Tampere University of Applied Sciences
Paper Technology Degree Program
International Pulp and Paper Technology
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Final Thesis

Development and Documentation of Packing Instructions

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Commissioned by Tamfelt PMC Corporation, Product Manager Juha Paavolainen
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ABSTRACT

This final thesis is about developing globally understandable instructions for industrial use. The thesis is a response to the challenge given by Tamfelt PMC Corporation who needed singularly better clear and unquestionable packing instructions when starting North American deliveries from it's China plant in Tianjin. The subject of the work was to develop, create, verify and implement new special packing instructions for Tamfelt's plants in Finland and China.

The used instructions did not respond the need of globalizing production. The instructions were mainly printed copies in Finnish language. There was a flagrant need for multilingual instructions which have high information density yet providing the information needed in a glance.

The research done was qualitative and the subject was approached in context of value chain model, business processes and cultures. This thesis introduces an instruction model which utilizes the best present practices available in business, literature and standards. The conclusions made are well argued and thus qualified.

The work is also a summary from the relevant literature and standards regarding the instruction making and in that way it gathers the information needed for instruction making into one document.

Based on the work readers are able to find answers to questions like: how to create an instruction which is understood in other cultures, what was wrong with Michael Porter's value chain model, how to run a development project if the client's demands are changing constantly and how to make functional instructions fast by using only ordinary tools.

At the beginning the reader is provided with an overview to the paper machine clothing products. The multistage production process is explained as well as the packing as the last stage. The financial effect of functional instructions is also stated.

By using acknowledged methods of agile development and taking the latest all-round presentation software into its limits, clarity and amount of information was increased impressively with minimal costs. With help of the thesis the other special packing instructions for different market areas can be updated by utilizing the guidelines of this thesis.

Keywords 3D, agile development, benchmarking, instruction, multilingualism, packing, paper machine clothing, PowerPoint, SAP, value chain

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TIIVISTELMÄ

Opinnäytetyö kertoo ohjeiden kehittämisestä maailmanlaajuisesti käytettäviksi. Opinnäytetyö tehtiin Tamfelt PMC Oy:lle korvaamaan vanhentuneet suomenkieliset pakkausohjeet uudella monikielisellä ohjemallilla. Selkeämpiä ohjeita tarvittiin Pohjois-Amerikan toimitusten alkaessa myös Kiinan Tianjinin tehtaalta. Työn aiheena oli kehittää, luoda, testata ja ottaa käyttöön uudet pakkausohjeet käytettäviksi Tamfelt PMC Oy:n tehtailla Suomessa ja Kiinassa.

Aiemmin käytetyt ohjeet eivät vastanneet globalisoituvan tuotannon tarpeita. Ohjeet olivat pääasiassa kirjallisia ohjeita suomen kielellä. Monikielisille ohjeille, jotka sisältäisivät paljon tietoa tarjoamalla samalla kaiken olennaisen tiedon yhdellä silmäyksellä, oli suuri tarve.

Tehty tutkimus on laadullinen ja aihetta on lähestytty arvoketjumallin, liiketoimintaprosessien ja kulttuurin viitekehysten kautta. Työ esittelee ohjemallin, joka on luotu parhaiden mallien ja käytänteiden avulla hyödyntäen liike-elämän tietoutta, kirjallisuutta ja standardeja. Tehdyt johtopäätökset on perusteltu ja ne ovat siten päteviä.

Työ on myös yhteenveto ohjeiden laatimiseen liittyvästä kirjallisuudesta ja standardeista ja siten kerää ohjeiden laatimiseen tarvittavan tiedon yksiin kansiin.

Lukijat löytävät työstä vastaukset muun muassa miten laatia ohjeen, joka ymmärretään myös vieraassa kulttuurissa, sekä mitä vikaa Michael Porterin arvoketjumallissa oli, kuinka viedä kehitysprojektia eteenpäin, kun asiakkaan vaatimukset muuttuvat jatkuvasti ja miten tehdä toimivat ohjeet nopeasti vain perusohjelmistoja käyttäen.

Työn alussa luodaan katsaus paperikonevaatetuksen tuotteisiin yleisellä tasolla, jonka jälkeen käydään läpi monivaiheinen valmistusprosessi, jonka viimeinen vaihe pakkaaminen on. Myös toimivien ohjeiden taloudellinen vaikutus on perusteltu.

Soveltamalla ketterän kehityksen tunnustettuja menetelmiä ja käyttämällä viimeisintä esitysgrafiikkaohjelmistoa sen äärirajoilla ohjeiden selkeys ja tiedon määrä nousivat merkittävästi pienin kustannuksin. Työn avulla muut pakkausohjeet eri markkina-alueille voidaan päivittää käyttämällä esitettyjä suosituksia.

Avainsanat: 3D, arvoketju, benchmarking, ketterä kehitys, monikielisyys, ohje, pakkaus, paperikonekudos, PowerPoint, SAP

PREFACE

The work proved to be challenging and the outcome was desired. This was an excellent subject to use my expertise and knowledge, as the work associated well the subjects of paper engineering, business and information technology. I have IT background and since I started studies at TAMK I have wondered how I could combine the IT know-how with paper technology.

I wanted to utilize the business studies I have taken to get an additional subject from business administration somehow in the thesis work. During this work it was possible to use all the knowledge gathered.

