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Plywood MES reporting

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<p>Currently UPM plywood production has a tailor made reporting platform that handles all production related data. This reporting platform is called PlyNET and it is based on Microsoft SQL Reporting Services (SSRS) technology. PlyNET platform is fully developed by the UPM IT-department and in the long run that could cause problems concerning product support and future development.</p> <p>During 2011-2012 UPM has implemented a standard MES solution for plywood production based on GE Intelligent Platforms' Proficy product family. This system is called PlyMES. the Proficy platform includes standard out-of-the-box reports, but these reports were found to be insufficient and needed to be extended or replaced. To be able to extend PlyMES reports and merge these with existing PlyNET reports, Novotek Report Plus (NRP) reporting tool was chosen as a candidate.</p> <p>Like PlyNET, the NRP platform is also based on standard SQL Server Reporting Services (SRSS) technology. Using NRP, UPM specific reports based on data in the PlyMES system can be designed and existing PlyNET reports can be merged together with PlyMES reports into single reporting portal.</p> <p>The goal of this thesis is to explore the possibility to use Novotek Report Plus as a single reporting portal for PlyMES and PlyNET reports. Alongside of this project WIP inventory balance, plywood average thickness and produced plywood quantity reports will be designed and created.</p>	
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<p>UPM vaneritehtaalla on tällähetkellä käytössä sen oman IT-osaston kehittämä raportointi-portaali PlyNET. PlyNET pohjautuu Microsoftin SQL Server Reporting Services (SSRS) teknologiaan. Koska raportointiportaali on UPM:n oma kehittämä, voi se pitkällä tähtäimellä tulla ongelmaksi, koskien tuotetukea sekä tuotekehitystä.</p> <p>Vuosien 2011–2012 aikana UPM on ottanut käyttöön GE Proficy tuoteperheeseen pohjautuvan MES- järjestelmän, jota kutsutaan nimellä PlyMES. PlyMES-järjestelmän standardi-raportit todettiin riittämättömiksi sellaisinaan. Jotta uusien PlyMES-raporttien käyttäminen yhdessä olemassa olevien PlyNET-raporttien kanssa olisi mahdollista, tarvittiin uusi raportointiportaali. Uudeksi raportointiportaali ehdokkaaksi valittiin Novotek Report Plus (NRP).</p> <p>Kuten PlyNET, NRP pohjautuu myös SSRS teknologiaan. Novotek Report Plussalla raportit, jotka pohjautuvat PlyMES-dataan ja raportit, jotka käyttävät PlyNET-dataa, voidaan tuoda yhteen yhden raportointiportaalin alle.</p> <p>Tämän insinööriyön tavoitteena on tutkia Novotek Report Plussan sopivuutta uudeksi raportointiportaaliksi UPM vaneritehtaalle. Projektin aikana luodaan myös joitain PlyMES-raportteja koskien välivarastosaldot, vanerin keskipaksuutta sekä tuotettua vanerin määrää.</p>	
Avainsanat	MES, NRP, SSRS, Raportointialusta, Novotek, Proficy

Abstract

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Abbreviations

MES	Manufacturing Execution System
NRP	Novotek Report Plus
SSRS	SQL Server Reporting Services
ERP	Enterprise Resource Planning
SQL	Structured Query Language
API	Application Programming Interface
OPC	Standard for communication between different control devices from different manufacturers
JDBC	Java Database Connectivity
ODBC	Open Database Connectivity
KPI	Key Performance Indicators
OEE	Overall Equipment Efficiency
BI	Business Intelligence
WIP	Work In Progress
SSU	Sort Station Unit
ISU	Input Storage Unit
BHO	Browser Helper Object
MLS	Multilevel Security
PAP	Password Authentication Protocol
BOM	Bill of Material
IIS	Internet Information Services
HTTP	Hypertext Transfer Protocol
SSMS	SQL Server Management Studio

1 Introduction

Currently UPM plywood production has a tailor made reporting platform that handles all production related data. This reporting platform is called PlyNET and it is based on Microsoft SQL Reporting Services (SSRS) technology. The PlyNET platform is fully developed by the UPM IT-department and in the long run that could cause problems concerning product support and future development.

During 2011-2012 UPM has implemented a standard MES solution for plywood production based on GE Intelligent Platforms' Proficy product family. This system is called PlyMES. The Proficy platform includes standard out-of-the-box reports, but these reports were found to be insufficient and needed to be extended or replaced. To be able to extend PlyMES reports and merge these with existing PlyNET reports, Novotek Report Plus (NRP) reporting tool was chosen as a candidate.

Like PlyNET, the NRP platform is also based on standard SQL Server Reporting Services (SRSS) technology. Using NRP, UPM specific reports based on data in PlyMES system can be designed and existing PlyNET reports can be merged together with PlyMES reports into a single reporting portal.

The goal of this thesis is to explore the possibility to use Novotek Report Plus as a single reporting portal for PlyMES and PlyNET reports. Alongside of this project WIP inventory balance, plywood average thickness and produced plywood quantity reports will be designed and created.

2 Introduction to Manufacturing Execution System (MES)

With the economic system changing continuously; manufacturing companies are compelled to develop their manufacturing processes to be more adaptive and agile against the demand-driven market. It is a buyer's market and when sterling products and yet cheaper prices are demanded, manufacturing companies are put on the spot. In order to keep the prices low, manufacturing companies are forced to utilize their resources to the maximum state.

The need to utilize resources to the maximum level led to developing Manufacturing Execution System (MES). The MES-system is an information and communication system that manages manufacturing operations in factories. MES takes care of data compilation between automation devices and financial-logistical information from Enterprise Resource Planning (ERP). The National Institute of Standards defines MES as a collection of hardware/software components that enables the management and optimization of production activities from order launch to finished goods. The scope of MES includes, but is not limited to: Resource allocation and tracking, Scheduling, Data collection, Labor management, Quality management, Process management, Maintenance management and Product tracking. [20]

2.1 Integration and ISA-95

Because the integration between different information layers is often challenging, the ISA-SP95 committee developed the ISA-95 Enterprise-Control System Integration Standard to solve this problem. Alongside ISA-95 standard development, standards ISA-88 (Batch Process Modeling) and B2MML-model (Business to Manufacturing Markup Language) were developed to support ISA-95 standard. ISA-88 and B2MML model defines how level 3 functionalities are executed and stored. ISA-95 standard consist of five parts and part 1 presented below figure 1, has become an IEC/ISO international standard. The subject of the standard is commonly known as MES.

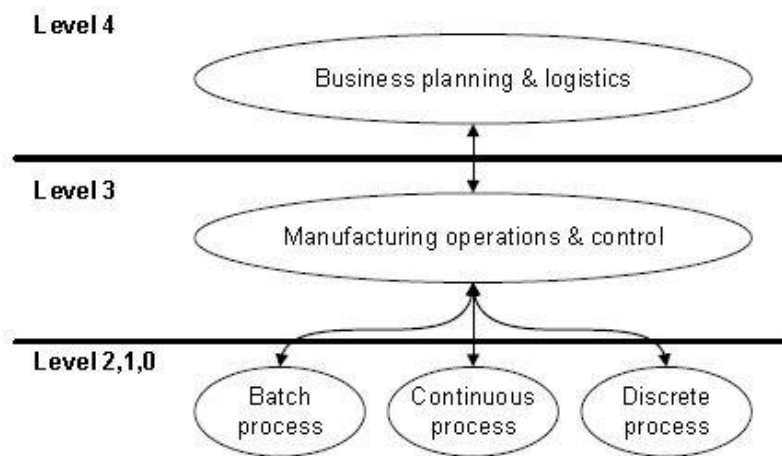


Figure 1. Functional hierarchy (ISA-95)

As figure 1 illustrates the ISA-95 standard defines a functional hierarchy model, which represents the hierarchy of information systems of a manufacturing company. Level 4 in Figure 1 defines the business-related activities needed to manage a manufacturing organization. Level 3 defines the activities of the work flow to produce the desired end-products. Level 2 defines the activities of monitoring and controlling the physical processes. Level 1 defines the activities involved in sensing and manipulating the physical processes. Level 0 defines the actual physical processes. [2]

The main purpose of a MES system is to operate and ameliorate all aspects that influence the manufacturing process. The logistical and production processes of a factory can never be fully automated. People are always in charge and responsible for the determined decisions concerning what to do next or how to act. The quality of these decisions is determining the overall performance of the factory. The MES-system is the key information provider to help to execute those determinant decisions. This thesis will discuss on handling the information provided by the MES-system. [1]

The MES-system is also much more than just an information provider. As the name implies MES is more than a planning tool like ERP. MES is an on-line planning tool with emphasis on executing the plan.

Execution stands for: making products, making and measuring parts, turning machines on and off, moving inventory to and from workstations, changing order priorities, assigning and reassigning employees, assigning and reassigning inventory, setting and measuring controls, changing order priorities, scheduling and rescheduling equipment. [1]

As mentioned before MES is also an important information provider. It provides almost real-time data from the shop floor and this thesis focuses on reporting using that data. The following chapters go through different reporting platforms there are to choose from but mainly the focus is on Novotek Report Plus reporting platform.

3 Defining Reporting and Reporting Technologies

This section focuses on why reporting is such a fundamental part of every business and what different reporting technologies and reporting software is commonly used by manufacturing companies. How the reporting technologies differ from each other and the advantages they offer on different user environments.

3.1 Reporting

Reports answer basically three questions. What happened, how it happened and what is eventually going to happen. In manufacturing business, enormous amount of data is collected every day. Data is collected so that we can answer those three questions as well as possible. The overall performance of a factory is based on decisions made by the people working in the factory. When information is gathered, calculated and grouped properly, those determining decisions become easier to make.

Reports make it possible to monitor every aspect of the manufacturing process. Today reports offer a large range of functionalities to help us with decision making. Charts, gauges and other visual objects offer visual aid to really understand the provided information. Of course data has no value in themselves, but when data is structured and

the relations between various items are presented in a clear manner, then they become information and their meaning increases.

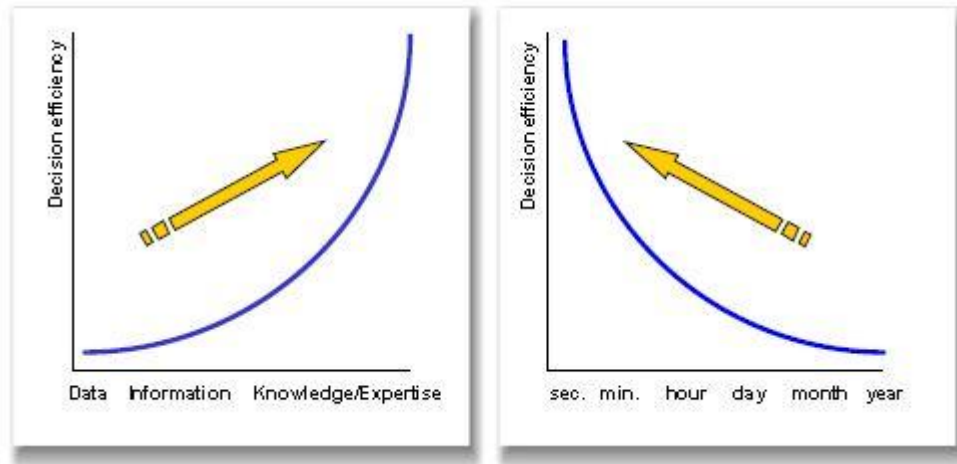


Figure 2. Use of information and communication speed

As expressed above on the left side of figure 2 the “decision efficiency” increases dramatically when people are using information combined with their knowledge. As seen on the right side of figure 2, value of the information depends heavily on its timely availability. When manufacturing products, the timely availability of the information is essential to be able to react effectively to events, trends and exceptions. Because there is different kind of information available, there are also different kind of reporting technologies available to suit the user’s needs.

