application. The problem is that the user interface does not always contain as good usability as web-based applications would. Or at least, the SAP R/3 system´s user interface is not as easily customized as a web application´s user interface. Moreover, web applications are not limited to certain hardware for running the applications in the way desktop applications are.

The main goal of this thesis is to represent the overall architecture of Metso´s Internet Sales solution and its main concepts. One of the problems is that currently Metso has no documentation of the overall web shop model. Having the architecture and concepts modeled helps Metso to improve its web shop development.

There are numerous ERP systems on the market. This thesis focuses on SAP R/3 system, which is an ERP system offered by a company called SAP AG. SAP R/3 is used as a backend system for a web shop solution called Internet Sales.

Chapter 2 describes the basic concepts regarding SAP R/3 system. What is SAP R/3 system and why do organizations use SAP R/3 systems? How is SAP R/3 system divided into different modules? What does SAP R/3 user interface look like?

SAP R/3 system offers web programming interfaces, which are discussed in Chapter 3. Chapter 3 answers the question - what kinds of ways does SAP R/3 system offer for establishing a connection to a web environment? Chapter 3 also presents how a web application establishes a connection to SAP R/3 system. These issues are viewed from the Java development point of view, because Internet Sales is implemented with Java.

Chapter 4 focuses on introducing key concepts regarding Metso´s Internet Sales solution. What is Internet Sales? What are the key concepts that Internet Sales utilizes? What kinds of processes are involved in the use of Internet Sales from a user´s point of

view? Chapter 4 includes information about Internet Sales when Internet Sales is not IPC enabled.

Chapter 5 describes the overall architecture that Internet Sales has. IPC is an add-in to Internet Sales and by enabling IPC in Internet Sales, the architecture changes. The change of the architecture is presented in chapter 5. Metso´s Internet Sales implementation is not the newest web shop solution which is available. Chapter 5 answers the question as to, what kind of architecture the latest web shop solution offered by SAP AG has?

Chapter 6 summarizes this thesis in a few sentences. What are the lessons learned? What kind of results did this thesis provide?

# 2 SAP R/3

SAP R/3 system is one of the most used ERP systems in the world. This chapter will introduce the basic concepts regarding the SAP R/3 system.

Section 2.1 introduces the history of the SAP R/3 systems development. It also introduces the main business areas where SAP R/3 is used.

Section 2.2 presents the system architecture of the SAP R/3 system. It shows how presentation, database, and controller layers are located from an architectural point of view.

SAP R/3 system is a large system and it is divided into modules. Section 2.3 briefly introduces most of the modules and their main mission.

Section 2.4 shows the graphical user interface of the SAP R/3 system. It answers the question: how does the SAP R/3 system look from a user´s point of view. It also states that the graphical user interface contains challenges in usability.

## 2.1 Introduction

MRP (Material Requirements Planning) during the 1960s and 1970s focused on production. What products are manufactured and what are the materials needed for manufacturing these products? Closed-loop MRP evolved from MRP, and it also contained sales planning, order-processing, forecasting, and production scheduling. The next step was MRP II (Manufacturing Resource Planning), which included sales and operational planning, financial interface and simulation capabilities in addition to closed-loop MRP. MRP II´s focus was still on manufacturing until ERP expanded the view to finance and accounting, customer relationship management, supply chain management and so on. [1]

The concept of ERP was invented in the mid-1990s. The Gartner Group coined the term ERP to refer to the next generation systems, which were different from the earlier ones. The biggest differences in comparison to the earlier systems were in the areas of relational database management, graphical user interface, client-server architecture, and open system capabilities. [2]

SAP R/3 is an ERP system [2]. It enables the transparency of data inside an organization. SAP R/3 system gives a competitive edge for large companies especially, because usually the benefits of centralizing and harmonizing data and business processes become more important on a large scale. Organizations can integrate different business units with SAP R/3 systems. The same data coming from a logistics department can be used in factories or in marketing departments. Organizations can also automate their business processes with the use of ERP system.

One of the largest software companies, called SAP AG, has developed the SAP R/3 system. The word "SAP" comes from the words "Systems, Applications, and Products in data processing". The letter R means "Real-time data processing" and number 3 means three-tier architecture, which includes 3 layers; the presentation, logic, and data layers. The previous versions of SAP R/3 have been named as SAP R/2 and SAP R/1. The newest version of SAP R/3 is SAP R/3 ECC 6.0 when writing this. SAP AG is a market leader in the ERP software market.

## 2.2 Architecture

SAP R/3 system can be viewed as a MVC (Model-View-Controller) model, as shown in Figure 2.1. The system consists of 3 layers: database layer (Model), presentation layer (View), and application layer (Controller) [3].

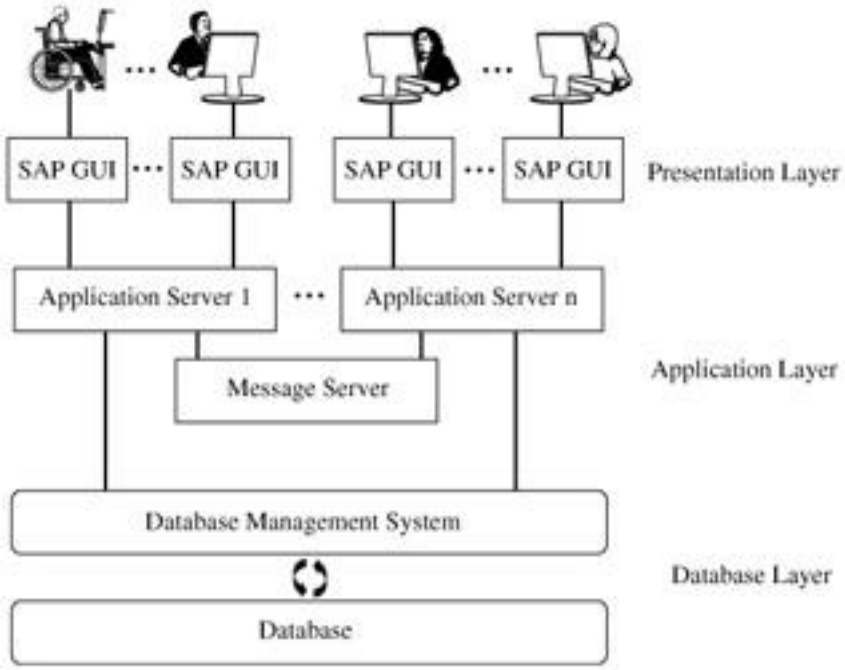


**Figure 2.1**: The architecture of SAP R/3 system [3].

The presentation layer takes care of showing data to users, and it allows users to view and input the data to the SAP R/3 system. It offers the user interface, which usually is a desktop application.

The application layer is a set of functions, which takes care of the communication between the presentation layer and the database layer. Functions are written in ABAP (Advanced Business Application Programming), which is a high-level programming language created by SAP AG. The application server contains work processes and queues for executing multiple tasks, as shown in Figure 2.2. The message server balances the load and exchanges messages. The message server is responsible for communication between the application servers.

The database layer consists of a database management system and the actual database. The database is a relational database which can be implemented with the following technologies for example: Adabas D, IBM UDB, Informix Adaptive Server, Microsoft SQL Server, or Oracle 8 [2]. The size of the database can be as large as 1.5 terabytes [2].

The database layer holds the data which the SAP R/3 system utilizes. It also holds the source code for the SAP R/3 system´s applications. The database contains master, transaction, and configuration data. Master data means an organization´s static data, like company codes, cost centers, and customer master. Transaction data is considered to be data which is created by a business activity, e.g. sales and purchase orders. Configuration data contains data needed in the application processing logic.

The dispatcher receives the request and sends the request to the queue. Then the dispatcher sends the request to the first available work process on a first-in, first-out basis. A work process handles one request at a time. The work process is linked to a memory area, and it contains the current data for the application program.

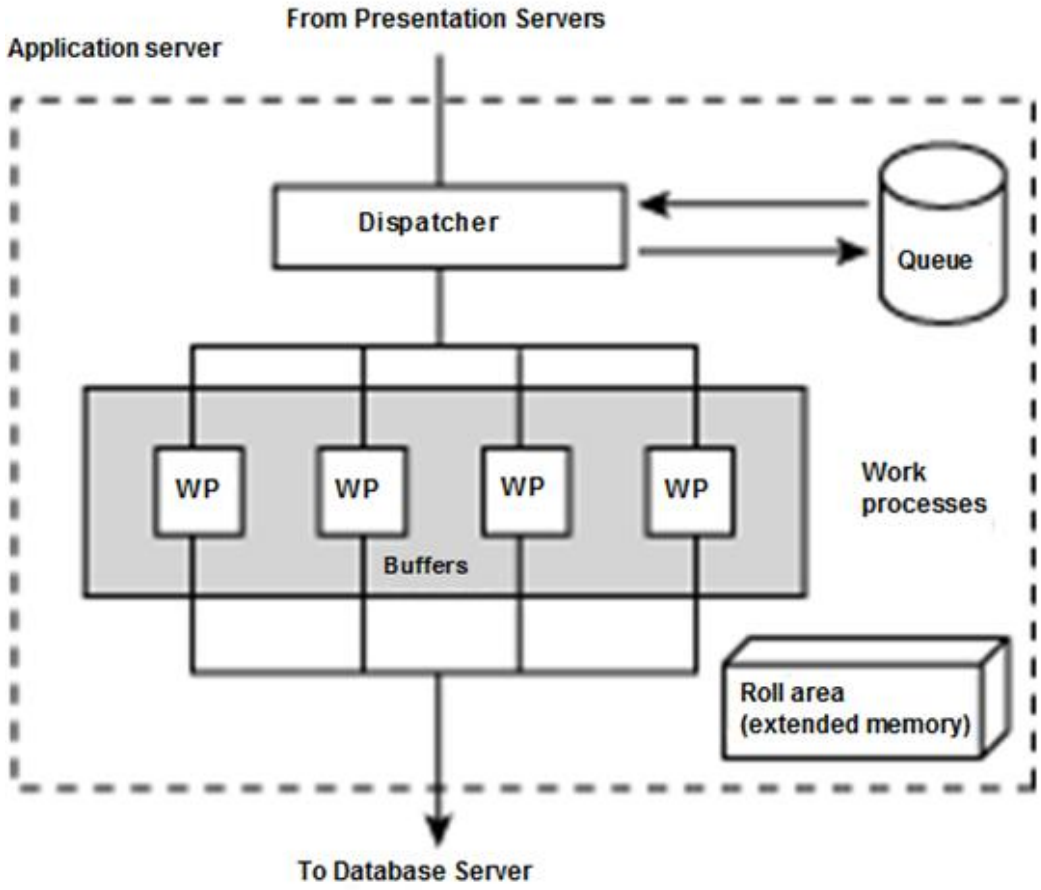


**Figure 2.2**: Application server in SAP R/3 system [3].

## 2.3 Modules

Different applications in the SAP R/3 system are divided into modules. Modules help users and developers to focus on different areas in SAP R/3. A module is like a set of applications which access the data within the SAP R/3 system. This set of applications is usually used with the SAP R/3 graphical user interface. Table 2.1 lists the most common SAP R/3 modules.

**Table 2.1.** *Most of the SAP R/3 modules [4]*

| Abbrevation | Module | Purpose |
|---|---|---|
| SD | Sales and Distribution | Managing the activities from receiving the order for a product to product delivery. |
| MM | Materials Management | Procuring and managing the material resources of a company. |
| PP | Production Planning | Planning the production phase of a product, such as the type of product and the quantity to be produced on the demand basis. |
| FI | Financial Accounting | Handling financial and accounting-related |

| | | |
|---|---|---|
| | | tasks. |
| CO | Controlling | Planning, reporting, and monitoring business operations in an organization. Mainly used by the management of an organization. |
| QM | Quality Management | Monitors the performance of various peripheral processes, such as planning and execution, and is incorporated into each and every step of the supply chain. |
| PM | Plant Maintenance | Operates the overall maintenance of business and functions. |
| HR | Human Resource | Includes personnel management, organizational management, travel management, time management, and payroll. |
| PS | Project System | Used for managing small- and large-scale projects. |
| WM | Warehouse Management | Assists users in processing movement of all goods and maintaining current stock of inventory. |

The web shop introduced in this thesis mostly utilizes the data which SD and MM modules also utilize. The SD module is needed for sales and customer data, and the MM module is needed for product data.

## 2.4 Graphical user interface

The SAP R/3 graphical user interface (GUI) is the same for developers and users. The motivation in this thesis has been the fact that SAP R/3 user interface is not as easily customized as web applications are. Customizing is required to fulfil the usability needs arising from end users.

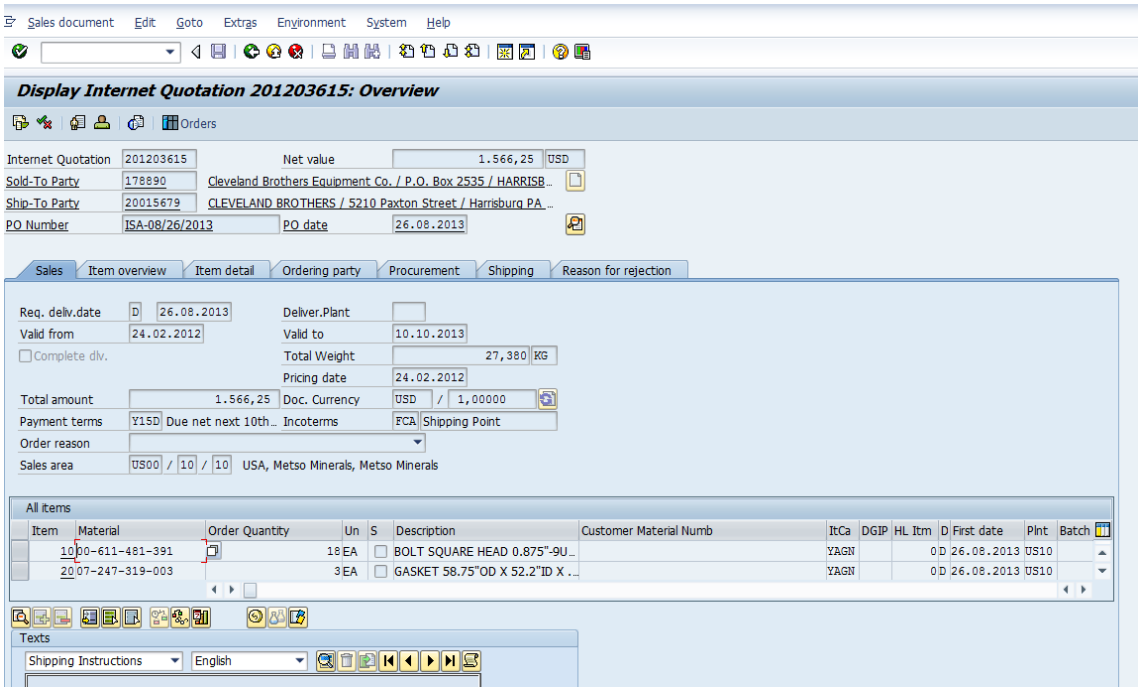


**Figure 2.3**: SAP R/3 graphical user interface when viewing a sales quotation.

Web technologies provide better usability and flexibility for the graphical user interface. Below are listed some of the key problems regarding usability in SAP GUI [5]:

- Understanding the layouts of screens is a complex task (UI presentation).
- Finding functionality and information is complex and tedious (navigation).
- Remembering how the different parts of the ERP system operate (learnability and memorability).

As shown in Figure 2.3, there are many tabs on the screen, and it is not easy to find out which is the right tab. Also, items under the “All Items” label need to be scrolled with a very small scrolling menu on the right, which makes finding the necessary information more difficult.

# 3 WEB INTEGRATION AND SAP R/3

An essential question is how web applications can access the SAP R/3 system. This chapter provides the answer to this question from the Java development point of view.

Web applications are deployed to a platform. Section 3.1 introduces some of the platforms which have been related to SAP AG´s web development.

Section 3.2 views the integration of SAP R/3 system into the web application. It provides an answer to the question: what interfaces the SAP R/3 system offers to Java web applications.