I took the challenge although I felt that had not very deep knowledge about the fabrics, but the challenge was definitely worth taking. A lot of time was spent familiarizing with literature regarding paradigmatic instructions, commissioning company's present practices, and operation of the SAP-system. Deepening of knowledge within paper machine clothing and SAP ERP system will definitely come in handy in the future challenges.

The multicultural study environment of International Pulp and Paper Technology Program has prepared us for work with different nationalities and cultures, which was a really useful skill during the work. Also the TAMK ProAcademy entrepreneur and business studies in an international team have been helpful in reflecting the importance of the instructions from the economic point of view.

I really like to thank my tutor Product Manager Juha Paavolainen, who even when he was busy had always time for me to explain things and to share his views. With him and Product Manager Juhani Saari we have had countless coffee table conversations which have opened insights of engineers' global work within the paper cluster.

Also I like to thank Product Manager Toni Pennanen for showing the functions and service measurements of paper machine clothing in practice at a paper mill. For familiarizing with quality and production management I commend Production Planner Aino Raudasoja and Production Development Engineer Ulla Alhamo.

I like to thank Vice President Olof Siljander for offering this work for TAMK Paper Technology Program, which offered the opportunity to combine the different subjects studied during the years in this thesis work. I thank also the thesis supervisor Lic. Tech. Päivi Viitaharju for exemplary teaching work throughout the past years and for guiding this work. Without you all this work could have never been done.

Last but not least I want to thank my family, especially my partner Leena for supporting me throughout my studies.

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TERMS & ABBREVIATIONS

Belt	a rubber belt made from polyurethane is used in a shoe press to form the extended nip.
Benchmarking	process of comparing business processes and practices to corresponding ones in other industry or subsidiary aiming to find the best available practices.
CD	Cross Direction refers that an object is situated perpendicularly to the course of the paper web.
dtex	unit of measure used to describe yarn caliper, 1 g / 10 000 m.
Drive side	drive side (DS) or back side (BS) is the opposite side to tending side, where drives and auxiliaries are located.
ERP	Enterprise Resource Planning, an IT system that consolidates all business operations into an enterprise wide system.
Greenfield	a new industrial site lacking constraints and earlier infrastructure like buildings, machinery and the know-how.
Leader	a leader fabric is used to draw the dryer fabric into the paper machine.
MD	Machine Direction refers that an object is situated lengthwise on the course paper web moves from the head box.
PDM	Product Data Management is a subset of a larger concept of product lifecycle management (PLM) and it serves as a central knowledge repository for process and product history.
PEEK	polyether ether ketone is an organic polymer thermoplastic which is used in dryer fabrics to improve the hydrolysis and alkali resistance.
PET	polyethylene terephthalate is an organic polymer thermoplastic which is used commonly in dryer fabrics due to its good strength and wear, heat and chemical standing properties.
PMC	Paper Machine Clothing, an umbrella term covering the fabrics and belts used on a paper machine.
PPS	polyphenylene sulfide is an organic polymer thermoplastic which is used in dryer fabrics to improve the hydrolysis and alkali resistance.
SAP R/3	versatile Enterprise Resource Planning (ERP) software made by SAP AG. The R stands for real time and 3 means 3-tier.
SSB	Sheet Support Binding structure is a modern forming fabric type which provides better formation and high retention.
Tending edge	also known as tending side (TS), the side of a paper machine, which is used for tending.
Triangle	a triangle-shaped fabric which is attached to the leader if the fabric cannot be drawn on the machine by using the old fabric.
Velcro	a hook-and-loop fastener used in dryer fabric seaming. Another commonly used seaming assist is a zipper.

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1 Introduction

The work was done for Tamfelt PMC Corporation to improve the existing packing instructions and to create new instructions for new customer positions. Tamfelt had opened a new factory at Tianjin, China and in some cases special instructions for packing are needed. At the beginning most of instructions were in the Finnish language for the Tampere Plant. The goal was to develop a new instruction model, a template, which should serve all Tamfelt PMC locations worldwide.

The recently introduced Tianjin Plant will increasingly serve North American customers in addition to local East Asian markets. Paper machinery in China is for the most part modern, made by the leading machinery suppliers. In these positions the Tamfelt standard packaging is widely used with success.

As the markets in North America are older and more mature compared with the Asian ones, there are certain challenges to overcome. Paper machinery in North America is widely supplied by local machine builders, like Beloit. Customers operating these machines frequently like to have the fabric packed differently to the Tamfelt's standard packing. The standard packing lends well for the majority of the deliveries, but some of the fabric change equipment might need modified packing to be used.

Packing is the last stage in the manufacturing process and it seals material quality of a product. Employees need specific instructions to fulfill the customer's wishes regarding the packing in order to maintain high quality and customer satisfaction. As there were hardly any visual instructions available for the Tianjin Plant, those had to be developed. Also the distribution channel of instructions was to be refined from traditional paper file and email customs to instructions embedded in the SAP system in the context of customer machine positions. This procedure will enable the use of coherent and updated instructions.

SAP held inside already some instructions, but they were at the beginning only in textual notes. Packing methods and special wishes of customers were hard to explain using only words and even harder to explain for a person from a different culture and background. The new instructions needed to be clear, visual and uniform. The layout and the visual appearance of instructions were enhanced significantly by using the new layout and template design together with 3D illustrations.

The real challenge was that instructions had to be understood identically regardless of the reader's nationality, language, culture, working experience and other factors. The new and revised instructions also needed to be verified before implementation.