3.2 Reporting Target Audience

Reporting technology is selected depending on the end user. Executives need different reports than operators working on the shop-floor and again production supervisors need different reports than operators and executives. Reports with a short time span are needed in all personnel levels from executives to operators. In today’s company, results from yesterday need to be available for analyzing the next morning. Monthly reporting is necessary but in some cases quarter year reporting is enough. Reports with a long time span give essential information about the direction the company is going. When planning use of resources, contracts with customers or investing on ma-

chines, those long time span reports help managers to control and forecast development of the business. The time span grows when moving higher on the company's hierarchy, as seen below in figure 3:

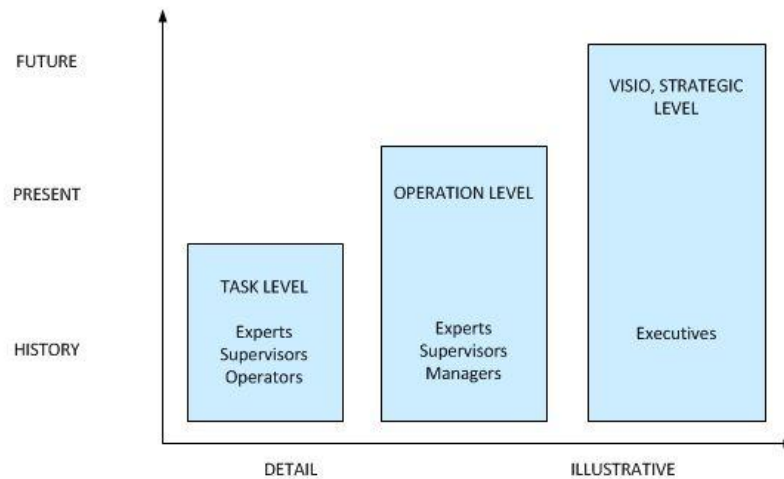


Figure 3. Internal Reporting.

As seen in figure 3 the executives need answers to questions concerning vision- and strategic level, is the company moving on the right direction on a long term. Reports aimed for executives often deal with financial matters. On an operational level experts, supervisors and managers need reports informing about the present period of time, if the ongoing year is going as planned, if the business is operating profitably and what is the financial solidity and does business have enough money to develop and grow. On a task level report emphasis is on everyday operations, so that all operations are operated efficiently and with the highest quality. [18]

3.3 Modern Manufacturing Reporting System Structure

Manufacturing reporting system is typically a combination of what is presented below in figure 4. Data is collected from the shop floor with collectors and then saved with Historian or SQL Database. Typically raw data is saved in Historian Database and event based data on SQL Database. The Reporting portal then queries the desired data from

different databases and different reports gather the data to readable and easy to understand form.

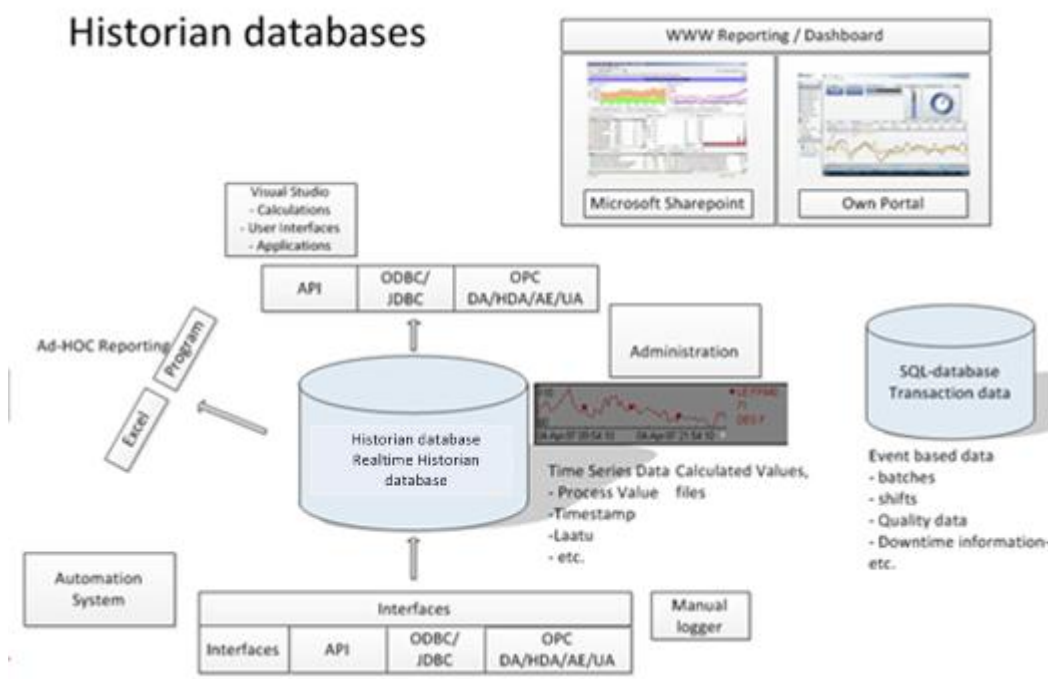


Figure 4 .Reporting System Structure.

3.4 Reporting Technologies

In this chapter different reporting technologies are introduced. Dashboards, Ad Hoc and managed reports are the three options to choose from if out-of-the-box reporting is not included. Each of the reporting technologies has their own strengths and weaknesses and when a new reporting platform is considered, it should cover all three fields at least at some level.

3.4.1 Dashboards

Let us consider a car's dashboard. There is a speedometer, a tachometer, an odometer, a fuel gauge and other indicators to help the driver to see the car's current state with only a quick glance. The driver is also informed with different warning lights if

something is out of the ordinary with the car. Usually that means taking the car to a workshop to prevent greater damage. Same principal has been applied with information dashboards. For example, a manufacturing dashboard may show Key Performance Indicators (KPI) related to productivity such as number of parts manufactured, or number of failed quality inspections per hour.

A dashboard is a computer software program that handles and processes bulk data so that data values are represented in a concise numerical language. The values on a dashboard can be manipulated in a way that affects real-time processes, such as manufacturing. Dashboard reports are designed to be very visual. Information is presented by using charts and gauges and other visual ancillaries. Visual ancillaries help to understand the information and they make it easy to notice possible exceptions and thus corrective actions can be done as soon as possible. [5]

Dashboards are diagnostic tools designed to provide end users overview of the company's performance. The KPIs are presented on a single screen display. Dashboards can be defined as *"An easy to read, often single page, real-time user interface, showing a graphical presentation of the current status (snapshot) and historical trends of an organization's Key Performance Indicators to enable instantaneous and informed decisions to be made at a glance."* [7]



Figure 5 Dashboard Screens.

Dashboards are used for various reasons, four of them being: monitoring, consistency, planning, and communication. Perhaps the most fundamental purpose of those four is monitoring. Monitoring refers to a day to day evaluation of metrics that should result in corrective action. Consistency relates to the alignment of measures and measurements procedures used across departments and business units. Dashboards may also be used for planning, given that scenario analysis is presented among its features. Finally, a dashboard communicates both performance and the values of an organization to its stakeholders through the choice of the metrics. [4]

Difference between managed reports and dashboards is in the amount of detail shown. Managed reports can have thousands rows of information and they are designed to be investigated more closely than dashboards. Additionally dashboards are designed to be exceptionally user friendly and they are extremely customizable and relatively simple to use.

The value of dashboard reporting is that it is a clear and concise presentation of key business drivers and risks. Such value is lost when the dashboard reports in great depth or variety of drivers. Detail on problems highlighted in a dashboard report should be provided in separate, more detailed reporting. It is important that business owners and managers and other users of the dashboard reports understand that the information given will only be effective where:

- The data that is used to generate the report is kept- up-to-date
- The report are reviewed regularly and the information contained in reports are reviewed regularly
- The information contained in the reports is useful to decision makers.

The use of dashboard reporting will assist business owners and managers in improving their decision making process and hence business performance. When used in conjunction with business evaluation, the key metrics can be set to monitor all important business drivers and risks. This should encourage regular review and action where required. The dashboard report should align with the business strategy and be easy to create, understand and explain. The dashboard report also needs to be flexible to introduce new, more relevant metrics to support the continual improvement of the business.

Dashboard reporting should be developed with due consideration to the needs of users. Where the business has a number of employees, processes, various divisions, or locations then a dashboard report for each of those areas may be advantageous. Significant advantages to the business will be achieved when the reports are prepared frequently and in a format that the user can easily read. The use of visual aids is the most common form of dashboard reporting, as this provides a quick and concise presentation of key information. Implementing dashboard reporting into the business will ensure that the important metrics for business success are continually monitored. [3] [6]

3.4.2 Ad Hoc Reporting

Ad Hoc means formed, arranged or done for a particular purpose only, from Latin, literally “for this”. Corporate reporting and analysis systems can be divided into two major categories, managed reporting and ad hoc reporting. With managed reporting, technical specialists and report developers build reports for others to use. The report developers work with end users to understand their reporting requirements and then build a set of reports for various groups in the organization. Ad Hoc reporting is the opposite of managed reporting. Instead of running a pre-designed report, Ad Hoc reports allow end users to easily build their own reports and modify existing ones with little or no training using a step by step wizard in the reporting program. In general Ad Hoc reports are very simple comparing to managed reports. See figure 6 below.

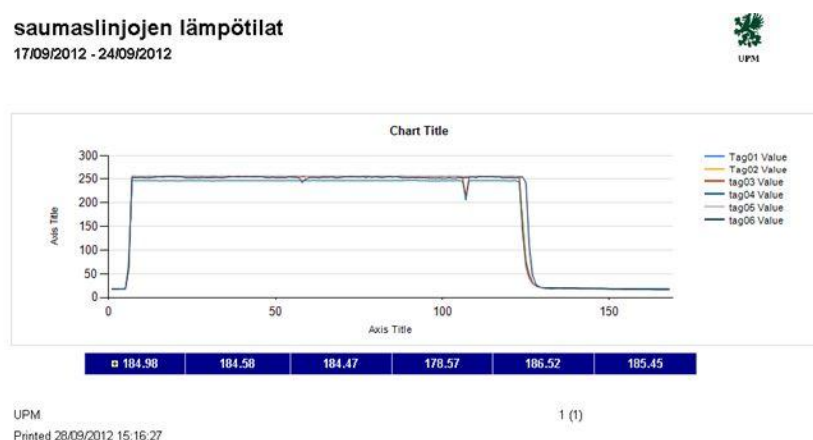


Figure 6 Example of Ad Hoc Report.

Sometimes, end users need reporting capabilities for a one-time question or they want to build specialty reports without having to request the IT-department to create a new report for them. Ad Hoc reporting allows end users to get answers on demand and customize their queries so that their reports contain only the information needed. This type of flexibility frees up valuable IT resources and gets information to end users immediately when the lengthy back and forth cycle between end user and IT-department has been eliminated. [9]

Still like dashboards, Ad Hoc reports alone are not the full answer to reporting needs in a manufacturing company. But as a helpful tool, again like dashboards it is very useful to many end users saving time and resources of the IT-department. When considering a reporting tool, it should be capable for both managed reports and also offer the possibility to do an Ad Hoc report.