Section 3.3 views the integration from the web application´s point of view. It provides an answer to the question of what interfaces the Java application provides for accessing the SAP R/3 system.

## 3.1 Introduction

SAP AG has been trying to establish connectivity from SAP R/3 systems to the Web environment for over 10 years. Web applications are deployed to platforms, which either have or do not have the ability to integrate with SAP R/3 systems. Platforms are the main link between SAP R/3 system and web application. Below is a brief history of the platforms used for this purpose [6]:

- Internet Transaction Server (ITS): Developed by Ixos and introduced around 1998.
- Business Connector (BC): Licensed from webMethods and introduced around 1999.
- Customer Relationship Management (CRM)/Internet Sales: Built by SAP AG and introduced around 2000.
- Web Application Server (Web AS): Built by SAP AG and introduced around 2001.

There are also ready-to-use web applications which communicate with SAP R/3 systems. The key technologies, which enable the integration between any kinds of web applications and SAP R/3 system, are the interfaces which the programming language

offers. In Java, there is JCo (Java Connector) which is an API for communicating with SAP R/3. Also, web services can transfer data from the SAP R/3 systems to the web application but JCo is used more in Java based applications.

## 3.2 SAP R/3 programming interfaces

SAP R/3 offers interfaces which allow external applications or interfaces to connect to a SAP R/3 system. It is possible to integrate relational database systems, such as Oracle, mySQL, DB2, or Microsoft SQL-Server to SAP R/3 system. SAP R/3 programming interface lets other external programs invoke SAP R/3 function modules via RFCs (remote function calls) or RPC (remote procedure calls). [6]

RFC plays a crucial role in Java-based application integration to SAP R/3. It is a very widely used mechanism in that area. It enables a connection between SAP R/3 and non-SAP systems. When a function is RFC-enabled in SAP R/3 system, it is possible to send and receive data outside SAP R/3.

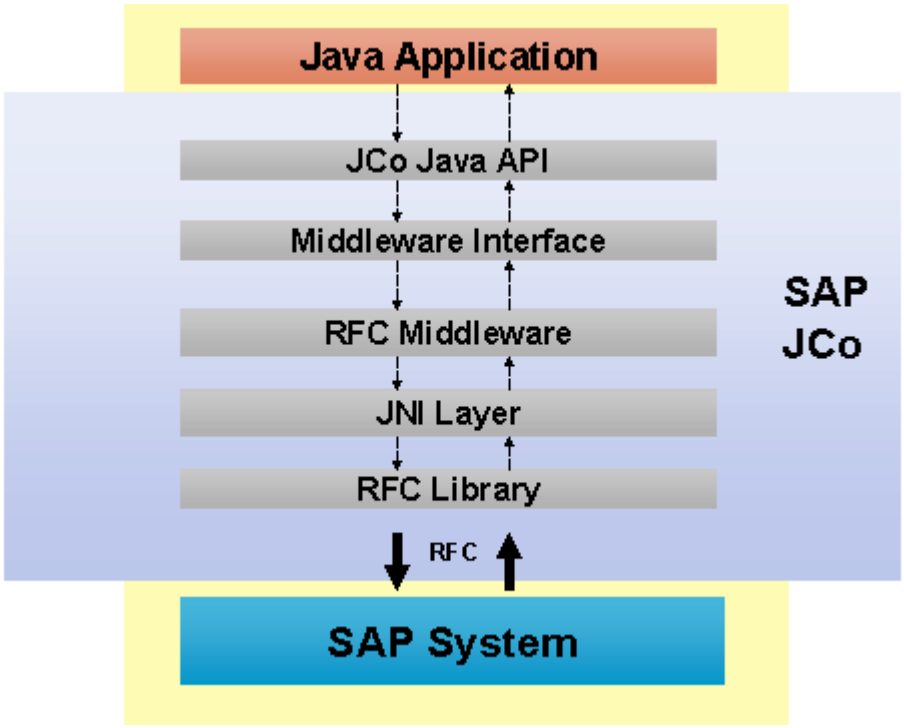


**Figure 3.1**: RFC in action. [7]

As shown in Figure 3.1, Java application connects to SAP R/3 system through JCo (Java Connector). RFC middleware interface and JNI Layer (Java Native Interface) convert the Java-based function call to ABAP, which is the programming language for functions located in SAP R/3. After conversion the function call can be executed in SAP R/3. [7]

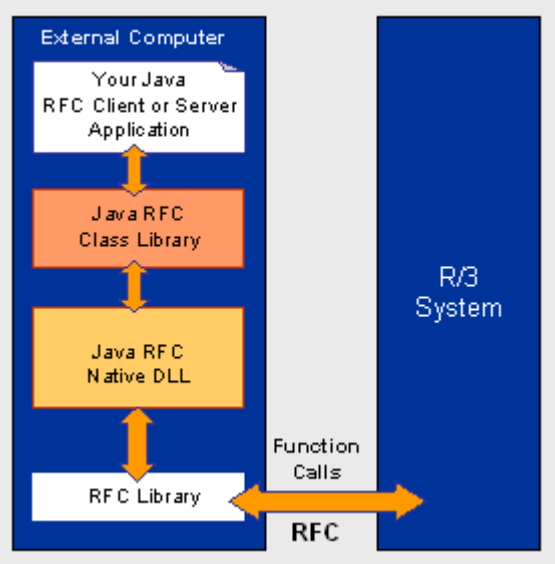


**Figure 3.2**: More details of RFC layers [8].

As shown in Figure 3.2, basic communication using the RFC function starts with the RFC library. Java RFC native DLL is the implementation of the JNI layer. Java RFC Class Library represents implementation of Java RFC classes. Finally, the application connects to the R/3 system. [8]

RFC function can retrieve any kind of data from SAP R/3 system. RFC functions are implemented with the ABAP programming language. ABAP is used for any kind of function in SAP R/3 system.

## 3.3 Web programming interfaces

JCo is the interface which enables the connectivity from a Java application to the SAP R/3 systems. As shown in Figure 3.1, JCO is the first layer that Java application calls, when the application tries to connect to the SAP R/3 system. JCO supports communication in both directions; inbound calls (Java calls ABAP) and outbound calls (ABAP calls Java). JCo can be installed by downloading the `sapjco3.jar` and `sapjco3.dll` files. Figure 3.3 shows the essential steps needed for retrieving data from SAP R/3 using JCo.

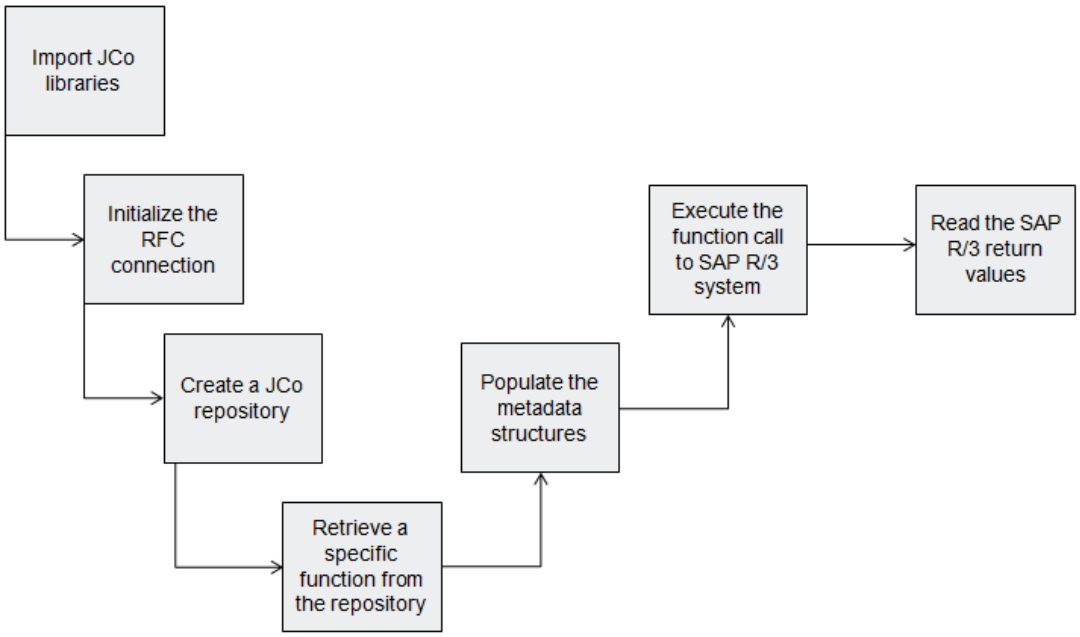


**Figure 3.3:** Using JCo and RFC functions and retrieving data from SAP R/3 system.

The steps presented in Figure 3.3 are described in more detail below. An example code is included for demonstrating each step in more details.

**Import JCo libraries.** Necessary libraries are needed for the Java application, so that APIs for JCo connection are available. As shown in programme 3.1, the library is named `com.sap.mw.jco`.

**Initialize the RFC connection.** Authentication is needed to open connection to SAP R/3 system and the connection needs to be opened. Programme 3.1 shows the `aConnection` variable, which creates the connection with the `connect()` method.

**Programme 3.1**: *Initialize RFC connection, create a JCo repository, and retrieve a specific function from the repository [9].*

```
import com.sap.mw.jco.*;
public class MaterialList {
    public static void main(String[] args) {

    final String SAP_CLIENT ="100";
    String USER_ID = "username";
    String PASSWORD = "password";
    String LANGUAGE = "E";
    String HOST_NAME = "hostname";
    String SYSTEM_NUMBER = "00";
    String matSearch;
    JCO.Client aConnection;
```

```
    IRepository aRepository;

    System.out.println("This class looks up materials.");
    try {
        aConnection = JCO.createClient(SAP_CLIENT,
                                       USER_ID,
                                       PASSWORD,
                                       LANGUAGE,
                                       HOST_NAME,
                                       SYSTEM_NUMBER);
        aConnection.connect();
        aRepository =
        new JCO.Repository("SAPRep",      aConnection);

        IFunctionTemplate functionTemplate =
        aRepository.
        getFunctionTemplate("BAPI_MATERIAL_GETLIST");

        JCO.Function function =
        new JCO.Function(functionTemplate);
        // See programme 3.2 also, it could
        // be added to this place also.
        }
    catch (Exception ex) {
        System.out.println("Call to SAP has failed.");
    }
    }
}
```

**Create a JCo repository.** A variable is needed to store all the parameters and structures which are needed when communicating with RFC function. In Programme 3.1, the variable `aRepository` holds this data.

**Retrieve a specific function from the repository.** In this example, the `functiontemplate` variable retrieves the repository regarding RFC function `BAPI_MATERIAL_GETLIST`. The variable `functiontemplate` holds all the data structures which the `BAPI_MATERIAL_GETLIST` uses (field types, structures, relationships).

**Populate the metadata structures.** Usually functions require parameters. This step includes inputting the needed parameters so that RFC function is can be executed. Programme 3.2 shows how the `tabParams` and `materials` variables first retrieve the

structures from RFC function, and then the structures are filled up with parameters which can be shown as methods used for the `materials` variable.

**Programme 3.2**: *Continuing the idea presented in Programme 3.1, and populating the metadata structures. Finally executing the function call to SAP R/3 system and retrieving the return values regarding the function call. [9]*

```
JCO.ParameterList tabParams =
function.getTableParameterList();
JCO.Table materials = tabParams.getTable("MATNRSELECTION");
materials.appendRow();
materials.setRow(0);
materials.setValue("I", "SIGN");
materials.setValue("CP", "OPTION");
materials.setValue(matSearch, "MATNR_LOW");
aConnection.execute(function);

JCO.ParameterList resultParams =
function.getExportParameterList();
JCO.Table materialList =

resultParams.getTableParameterList().getTable("MATNRLIST");
```

**Execute the function call to SAP R/3 system.** In this example this step includes opening the connection to SAP R/3 system and then the `BAPI_MATERIAL_GETLIST` function is executed with needed parameters.

**Read the SAP R/3 return structures.** After execution, function might return some values and those are read in this step. In Programme 3.2, `resultParams` variable first stores the the structure and metadata regarding the return values, and then `materialList` stores the specific data from that large structure. In this example the contents of the `materialList` variable could now be iterated and the return values could be printed on the screen of the web application.

## 3.4 Platforms

SAP Web Application Server (WebAS) is a platform for running web applications. WebAS enables integration to the SAP R/3 or to the IBM WebSphere portal for example. SAP WebAS is based on Java and ABAP. It is a platform for running applications integrated to SAP R/3 system. SAP WebAS is part of the SAP NetWeaver product family.

In Figure 3.4, a rough interpretation is provided, in which the J2EE Engine includes the Web application server Java, which provides the platform for running web applications. The ABAP engine includes the processes which are needed for running the SAP R/3 system. The ABAP engine is also called Web Application Server ABAP. In that sense, the ABAP engine can also be considered the same as the SAP R/3 system. The components and architecture of the SAP R/3 system were presented in Section 2.2.

Each engine has its own database. Communication between the J2EE Engine and the ABAP engine is established with JCo FastRFC, which is almost the same as JCo RFC, but JCo FastRFC allows switching the communication to shared memory instead of TCP/IP. JCo FastRFC is only available if the J2EE Engine and the ABAP engine are physically on the same server. SOAP could also be used also for connectivity between the two engines but that is applicable for loosely coupled applications. [11]

Internet Communication Manager (ICM) listens to several ports from ABAP and J2EE engines, and it is capable of receiving URL (server/port) via HTTP/HTTPS/SMTP protocols and selecting the correct target engine needed [12]. As we can see, users who use SAP R/3 graphical user interface access the SAP R/3 system directly without the ICM.

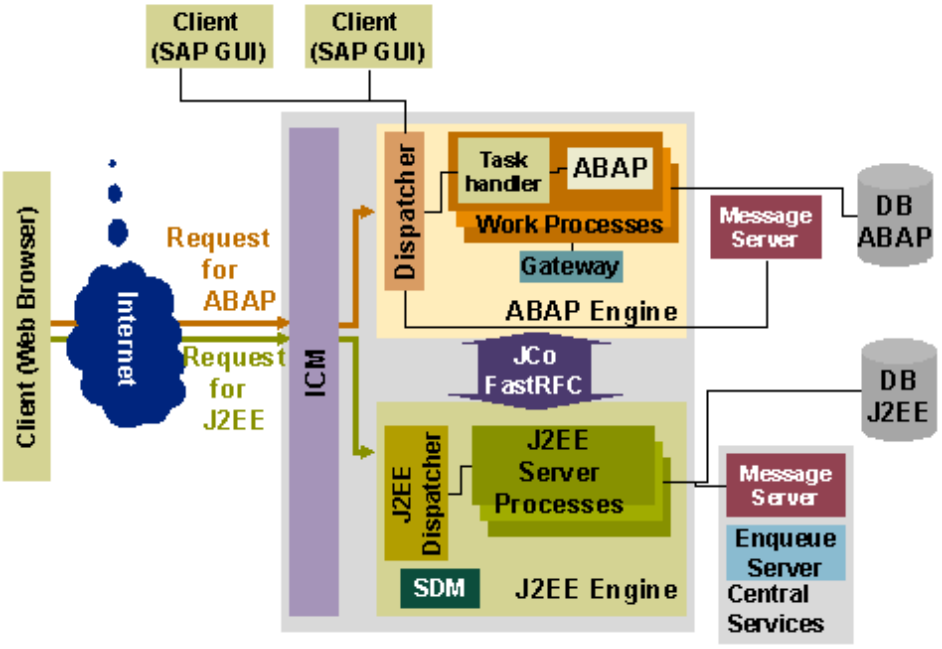


**Figure 3.4**: The overall architecture of SAP WebAS [10].

Figure 3.5 introduces the J2EE engine description in more details. The architecture consists of 3 different instances, which can be located on different servers in order to increase system performance. The dispatcher receives requests and communicates them to the server. The dispatcher is like an internal load-balancer which decides where the

message request will be delivered. Server processes are responsible for processing the requests and storing the user session. SDM (Software Deployment Manager) is located on the main server and it is a tool for deploying applications on the J2EE engine where WebAS Java is running. [13]

The message server takes care of the communication between dispatcher and server. It also keeps track of the state of different instances indicating whether they are on or off. The enqueue server maintains a lock table which determines data access to portal applications, components, and services. Whenever data access is needed to an object, the request goes first to the enqueue server. [13]

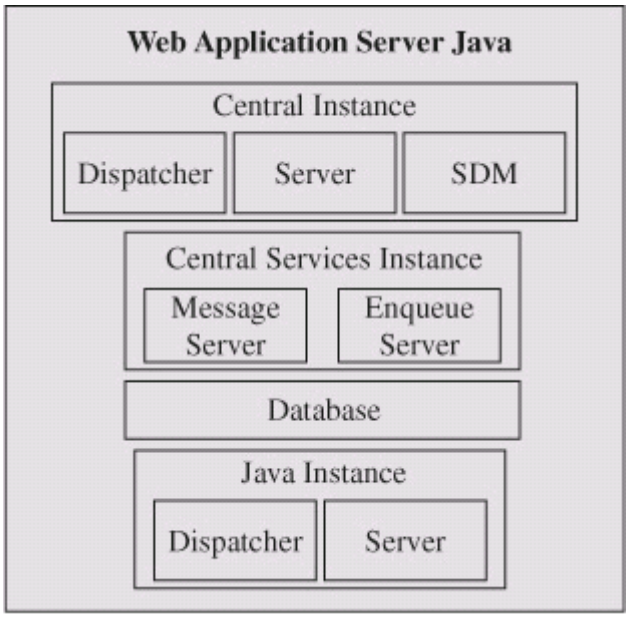


**Figure 3.5**: The architecture of WebAS Java [2].

WebAS Java includes several ready-to-use products, such as defined layouts and functions for portal developing. It also has some solutions for managing the SSO (Single Sign-On) and integration to SAP R/3 systems. The disadvantage of WebAS Java is the performance, but that could be avoided by decentralizing the instances to multiple servers which divide the overall load into smaller pieces.