2 Company

Tamfelt Corporation is an international supplier of technical textiles. Tamfelt Corporation consists of Tamfelt Filtration Corporation and Tamfelt PMC Corporation. As the final thesis was made for Tamfelt PMC Corporation, the Tamfelt PMC is introduced more thoroughly by giving short shift for Tamfelt Filtration.

Tamfelt was founded in Jokioinen in 1797 and the paper machine clothing manufacturing was started in 1882, which means Tamfelt is the oldest still operating company in Tampere. The plant was located in the center of Tampere by the Tammerkoski rapids. Due to the lack of space and outdated facilities the plant moved into new premises to the Hankkio plant in 1970's, shown in the picture 1. Even today the Hankkio plant is the biggest factory in Tampere (Niemelä 2006, 137).

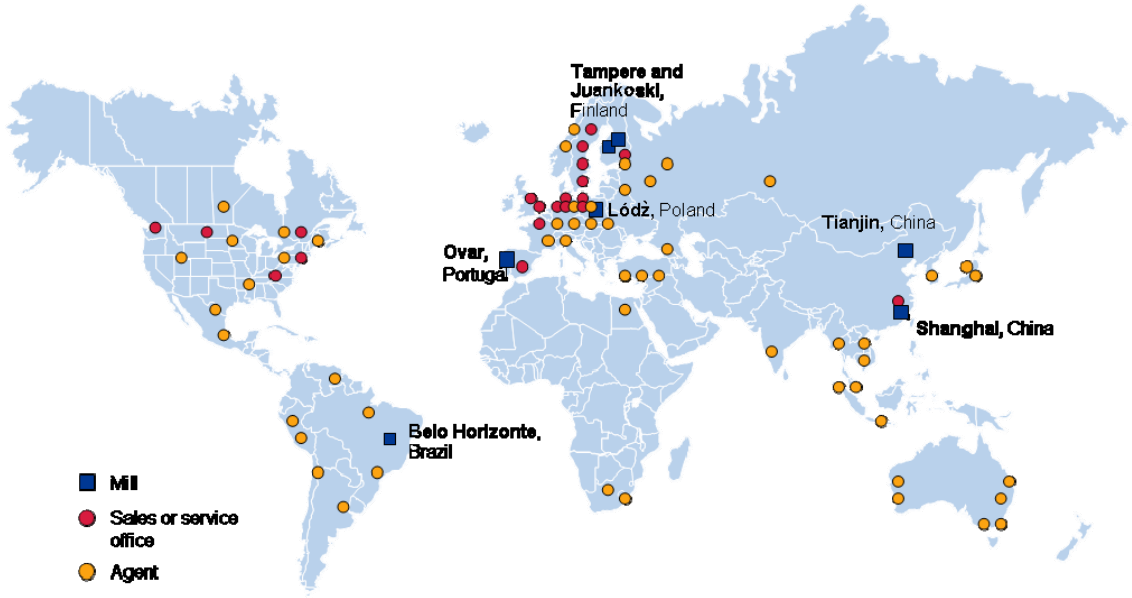
Picture 1: Tamfelt's Tampere plant is located at Hankkio area (Tamfelt – international supplier of technical textiles 2010)

Tamfelt's customers are world leading manufacturers of paper, board and pulp. Also mining, chemical and other process industries, as well as environmental technology companies belong to the clientele.

Tamfelt's values are satisfied customer, good profitability, openness and fairness, know-how and working ability and sustainable development. Tamfelt was among the first paper machine clothing suppliers to receive ISO Quality Certification in 1992 and the very first to receive it for the full range of PMC products. (Tamfelt – international supplier of technical textiles 2010)

Tamfelt has had ISO 14001 certified environmental system since 1998 and continuously focuses on efficient use of energy and reducing environmental impacts. The raw material utilization is being improved all the time which has straight impact on waste reduction.

The Tamfelt Group employs about 1,350 people and its net sales in 2008 were 165 million euro. Tamfelt has operations worldwide and production in Finland, China, Brazil, Portugal, and Poland. Paper machine clothing is made in two locations: Tampere, Finland and in Tianjin, China. These locations are shown in picture 2.Two production units enable the high efficiency and customer satisfaction by reducing the costs and delivery times. (Tamfelt – international supplier of technical textiles 2010)



Picture 2: Tamfelt has worldwide operations (Tamfelt – international supplier of technical textiles 2010)

Tamfelt PMC concentrates to wide, high speed paper machines. Other cornerstones of success are strong focus and agility, innovative research and development, customer oriented approach, modern machinery and large, efficient production units in Finland and China.

Research and development is one of Tamfelt's cornerstones that enable to offer spearhead products in the forefront of development for the customers. The devotion to R&D is strong as around 4 % of net sales are used for research and development. There are around 40 patent families in force or pending (Tamfelt – international supplier of technical textiles 2010).

Tamfelt has R&D co-operation with papermakers, machine suppliers, pulp and paper research institutes, technical research centers and universities. Modern paper testing and textile laboratories are located in Tampere and Juankoski. The laboratories are well equipped being capable for example doing distribution analyses, electron microscopy studies and press section

simulations. Tamfelt has also common development projects and troubleshooting with customers. (Tamfelt – international supplier of technical textiles 2010)

2.1 Metso integration

Metso is a global supplier of sustainable technology and services for mining, construction, power generation, automation, recycling and the pulp and paper industries. Metso has about 26,500 employees in more than 50 countries. Group's net sales for year 2009 were about 5.0 billion euros. (The world shapes us 2010)

Main themes in Metso's strategy are services business, environmental business and global presence (The world shapes us 2010, 9). Metso and Tamfelt have been in close co-operation before as regards the research and development of the paper machine clothing.