3.4.3 Managed Reporting

Managed reporting lets developers, usually people from the IT-department, to create powerful and feature-rich reports. Managed reporting is a model of business intelligence (BI) in which reports are built and distributed by report developers. The report creation environment is more complex and versatile than Ad Hoc report environments. They require IT background and knowledge about SQL queries to develop the reports. [10]

Managed reporting therefore “manages” in the sense that end-users receive reports that are built and distributed from the top down by technical users, who “manage” the process, ensure that users have what they need and correct any bugs or flaws that report may have. Managed reports are the opposite of Ad Hoc reports, the model by which nontechnical end-users prepare the reports themselves.

NOVOTEK

Report Plus

PlyMES >> PROD Varastosaldo Karsittu

1

of 2

75%

WIP Inventory	Quality	Event Number	Thickness	Width	Length	Order Number	Status	Timestamp	Run meters	Volume	Veneer count				
2100 PATCHING LINE 01 - INPUT STORAGE UNIT									3,207.00	rm	6.97	m3	1,066.00	pcs	4kpl
2100 JOINTING LINE 01 - INPUT STORAGE UNIT									273,099.00	rm	532.96	m3	86,240.00	pcs	67 kpl
2100 JOINTING LINE 02 - INPUT STORAGE UNIT									13,534.00	rm	36.38	m3	11,275.00	pcs	27 kpl
2170 SCARF JOINTING LINE 01 - INPUT STORAGE UNIT									24,123.00	rm	55.20	m3	14,994.00	pcs	38 kpl
BK2									3,219.00	rm	6.23	m3	2,473.00	pcs	6 kpl
		2145_SSU010320120007#25	1.5	130	130	0	Varastossa	07/06/2012 22:44:20	551.00	rm	1.06	m3	423.00	pcs	
		2145_SSU010320120025#5	1.5	130	130	0	Varastossa	25/06/2012 21:04:35	546.00	rm	1.06	m3	417.00	pcs	
		2145_SSU010320120007#17	1.5	130	130	0	Varastossa	07/06/2012 17:36:04	544.00	rm	1.05	m3	417.00	pcs	
		2145_SSU010320120023#10	1.5	130	130	0	Varastossa	29/06/2012 22:40:38	529.00	rm	1.03	m3	407.00	pcs	
		2145_SSU010320120007#4	1.5	130	130	0	Varastossa	07/06/2012 10:46:59	529.00	rm	1.02	m3	406.00	pcs	
		2145_SSU010320120014#10	1.5	130	130	0	Varastossa	14/06/2012 20:47:53	525.00	rm	1.01	m3	403.00	pcs	
									2,277.00	rm	5.05	m3	1,482.00	pcs	4kpl
									3,009.00	rm	6.98	m3	1,387.00	pcs	4kpl
BK4															
		2145_SSU011220120004#1	1.5	130	259	00688321	Varastossa	04/06/2012 13:55:37	1,044.00	rm	2.03	m3	402.00	pcs	
		2100_SSU020120120711#1	1.5	159	355	00689316	Varastossa	11/07/2012 09:04:41	712.00	rm	1.59	m3	200.00	pcs	
		2145_SSU0200520120520#1	1.5	159	160	0	Varastossa	27/05/2012 22:51:02	644.00	rm	1.52	m3	403.00	pcs	
G1															
		2145_SSU0200520120018#1	1.5	159	160	0	Varastossa	18/06/2012 03:47:21	609.00	rm	1.46	m3	382.00	pcs	
PakWGE															
									14,064.00	rm	33.33	m3	9,032.00	pcs	22 kpl
W/G									1,106.00	rm	2.63	m3	426.00	pcs	1kpl
									448.00	rm	1.39	m3	214.00	pcs	1kpl
		2145_SSU040620120620#3	1.5	208	259	99689375	Varastossa	21/06/2012 02:31:12	448.00	rm	1.39	m3	214.00	pcs	
Total 38 kpl									24,123.00	rm	55.20	m3	14,994.00	pcs	
2170 SCARF JOINTING LINE 02 - INPUT STORAGE									27,162.00	rm	54.80	m3	20,015.00	pcs	48 kpl

Figure 7. Managed Report.

As said, managed reports are created by IT professionals. Reports are constructed and created by requirements defined by the end user. All the end user needs to do is to fill in parameters to run the report, parameters such as start time, end time, sample interval or any other depending on the nature of the report.

The IT-department maintains the reporting portal and authenticates users to access to reports they need. They also design the queries against datasources, if a report contains loads of data, it might be preferable to run it from subscription or schedule automated delivery to email or shared folder to avoid unnecessary traffic on the report server

4 UPM Production Related Reports

A manufacturing company needs a variety of reports showing key metrics for the production. When these key metrics are presented in an informative way, the company can improve efficiency and increase profits. Efficiency, waste, production and inventory are the main reporting areas in a PlyMES-system. This chapter covers some of the reports in those four main areas.

4.1 Efficiency

All businesses try to operate efficiently. In numerous markets, a business needs to be at least as efficient as its main rivals in order to be competitive and survive in the long-term. Increasing efficiency boosts the capacity of a business, assuming there is no change in the number of inputs employed. The capacity of a firm refers to how much a business can produce during a specific period of time. Efficiency measures how well the production or transformation process is performing. Efficiency is operating at maximum output at minimum cost per unit of output. There are several ways to measure efficiency, but downtime, waste, production rate and overall equipment effectiveness (OEE) are four efficiency reports that should be generated in each manufacturing company. [21]

4.1.1 Efficiency Related Reports

- *Downtime report*: shows period of time that a system fails to provide or perform its primary function. Usual causes for the system to fail are unplanned events or routine maintenance.
- *Waste report*: shows goods gone to waste due to poor quality.
- *Production rate report*: shows a machines production rate. It can be calculated dividing units produced by time it took to produce them.
- *Overall equipment efficiency (OEE) report*: shows simple metric to immediately indicate the current status of a manufacturing process. OEE is expressed as a percentage which is calculated $\text{Availability} * \text{Performance} * \text{Quality}$.

4.2 Waste

Waste in manufacturing is defined all activities in production that does not add value to the final product. Waste is very commonly found in the production process. Each company has different standards in the categorization and treatment. But in general is the same. Most important is the goal of lean manufacturing is to eliminate waste in produc-

tion processes. Waste in question may not have a direct impact on the final product. Waste increases the company's financial burden.

4.2.1 Waste Related Reports

- *Process Waste (input – output) report*: shows how much product went in to the production unit and its then compared what came out from the production unit. The difference between input and output is process waste.

4.3 Production

Production is a flow concept process. Production is measured as a “rate per output per period of time”. Production related reports should cover all possible information considering a single production event. From the first step when raw materials are released onto the production line to a finished good.

4.3.1 Production Related Reports

- *Processing lead time report*: shows how much time was required to produce a finished product.
- *Genealogy report*: shows materials consumed, processes completed, equipment utilized for one finished product.
- *Production schedule/plan report*: shows how different production units have been scheduled to produce products.
- *Waiting between work phases report*: shows time spent between work phases.

4.4 Inventory

In the MES-system inventory management focuses on production related figures rather than keeping eye on the value of the inventory. Production management in the MES-system provides complete visibility to all aspects of inventory levels by providing real-time information on: current raw material inventory levels, material usage, consumption rates, waste and defective materials, finished products, alarms, cycle times and frequency.

4.4.1 Inventory Related Reports

- *Work in Process (WIP) inventory report*: shows materials and components that have begun their transformation to finished goods. Usually WIP locations are located near different production units.
- *Veneers on conveyors & automatic wagons report*: shows amount of veneers on conveyors or automatic wagons, status of these veneers is also “work in process”.

5 Working with SQL Server Reporting Services (SSRS)

SQL Server Reporting Services is Microsoft's server-centric reporting platform; the server-centric platform allows users to access reports from multiple locations, multiple devices and multiple applications. Reports are created locally on client by user and then deployed to a server. Reports can be created with different solutions like Visual Studio, Report builder or some third party solution. After the report is deployed to the report server, reports can be accessed by multiple users from various locations and devices. Also after the report has been deployed on the server it can be applied with security settings such as who is able to run the report and who is able to edit the report. SSRS virtual directory is presented in figure 8 below. [11]

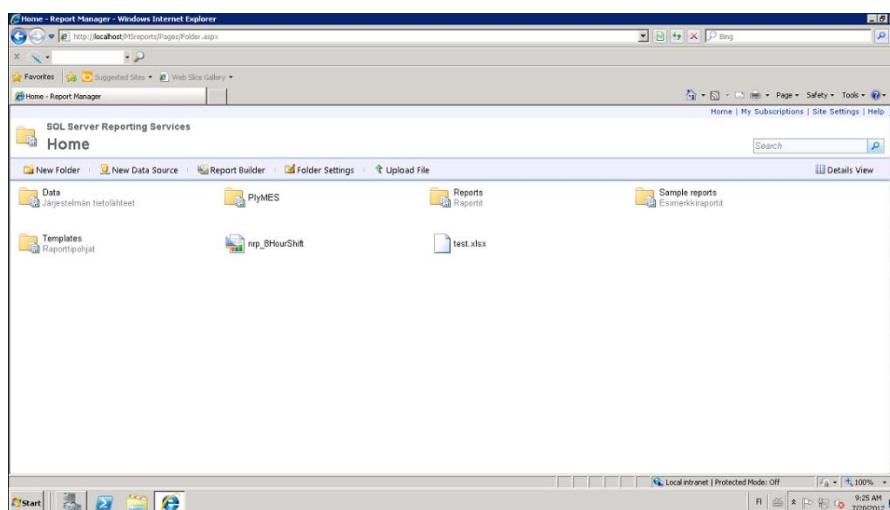


Figure 8. SQL Server Reporting Services Virtual Directory

6 Data Security

Data security is term used for protecting personal or corporate data from corrupting and unauthorized access. Data is raw form of information and the most valuable asset of a company. Valuable information that an organization holds:

- Information from production control systems
- Production development information
- Business information
- Production information
- Sales information
- Personnel data
- Marketing information

If the data would end up in wrong hands, the cost could be immeasurable. Imagine if an oil company's managers shared information of discovered oilfields via email and that information would end up in someone else's hands, actually that happened in 2009. A group of Chinese hackers targeted at least three of the largest oil companies and stole information of discovered oilfields and gas deposits; however they also collected data from the industrial control systems that contained proprietary production data, such as pressure and temperature settings and valve openings needed to produce a product properly. The whole stealing process lasted estimated from 2 to 4 years.

To prevent these kinds of situations there are several ways to protect data, but no protection system can prevent security leaks if authorized personnel act negligent or do not follow security guidelines. In this chapter different ways to secure data are presented and how data security and user authentication is reflected in the PlyMES reporting system.

6.1.1 Firewalls

Firewalls are used to conduct network security. Firewall controls incoming and outgoing network traffic. Data packets are analyzed and firewall determines are they safe to let through or not based on predetermined rule set. The firewall builds a bridge between trusted internal network and usually untrusted external network such as the internet. [19]

6.1.2 Antivirus Software

Antivirus software is always one step behind. That is because known patterns of data revealing the virus are always added after the virus is already infected one or more computers. Antivirus software is used to detect, prevent and remove all kinds of malwares (malicious software) such as: computer viruses, adwares, backdoors, malicious BHO (Browser Helper Objects), dialers, fraud tools, hijackers, key loggers, MLS (malicious layered service providers), rootkits, spyware, Trojan horses and worms.