# 4 INTERNET SALES

Internet Sales is a web shop product offered by SAP AG. Metso is using this product and Metso´s Internet Sales implementation contains the same kind of system architecture as SAP AG´s standard Internet Sales product contains. Naturally some customizing and modifications have been made to Metso´s Internet Sales implementation. Metso has been successfully using Internet Sales for many years now.

The main goal of this chapter is to provide information about Internet Sales. Internet Pricing and Configurator (IPC) is also mentioned, but Metso is not currently using IPC in its web shops. In that sense, the focus in this chapter is in Internet Sales and its main concepts.

Section 4.1 describes what Internet Sales is. What basic elements are involved in Internet Sales? What is IPC´s relation to Internet Sales?

Section 4.2 describes the key concepts regarding Internet Sales. What is a user and what kind of relationships does a user have with other Internet Sales´ key concepts? What are a product and a catalog and how are they related to Internet Sales?

Section 4.3 examines the processes. How is Internet Sales used? What kind of use cases are related to Internet Sales?

## 4.1 Introduction

Figure 4.1 represents the basic components of Internet Sales. IPC (Internet Pricing and Configurator) is a part of Internet Sales. Internet Sales can also be used without IPC.

The benefit of using IPC is that it also enables selling configurable products, which requires several selections made by the user. A car is an example of a configurable product; it requires several selections by the user (engine type, colour, interior, etc.). Internet Sales without IPC is used for selling standard products like hoses and nuts, which do not require any selections from the user. A nut is like a standard product; it has static measures like weight and it does not require any configuration. IPC is like an add-in inside Internet Sales.

In addition to using SAP R/3 as the backend system, Internet Sales uses another database also which is located in the WebAS Java server. This database is called TREx (Text Retrieval and Information Extraction). Internet Sales retrieves most of the data directly from SAP R/3 (e.g. customer and price data). Some data is retrieved directly from the database (e.g. product data).

SAP R/3 replicates the product data to the database, and Internet Sales has access to the same database. One may ask why an additional database is needed? Why is all data not retrieved directly from SAP R/3? The answer is that there can be tens of thousands of different products, and the user needs to see all those products when he/she logs in to Internet Sales. It would cause unnecessary load to the SAP R/3 system if those products would be retrieved directly from SAP R/3 every time the user accesses Internet Sales. Instead, those products can be replicated in the database once a day for example.

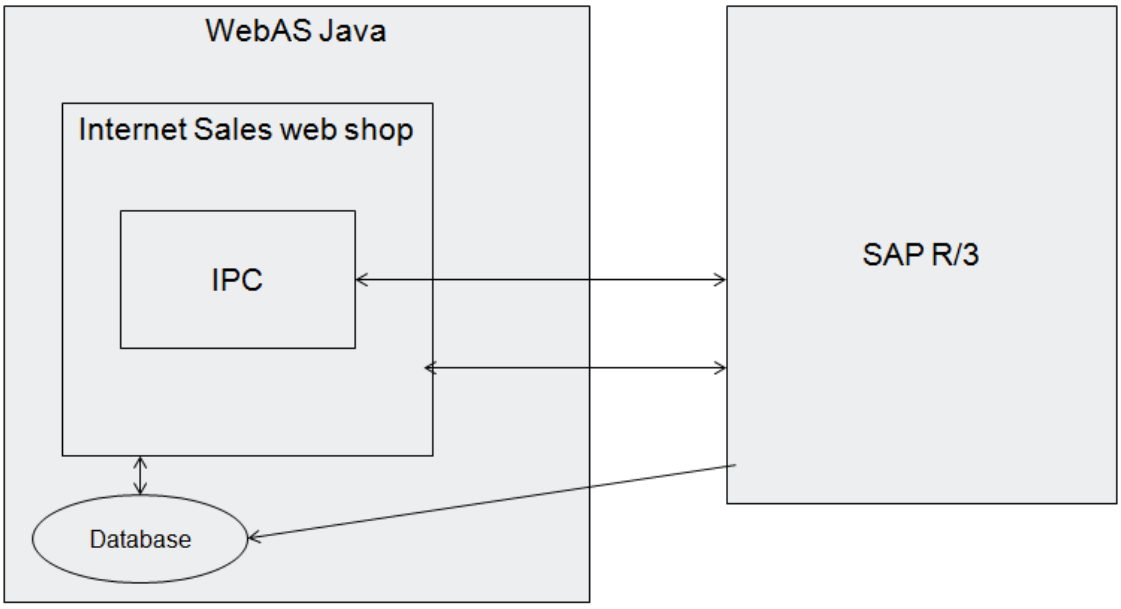


**Figure 4.1:** Basic system components of Internet Sales.

As shown in Figure 4.2, the database contains a catalog, which contains all the products. The catalog is replicated from SAP R/3 system to the database.

In Figure 4.2, the user always represents a customer. Customer data is stored in the SAP R/3 system, and Internet Sales accesses that data directly without the use of an additional database. If the user wants to see the price of a product, Internet Sales retrieves the price and availability for the product directly from the SAP R/3 system.

One may ask why not store customer, price, and availability data in the database? The reason is that prices can change many times a day. Availability data changes every time new orders are made, because the number of products in the warehouses changes when new orders come in.

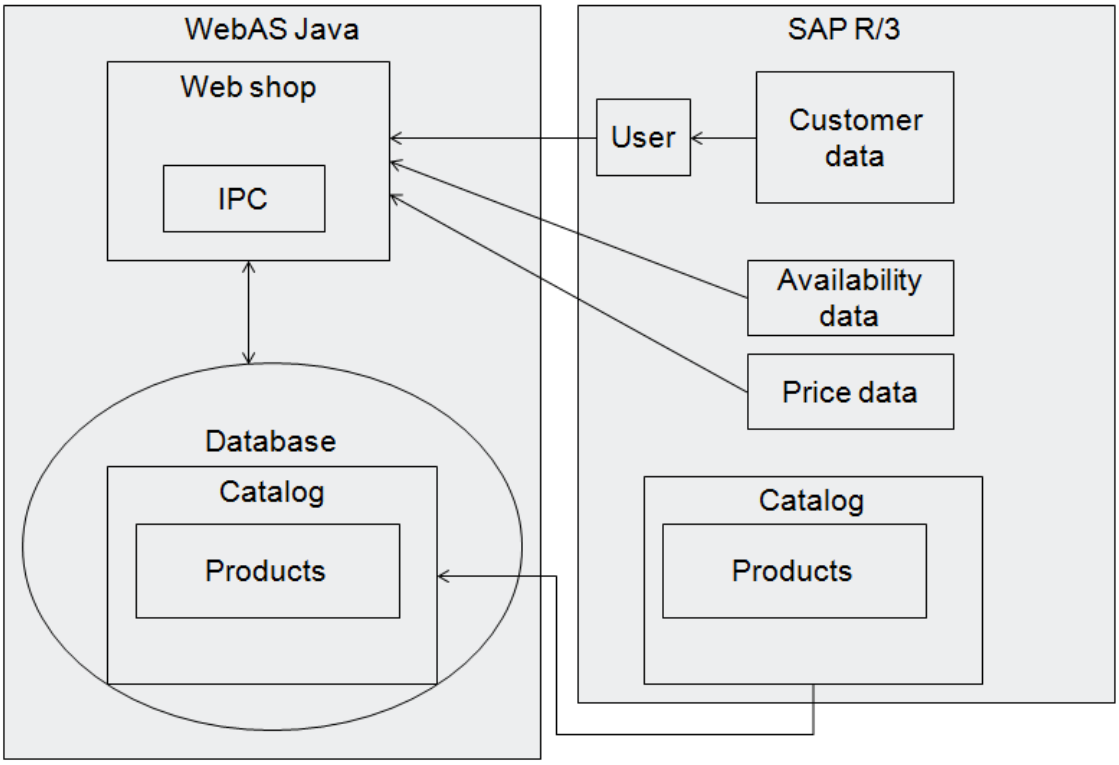


**Figure 4.2**: Key concepts of Internet Sales and their relations in system architecture.

Internet Sales can be accessed with a web browser. Figure 4.3 shows the first screen the user sees after login. There are several choices the user can do in the screen Figure 4.3 represents. These choices are provided by links. The user could search for orders which have been created earlier (Search for Orders), browse what products are sold in the web shop (Browse in the Product Catalog), or create a new order or quotation (Create new shopping basket). There are many other functions as well.

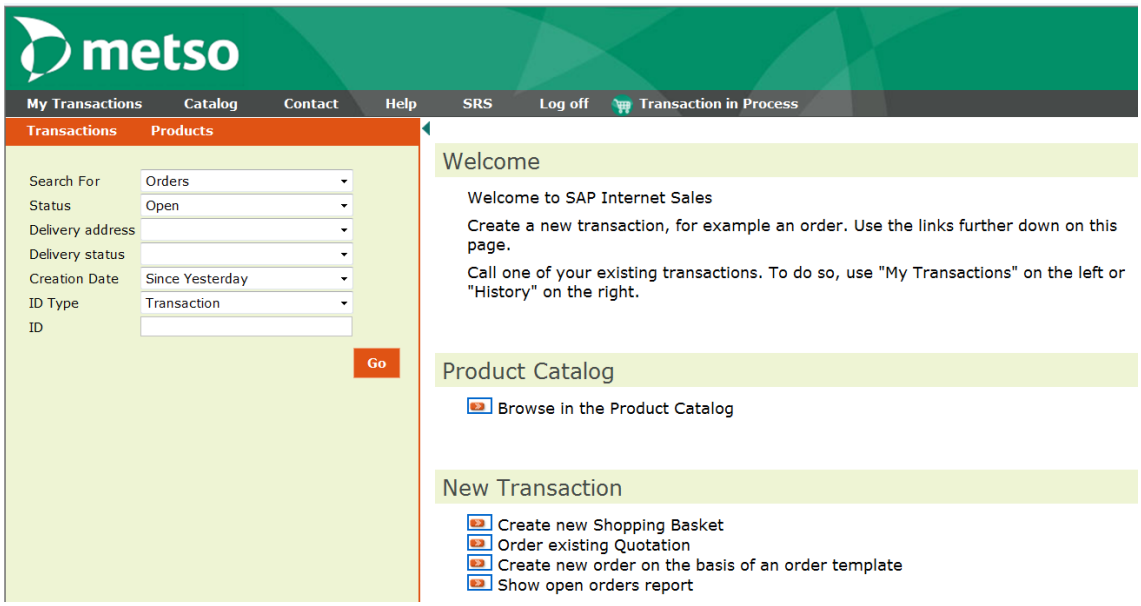


**Figure 4.3**: Internet Sales user interface. The front page of Internet Sales.

Figure 4.4 shows the user interface of IPC. The user accesses IPC user interface in the web shop which Internet Sales provides. The user interface of IPC is basically only one web page which contains the configurator of the product. Every other web page of the web shop can be considered the same as Internet Sales. In that sense, IPC´s part of Internet Sales is rather small.

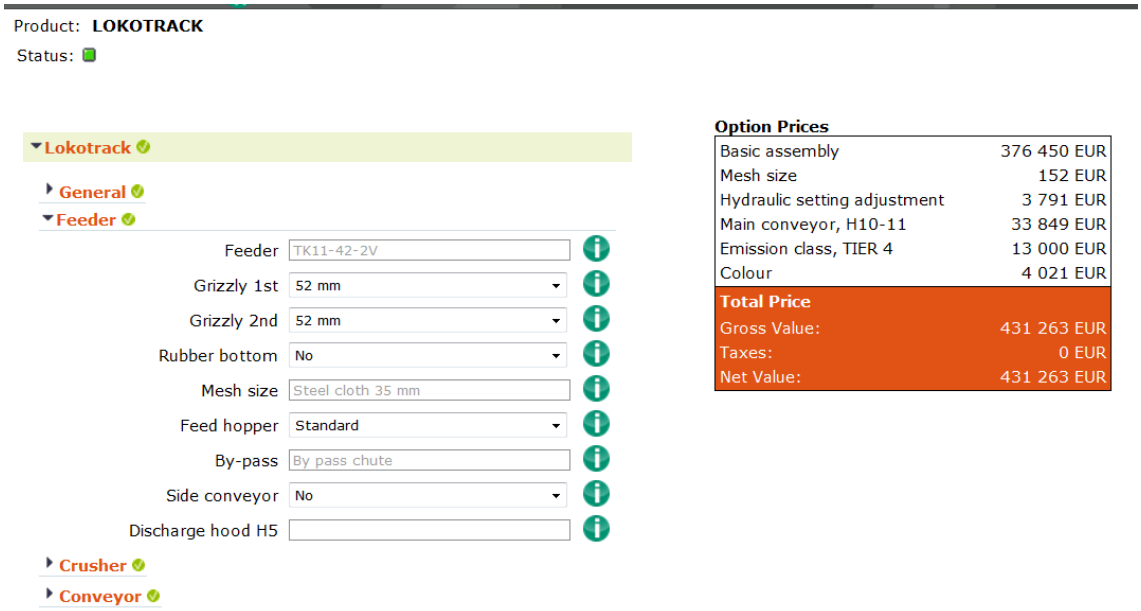


**Figure 4.4**: IPC user interface. IPC is part of Internet Sales and it is only one web page which can be accessed from Internet Sales.

The look and feel of Internet Sales is different to the SAP R/3 graphical user interface, which was presented in Section 2.3. One may say that the user interface is more elegant and user-friendly when compared to the SAP R/3 graphical user interface.

## 4.2 Key concepts

To understand Internet Sales, key concepts need to be clarified. User, product, and catalog are the key concepts of Internet Sales. This section will provide the technical background regarding these concepts and how they apply in Metso´s business ecosystem.

### 4.2.1 User

In Metso´s Internet Sales implementation, the user can be considered as a distributor or agent who sells Metso´s products on behalf of Metso. A distributor sells the product to the end customer after first buying the product from Metso. There are also situations where a Metso employee uses Internet Sales. Usually in that case the Metso employee does not have access to SAP R/3 and that is the reason why Internet Sales is needed.

Also there are very rare cases in which the end customer buys the products directly from Internet Sales.