In order to strengthen services business and the global presence, Metso and Tamfelt announced on November 5, 2009 that they have agreed to combine their operations (Metso and Tamfelt enter into a Combination Agreement 2009).

The extensive installed machine base of Metso and local presence in a form of a wide sales and services network enhance the sales potential of Tamfelt's products and give new growth possibilities for Tamfelt. With the new state-of-the-art fabric factory located conveniently close to the emerging markets in China, Tamfelt's fabrics will have good possibilities outside Tamfelt's main markets in Europe (The world shapes us 2010, 12).

Paper machinery business is considered as a mature business (Toivanen 2005, 177), hence the fabric business is a welcome supplement for Metso's services palette as a response to the competition.

As Metso did not have such services business before the acquisition can be considered as a good complement for Metso's business. Also when considering the fact that the demand of certain paper qualities is on the wane and the fact that the annual number of new paper machine line startups has been plunged, the services business is a good way to ensure continuous cash flow. When agility and flexibility can be maintained as a part of Metso, Tamfelt will be even stronger player and a valued supplier in the demanding market situation.

2.2 Products

Tamfelt PMC is a full-scope supplier of paper machine clothing. The product palette comprise all the clothing for paper machine: forming fabrics for wet end, press felts, fabrics and belts for press section and dryer fabrics for dryer section.

Full-scope supplying does not mean only products, it means also services. Tamfelt PMC has understanding of customer's process and quality needs and can utilize the know-how to optimize paper machine performance.

Tamfelt continuously develops all PMC products and troubleshooting methods for the whole paper machine. Contribution to improving customer's competitiveness is characteristic for Tamfelt. These qualities enable Tamfelt to take full responsibility of total PMC in new machine start-ups, thus Tamfelt is common participant in many wide and high speed paper machine start-ups around the world.

The picture 3 shows a paper machine and locations of the fabrics, felts and belts. Properties of the products are introduced next.

Picture 3: Tamfelt is a full-scope paper machine clothing supplier (Tamfelt 2010)

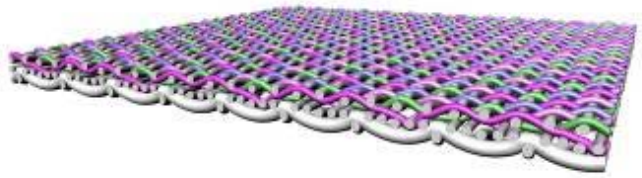
2.2.1 Forming fabrics

Forming fabrics are used in forming section, which is the initial section on paper machine and which forms paper web. The function of a forming fabric is to work as a bed for stock coming from head box. A good forming fabric provides good formation, high retention, low porosity, high dry content, as low marking as possible, low soiling and long life time.

A typical lifetime of a forming fabric on a paper machine is around two months, while slow board machines can reach one year lifetime but high speed machines producing SC paper grade with abrasive furnish can yield under one month lifetime. Monofilament PET and PA yarns are used as raw material, while the diameters vary from 0.1 mm to 0.5 mm (Ojanen, 2009).

Forming fabrics can be double, triple or multilayer fabrics. The latest innovation are sheet support binding structure (SSB) forming fabrics, which utilize high amount of very fine fabrics for decreased fabric marking and stability. Forming fabrics are made at Juankoski and Tianjin plants.

The picture 4 illustrates a HiSpeed forming fabric, which is a thin modern SSB forming fabric for low grammage paper grades like SC and LWC.

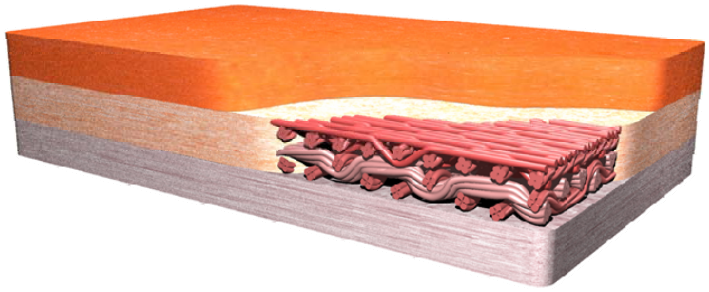


Picture 4: HiSpeed forming fabric (Tamfelt 2010)

2.2.2 Press felts

Press felts are used in press section, which removes water from paper web in the nips. Finesse of polyamide yarns used in press felt manufacturing varies from 3.1 to 67 dtex (Ojanen, 2009). Tampere plant manufactures all press felts.

The picture 5 illustrates TransMaster Open press fabric which is a patented totally unique press felt having smooth impregnated felt surface. It offers less felt marking to the paper, fast start up, good runnability as well as high and even dewatering which leads to improved dryness after press section.