All these malwares put the corporate information at risk. If a worm or virus does find vulnerability and compromises the system, it can do one of several things. Almost always it starts looking for other systems to attack so that in can spread itself further. That decreases computing resources and bandwidth. Even if the virus does not recognize confidential data it can leave a backdoor open to someone else and leave unnoticed. [20]

6.1.3 User Authentication

User authentication is used to control user and user group permissions to access corporation data. Commonly used control is handled by role based access control. A natural grouping sets of user groups that perform similar functions and by that need the same privileges to perform their daily job.

Authentication on an IT-system is commonly performed by using username and password. It is called Password Authentication Protocol (PAP) and it is used by Point to Point protocol which establishes a direct connection between two network nodes.

Novotek Report Plus system uses integrated Windows security which means the users browser and the web server negotiates to authenticate the user automatically with the credentials used when logged into Windows, if the user's computer and the server belongs to the same domain. If the server does not belong to a domain, the user will have to login manually using a local server account.

The automatic logon feature is controlled by the security settings of the browser. As default Internet Explorer settings automatically login only for sites belonging to intranet zone.

When a user is added to a user list the system checks if the user has permission to view the requested page, this process is called authorization. User roles can be modified and explored through the administrator client. User control view is present below in figure 9.

Domain and user name	<input type="text" value="GRIFFIN_v760537"/>
Full name	<input type="text" value="Pekka Kuoppamäki"/>
System roles	<input checked="" type="checkbox"/> View reports <input checked="" type="checkbox"/> Perform data correction <input checked="" type="checkbox"/> Input manual data <input checked="" type="checkbox"/> Manage content <input checked="" type="checkbox"/> Manage system settings
<input checked="" type="button" value="Cancel"/> <input type="button" value="Save"/>	



User name	Full name	
GRIFFIN_v760537	Pekka Kuoppamäki	 

Figure 9. NRP User Control.

Each of the users in NRP must also be created on the local computer or domain.

Users can be granted the following rights:

- | | |
|---------------------------|--|
| • View reports | Can view reports |
| • Perform data correction | Can edit Historian data |
| • Input manual data | Can manually enter data into Historian |
| • Manage content | Can change folder/report properties |
| • Manage system settings | Can edit system settings Local Computer or Domain Administrators, always have the right to edit system settings (to avoid being locked out by mistake) |

7 Case UPM PlyMES Reporting

7.1 Plywood Manufacturing Process

Plywood is made from layers of veneer so the manufacturing process begins from the making of the veneer. The first step of the process is soaking of the logs. Logs are soaked to soften the wood which facilitates peeling and producing an acceptable quality of veneer. After the wood is soaked it is moved to debarking. The debarking process takes place to facilitate the lathe's work and to remove the debris and dirt which might otherwise damage the lathe's knife. From debarking the log is moved to cutting operation, in Savonlinna logs are cut to three main sizes: 50", 60" and 7ft. The scope of Savonlinna MES-system is presented below on figure 10.

1"=25,4mm

1ft = 12"= 0, 3048 m

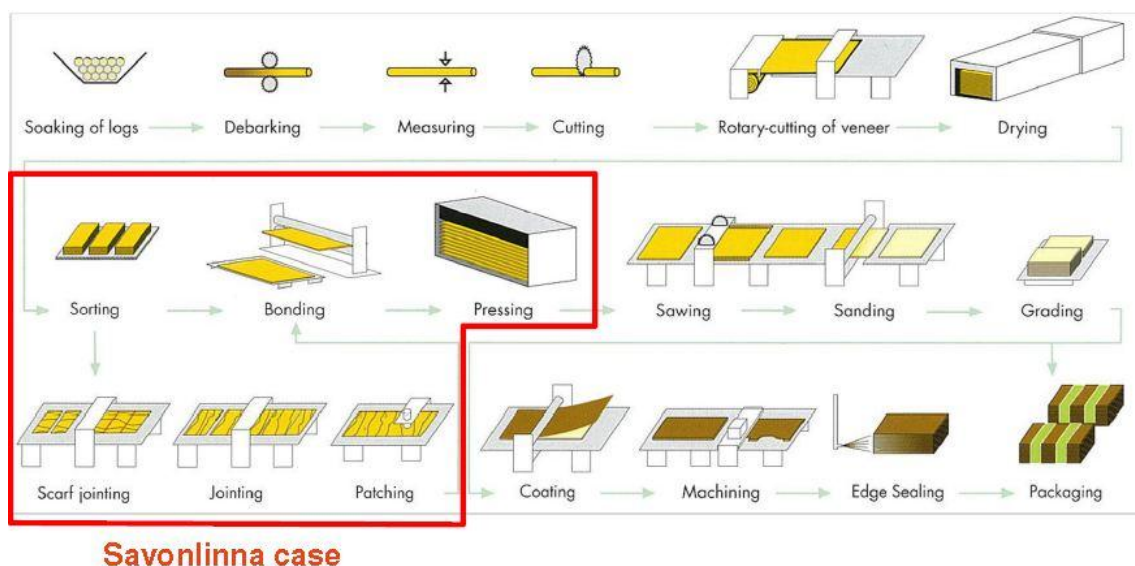


Figure 10. PlyMES Savonlinna Scope.

A rotary-cutter produces continuous veneer sheet which is dried before cutting and sorting, drying is done to aid the gluing process. In the cutting operation, the veneer sheet is cut to the desired dimension. In the sorting operation the cut veneers are sorted by quality classifications. Quality classifications can be grouped into three main groups:

- Face veneer
- Glue veneers
- Dry veneers

The yield of face veneers (plywood surface) is minor compared to veneer materials used between top layers in plywood product. Some veneers reach the face veneer quality straight from cutting and sorting and can be then moved to bonding operation. These qualities are A, B, Premium S, S, and WG. Veneer qualities BB and WGE can be used as face veneer after the patching operation. Other qualities are BK1, BK2, BK3 and BK4. Letter represents the wood species (B = birch), and number the quality level.

In the scarf jointing operation glue veneers are produced for required quality and thickness in glue dimension. In the jointing operation dry veneers are produced for required quality and thickness in glue dimension.

When there are required amount of all components: face veneers, glue veneers and dry veneers, bonding operation can start. In bonding operation veneers are piled according to BOM (Bill of Material). The product definition BOM for veneers includes following items:

- Materials / BOM
- Wood species (Birch, Spruce etc.)
- Quality (B, BB, WGE, K1, K2, K3 etc.)
- Thickness
- Width
- Length

At the end of each bonding line there is a pre-pressing station. The plywood stack must be processed from pre-pressing within 30 min after stacking has started. The pre-pressing operation for plywood stack takes less than 10 minutes. A one hour waiting time is required after pre-pressing before the stack may be processed in a hot-pressing unit. Time between pre-pressing and hot-pressing should not exceed 4 hours. Exceeding four hours might cause a decrease of product quality.

If plywood does not need coating, machining or edge-sealing it is ready for packaging. Plywood sheets may be coated with a liquid stain to give the surfaces a finished appearance, or may be treated with various chemicals to improve the plywood's flame resistance or resistance to decay. Edge sealing is done for the same reasons. In machining plywood boards can be machined to desired shape.

7.2 Current Reporting Portal PlyNET and PlyNET Reports

All UPM plywood factories use the PlyNET reporting portal. PlyNET offers five different reports that contain information of produced veneer amounts, OEE figures, veneer quality, etc. Following five reports are available on the PlyNET reporting system:

- Day report
- Alarms
- Plywood Quality

- OEE
- Production

The current reporting portal is fully developed by UPM's own IT-department and it has its own special functions and design. Alongside of implementing the new standard GE Proficy MES-system, the option to replace the old reporting platform was investigated. Because the existing PlyNET reports offer such valuable information about the plywood production, and because it is currently in use in every UPM plywood factory, replacing the old reporting portal with Novotek Report Plus cannot be performed without both reporting portals running at the same time.

UPM Savonlinna factory is also the first UPM plywood factory with a MES-system so for now there is no need to replace the current PlyNET reporting portal in factories that does not yet have MES-system controlling the plant manufacturing operations.

The main reason to investigate the possibility to replace the current reporting portal is future development possibilities and lag of product support after personnel who developed the existing reporting system retire or go work elsewhere

PlyNET and Novotek Report Plus are both web-based solutions and both are based on Microsoft SQL Server Reporting Services technology. PlyNET has some functionality that work separately from SSRS, those functionalities concern various warning limits on charts and in proof-of-concept phase those functionalities aren't a concern.

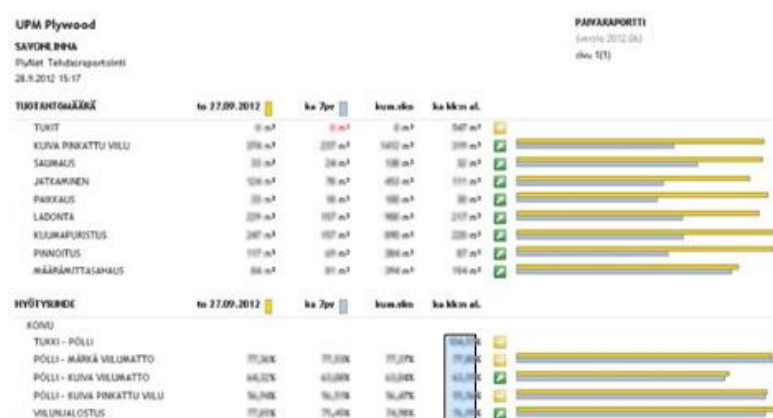


Figure 11. PlyNET Day Report.

7.3 New Reporting Platform Novotek Report Plus

Novotek Report Plus is a reporting portal especially designed for process and production related reporting. It is based on Microsoft SQL Server Reporting Services (SSRS) technology and it is a truly web-based reporting portal. Hundreds of installations in several industries across Europe, makes the Report Plus a proven solution for various production environments.

Versatile data handling and similar technology as base that current UPM reporting portal PlyNET uses, make's the Novotek Report Plus a considerable candidate for substituent as a single information portal for all production related data from the PlyMES-system.

NRP accepts all SQL- databases available on the market and top of that it comes with intelligent data connection to Proficy Historian. Data from shop floor is saved to Historian database and can be accessed with functions that NRP provides. NRP can utilize Historian data with efficient data aggregation and with the ability to data correction with auditing.

7.3.1 System Components

The report system is built using a layered architecture which allows for flexible deployment scenarios. The system consists of three main server components that are installed separately. Table 1 shows the components of NRP, the table also states on which server the component should be installed if using multiple servers.

Component	Description	Installed on same server as
NRP CLR	Configuration database and database functions.	SQL Server
NRP Client - Server	Report system client- server used for all data manipulation.	IIS
NRP Scheduler	Scheduler used to schedule subscriptions.	NRP Server

Table 1. NRP Components.

The components communicate using web services and the HTTP-protocol. If the components are installed on different servers, it is crucial to notice possible firewall restrictions. Figure 17 shows an overview of the components and how they interact with each other. NRP client-server is hosted inside Internet Information Services (IIS).