There are at least two kinds of buying types which occur via Internet Sales. These are presented below.

a) A distributor buys the products for their own stock. The distributor stores the products and slowly sells the stock items to the end customer.
b) An end customer calls the distributor to inform that they urgently need a certain product. The distributor places an order via Internet Sales and demands a fast delivery time for the product. Metso should deliver the products the same day as the order has been received, if they are highly critical for the customer´s business.

The above scenarios set some requirements for Internet Sales. Internet Sales needs to be available whenever needed. It has to be accessible 24/7, and it has to provide integration to SAP R/3 systems, which decreases order handling time. It would not be acceptable that a distributor has places a highly critical order via Internet Sales and the order disappears from SAP R/3 systems. That would cause a situation where the distributor is waiting to receive a product, but no one is aware that the product needs to be delivered to the distributor.

The sales process between Metso and a distributor can be considered a B2B process, meaning business to business. The sales process occurs between the distributor´s company and Metso. From a technical point of view, Internet Sales also enables the sales process of B2C, which means Business to Customer. In Metso´s case B2C is not needed. In a B2B process, Internet Sales requires that the user has to belong to a company. Every user is attached to a company in the SAP R/3 system as shown in Figure 4.5.

In Figure 4.5, the customer company can be considered to be the distributor´s company. The user is linked to a customer contact, which is the actual person who is working for the distributor´s company and placing an order via Internet Sales. Ship-to-party is the partner who will receive the products. Ship-to-party is conceptually separated from the customer because ship-to-party´s address can be different from the customer´s address. A forwarding agent takes care of shipping the products. The forwarding agent is linked to a customer because different customers can have different forwarding agent partners. The Metso contact is Metso´s employee who is the distributor´s contact from Metso´s side.

Each customer company is linked to one or several sales areas. A sales organization is a selling entity in the SAP R/3 system. A distribution channel is the channel to be used for

distributing products to the market. Division represents one of the various product divisions that exist in a sales organization. [4]

Sales area data is created when a customer company is linked to a sales area. Sales area data defines some customer information for that specific sales area. For example, the customer´s company could have different kinds of Incoterms (International Commercial Terms) and shipping conditions in different sales areas.

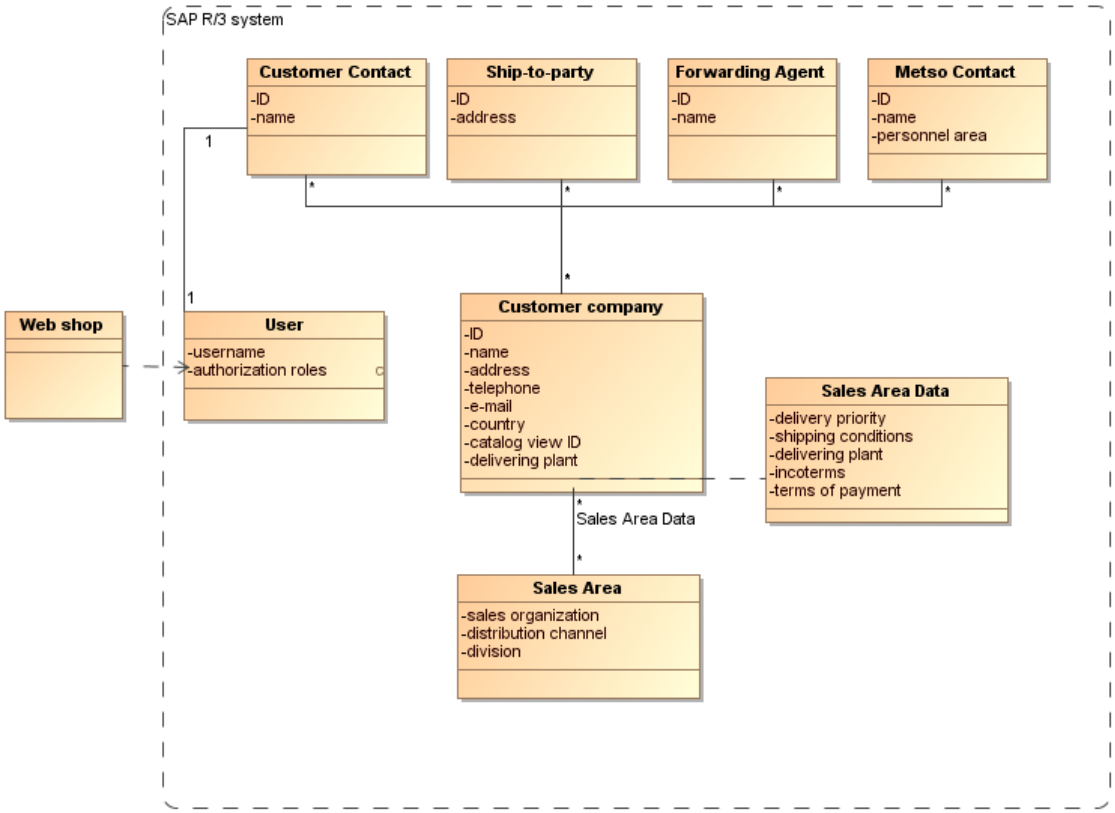


**Figure 4.5:** Key concepts regarding the user in Internet Sales. The SAP R/3 system is used for storing and maintaining this data.

Figure 4.6 helps to understand how a sales organization is defined in SAP R/3. Corporate group is the highest of all organization units in the hierarchy, and corresponds to a retailing company with several subsidiaries, which are defined from a financial accounting point of view as individual company codes [15]. Company code is the smallest organizational unit of external accounting [16]. A sales organization takes care of selling the products, which are manufactured in a plant. Products are stored in warehouses, and each warehouse can contain storage bins where the products are stored.

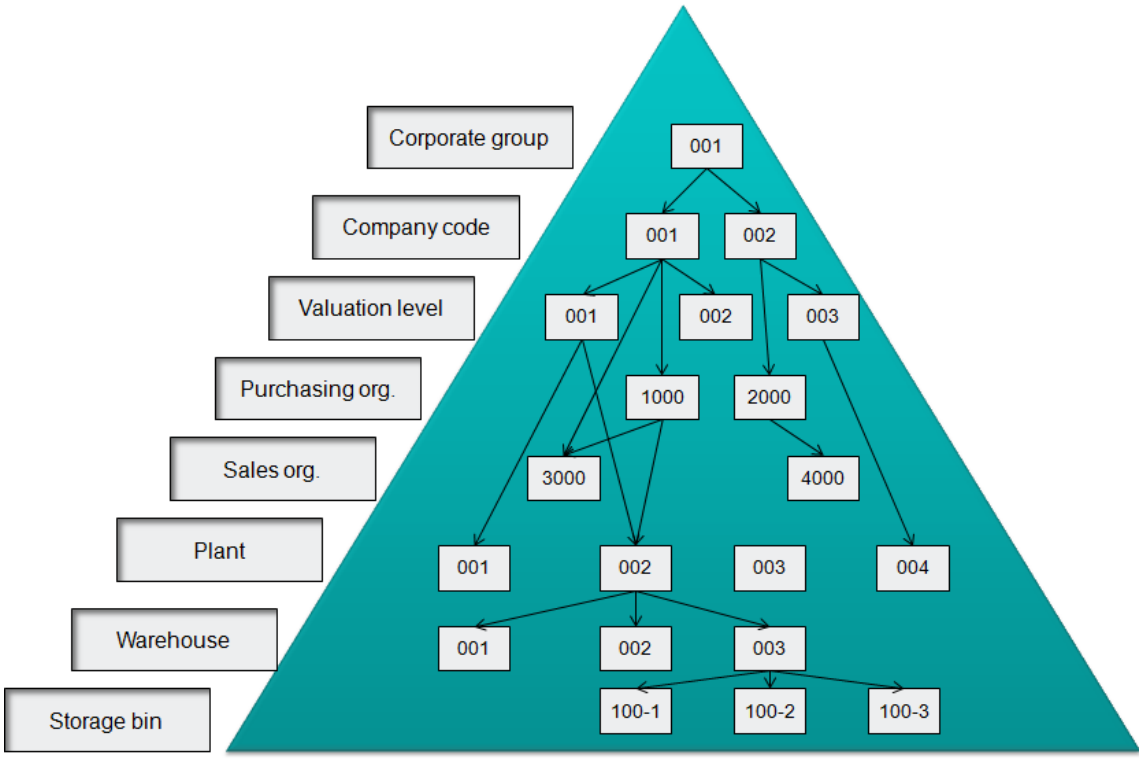


**Figure 4.6**: SAP R/3 definition of organizational structure [14].

Customer data is maintained in the SAP R/3 system as shown in Figure 4.7. Internet Sales is able to access customer data in real-time.

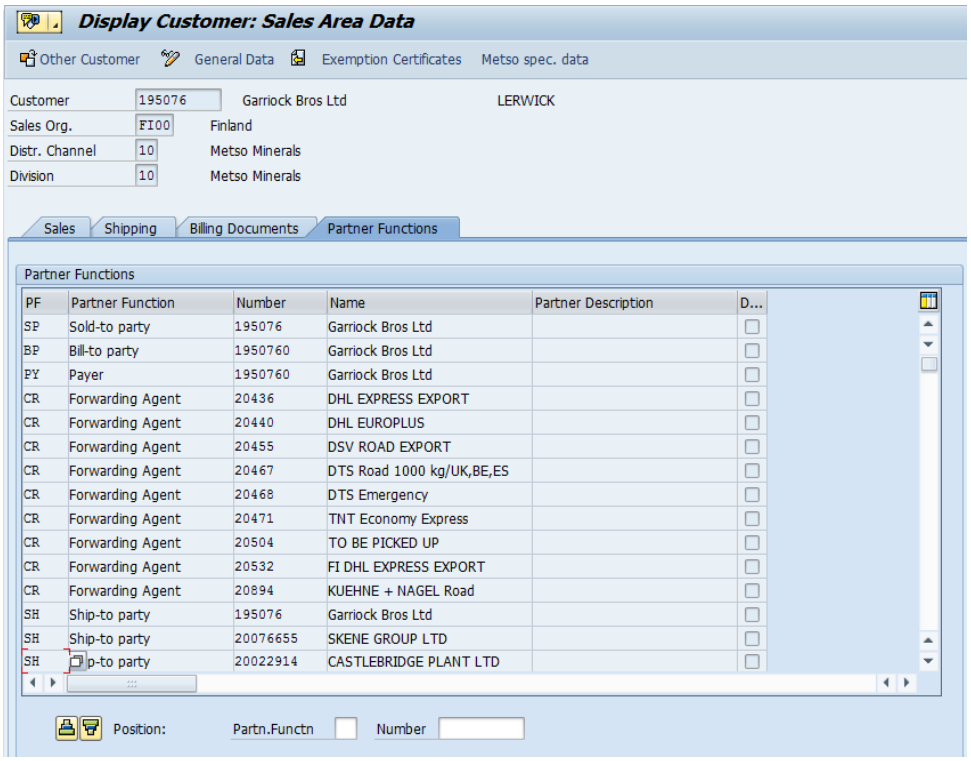


**Figure 4.7**: Maintaining customer data in the SAP R/3 system.

In Internet Sales, the end user accesses the same customer data, which was described in Figure 4.7. As shown in Figure 4.8, the user can input forwarding agent, ship-to-contact, customer contact, and many other customer dependant data. After inputting the data in Internet Sales, the user can make an order or quotation. After saving the order or quotation in Internet Sales, the same data is also available in the SAP R/3 system.

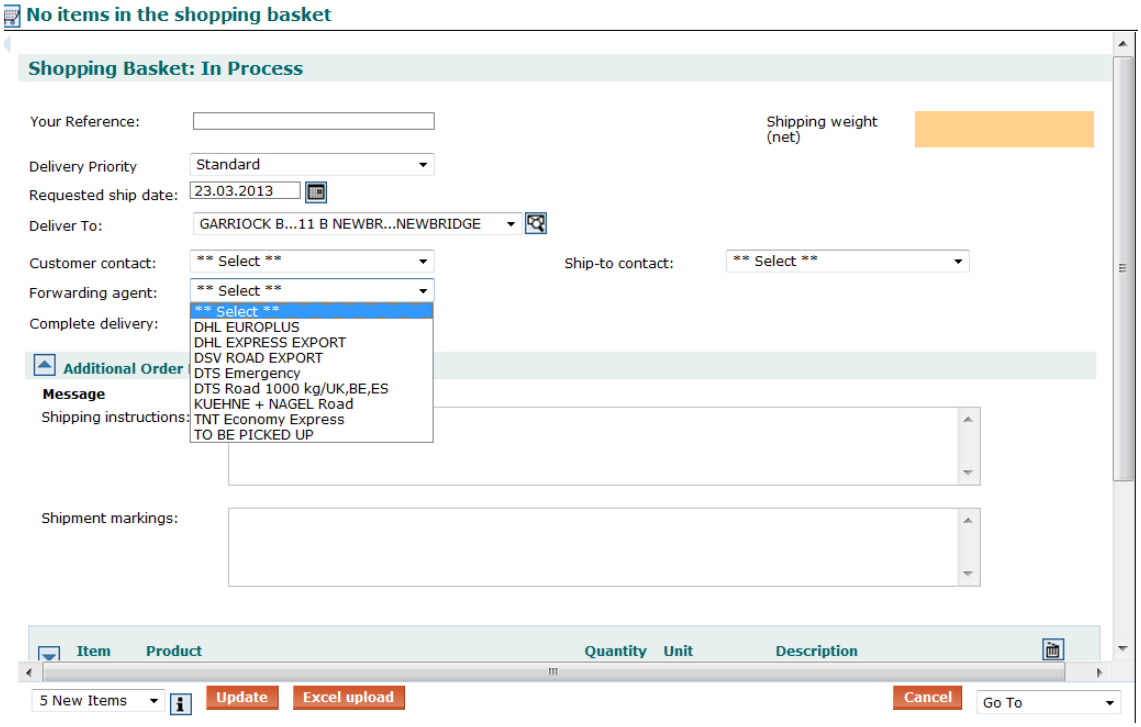


**Figure 4.8**: User accessing customer data in Internet Sales.

This subsection proved that from the web shop´s point of view, the user is the link to customer-specific data located in the SAP R/3 system. The next subsection will introduce what kinds of products are sold via Internet Sales.

### 4.2.2 Product

A distributor can order spare and wear parts via Metso´s Internet Sales implementation. Spare and wear parts are standardized products which have static measures, and they are all defined in the material master data in SAP R/3 system. There are different kinds of products which can theoretically be ordered:

a) Standard products. A hydraulic hose of a crushing plant could be considered a standard product.
b) Kit products. A kit product consists of several standard products. An example of a kit product would be a product which contains a blade, tensioner, and a main frame. A kit product is a set of products.

c) Configurable products. A crushing plant can act as an example of a configurable product. A configurable product can consist of hundreds of different products and ordering a configurable product requires many selections to be made, e.g. selection of the engine type and colour of the product.
d) Services. Maintaining crushing plants requires maintenance work and inspections. This service could be ordered as a service product.

Currently Metso´s implementation of Internet Sales enables the selling of standard products and kit products. These contain a simplified definition of prices and availabilities. At least, the customer´s sales organization, delivering plant, and product number are needed for determining a price for the product in the SAP R/3 system. Internet Sales calls the pricing functions directly from SAP R/3.

Selling services is theoretically possible if services are maintained as products in the SAP R/3 system. Configurable products, however, require a configuration tool for the user. Internet Sales contains this feature, but it is not enabled as default. IPC offers the configuration tool and it can be used for that purpose. One configurable product can consist of over 1000 different spare and wear parts. This means the pricing structures and rules are also more complex in the SAP R/3 system, and they are recalculated when the user changes the configuration of the product.

### 4.2.3 Catalog

There can be several web shops, and each web shop can have their own catalog. One catalog can contain thousands of different kinds of products. A catalog includes the overall hierarchy for a product as shown in Figure 4.9, which can be explained by the examples below:

- A catalog contains several product hierarchies (e.g. computers).
- Product hierarchies contain material groups (e.g. laptops).
- Material groups contain external material groups (e.g. Lenovo laptops).
- External material groups contain products (e.g. Lenovo W520 laptop).