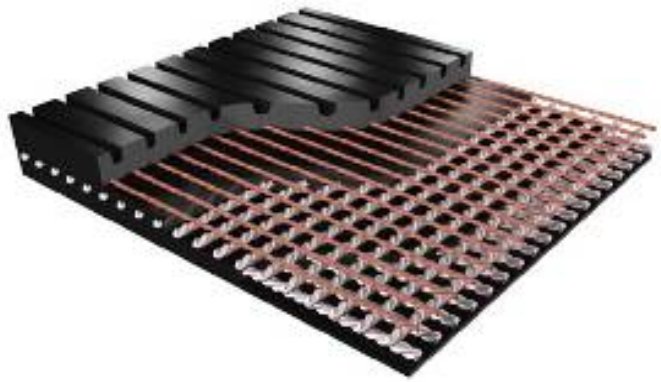
Picture 5: TransMaster Open (TMO) press fabric (Tamfelt 2010)

2.2.3 Belts

Belts are used in the press section on shoe press. A press shoe roll is covered with rotating flexible polyurethane belt which works as an opposite surface for the mating roll to form extended nip. Both rolls have very rigid structure because the linear loads in a nip can be up to 1 500 kN/m, which means around 150 tons per one meter. The belt has to stand the extreme pressure simultaneously running around 2 000 meters per minute on modern paper machines.

To attain long life time quality of a product has to be top class. Structure and water removal grooving are shown in the picture 6.

The use of shoe press enhances production and dry content of paper. It also provides better runnability, lower draw and preserves bulk.



Picture 6: BlackBelt shoe press belt (Tamfelt 2010)

The Tamfelt BlackBelt is a successor of the successful Tambelt. It is available in various grooving layouts which stay open even under the high load in shoe nip. The belts are made at Tampere mill with patented production technology by casting the belt inside a rotating cylinder.

2.2.4 Dryer fabrics

Dryer fabrics are located at the dryer section which removes only around 1 % of total the amount of water removed at a paper machine, but which consumes 65 % of the energy. This leads to a situation where fabric performance has a strong effect on energy consumption. A good dryer fabric stays open, thus maintains its air permeability properties by resisting soiling and staying dimensionally stabile. (Paavolainen 2009)

Dryer fabric has many functions as a part of the paper machine. The main function is to ensure even and efficient drying. It conveys and supports the paper web throughout the dryer section and drives the cylinders having not own drive. Aerodynamic properties are also important, as the permeability of the fabric has a strong influence on pocket ventilation and the evaporation rates. Tension of fabric improves the heat transfer from the cylinder (Fagerholm 2000, 433).

Life of a fabric is determined increasingly by contamination caused by use of recycled fiber. Abrasiveness of filler particles and bad condition of cylinder and roll surfaces also cause fabric wear and thus shorten life of fabric. Typical lifetime of a fabric is from 6 to 24 months (Paavolainen 2010).

A woven dryer fabric can have one, one and a half, two or multilayered structure depending on amount and structure of CD and MD yarns. Important requirements for a good fabric are maintaining of air permeability, low air carrying, stabile structure, high quality raw materials

which provide a good lifetime and a non-marking, strong, durable easy to join seam (Paavolainen 2009).

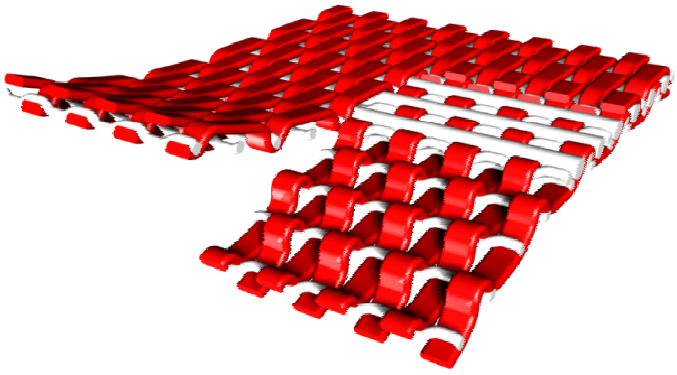
Dryer fabrics have to stand hydrolysis, high temperatures, mechanical wear, alkalis and acids. Most common raw materials used in yarns are PET and PPS. PET is affordable material to use and it can be woven easily. Its only disadvantage is propensity to hydrolysis in alkali containing and/or hot and humid conditions; hence PET qualities used are chemically stabilized against hydrolysis. Hydrolysis means that the polymer breaks down and becomes brittle (Ojanen, 2009).

PPS has particularly good resistance against high temperatures and organic chemicals. Therefore it is used in positions tending to hydrolysis. Disadvantages are the lower strength, which with higher heat standing properties cause extra challenge in weaving and heatsetting. Price of PPS is also higher compared to PET (Ojanen, 2009).

PEEK yarns have ultimate heat and hydrolysis resistance. Wear durability is also outstanding. It can be used in demanding special products and applications, like in the seam thread. Applications are limited due to multiple cost compared to PPS (Ojanen, 2009).

Air permeability should be as high as possible to enable efficient drying, however too high permeability leads to runnability problems. Air permeability is controlled by modifying densities and profiles of the yarns and the bond structures. Raw material choices for yarns and structure of fabric affect other properties.

Tamstar dryer fabric presented in the picture 7 has high quality double cloth structure which provides good runnability and excellent life time.