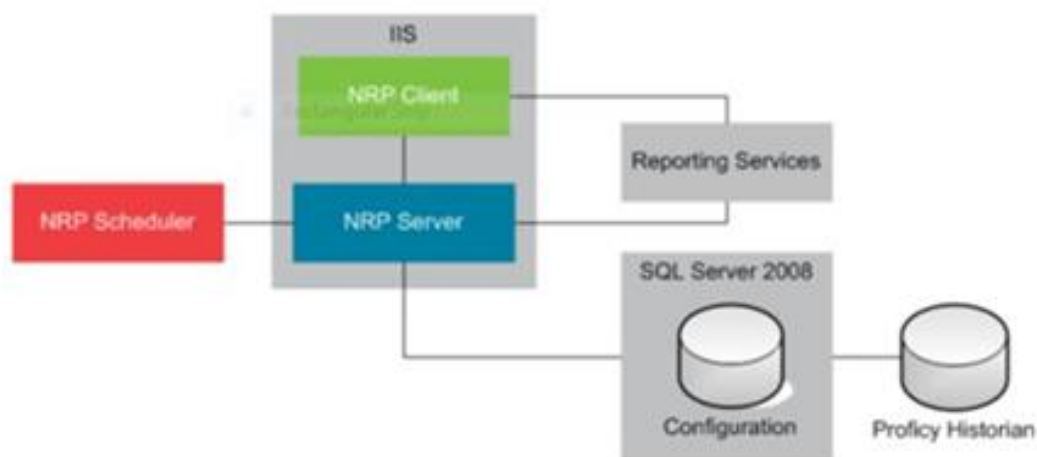


Figure 12. NRP System Design.

Before installation a deployment scenario must be determined, for UPM a distributed system scenario was the most suitable. In the distributed system the system splits over multiple servers to gain performance. The system is split into one server used for NRP and one used for SQL Server.

The report system is installed by running the setup for each component individually with administrator privileges. The system components are presented in table 1 above.

After installation of all three components the system can be started for the first time. The first time when the web client is opened an automatic configuration utility is provided. The configuration utility is used to automatically perform the following tasks:

- Set system language
- Set license number and activate license
- Set required user permission in Reporting Services
- Create default folders in Reporting Services
- Create default data source in Reporting Services
- Create default templates in Reporting Services

After the automatic setup has been performed users can be added on the Administrator site on NRP client.

7.4 Novotek Report Plus Unique Features

There are several differences between features in the PlyNET- reporting portal and Novotek Reporting Plus. Features presented below are features that current reporting portal cannot deliver. These features are Proficy Historian connection, dynamic time parameters, Ad-Hoc reporting with report templates and report quick links.

7.4.1 Proficy Historian Connection

In manufacturing business it is often necessary to accurately record and retrieve manufacturing information for business decision support. Analysis of past performance is essential to continuously improve future operations. Proficy Historian is a high performance data archiving system designed to collect, store, and retrieve time based information efficiently. Main features of Proficy Historian:

- Stores and makes available large amounts of data
- Processes large amounts of data at a high speed
- Distributes components across a network environment
- Stores and forwards data when network connectivity is interrupted

Historian serves can be added to Novotek Report Plus from the user interface. After the servers are added, historian tags can be selected to report as presented in figure 13 below.

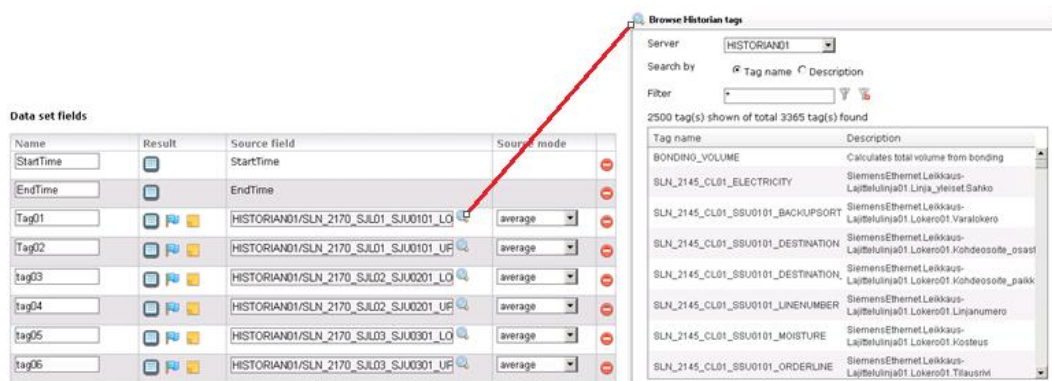


Figure 13. Historian Tag Selections.

NRP queries historical data with CLR function in SQL server. SQL server handles the retrieval of data in the Proficy Historian database. Principle of data retrieval:

1. NRP queries the SQL server for data (start/endtime and interval)
2. SQL server queries Historian for data
3. Historian returns data to the SQL server
4. SQL server forwards the data result set back to NRP – which shows it in the browser

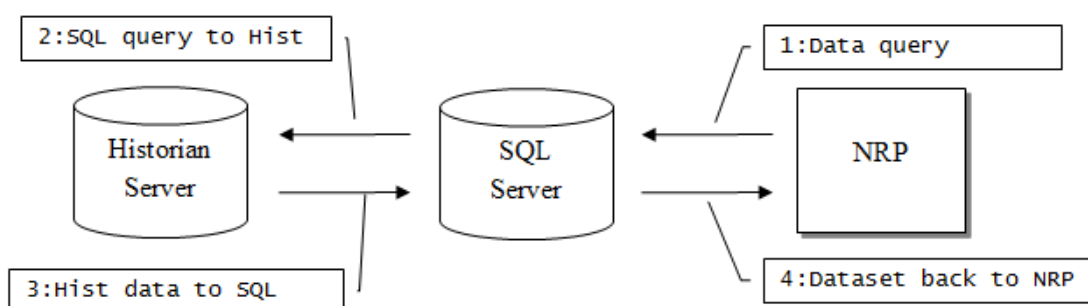


Figure 14 Principle of Retrieving Data from Proficy Historian.

7.4.2 Data Correction

When a historian server is running, data is logged continuously. If the connection between server and a collector is lost, the collectors will buffer data locally until the connection is reestablished. Sometimes the server where the collector is installed must be restarted. This might result in missing data in Historian. There may also be other situations where data either is lost or being saved incorrectly.

The Novotek Report Plus can correct this with functions “Raw data correction” and “Add manual data”. These features provide the opportunity to either edit existing data or add new data manually from the web client interface as presented in figure 15 below.

Selected data

Timestamp	Value	Quality
01/10/2012 08:59:43	247	Good
01/10/2012 08:59:48	248	Good
01/10/2012 09:00:16	247	Good
01/10/2012 09:00:20	248	Good
01/10/2012 09:00:24	247	Good
01/10/2012 09:00:52	248	Good
01/10/2012 09:00:56	247	Good
01/10/2012 09:00:57	247	Good
01/10/2012 09:00:58	247	Good
01/10/2012 09:00:59	248	Good
01/10/2012 09:01:24	247	Good

Figure 15. Raw Data Correction from NRP Client.

The data can be corrected in different ways:

- Constant value Exchanges the values with a constant value
- Absolute change Adds/subtracts a constant value to the already logged value

- Relative change Adds/subtracts a percentage of 'Hi Engineering Units' to the already logged value
- Set quality Sets the quality of the selected value to either Good or Bad
- Set comment Adds a comment to the selected values

NRP has a built-in audit trail of every raw data correction made through this interface. It is possible to implement the content of this audit trail into existing reports, or make a special data correction report.

7.4.3 Manual Data Adding

Adding data manually is done in two steps, the first tag is selected and a timestamp is set on the time when the data should appear as presented in figure 16 below:

The screenshot shows a web-based interface for adding data manually. It features two tabs at the top: 'Select target' and 'Set value'. The 'Select target' tab is currently active. Below the tabs, there is a 'Tag name' input field containing the text 'HIST/ManuelTag'. To the right of this field is a magnifying glass icon. Below the 'Tag name' field is a 'Timestamp' section. This section contains a date input field with '02/05/2011', a time input field with '21:49:48', and a clock icon. At the bottom of the form are two buttons: a red 'Cancel' button with a close icon and a blue 'Next' button with a right arrow icon.

Figure 16 Manual Data Adding Step 1.

Secondly the value is entered on the log, the quality and optionally a comment can be associated with the value as presented in figure 17 below:

Select target Set value

Tag name ManuelTag

Server name HIST

Unit

Range 0 - 999999

Value 14,895.00

Quality Good

Comment Manually entered data

Cancel Prev Save

Figure 17. Manual Data Adding Step 2.

7.4.4 NRP Times

One key feature of Novotek Report Plus is dynamic time parameter selection. The time objects are used to set the report start time as a part of a period object or when setting the report period using the Duration tab in the client. A time object represents a certain point in time, either relative to the current date or an absolute date. Virtually any date and time can be created using the time object by combining absolute and relative properties. [21]

A standard installation of NRP automatically creates a list of predefined times and intervals. As said virtually any date and time can be created with time editor. Predefined times can be seen in figure 18 below:



















Name	
Last month	 
Last week	 
Last year	 
Second	 
This month	 
This week	 
This year	 
Today	 
Yesterday	 

Figure 18. Predefined Times.

On time selection it is possible to choose relative or absolute values calculated from the time of report generation as presented in figure 19.

Figure 19 shows a 'Custom Time Creating Window' with the following fields and options:

- Name:** Text input field.
- Year:** Input field with value 0, slider, and 'Relative' radio button.
- Month:** Input field with value -3, slider, and 'Relative' radio button.
- Day:** Input field with value 1, slider, and 'Absolute' radio button.
- Weekday:** Dropdown menu with 'Select...'.
- Week number:** Dropdown menu with 'Select...'.
- Hour:** Input field with value 7, slider, and 'Absolute' radio button.
- Minute:** Input field with value 0, slider, and 'Absolute' radio button.
- Second:** Input field with value 0, slider, and 'Absolute' radio button.
- Buttons:** 'Cancel' (red X) and 'Add' (green +).

Figure 19. Custom Time Creating Window.

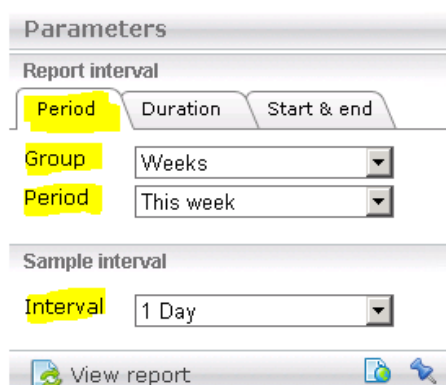
The interval objects are used to set the duration of the report period as a part of a period object or when setting the report period using the Duration tab in the report client. The interval objects are also used to set the sample interval of the report. The interval object represents a certain length of a time span. There is also an option to choose specific date and time for report start and end parameters as seen in figure 20 below.

Figure 20 shows two views of the 'Parameters' window:

- Left View (Duration tab):**
 - Report interval:** 'Period' and 'Duration' tabs are active. 'Group' is 'Weeks' and 'Period' is 'This week'.
 - Sample interval:** 'Interval' is '1 Hour'.
 - Buttons:** 'View report' and a pin icon.
- Right View (Start & end tab):**
 - Report interval:** 'Start & end' tab is active. 'Start' is 01/10/2012 22:00 and 'End' is 03/10/2012 11:00.
 - Sample interval:** 'Interval' is '1 Day'.
 - Buttons:** 'View report' and a pin icon.

Figure 20. Duration and Start & End Parameters.

The period objects are used to set the report period using the Period tab in the report client. The period object uses a time object to determine the start time of the period and an interval object to determine the length of the period. The period objects can be grouped into period groups to be easier to find as presented in figure 21.