As shown in Figure 4.9, the hierarchy is flexible. It is possible to have a structure where only a catalog, product hierarchy, and products, exist for example, and other hierarchies (material groups and external material groups) would be removed.

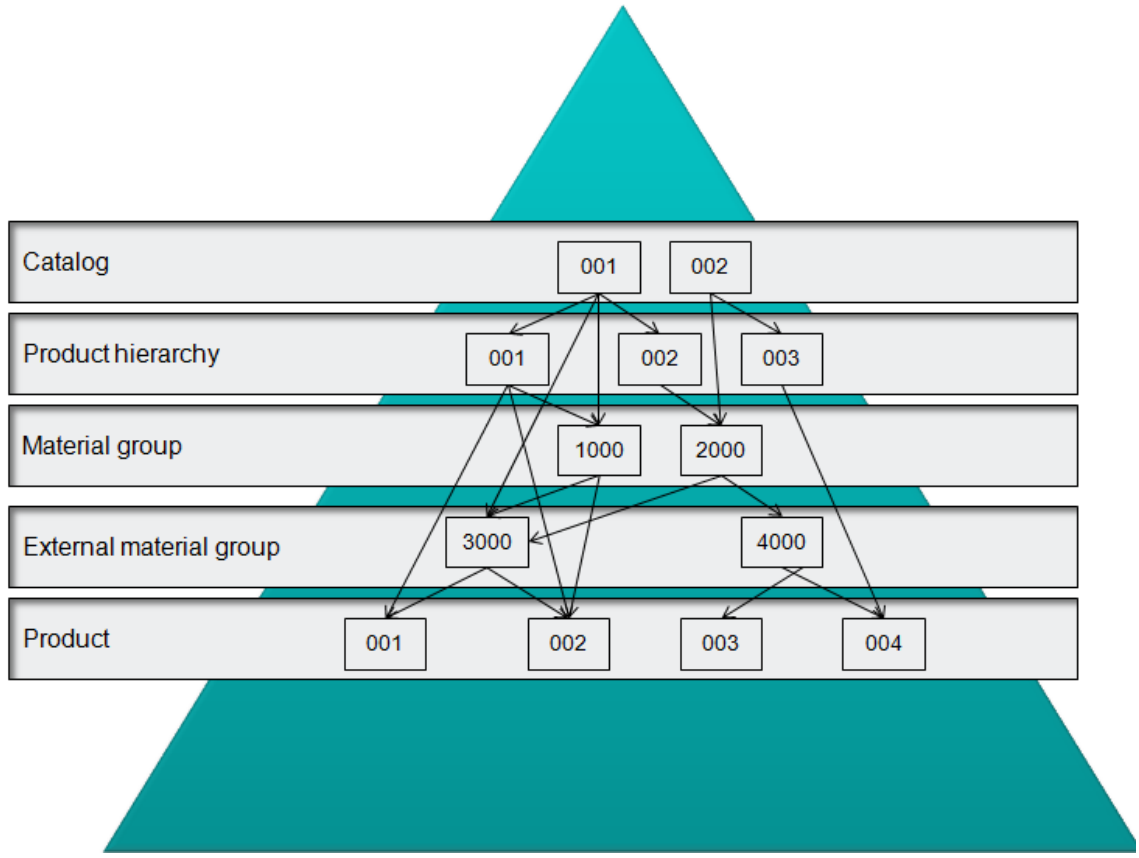


**Figure 4.9**: Overall product hierarchy and its relationship to catalog.

Contents of product catalog are maintained in the SAP R/3 system, as shown in Figure 4.10. There are two materials added to the `FI10_CAT` catalog in Figure 4.10. The term material in Figure 4.10 means the same as a product. Material is SAP´s terminology for products.

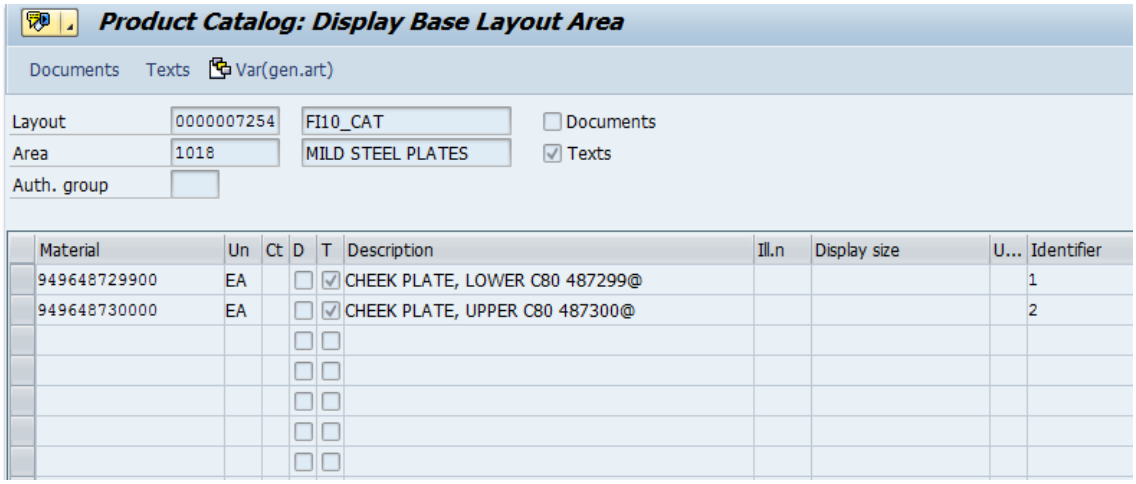


**Figure 4.10**: Maintaining a catalog in the SAP R/3 system.

Internet Sales offers the same catalog for end users. As shown in Figure 4.11, Internet Sales includes the same kind of structure for the catalog as presented in Figure 4.9.

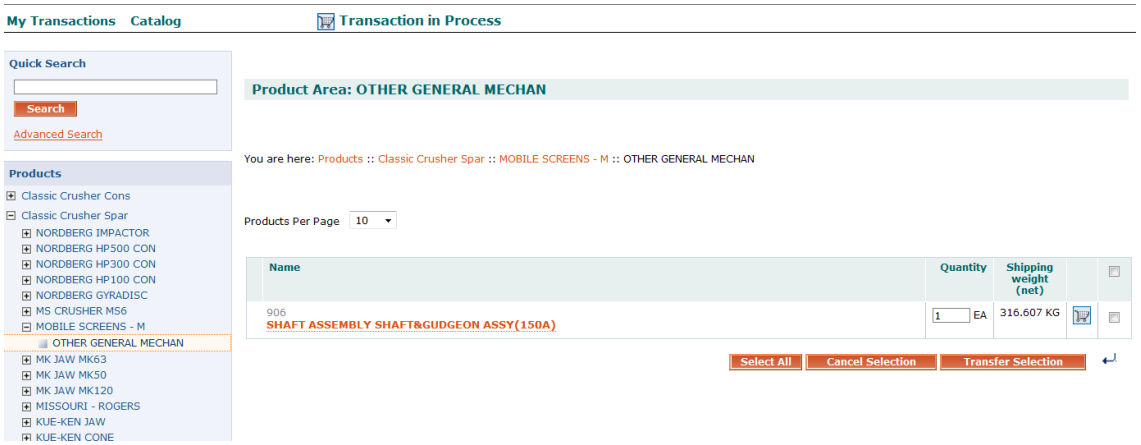


**Figure 4.11**: User browsing the catalog in Internet Sales.

One may ask why the catalog is needed in Internet Sales. The web shop needs a definition what products are needed to be sold. That can be made with the catalog. The catalog enables manual control of the products, and setting the definition of which products are going to be sold via Internet Sales and which not. The catalog is only a subset of all the products which are in the SAP R/3 system. Metso´s SAP R/3 system holds millions of different kinds of products. There can be also several web shops, and each web shop may have its own catalog.

The next section will introduce what kind processes are involved in Internet Sales and how users use Internet Sales. It will not include all the functions that are possible with Internet Sales, but it will introduce the most basic ones.

## 4.3 Processes

When users create new orders or quotations, pricing and availability calculations in the SAP R/3 system are executed instantly and Internet Sales shows the results to the user. Prices are not the same for different combinations of products and users. Prices depend on the distributor´s country and discounts for example. Several distributors may have different prices for the same product. The same applies for availability, since each user may be in a different country and use different delivering plant, and that may cause different delivery time results for different users for the same product. The created order or quotation is instantly stored in the SAP R/3 system after saving it in Internet Sales.

As shown in Figure 4.12, new orders and quotations can be made by distributors and Metso´s personnel. Metso´s personnel select the distributor in Internet Sales. The selected distributor will receive the quotation or order. If the distributor is using Internet Sales, he/she cannot select the distributor because it can execute transactions only on behalf of his or her own company. Distributors are connected in the SAP R/3 system to

only one company, and Internet Sales retrieves this information. As shown in Figure 4.12, the most significant difference between distributors´ and Metso´s personnel in Internet Sales is that some of the internal people are able to modify already existing quotations in their prices.

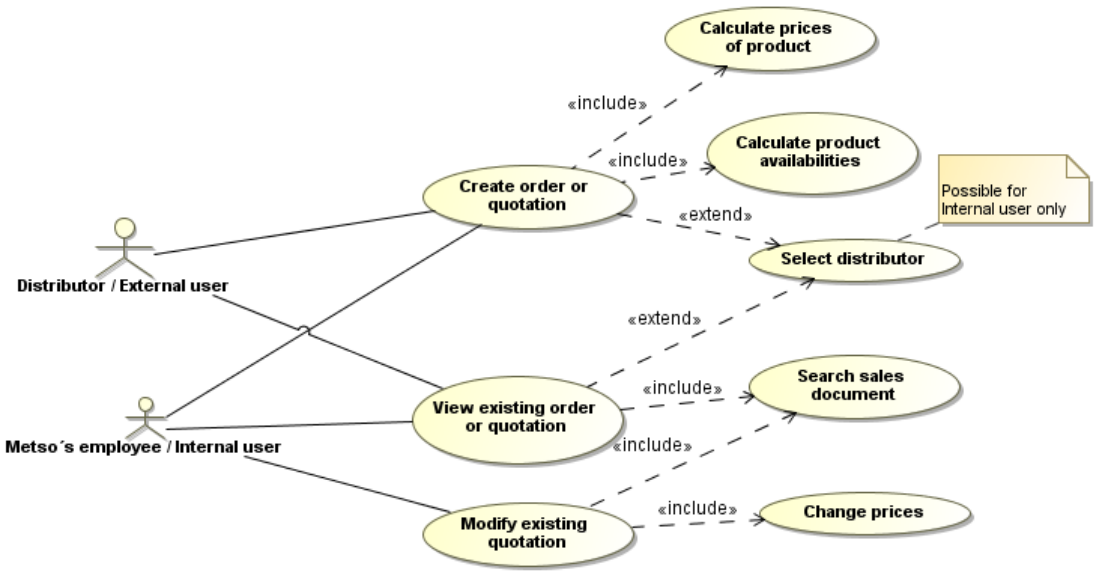


**Figure 4.12**: Most common use cases in Internet Sales.

The way in which a new order is created with Internet Sales is clarified in Figure 4.13. The user first logs in to the web shop. Then the SAP R/3 system sends necessary authorization and customer details to the web shop. It needs to be checked that the user has authorization roles set in the SAP R/3 system, which enables use of the web shop. Then the user selects the products which are to be ordered. When proceeding further with the order, the SAP R/3 system simulates prices and availabilities for the products. Then the user checks the prices and confirms the order, which will be saved to the SAP R/3 system for later use.

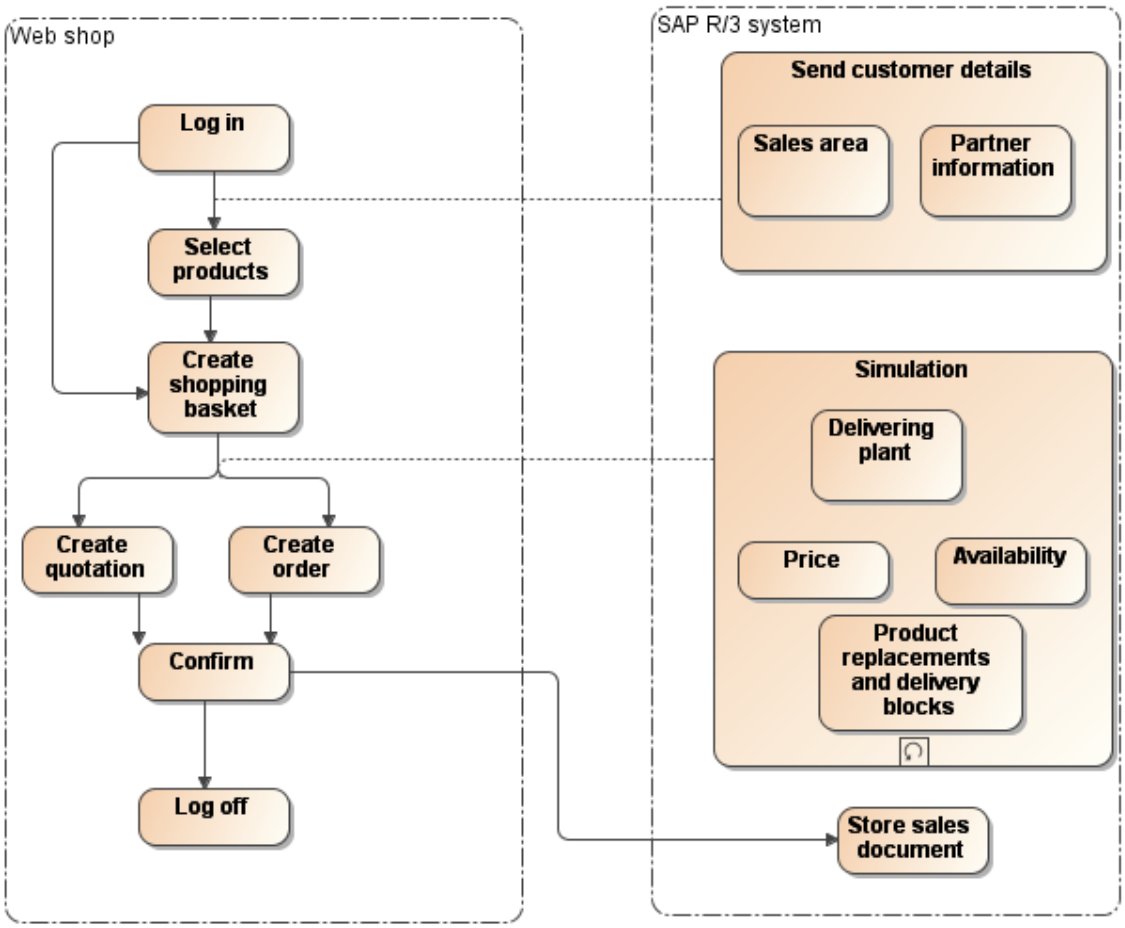


**Figure 4.13**: Order creation in Internet Sales.

The process of creating a new order is straightforward. Internet Sales is not used only for creating new orders or quotations, but it can also be used for viewing those documents. This adds value to the user in the value chain because it will increase the visibility as the user is able to follow the status of orders and quotations. Are all the products delivered? If not, when will the products be delivered? Figure 4.14 represents the process of viewing an existing order or quotation. If the user is viewing a quotation, it can be turned into an order if needed.

Viewing an existing order or a quotation starts by logging in, which is already introduced in Figure 4.13. Then the user can either search for quotations or orders, and the SAP R/3 system returns a list of the user´s quotations and orders. When the user opens the order or quotation, the SAP R/3 system sends the sales document with its details to the web shop. The user can open a quotation and view it, but usually users want to order the products which are in the quotation. When the user views an order, it includes order-specific information, such as invoices, packing lists, and an order confirmation PDF file, which is Metso´s official order confirmation.

When an internal user wants to modify an existing quotation, the process follows the basic principles introduced in Figure 4.13. The user opens the quotation, changes the price in it, and saves the quotation.