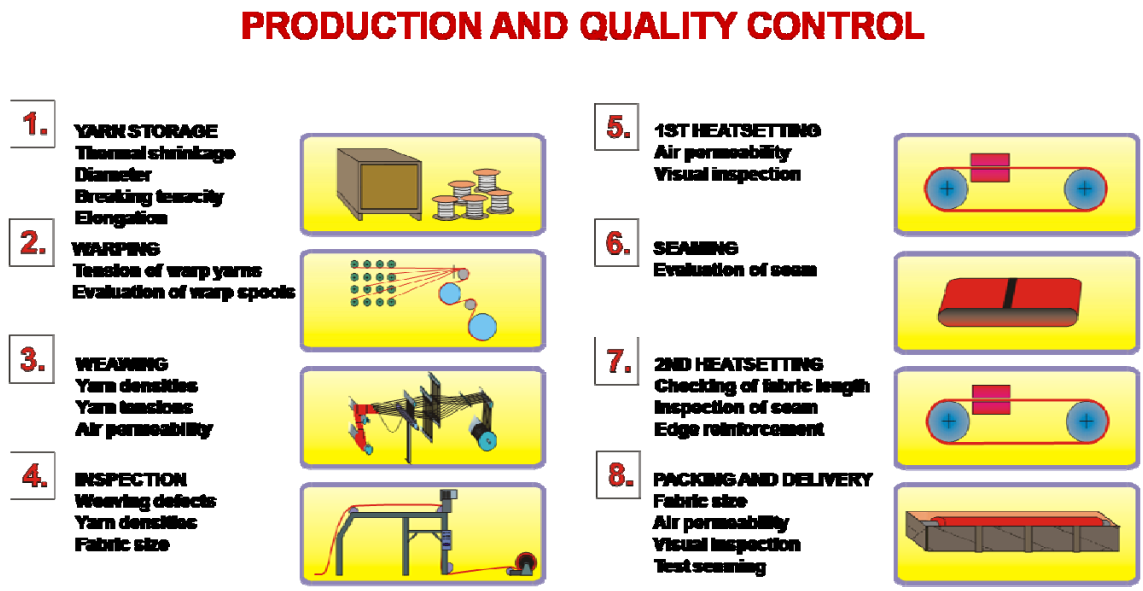


Picture 7: Tamstar dryer fabric (Tamfelt 2010)

The double cloth structure enables the long lifetime as the topping yarns can wear not breaking fabric structure.

3 Dryer fabric manufacturing process

The dryer fabric manufacturing process has many production stages. The picture 8 below shows different production phases of a dryer fabric which are reviewed later.



Picture 8: Production and quality control steps of a dryer fabric (Enqvist 2007)

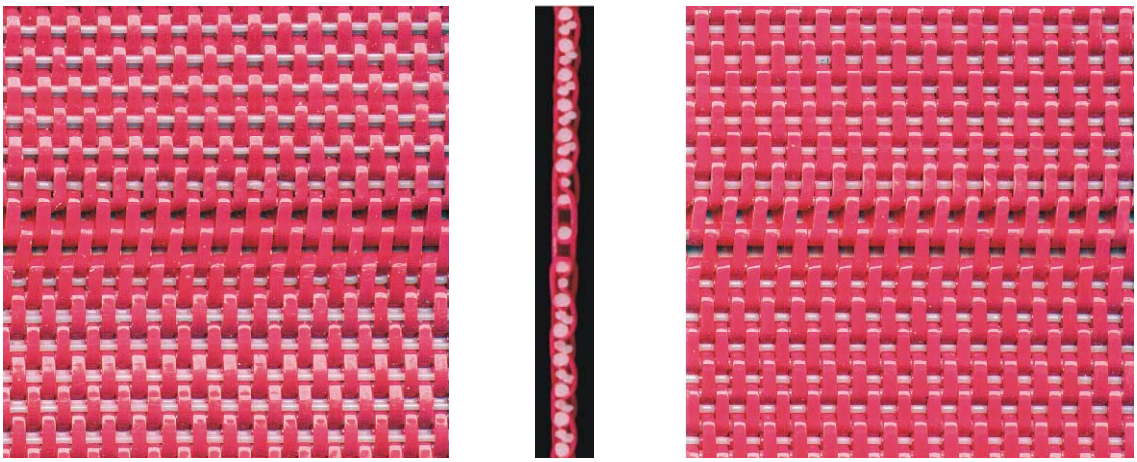
In raw material inspection yarns are inspected before they can be used in production as quality demands of paper machine fabrics are extremely high. The yarns should be as consistent as possible to enable production of high quality fabrics. All deviations are unwanted, as they cause problems in fabric production and paper making. Acceptance inspection consists of measurements of heat shrinkage, tex value, stretch and loop strength (Alhamo 2009).

In warping the warp cassettes are spooled and circular length of warp reels is evaluated. Tension of warp yarns is also important factor as it affects the warp reel circular length. Weaving is the production process where actual raw fabric is made. Important variables to be taken into account according to a customer order among others things are weft density, warp tension, air permeability, length and width. After weaving the raw fabric is inspected for weaving defects. Also yarn densities and dimensions of fabric are checked.

In heatsetting fabric is treated with heat by running fabric between two heated rolls and blowing hot air on the fabric. The fabric is also stretched by first disentangling and then bringing the rolls closer in order to gain desired elongation properties for the fabric. All events and properties are defined in a heatsetting recipe that is unique for each type of a product. The fabric is shrunk into the right air permeability and it is stabilized into the right dimensions to secure the dimensional stability and to avoid the unwanted variations on the paper machine.

Most important inspections are made after heatsetting, because of expensiveness of the following seaming.

Seaming is the most demanding part of dryer fabric making. It requires a lot of handwork, thus it is the most expensive and time-consuming stage. Seaming doubles the value of fabric so it is essential that the heatsetted fabric is flawless. In seaming the seam area is rebuilt for many centimeters length to retain the high tensile strength of the fabric. The seam must also be as similar as possible with the weave pattern to avoid the seam marking. Picture 9 below shows a common warp loop seam.