The screenshot shows a 'Parameters' dialog box with a 'Report interval' section. Under 'Report interval', there are three tabs: 'Period', 'Duration', and 'Start & end'. The 'Period' tab is selected. Below the tabs, there are two dropdown menus: 'Group' set to 'Weeks' and 'Period' set to 'This week'. Below these, there is a 'Sample interval' section with a dropdown menu 'Interval' set to '1 Day'. At the bottom of the dialog, there is a 'View report' button and a globe icon.

Figure 21. Period Parameter.

7.4.5 Ad-Hoc Reporting and Reporting Templates

Reporting templates makes powerful Ad-Hoc reporting possible. A template is a report definition that is used as a base when creating reports. When creating a new report the template definition is copied, changed and then saved as a new report. That means that there is no persistent connection between templates and reports, if the template is changed it will not affect the reports that are created by using that template. The templates are stored as normal reports in SQL Server Reporting Services.

Novotek Report Plus comes with five standard templates. New templates can be created with different application tools such as Report builder or Visual Studio. Also any report can be easily converted to a report template.

When Ad-Hoc reporting is needed, new reports can be added from the Report Plus client. NRP comes with step by step wizard that guides through the report making process. First step is to select a report template and then the tag selection window appears. There is an option to aggregate the Historian data from tag selection list and name selected tags as presented in figure 22. [21]

Name	Result	Source field	Source mode	
StartTime		StartTime		
EndTime		EndTime		
temperature low		HISTORIAN01/SLN_2170_SJL01_SJU0101_LO	average	
temperature high		HISTORIAN01/SLN_2170_SJL01_SJU0101_UF	maximum	
temperature MIN		HISTORIAN01/SLN_2170_SJL02_SJU0201_LO	minimum	
tag04		HISTORIAN01/SLN_2170_SJL02_SJU0201_UF	sum	
tag05		HISTORIAN01/SLN_2170_SJL03_SJU0301_LO	rawaverage	
tag06		HISTORIAN01/SLN_2170_SJL03_SJU0301_UF	delta	
1 of 1				

Add tag

Figure 22. Ad-Hoc Reporting.

After tag selection, report name must be given and Data Source selected as presented in figure 23 below.

Basic properties Data selection Static items **Data sources**

nrp_HistoricalData LocalHistoricalData1

Cancel Prev Save

Figure 23. Data Source Selection.

7.4.6 Report Quick Links

To make it faster to view a report with a report period, sample interval and perhaps custom parameter values that are often used, report quick links can be created. The report quick link holds values for all parameters of a report. For reports with multiple custom parameters it makes the user experience more pleasant. Report Quick links are presented in figure 24 below.

Add new report quick link

Name	<input type="text" value="Sample Quick link"/>
Description	<input type="text" value="Jyväskylä OEE"/>
Tehdas	<input type="text" value="JYVÄSKYLÄ"/>
Tyopiste	<input type="text" value="All Items Checked"/>
Aikajakso	<input type="text" value="Vuoro"/>
Mittari	<input type="text" value="Kayntiaste vs. suunnit"/>
Ajan esitysmuoto	<input type="text" value="Paivat tunnit : minuut"/>
1. Ryhmittely	<input type="text" value="Tyopiste"/>
2. Ryhmittely	<input type="text" value="Aikavali"/>
3. Ryhmittely	<input type="text" value="[Ei mitään]"/>
Kuvaajan sarjoitus	<input type="text" value="Tyopiste"/>
Nollien poisto	<input type="text" value="Poistetaan nollat"/>
Nayttovalinnat	<input type="text" value="All Items Checked"/>
Kuvaajan tyyppi	<input type="text" value="Kayntisuhde"/>

Figure 24. Report Quick Link Parameter Settings.

After report quick link has been added it show on report navigation tree as presented in figure 25 below.

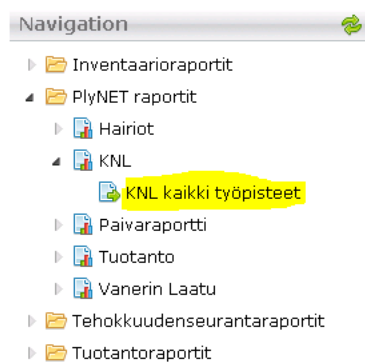


Figure 25. Report Quick Link.

7.5 PlyMES Reports

Production reporting is needed to monitor production execution operations. Reports concerning WIP inventories at the production units and quantities of the finished goods are in scope of this thesis. To prove Novotek Report Plus capability to handle existing PlyNET reports and data from the PlyMES-system, PlyNET reports were configured to work in NRP and few PlyMES reports were created. PlyMES reports are based on data in Proficy database. In this chapter, created PlyMES-report designs and report functionalities are presented. Created PlyMES reports are:

- WIP Inventory Balance
- Stack Details
- Plywood Thickness Daily Average
- Produced Plywood Quantities
- Completed Operations From Production Line

All reports are created by using Report Builder 3.0 which is included in SQL Server Reporting Services (SSRS) installation. Data is retrieved from the SQL database using SQL stored procedures which can be found as appendices. Stored procedures were created and tested with SQL Server Management Studio (SSMS) client as presented below in figure 26.

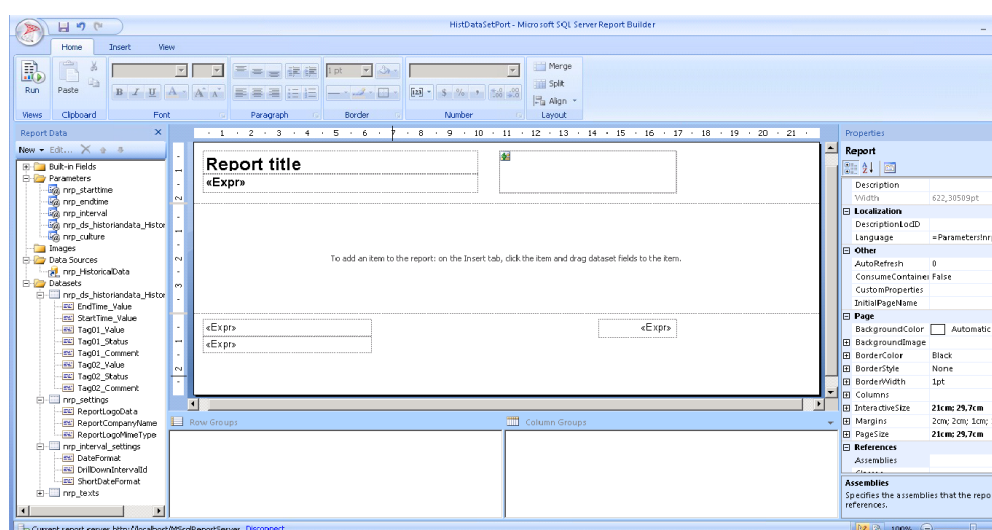


Figure 26. Report Builder 3.0

7.5.1 WIP Inventory Balance Report

1 Välivarastosaldoraportti
 Raportti ajalla 04/10/2012 13:36:21 Ajanjakso: 04/10/2012 - 04/10/2012

2 Valivarasto	4 Laatu	5 Puulaji	6 Paksuus	7 Pituus	8 Leveys	9 Tilainumero	11 Nippu Id	12 Kpl maara	13 Maara m3	14	15
■ WG								421	kpl	732.00	m3
■ SAUMAUSLINJA 2 ISU								83	kpl	2,413.00	m3
■ SAUMAUSLINJA 1 ISU								103	kpl	567.00	m3
■ SAUMATTU 1								186	kpl	318.00	m3
■ B&Q								7	kpl	14.00	m3
■ Koku	1.5	208	208	96682293	33110	331	kpl	2.00	m3		
■ Koku	1.5	208	159	96690416	72982	404	kpl	2.00	m3		
■ Koku	1.5	208	159	96690416	73003	413	kpl	2.00	m3		
■ Koku	1.5	259	130	96692442	78618	402	kpl	2.00	m3		
■ Koku	1.5	259	130	96691127	78824	400	kpl	2.00	m3		
■ Koku	1.5	376	159	1017469	84559	372	kpl	2.00	m3		
■ Koku	1.5	2800	1590	1019375	84619	400	kpl	2.00	m3		
■ B&Q								117	kpl	200.00	m3
■ B&K4								46	kpl	79.00	m3
■ B&LEK								6	kpl	5.00	m3
■ PaikWGE								1	kpl	2.00	m3
■ WGE								9	kpl	18.00	m3
Total 186 kpl										318.00	m3
■ SAUMATTAVA 1								104	kpl	115.00	m3
■ PAIKKAUSLINJA 1 ISU								6	kpl	10.00	m3
■ PAIKATTU 7								4	kpl	7.00	m3
■ PAIKATTU 150 ED								49	kpl	69.00	m3

Figure 27. WIP Inventory Balance Report.

1. Report name and execution time
2. WIP Inventory Location with drilldown function
3. Drilldown from quality
4. Veneer quality
5. Wood species
6. Veneer Thickness
7. Veneer Length
8. Veneer Width
9. Order number
10. Action to move more detailed report about chosen stack by clicking stack id number
11. Stack Id number
12. Stack count and veneer count on stack
13. WIP quantity and veneer quantity on veneer stack

WIP Inventory Unit is used for tracking WIP inventory levels in PlyMES-system. This unit is set as “Inventory” type and divided into inventory sub locations in Plywood Production. When veneer stacks are transported in the plywood production process, Inventory Location for production event is updated accordingly.

Work in Progress (WIP) inventory balance report shows all veneer stacks at WIP locations in the Savonlinna plant. On the report there is a filter parameter for veneer length with six different filter options to choose from: no filter, 130, 159, 188, 208, other. WIP Inventory Balance Report is presented below on figure 27 and custom parameter selection is presented in figure 28 below.

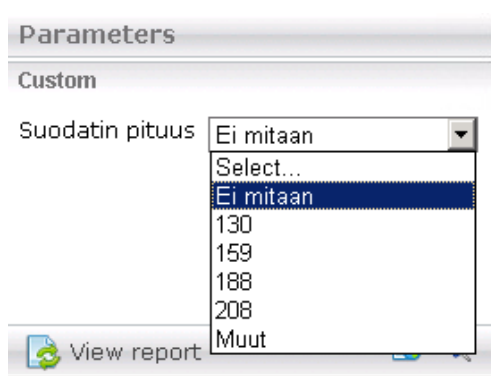


Figure 28. Length Filter Parameter.