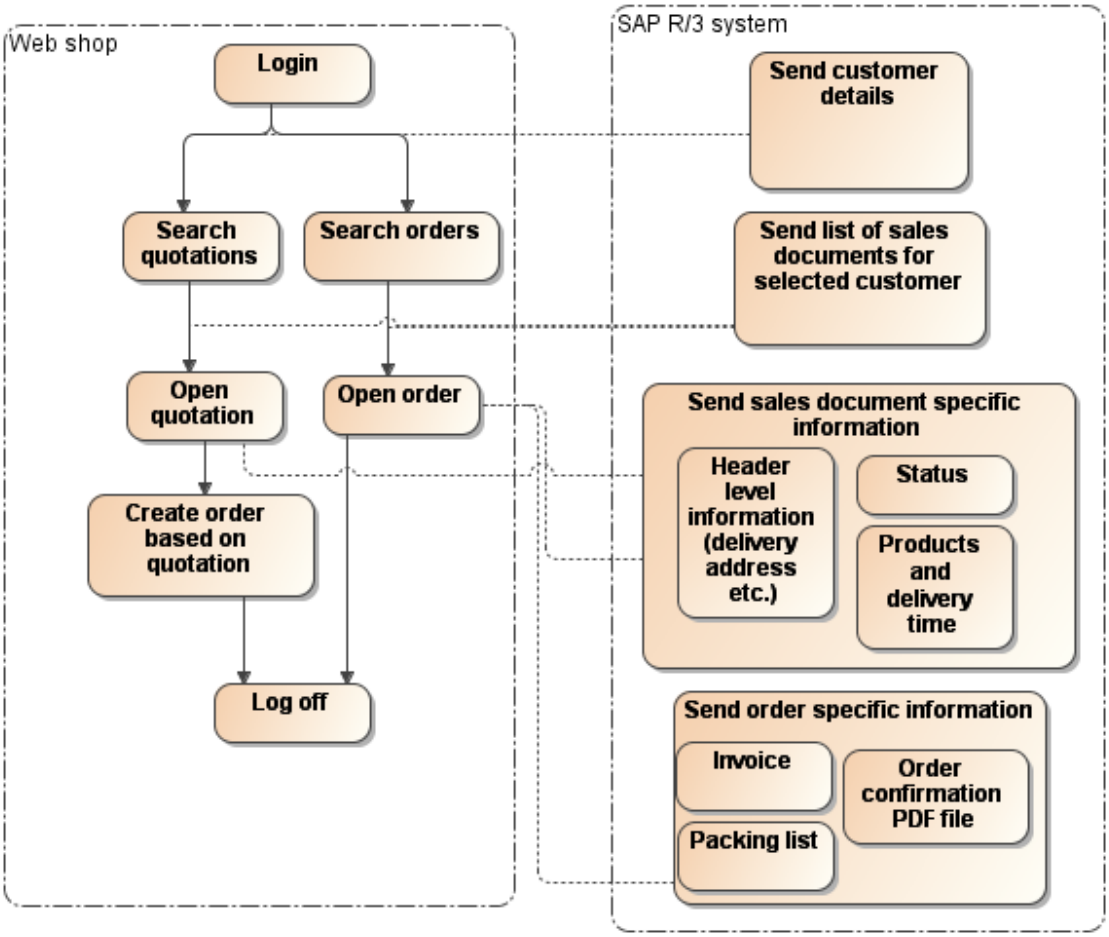


**Figure 4.14**: Viewing existing order or quotation.

Figure 4.15 shows the end-to-end process between creating the quotation and finally receiving the products. Some parts of the process are executed in Internet Sales, but most of the processes occur in the SAP R/3 system.

A user can create a quotation or an order without creating a quotation. A quotation can also be changed into an order. When an order is placed, shipping activities can be started by creating a delivery. A transfer order is an instruction to move products from a source storage bin to a destination storage bin in a warehouse at a specified time. Shipment refers to the process of transporting goods from a warehouse (manufacturing company) to the target (customer). Goods issue updates the quantity of stock available. Finally, a billing document is created and an invoice is sent to the customer. When the customer´s payment has been received, accounts receivable can be updated.

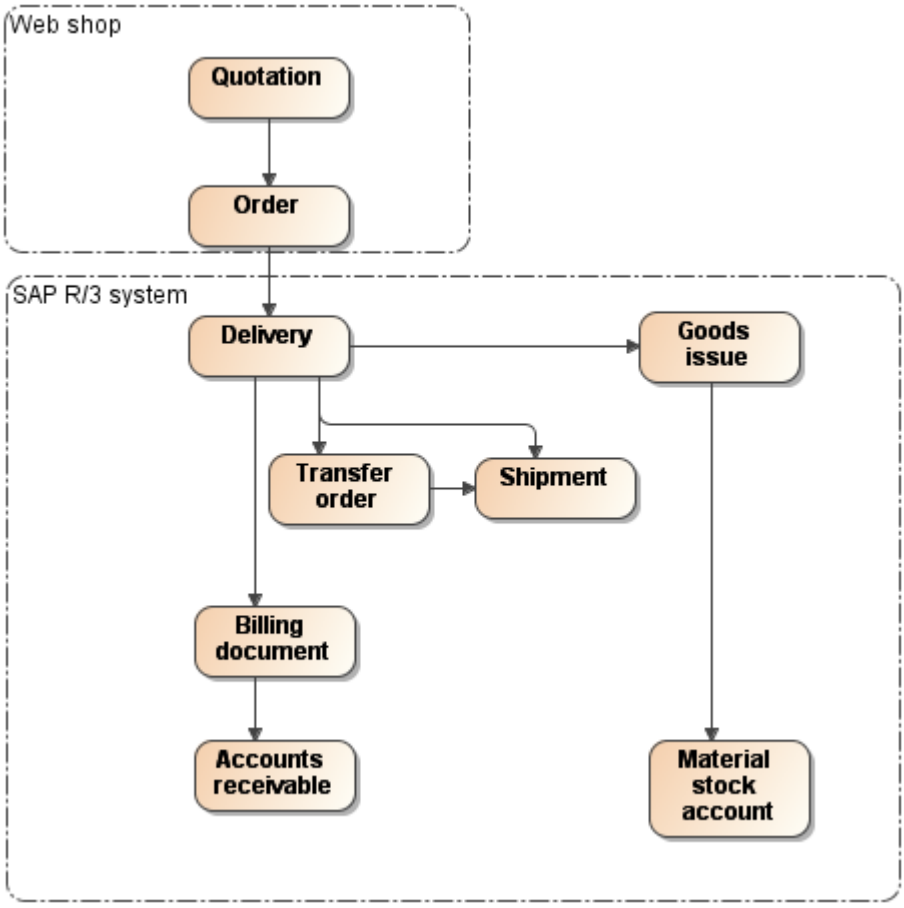


**Figure 4.15**: End-to-end process, a simplified overall sales and delivery process [4].

Internet Sales is needed in creating the quotation and the order. The rest of the process is managed in the SAP R/3 system. In Internet Sales it is possible to view the documents regarding the different steps of the process; for example, billing and shipment documents.

# 5 ARCHITECTURES

This chapter investigates the architectures of Internet Sales and IPC in Metso´s system environment. Section 5.1 describes how Metso has set up its Internet Sales web shops globally, which is mostly investigated from a business point of views.

Internet Sales´ technical architecture regarding the basic concepts is investigated with many kinds of views in Section 5.2, which also models, on a system level, how end users access Internet Sales. The technical architecture of Internet Sales is presented at the end of Section 5.2. Section 5.3 describes Internet Sales´ overall technical architecture when it is IPC enabled. Section 5.3 answers the question: how does the architecture changes when Internet Sales is used with or without IPC?

SAP AG is strongly putting effort into publishing new web shop versions and SAP AG´s latest web shops and their architectures are investigated in Section 5.4. Also, their suitability to Metso´s system landscape is examined in Section 5.4.

## 5.1 Introduction

Metso has Internet Sales web shops in several countries. Different countries sell different kinds of products. Different countries have local order offices which handle all the orders and quotations proceeded via Internet Sales. Order offices use the SAP R/3 system for further processing of orders and quotations.

Figure 5.1 shows how the web shop model is divided. There can be only one web shop application implemented with Java, but the web shop application enables using one or several web shops. This is comparable to Amazon having one web shop application which offers different kinds of web shops in each country. Metso needs several web shops because of business differences in different sales areas.

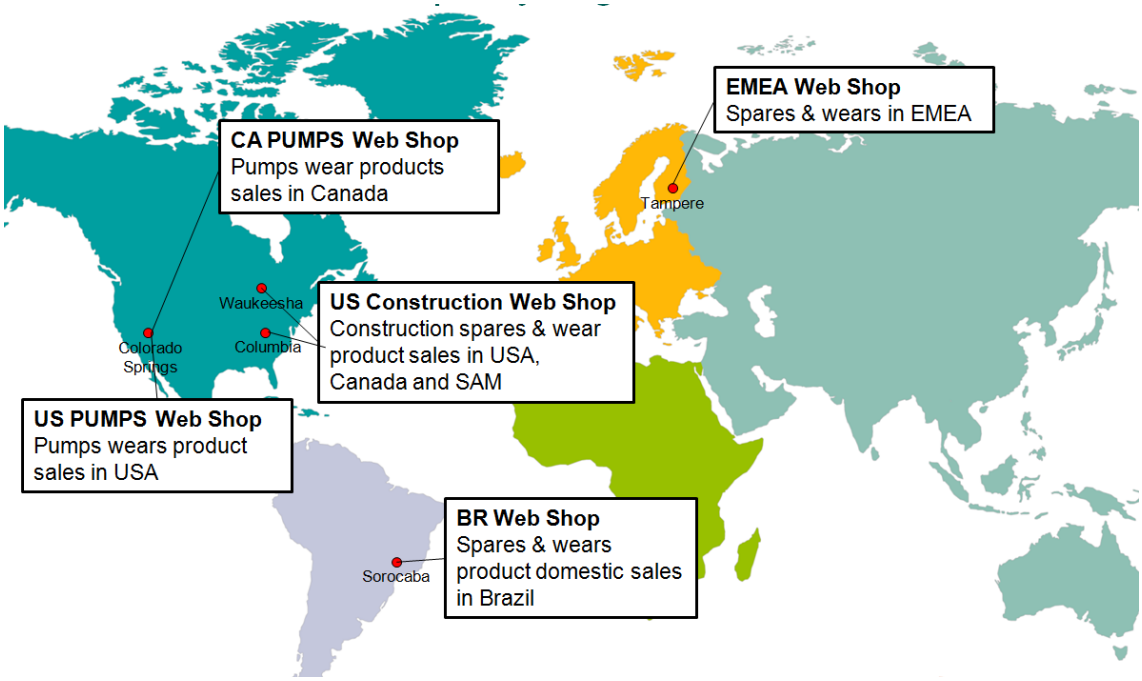


**Figure 5.1**: Metso´s web shop model on a world map.

Each web shop can have different settings. For example, the United States´ web shop could use US00 for a sales organization, and Finland´s web shop could use FI00 as a sales organization in the SAP R/3 system. Sales organization is a mandatory value in SAP R/3 for sales, because it helps to identify where the product are sold. A web shop can have only one sales organization, which means there have to be several web shops. Table 5.1 shows the main differences between each web shop.

**Table 5.1:** Metso´s web shop set-up and its configuration.

| **ECC system preference** | **Value for USA** | **Value for Brazil** | **Value for Finland** | **Value for Canada** |
|---|---|---|---|---|
| *Sales organization* | US00 | BR00 | FI00 | CA00 |
| *Plants for product catalog* | US01, US10 | BR02, BR04 | FI91* | US15 |
| *Currency* | USD | BRL | EUR | USD |
| *Language* | English | Portuguese | English | English |
| *Ability to give discounts* | no | yes | no | no |
| *Ability to modify existing quotation documents* | no | yes | no | no |
| *Ability to set any validity time for quotation docu-* | no | yes | no | yes |

| | | | | |
|---|---|---|---|---|
| *ments* | | | | |

** Some of the products are shipped from FI03 plant but they are located at FI91 plant also. FI03 plant is located physically in Tampere and FI91in Tongeren.*

Dividing the web shop model provides several technological and business advantages. Below are listed the advantages:

- *A clear separation between different features*. Different web shops can have their own set-up, and developing one web shop does not negatively affect another web shop.
- *Clear responsibilities.* It is easier to split responsibilities in a large organization when the web shop model is divided. There are several tasks which require resource allocation and responsibilities, e.g. training end users, testing, and other communication with end users.
- *Localization.* Local legal aspects and languages are easier to handle in several web shops than in one web shop. Brazil may have different Incoterms to Finland, for example.

There are also some disadvantages to having many web shops:

- *Technical maintenance.* The development work regarding maintenance increases if the number of the web shops increases. All technical changes must be implemented and tested in all web shops if necessary.
- *Risk of losing global processes.* There is a risk that different web shops start to live their own lives and global sales processes are forgotten. This risk can be avoided by focusing on global processes and having centralized control of all the web shops.

## 5.2 Internet Sales

As shown in Figure 5.2, the user logs in to Extranet, where the user can select a link to Internet Sales from a list of different applications. The Internet Sales web shop runs on WebAS Java.

Extranet creates a cookie which contains the username. The user´s username in SAP R/3 system is located in the LDAP (Lightweight Directory Access Protocol) server also.

The user is redirected to WebAS Java after clicking the link to Internet Sales in Extranet. At this point, WebAS Java has automatically retrieved the username from the Ex-

tranet´s cookie, so the user does not need to do additional authentication. WebAS Java checks that the username is found in UME (User Management Engine), which contains the list of users and their authorization roles. If the username is found in UME, the user accesses the Internet Sales application.

The web shop makes a JCo function call to the SAP R/3 system for in order to check that the username is found on the SAP R/3 system also. The JCo function call is also used for retrieving users´ authorization data, e.g., technical roles.

As shown in Figure 5.2, the username is stored in the LDAP server, the UME server, and the SAP R/3 system. An easier way to handle the data maintenance would be storing the username in only one backend system. One could ask, why are so many systems used for storing the username? The SAP R/3 system and the Internet Sales server use Metso´s internal network. Extranet uses an external network which is accessible for distributors via the Internet. The user is not able to retrieve data directly from Metso´s network.

Theoretically, the LDAP username could be used for accessing Extranet, and the UME system could be used for storing the username and authorization data. In that case, storing the username in the SAP R/3 system would not be needed.

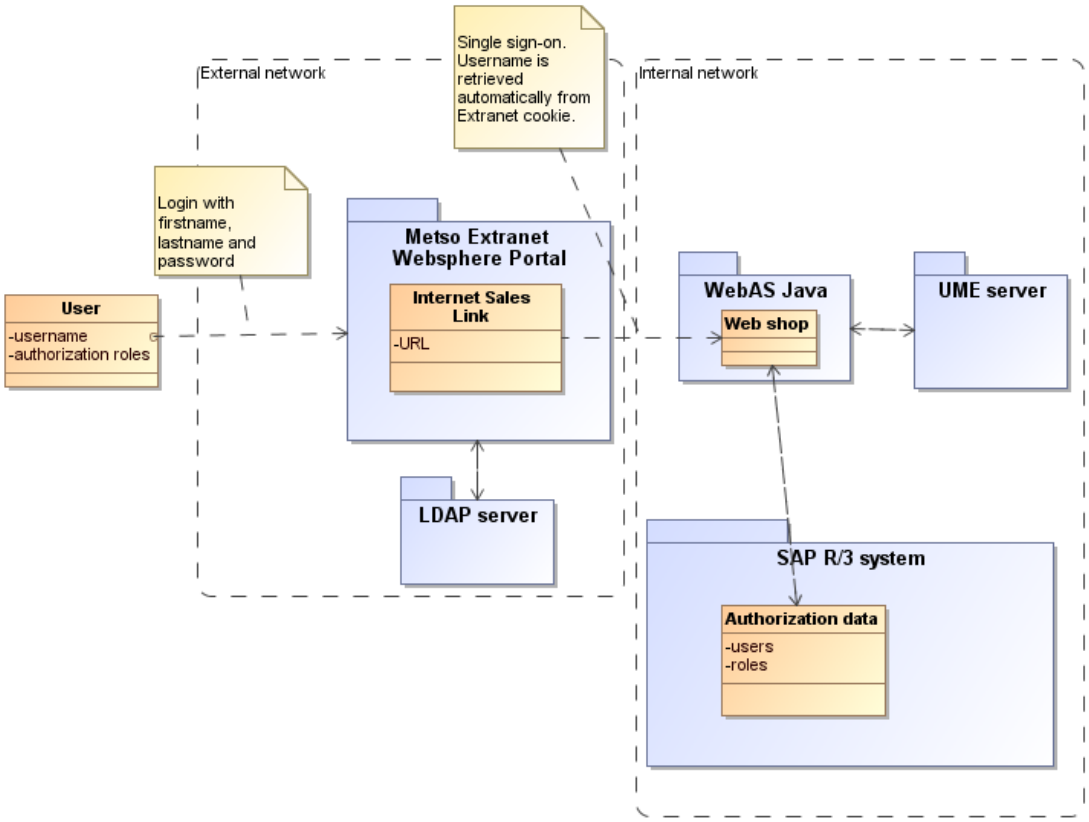


**Figure 5.2**: User accessing the web shop in Metso´s system architecture.

Each web shop is linked to one sales organization. Figure 5.3 represents a model of how the web shop retrieves the sales organization. Firstly, the user logs in to the web shop, and then the web shop checks whether the user has a user account in the SAP R/3 system.