Picture 9: First image shows roll side of seam, image on the center shows seam in cross direction and the final image shows paper side (Paavolainen 2008, 22)

In second heatsetting the length of fabric is checked and seam is inspected. Also edge reinforcement is applied in this production phase. As paper web does not cover the edges of a dryer fabric, the edges are subjected to greater strain than the paper web area. Therefore the edge reinforcement is applied to the edges to improve long term heat resistance and abrasion resistance.

In packing phase fabric has gone through all processing points and it has reached its maximum value. It is essential that everything in this phase goes as designed; this is the last point to make final inspections before customer. The most frustrating mistakes can be made in packing if a high quality product cannot be installed due to a packing error (Paavolainen 2010). This matter comes out particularly with new customers having special wishes regarding packing and the package. There has to be well-designed up-to-date packing instructions available when a product enters to the packing stage.

Packing is not just putting the fabric inside a box, it encompasses a lot more. Final inspections are made to verify the length, width and air permeability. Fabric is also inspected throughout visually and a trial seaming is made for the seam to assure the reliable seaming at the customer’s site. Edges of the fabric are also checked and the ordered seaming assists are added into box. Some customers have special requests concerning the package and markings, so they also have to be taken into account.

4 Packing process

Correct packing method is absolutely necessary to allow the fabric to be installed by customer on a paper machine. Winding direction has to be correct, seam must be easily seamable and right seaming assists must be added to the delivery.

When the fabric to be packed arrives to the packing stage, all the packing material, seaming assists, leaders and so on, not forgetting the up-to-date packing information and production order shall be available on the scene.

4.1 Packing methods and functions

Packaging protects fabric during freight and storage. It provides also information for every phase between supplier and end-user. Destination, paper machine position, the content of the package for customs, center of mass for fork lift operators, lifting points, air permeability, side to be upwards, measures, trade mark and wrapping direction are just examples of data a package contains.

To prevent the oxidation of polymers caused by prolonged direct sunlight the box structure has to be dense. During heavy swell of sea wrapped fabric layers can start sliding over each other, which causes the deformation of fabric to a shape like a carrot. The deformation itself does not harm fabric, but installation is more time consuming and demanding as the fabric tends to warp and has to be centralized with care. Therefore fabric is fastened closely to a pole, which is equally fastened to the supporting structure in the box.

Different packing methods for different products and shipping distances are used. At Tampere plant package for domestic customers and customers in nearby countries is a robust split cardboard tube. Fabric roll is placed inside a tube and halves are fastened together with h-profile rails and with metal or plastic bands depending on the customers wish.

Customers with distant destinations will have the fabric packed in a plywood box. Fabric is firmly secured inside box to prevent deformation of fabric wrap. Plywood boxes are fast and easy to make compared to wooden board boxes. They are also stiff, light and clean-cut. The only disadvantage is bursting strength as box does not stand a collision with a forklift fork. Hence fabric box has to be handled with care.

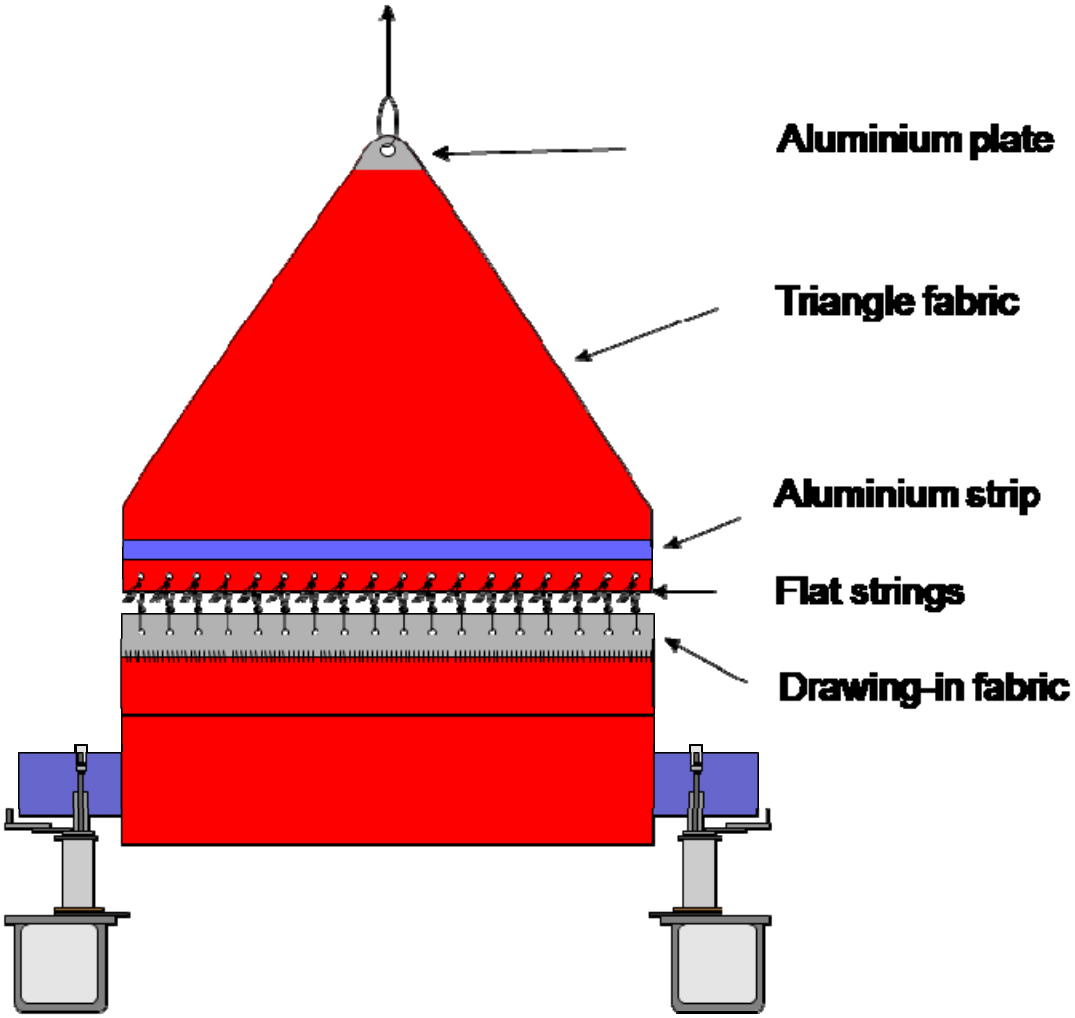
In order to avoid fabric to be damaged during unpacking and installation some customers prefer plastic bands, easily openable lid and supporting structure to be used in their boxes.