7.5.2 Stack Details Report

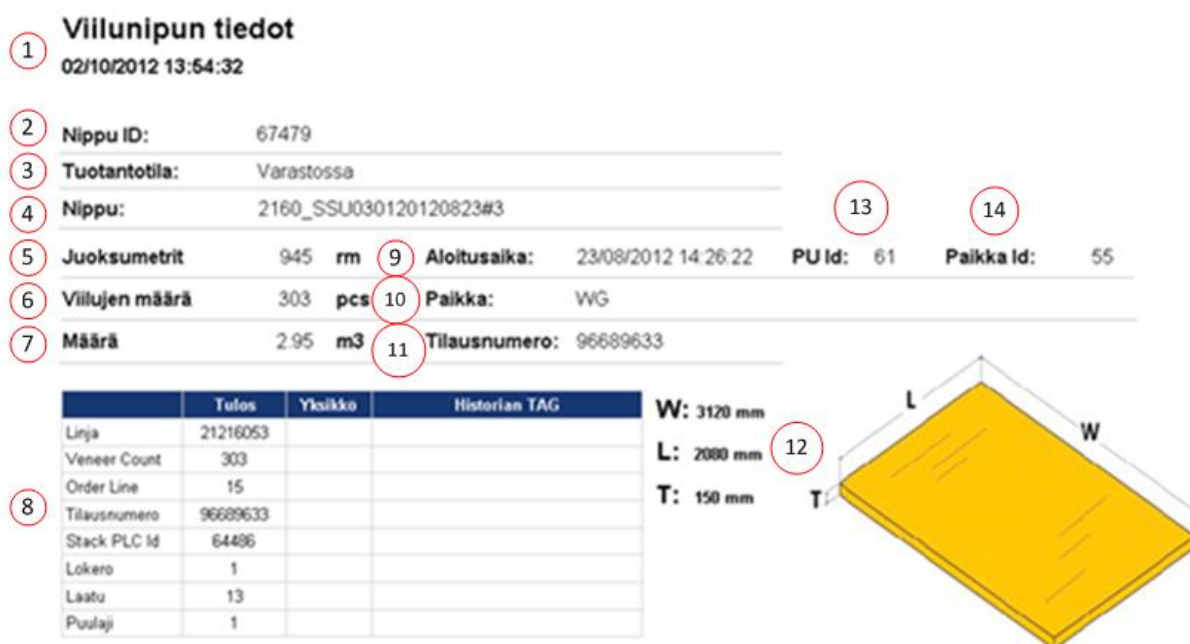


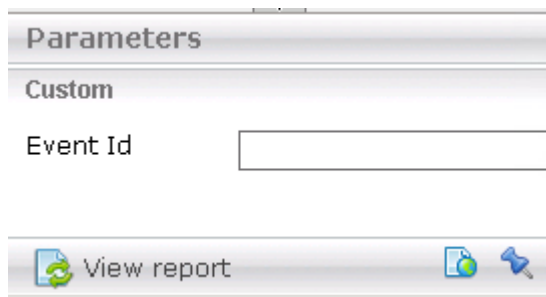
Figure 29. Stack Detail Report.

1. Report name and execution time
2. Veneer stack event Id number
3. Production status of veneer stack
4. Veneer stack event number
5. Veneer quantity in run meters
6. Veneer count in species
7. Veneer volume quantity
8. Table showing various PlantApp variables about veneer stack
9. Start time
10. WIP location
11. Order number
12. Veneer width as W, length as L and thickness as T
13. Production unit Id number
14. Location Id number

Stack details report shows specific information about veneer stack. It is sized to fit A4 paper so it can be printed and placed on top of a veneer stack. The report is designed

so that WIP Inventory Balance Report would perform more efficiently when all information related to one stack isn't found on one report. Bold texts are names and normal texts are variables that change according stack.

Stack Detail Report is designed to be a sub report for WIP Inventory Balance Report, but it can be rendered also separately if stack event id is passed as report parameter as presented in figure 30 below.



The image shows a software interface for report parameters. At the top is a tab labeled 'Parameters'. Below it is a section titled 'Custom'. Inside this section, there is a label 'Event Id' followed by a text input field. At the bottom of the dialog, there is a button labeled 'View report' with a circular arrow icon to its left. To the right of the button are two small icons: a globe and a pushpin.

Figure 30. Stack Event id Parameter.

7.5.3 Plywood Thickness Daily Average

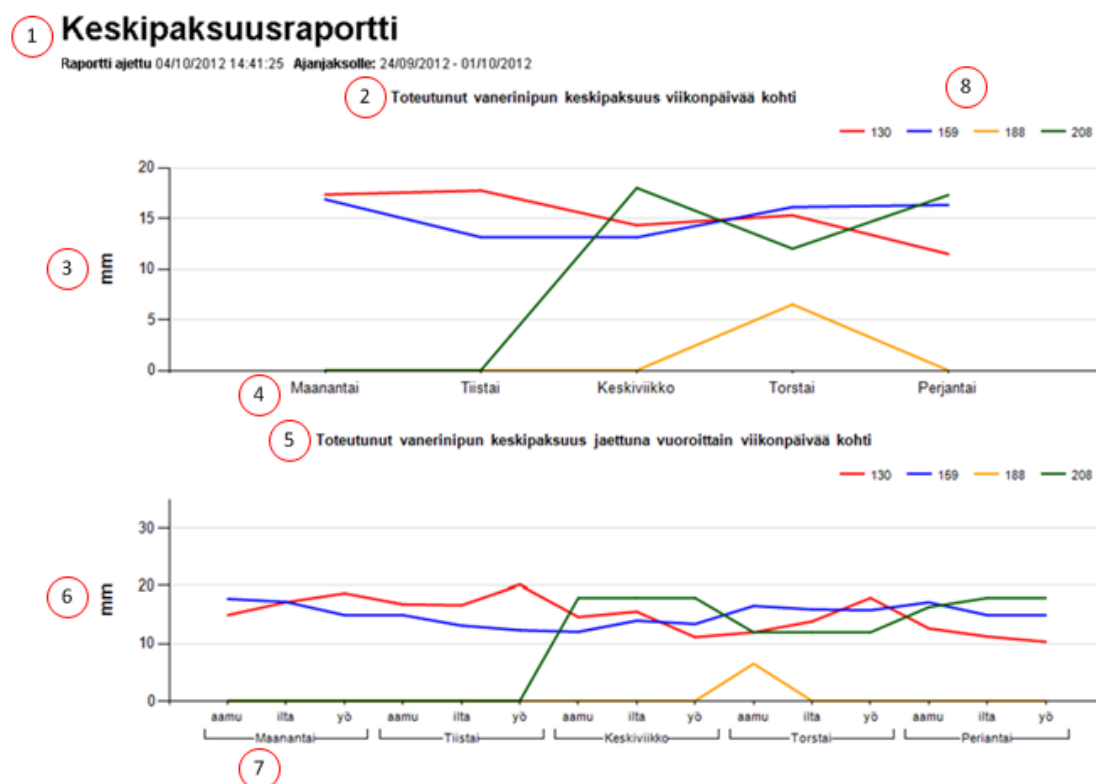


Figure 31. Plywood Thickness Daily Average.

1. Report name and execution time
2. Chart 1. Title daily average divided on weekdays
3. Chart 1. Vertical scale, millimeter as unit
4. Chart 1. Horizontal scale, divided on weekdays
5. Chart 2. Title daily average divided on work shifts and on weekday
6. Chart 2. Vertical scale, millimeter as unit
7. Chart 2. Horizontal scale, divided on work shifts and weekdays
8. Chart Legend showing Plywood Length

Plywood thickness daily average report shows thickness in millimeters on two charts. In figure 31 the top chart draws a line using daily average value as connecting points. Different colors represent different dimension. Chart only shows four length dimensions: red 130, blue 159, yellow 188 and green 208.

In figure 31 the bottom chart draws a line using daily thickness average and it is divided by work shifts,. Work shifts are: morning shift, evening shift and night shift. Report calculates the average thickness on shift and those calculations work as connection points.

In the report there is also a table that shows more detailed information about plywood average thickness as presented in table 2 below.

1	2	6	7	8	9
Paivämaa	Vuoro	130 AVG Paksuus	159 AVG Paksuus	188 AVG Paksuus	208 AVG Paksuus
24/09/2012 Maanantai 3	aamu	15.00 mm	17.84 mm	0.00 mm	0.00 mm
	ilta	17.25 mm	17.31 mm	0.00 mm	0.00 mm
	yö	18.80 mm	15.00 mm	0.00 mm	0.00 mm
	Paiva AVG (mm)	17.34	16.87	0.00	0.00
25/09/2012 Tiistai	aamu	16.88 mm	15.00 mm	0.00 mm	0.00 mm
	ilta	16.71 mm	13.18 mm	0.00 mm	0.00 mm
	yö	20.22 mm	12.37 mm	0.00 mm	0.00 mm
	Paiva AVG (mm)	17.74	13.13	0.00	0.00
26/09/2012 Keskiviikko	aamu	14.67 mm	12.08 mm	0.00 mm	18.00 mm
	ilta	15.60 mm	14.03 mm	0.00 mm	18.00 mm
	yö	11.15 mm	13.46 mm	0.00 mm	18.00 mm
	Paiva AVG (mm)	14.32	13.12	0.00	18.00
27/09/2012 Torstai	aamu	12.00 mm	16.61 mm	6.50 mm	12.00 mm
	ilta	13.89 mm	16.00 mm	0.00 mm	12.00 mm
	yö	18.00 mm	15.87 mm	0.00 mm	12.00 mm
	Paiva AVG (mm)	15.30	16.11	6.50	12.00
28/09/2012 Perjantai 4	aamu	12.67 mm	17.23 mm	0.00 mm	16.40 mm
	ilta	11.26 mm	15.00 mm	0.00 mm	18.00 mm
	yö	10.33 mm	15.00 mm	0.00 mm	18.00 mm
	Paiva AVG (mm)	11.48	16.32	0.00	17.29
5	Viikko AVG (mm)	15.32	14.90	6.50	15.91

Table 2. Plywood Thickness Daily Average as Table.

1. Date column
2. Work shift column
3. Drilldown option to detailed event history on work shift
4. Average daily plywood thickness calculated
5. Average weekly plywood thickness calculated
6. Column for length Avg. 130 thickness
7. Column for length Avg. 159 thickness
8. Column for length Avg. 188 thickness
9. Column for length Avg. 208 thickness

7.5.4 Produced Plywood Quantities Report

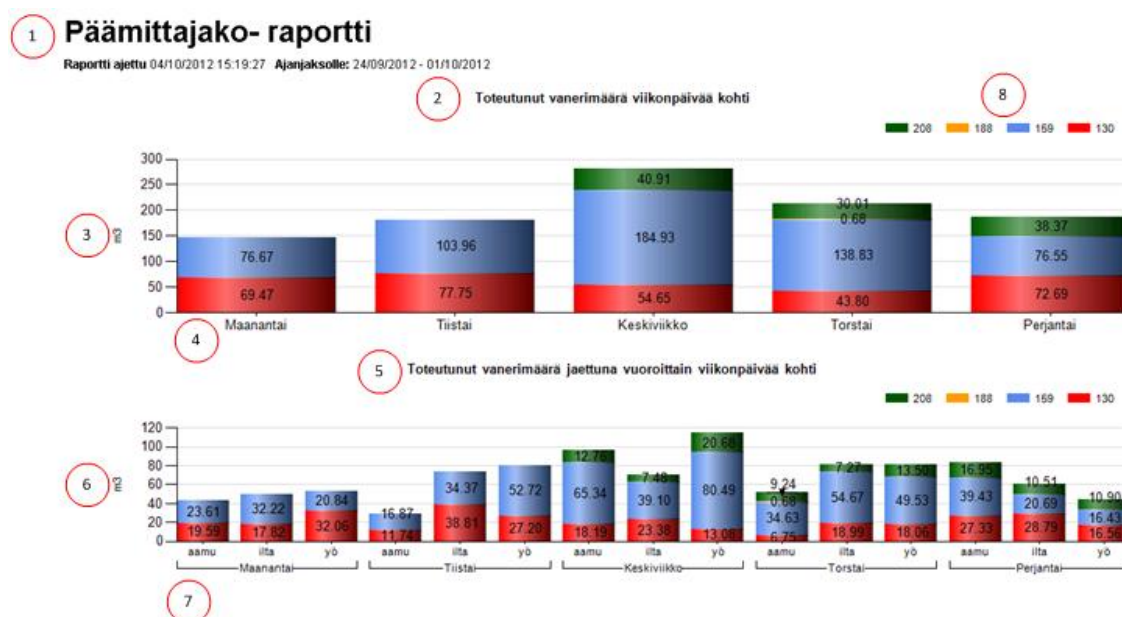


Figure 33. Produced Plywood Quantities.