A contact person can be linked to a SAP R/3 user account, as shown in Figure 5.3. Each customer has one or more contact persons; for example salesman X could be a contact person, and company Y could be the sold-to-party. Salesman X is the contact person for company Y, and Salesman X´s SAP R/3 user account is linked to the contact person. The sold-to-party is linked to certain sales areas, because customers do business in different sales areas.

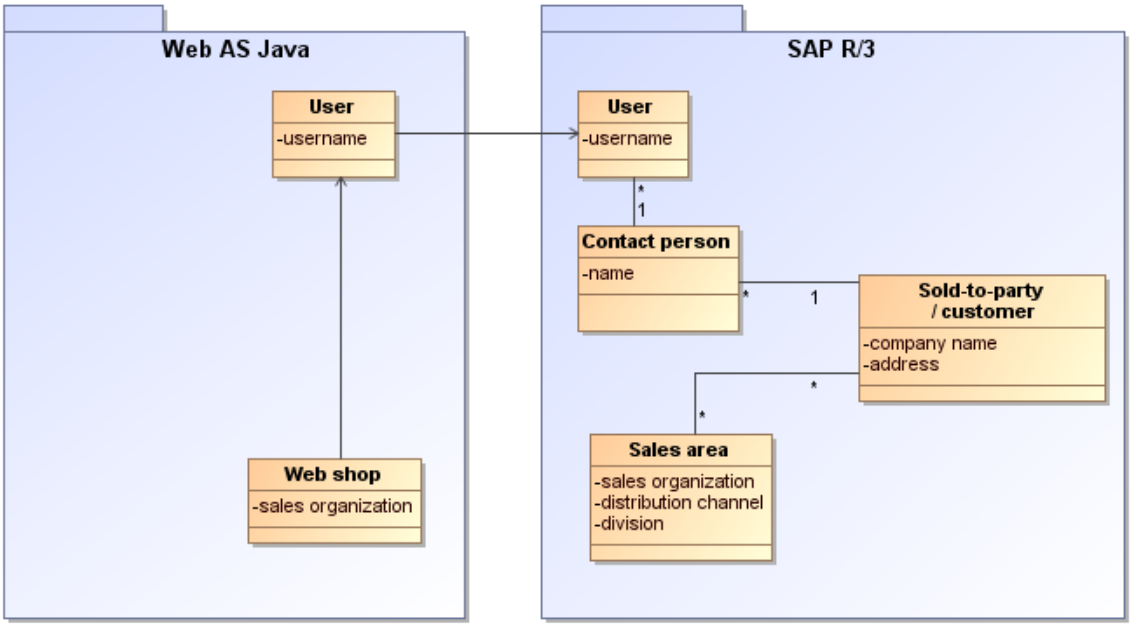


**Figure 5.3**: A model depicting how the web shop finally retrieves information about which sales organization will be used.

The next question is what architectural components are needed when the user is viewing the products in Internet Sales. Figure 5.4 holds an answer to the question. First, the catalog is created in the SAP R/3 system. Then the catalog is replicated from the SAP R/3 system to a TREx database system. TREx consists of the actual database and the database management system. TREx contains the catalog, which means that TREx holds the product data. In Metso´s Internet Sales implementation catalog replication is executed every night as an automatic background job, which will keep the product data up to date in TREx.

Basic product data is maintained with a MM module (Material Management). As shown in Figure 5.3, customers are linked to a certain sales area. Also, products are linked to certain sales areas in the SAP R/3 system, because different countries sell different products. Setting a product to a certain sales area requires sales area information from the SD module. Products are gathered into the catalog.

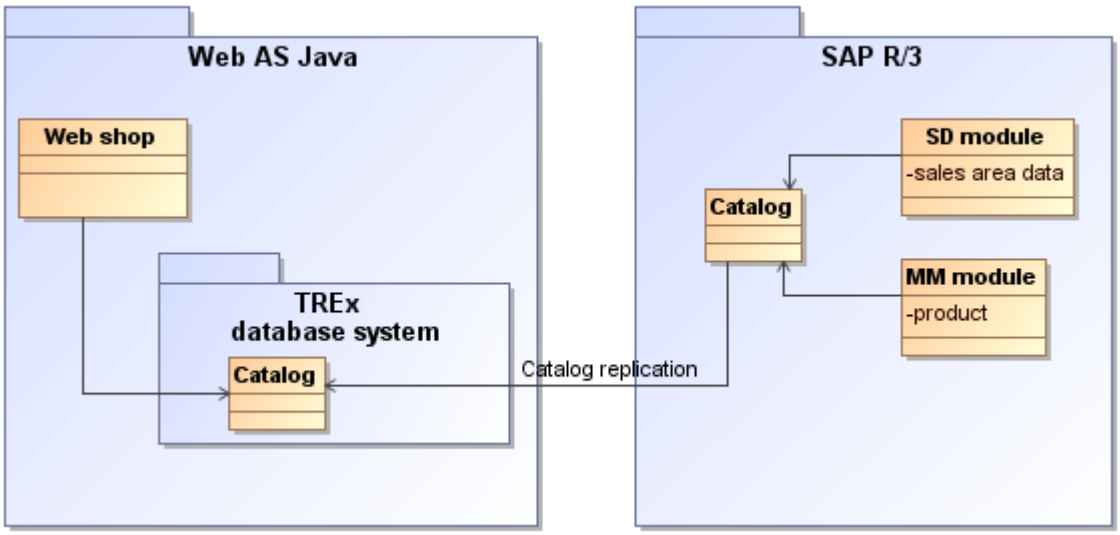


**Figure 5.4**: Web shop retrieving the catalog from the TREx database system.

A sales area is needed in many components: customer, product, and even catalog. These three components need to be synchronized with the same sales area. The issue of how the web shop determines what delivering plant is used is described below.

Internet Sales is used in many countries, and Metso has delivering plants all around the world. The delivering plant is used for calculating the availability for a product. One may ask, how does Internet Sales know which delivering plant is used for at product for a certain user?

As shown in Figure 5.5, a product contains the delivering plant and it can be defined on a customer level also. The most powerful way to set the delivering plant is to use a customer – product info record, which means defining the delivering plant for the combination of product and customer. The customer – product info record overwrites other delivering plant configurations on other levels. The second strongest way is to define the delivering plant for the customer, and the weakest way is to define it at the product level. So, there are three levels to maintain in delivering plant data (product, customer, and product – customer).

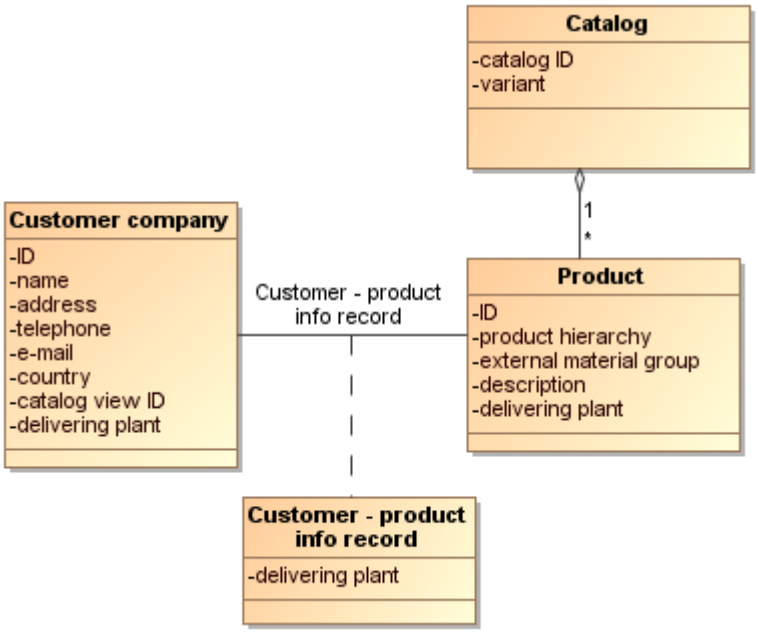


**Figure 5.5**: Catalog includes the products. This figure also represents how the delivering plant can be determined in different ways. This data is maintained in the SAP R/3 system.

Figure 5.6 represents the overall architecture of Internet Sales. Most of the data Internet Sales utilizes is stored in data tables in the SAP R/3 system (pricing, customer, and product data). SD and MM modules include the applications which enable users and developers to input the data into the data tables. These modules are used by the SAP R/3 system´s GUI. Below is listed a basic scenario of using the SD and MM module in the SAP R/3 system.

1) The user creates a new customer for a specific sales area in xd01 transaction. SD module provides the xd01 transaction. Applications are also called transactions in the SAP R/3 system.
2) The user creates a new product for a specific sales area in mm01 transaction, which is included in the MM module.

After steps 1) and 2) are completed, a customer and a product are stored in the data tables for a specific sales area.

As shown in Figure 5.6, JCo is used as an API for retrieving prices and availabilities directly from the SAP R/3 system. This means Internet Sales calls function modules inside the SAP R/3 pricing engine. In that sense, the price result is the same whether the pricing is originally called via Internet Sales´ user interface or the SAP R/3 system´s GUI. Products are replicated from the SAP R/3 system to TREx manually once a day with the RFC protocol.

Different customers can have different prices (Pricing master data). Usually the product and the customer´s sales organization are the key factors when a pricing calculation is run. This means that the same customer can have a different price in different sales organizations. Pricing customizing is used if the logic of pricing has to be changed.

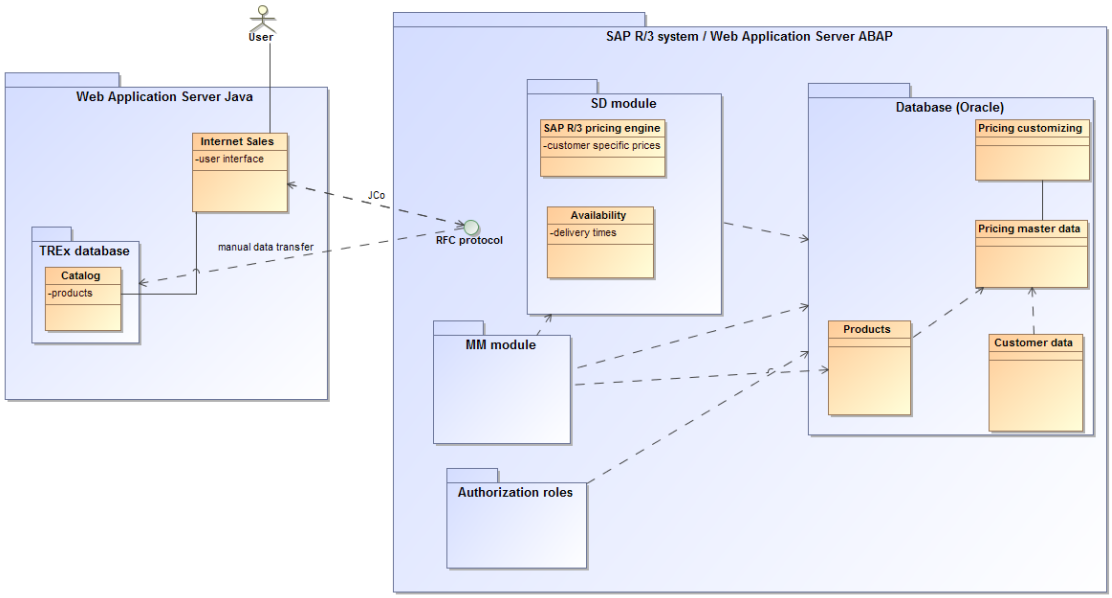


**Figure 5.6**: Overall technical architecture of Internet Sales. This architecture describes Internet Sales when IPC is not active.

From the architecture point of view, TREx adds some uncertainty to the landscape. Instead of having only one dependency on the backend system by using only the SAP R/3 system as the data source, there will be two more dependencies added by using TREx. Every time the system landscape is updated or changed, it has to be ensured that:

1) The link between SAP R/3 system and TREx has not been damaged.
2) TREx connection to web shop is functioning well.
3) The link between web shop and the SAP R/3 system is functioning well.

The web shop is able to make queries for products directly to TREx, which reduces the amount of communication between the SAP R/3 system and Internet Sales. If only the SAP R/3 system is used as the backend system, it is necessary only to check number 3) above. There are numerous visions of having multiple times faster SAP R/3 systems and when those visions have been realized, TREx might not be needed anymore. Currently, the SAP R/3 system might not be able to handle the data load. Table 5.1 shows how the load is shared between different backend systems:

**Table 5.1**: Most common query types in Internet Sales and their usage in TREx and SAP R/3.

| **Query type** | **TREx system** | **SAP R/3 system** |
|---|---|---|

| | | |
|---|---|---|
| Viewing the products which are sold in the web shop. | x | - |
| Viewing detailed product descriptions. | x | - |
| Viewing product replacements. | - | x |
| Retrieving price for product. | - | x |
| Calculating availability for product. | - | x |
| Saving a new order or quote. | - | x |
| Retrieving sales document data of already existing orders and quotes. | - | x |

As Table 5.1 reveals, the SAP R/3 system is heavily used by Internet Sales. The SAP R/3 system has decent load handling mechanisms, which enables the use of Internet Sales on a large scale also.

This section viewed Internet Sales architecture on smaller and larger scales. First, the basic components were viewed in architectural matter. Last, the overall technical architecture of Internet Sales was presented. The next section shows what kind of technical architecture Internet Sales has when it is IPC enabled.

## 5.3 Internet Sales and IPC (Internet Pricing and Configurator)

First, this section describes what IPC (Internet Pricing and Configurator) is. After presenting what IPC is, the overall technical architecture of Internet Sales with the use of IPC is presented at the end of this section.

When Internet Sales is IPC-enabled, it is possible to configure products with IPC. This can be compared to a situation when a user is trying to buy a car from a web shop. This requires several selections to complete the configuration of the car (engine, colour, accessories…). These selections usually have dependencies between each other, e.g. if the engine is diesel powered, the power selections are also different compared to a petrol engine.

As shown in Figure 5.7, the concept of product changes when Internet Sales is IPC enabled. The product is not just one product, but a product will consist of several other products. The list of all products that are involved in a product is called BOM (Bill of Material).

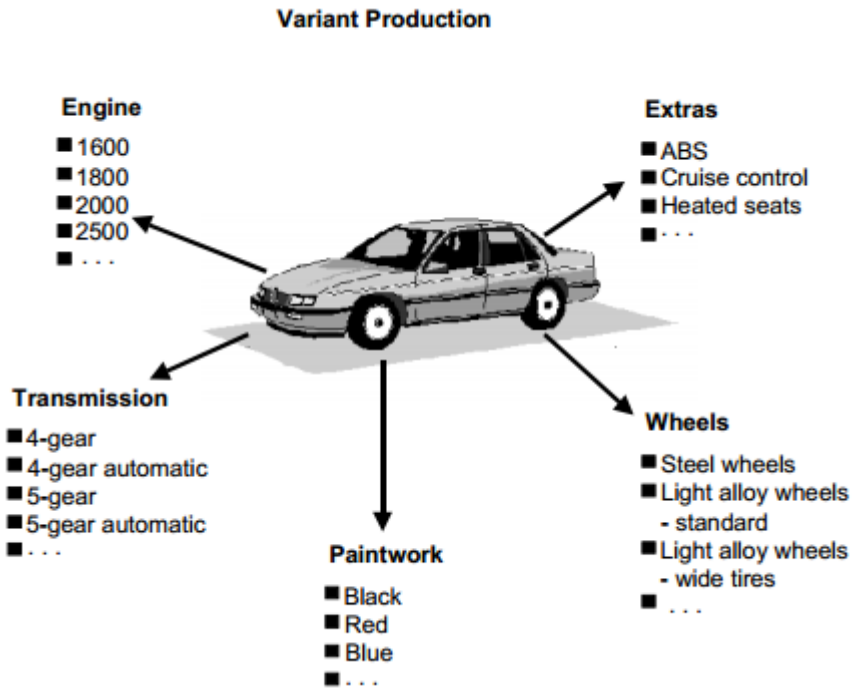


**Figure 5.7**: A product with options [17].

The benefit of IPC is that it retrieves product configuration and price data directly from the SAP R/3 system. When the user makes a change to the configuration, IPC calls the SAP R/3 system and retrieves necessary dependencies and prices from the SAP R/3 system.

From the architectural viewpoint, enabling IPC makes the architecture a little bit more complicated. Figure 5.8 represents the architecture when Internet Sales is IPC-enabled. The architecture follows the same principles as described in Figure 5.6. There are several new components needed, which would not be needed if Internet Sales would be run without IPC. The role of these components is described below.

An IPC client is an application implemented with Java and JSPs and it communicates with the Internet Sales web shop. It provides the UI of IPC to the user, which is shown in Figure 4.4. It retrieves data directly from the IPC server by using the JCo protocol.

The IPC server includes the sales configuration engine, which sends the configuration data to the IPC client. Configuration data is originally located in the SAP R/3 system´s database (Configuration master data in Figure 5.8). A price is needed for the configuration of a product, and the IPC server´s pricing engine does the pricing. The IPC server´s

data is cached to a Virtual Machine Container (VMC) cache. VMC is a set of Java classes and the IPC server is a Java application.

The configuration of a product is originally generated in Variant Configurator in the SAP R/3 system. Variant Configurator stores the configuration into a database (Configuration Master data in Figure 5.8).

There can be many pictures or files stored to a product or its configuration. These pictures can be attached to the configuration data using the Document Management System. Pictures are replicated from the SAP R/3 system to an image server via the FTP protocol. The image server use the Apache server, and Internet Sales accesses this image server using the HTTP protocol.

If a product´s configuration needs to be changed in the SAP R/3 system, some kind of version control management is needed. KB runtime version in Figure 5.8 contains a snapshot of the configuration for a product and provides this version management for each configuration of a product. There can be many KB runtime versions, but the IPC server contains the logic for reading the latest KB runtime version.

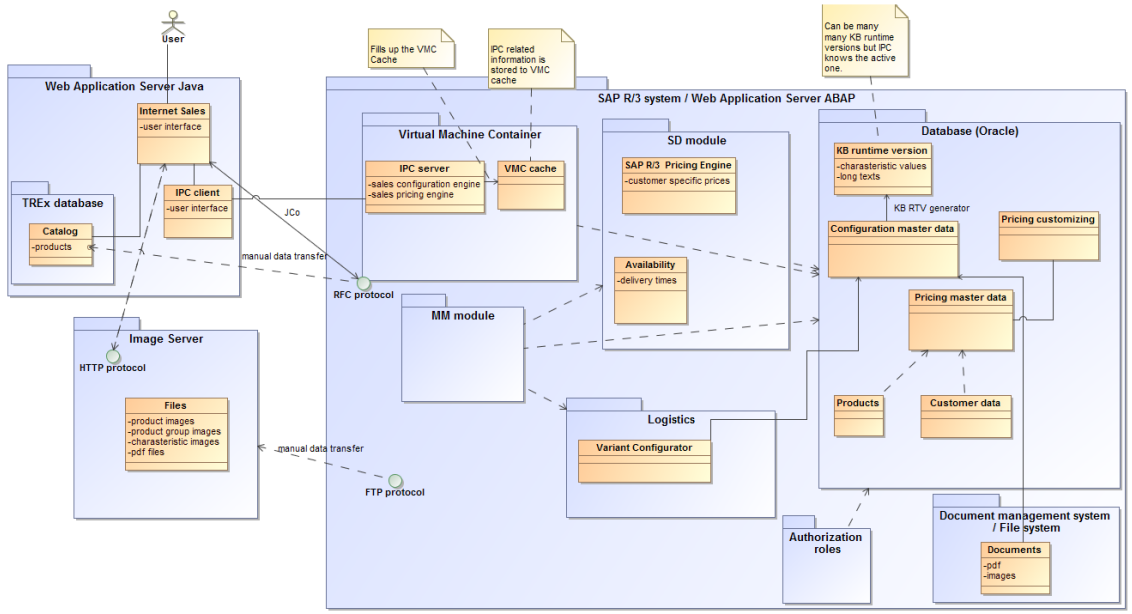


**Figure 5.8**: Internet Sales with the use of IPC.

This section provided a brief summary of IPC´s architecture leading to a more complex system. The next section provides some future thoughts on what kind of architecture and technologies SAP AG´s newest web shop versions include.

## 5.4 Web shop trends for the future

Internet Sales is used by many hundreds, maybe even thousands of companies. It is mostly used in a Business-to-Business scenario. Metso´s version of Internet Sales is 4.0, and its UI is generated with JSP technology, and its core is developed with Java [18]. The history of Internet Sales and its versions is presented below [19].

- SAP Internet Sales 2.0x included B2B and B2C scenarios. CRM was supported as a backend system. This occurred around the year 2000. Web-based UI was generated automatically from the CRM system with ITS FlowLogic technology.

- SAP Internet Sales 3.0 became an independent J2EE-based solution. It was still using CRM as the backend system so the catalog was also located in CRM. UI technology changed to Java Server Pages (JSP), which enables more efficient customizing to the UI.

- Due the fact that many customers were not willing to use CRM as the backend system, Internet Sales 4.0 enabled also using SAP R/3 as the backend system.

- SAP Internet Sales 5.0 introduced newsletters and campaigns. The next version was SAP CRM Web Channel 6.0 which enabled selling complex and packed products in the telecommunications industry. SAP CRM Web Channel 7.0 included loyalty management, which means that the user receives loyalty points when he creates new orders.

After CRM Web channel 7.0, the next version, released in 2012, was WCEM 1.0 (Web Channel Experience Management), which uses SAP R/3 or CRM as the backend system. This included a totally new UI, implemented with JSF and AJAX technology [20]. Also, some architectural changes were implemented. The application was modularized differently so that the logic layer could be re-used in all kinds of hardware (mobile phones, tablets, laptops etc.). The newest version of WCEM is 3.0 when writing this.

Figure 5.9 represents the architecture of WCEM 3.0, which is running on the same Web Application Server Java as Internet Sales 4.0. The biggest difference in an architectural sense compared to Internet Sales 4.0 is the use of MDM (Master Data Management) and SAP PI. MDM has the same role as TREx. It contains the products which will be shown to the user. MDM can also hold pictures of the product. MDM is faster than TREx and it provides a better browsing experience than TREx for the products in the catalog [19].

Product data is loaded from SAP R/3 into MDM using ALE Idocs and with SAP PI acting as a message hub between SAP R/3 and MDM [19]. ALE supports communication interfaces that allow connections from the SAP R/3 system to non-SAP systems. Idoc is

simply a data container used to exchange information. Idoc is like a data file with a specified format, which is exchanged between two systems, which know how to interpret that data. ALE transfers Idocs. [21]

In Figure 5.9, MDM is located on the same server as WCEM, but it could be located on a separate server also. The architecture presented in Figure 5.9 is clearly a major change when compared to Metso´s current architecture. It requires several more components and servers – MDM and SAP PI. This requires effort and may require major monetary investments.

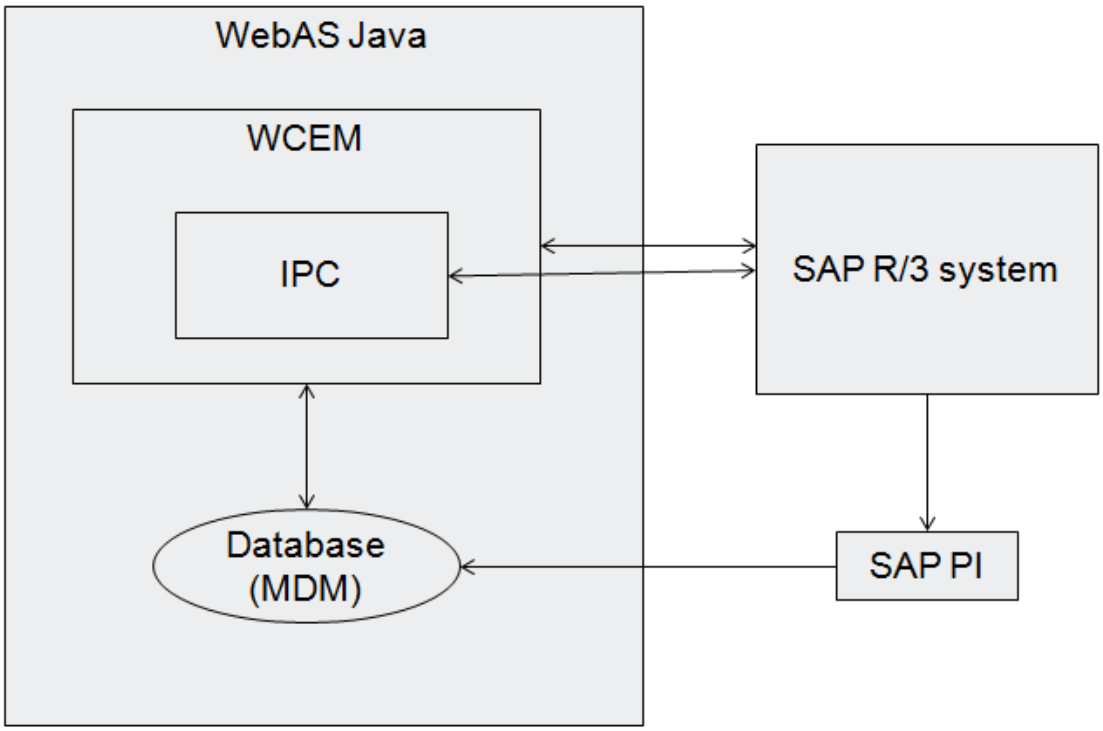


**Figure 5.9**: Architecture in WCEM 3.0 with the use of MDM.

There is also a possibility to install WCEM using TREx, as shown in Figure 5.10. This kind of WCEM 3.0 implementation involves the smallest monetary cost of the WCEM installations. Architecture presented in Figure 5.10 includes TREx which means that migrating to WCEM from Internet Sales 4.0 would be easier. This kind of set-up offers the benefits in better user experience in the user interface and the new features that WCEM offers.

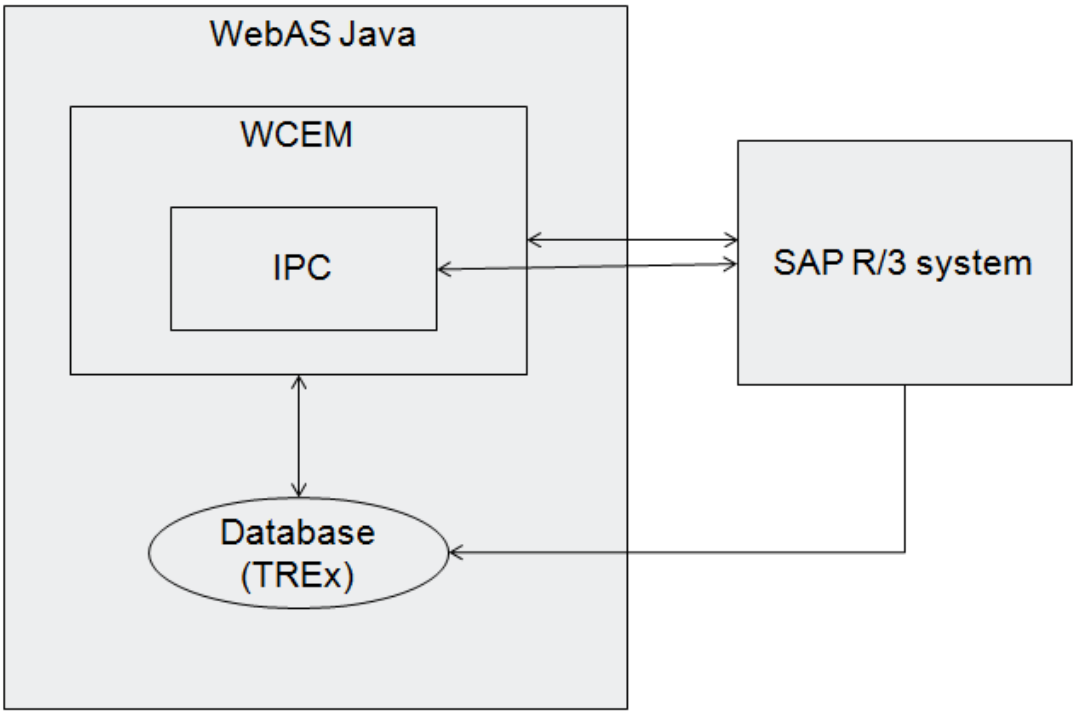


**Figure 5.10**: Architecture in WCEM 3.0 with the use of TREx.

SAP AG has increased their efforts in developing web shop solutions containing good usability. Current SAP AG´s web technology trends seem to be towards HTML5, AJAX, and JSF. Also, one remarkable trend is SAP AG´s effort to develop not only browser applications, but also mobile applications.

WCEM 3.0 includes a lot of new functionalities which are not described in this thesis. One example would be that in WCEM 3.0 the user is able to download orders in XML format and upload products in CSV format [22]. This speeds up the ordering process if there are many products in one order. Another example is that WCEM 3.0 contains probably better performance in the browser-side because it utilizes the latest technology. Metso´s current Internet Sales 4.0 is not easy to use with mobile phones, so in that sense WCEM could be worth implementing, depending on what kinds of needs the end users have.

# 6 CONCLUSIONS

Metso´s Internet Sales solution consists of several components and concepts. Every component and concept has its justified role. This thesis provided the description of Internet Sales and its main concepts. Also, the overall architecture of Internet Sales and IPC was introduced.

It will be interesting to follow the development of SAP AG´s new web shop products. The SAP R/3 system sets some limitations to the web shop – sales organizations, customers and, users must be linked to SAP R/3 models of them. In the future there probably will not be any major changes to the key concepts of the new web shops, because the backend system restricts the data model. One might guess that only web technology changes and perhaps some minor architectural changes will occur in the future. WCEM 3.0 supports this assumption.

This thesis also shows that the architecture of Internet Sales is not perfect, but it is good enough to process daily transactions. More optimized architecture would be having only one backend system for all queries. Currently Internet Sales retrieves its data from the TREx database and the SAP R/3 system. Having many backend systems makes the systems potentially inconsistent because they depend on each other.

The new products offered by SAP AG will offer technology for a multichannel solution, where the web shop could be accessed with different devices, like mobile phones, tablets and laptops. Metso´s current Internet Sales implementation does not support mobile devices so well. The mobile market is growing and perhaps Metso will consider updating its web shop technology in the future. Currently, Internet Sales is up and running, and it is successfully used all around the world.

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