1. Report name and execution time
2. Chart 1. Title Produced plywood quantity per weekday
3. Chart 1. Vertical scale, m3 as unit
4. Chart 1. Horizontal scale, produced plywood divided on weekdays
5. Chart 2. Title Produced plywood quantity per work shift and per weekday
6. Chart 2. Vertical scale, m3 as unit
7. Chart 2. Horizontal scale, produced plywood quantity divided per work shift and weekday
8. Chart legend showing plywood length

In figure 33 report shows produced plywood volume for lengths 130, 159, 188 and 208 in two separate charts. Top chart is divided by produced plywood volume per weekday and chart below on produced plywood volume per work shift and weekday. Different colors represent the four lengths. Labels on the charts show the quantity in m3 units. In UPM plywood factory work is done in three shifts, morning shift, evening shift and night shift.

Table 3 below there is more detailed table which shows every operation per work shift and per day. Drilldown can be performed by clicking work shift.

1	2	6	7	8	9
Päivämäärä	Vuoro	130 (m3)	159 (m3)	188 (m3)	208 (m3)
24/09/2012 Maanantai	aamu	19.59	23.61		
	ilta	17.82	32.22		
	yö	32.06	20.84		
	Total	69.47	76.67		
25/09/2012 Tiistai	aamu	11.74	16.87		
	ilta	38.81	34.37		
	yö	27.20	52.72		
	Total	77.75	103.96		
26/09/2012 Keskiviikko	aamu	18.19	65.34		12.76
	ilta	23.38	39.10		7.48
	yö	13.08	80.49		20.68
	Total	54.65	184.93		40.91
27/09/2012 Torstai	aamu	6.75	34.63	0.68	9.24
	ilta	18.99	54.67		7.27
	yö	18.06	49.53		13.50
	Total	43.80	138.83	0.68	30.01
28/09/2012 Perjantai	aamu	27.33	39.43		16.95
	ilta	28.79	20.69		10.51
	yö	16.56	16.43		10.90
	Total	72.69	76.55		38.37
	4 TOTAL	318.35 m3	580.93 m3	0.68 m3	109.29 m3
	5 ALL TOTAL	1,009.25 m3			

Table 3. Produced Plywood Quantities as Table.

1. Date column
2. Work shift column
3. Drilldown option to detailed event history on work shift
4. Produced plywood daily total
5. Produced plywood daily total for all lengths (130, 159, 188 and 208)
6. Column for length 130
7. Column for length 159
8. Column for length 188
9. Column for length 208

7.5.5 Completed Production from Production Line Report

1 Tuotantoraportti
Raportti ajettu 04/10/2012 15:33:59 Ajanjakso: 03/10/2012 - 04/10/2012

2	5	6	8	9	10	11	12	13
Tuotantoyksikkö	Laatu	Päiväys	Nippu Id	Aikaleima	Maara			
3 Jaskos 1, Lokeri 1	BH3				4 kpl	3210	mm	1,309.00 pcs 6 m3
Jaskos 1, Lokeri 2	WGE				4 kpl	3139	mm	1,361.00 pcs 5 m3
		03/10/2012	85328	03/10/2012 08:32:05		1036	mm	370.00 pcs 2.00 m3
			85491	03/10/2012 09:39:24		569	mm	253.00 pcs 1.00 m3
			85594	03/10/2012 12:45:32		769	mm	370.00 pcs 1.00 m3
			85689	03/10/2012 15:46:35		765	mm	368.00 pcs 1.00 m3
Jaskos 1, Lokeri 3	BH2				1 kpl	237	mm	76.00 pcs 0 m3
Jaskos 1, Lokeri 4	BH3				4 kpl	3532	mm	1,480.00 pcs 6 m3
4 TOTAL					13 kpl	10118	mm	4,226.00 pcs 17.00 m3

Figure 34. Completed Operations from Production Line Report.

1. Report name and execution time
2. Production unit name
3. Drilldown function by clicking the production unit name
4. Total row shows total quantities (pcs, run meters, volume (m3))
5. Quality column
6. Date column
7. By clicking stack Id number, Stack Detail report opens
8. Stack Id column
9. Timestamp column
10. Stack count
11. Stack count in run meters
12. Stack count in pieces
13. Stack volume (m3)

Completed Operations from Production Line Report offers view to completed production events. Report time span can be easily chosen from minutes to months. In figure 34 report shows all completed production events, e.g. produced veneer stack from the chosen department and line.

The report contains two custom parameters, first the production department must be selected and then the desired production line can be designated as seen in figure 35.

Report interval

Period Duration **Start & end**

Start Yesterday

Duration 1 Day

Custom

Osasto 2170 JATKOS

Linja Jatkos 1

View report

Figure 35. Completed Operations from Production Line Report Custom Parameters.

8 Conclusions

The goal of this thesis was to explore the possibility to replace UPM:s existing reporting portal PlyNET with the Novotek Report Plus reporting portal. One crucial angle was to get existing PlyNET reports to function in the Report Plus reporting environment and additionally create production related reports concerning WIP inventory levels and finished operations using data from the PlyMES-system.

The PlyNET reports were successfully configured to work in Novotek Report Plus and the PlyNET reports can utilize functions that the NRP reporting portal offers: quick links, subscriptions and dynamic time parameters.

The PlyNET reporting portal has some special functionalities that work separately from Microsoft SQL Reporting Services, bringing those functionalities to Novotek Report Plus was not investigated at this point of the project. Functionalities concern report warning levels in report charts etc.

The Novotek Report Plus reporting portal is mainly designed to work on top of Proficiency Historian, One angle of this thesis was to also examine how the Report Plus functions with combining information from relational SQL database and process Historian. As a conclusion, Report Plus contains powerful functionalities to combining data from multiple data sources. In addition it also can be used as reporting platform in Historian or SQL- only environments.

With the Historian connection Report Plus offers Ad-Hoc reporting tools. Ad-Hoc reporting frees valuable IT-resource time and thereby maximizes ROI (Return of Investment) for the investment.

A commercial product offers a long product life cycle and Novotek Report Plus is developed continuously. Also Novotek support contract frees IT-resources and system updates are delivered regularly.

All PlyMES-based reports were approved by UMP.

9 Future development

Novotek Report Plus is being developed continually. Development ideas spring mainly from user experiences. All discovered bugs are reported and fixed in future releases.

With Novotek Report Plus 2.5 there are some matters that need to be re-examined. The report parameter input box is too small in case a report has more than three parameters. The UPM PlyNET reports for instance have more than 10 parameters each and that causes problems with fluid user experience.

Also user control needs some improvements. For now there is no possibility to restrict outlook between reports and users, it means everybody automatically has permission to view each report in Report Plus. Also there are no user groups, which would help to improve the above mentioned problem with a view to all reports. Report view could be restricted with user groups like: operators, production supervisors and managements.

References

- 1 M. McClellan, *"Introducing manufacturing execution systems,"* in *MESA 2001 MES Conference & Exposition*, 2001. Available on-line: http://ime.syr.edu/PDF%20files/Intro_MES_McClellan.pdf, Referenced 15.7.2012.
- 2 J. Virta, *"Application Integration for production operations management using OPC UA unified architecture,"* Master's thesis, Helsinki university of Technology, Department of Automation and systems technology, Espoo, Finland 2010.
- 3 *"Dashboard Reporting, A Guide to improving management reporting in SMEs,"* 2011. Available on-line: <http://www.cpaaustralia.com.au/cps/rde/xbcr/cpa-site/dashboard-reporting-brochure.pdf>, Referenced 17.7.2012.
- 4 O. Velcu-Laitinen, *"The Use of Dashboards in Performance Management: Evidence from Sales Managers,"* 2012. Available on-line: http://www.uhu.es/ijdar/10.4192/1577-8517-v12_2, Referenced 17.7.2012.
- 5 *"Why use a Dashboard,"* 2010. Available on-line: <http://www.sixsigmaonline.org/six-sigma-training-certification-information/articles/why-use-a-dashboard.html>, Referenced 17.7.2012.
- 6 *"A guide to creating dashboards people love to use,"* 2009. Available on-line: http://www.juiceanalytics.com/wpcontent/uploads/2010/11/Guide_to_Dashboard_Design.pdf, Referenced 18.7.2012.
- 7 *"Dashboard business,"* Available on-line: http://en.wikipedia.org/wiki/Dashboard_%28business%29, Referenced 18.7.2012.
- 8 L. Wise, *"Operational Dashboards vs. Analytical dashboards,"* Available on-line: <http://www.klipfolio.com/resources/operational-analytical-bi-dashboards>, Referenced 18.7.2012.
- 9 LogiXML, *"AdHoc reporting Self-service, Personalized Reporting for any business user,"* 2007. Available on-line:

- <http://clarusvuca.ihostsolutions.net/Userfiles/Files/AdHocReporting.pdf>, Referenced 19.7.2012.
- 10 LogiXML, *"Business intelligence defined,"* 2012. Available on-line: <http://www.logixml.com>, Referenced 20.7.2012.
 - 11 N. Bhatt, *"SQL Server Reporting Services (SSRS) Architecture Overview,"* 2009. Available on-line: <http://nirajrules.wordpress.com/2009/12/29/sql-server-reporting-services-ssrs-architecture-overview/>, Referenced 2.7.2012.
 - 12 Microsoft, *"Extensions SSRS,"* Available on-line: <http://msdn.microsoft.com/en-us/library/hh213576.aspx>, Referenced 2.7.2012.
 - 13 Microsoft, *"Reporting services report server,"* Available on-line: <http://msdn.microsoft.com/en-us/library/ms157231.aspx>, Referenced 2.7.2012.
 - 14 Microsoft, *"Reporting services configuration manager,"* Available on-line: <http://msdn.microsoft.com/en-us/library/ms156305.aspx>, Referenced 2.7.2012.
 - 15 Virtual Training Company, *"Introducing to Microsoft Reporting Services course,"* Available on-line: <http://www.vtc.com>, Referenced 5.7.2012.
 - 16 A. Maunu, *"Implementation of Production Reporting at Kemi Shipping Oy,"* Bachelors thesis, Kemi-Tornio University of Applied Sciences, Department of Industrial management, Kemi-Tornio, Finland 2011.
 - 17 Tutor2you, *"Production & operations: Production efficiency,"* Available on-line: http://tutor2u.net/business/gcse/production_efficiency_improvements.htm, Referenced: 15.8.2012
 - 18 A. Nasarwanji, *"The Impact of Manufacturing Execution Systems on Labor Over-heads,"* Available on-line: http://www.iaeng.org/publication/WCE2009/WCE2009_pp734-737.pdf, Referenced: 27.8.2012
 - 19 Wikipedia, *"Firewall (computing)."* Available on-line: http://en.wikipedia.org/wiki/Firewall_%28computing%29, Referenced: 20.9.2012

- 20 Wikipedia, "*Antivirus software*." Available on-line:
http://en.wikipedia.org/wiki/Antivirus_software, Referenced: 20.9.20
- 21 Novotek, "*Novotek Report Plus Administrator Manual*", Referenced 29.9.2012