4.2 Unpacking and installation of the fabric

It is important that fabric is wrapped on a steel pipe that is made according to the dimensions and wishes of customer. Safety of the installation crew on machine could be jeopardized if pipe is not made according to the order. In machine the pipe is lifted with a crane inside hood and placed to rest on the installation rigs. If the diameter of tube differs from requested it would be impossible to control unwinding of fabric which causes danger to the crew members.

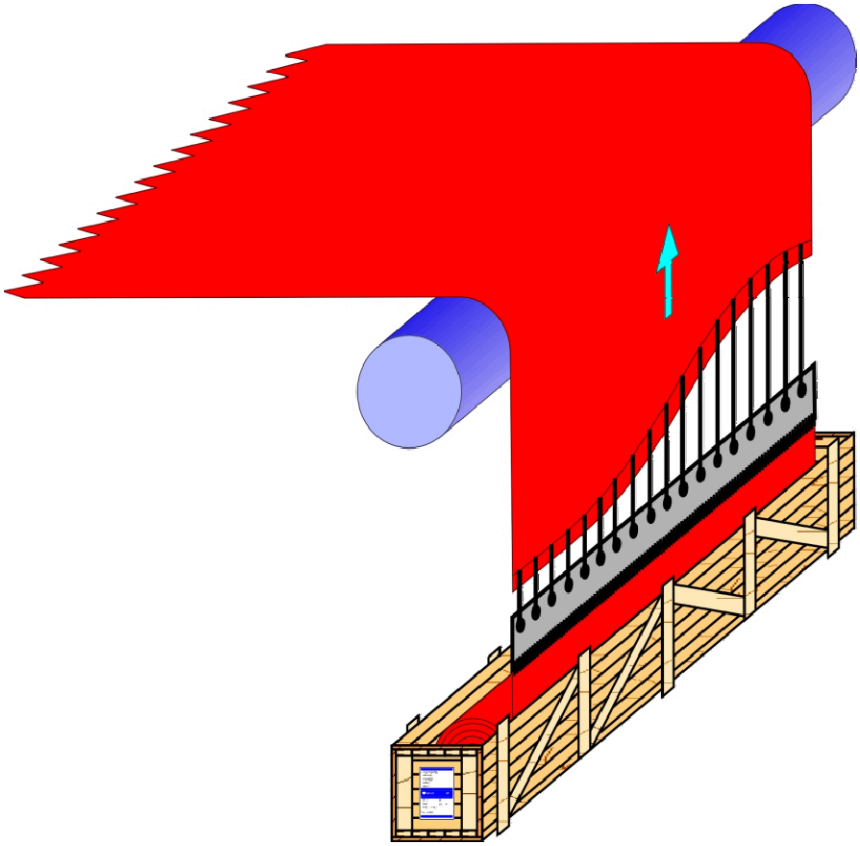
Fabric is usually drawn into machine by using old fabric as an assist to run the new fabric on. Square leader, which is attached to the new fabric, is tied with flat straps to punctures made in old fabric. The machine is run on crawl while the new fabric winds out of the reel following the old one round the rolls.

In those positions, where the old fabric is wrecked or it cannot be used because of some reason or a new machine is starting up, a triangle fabric is used instead. A rope is led through the fabric loop and then the new fabric is fed into machine. The basic principle of fabric installation using the triangle fabric with the roll lifted on the rigs is shown in picture 10.



Picture 10: Fabric with leader and triangle lifted on the installation rigs at the paper machine (Ojanen, 2009)

In some older machine positions fabric can be installed straight from the box. The box is often located in machine basement and the new fabric is attached to old one with flat straps and then driven on the machine. This is illustrated below in the picture 11.



Picture11: Installation of a new fabric by using the old fabric to draw it on the machine (Ojanen, 2009)

5 Information network of the product

Products have a great amount of information and data associated with them. The value chain is not able to build up value without real time information needed in different stages. The ability to share and exploit real time information makes up the competitiveness of value chain.

Information is partly stored in the enterprise wide resource planning system as explicit information that is readily shareable. The more problematic form of information is the tacit information. Tacit information can be described as the know-how of people. People can recall information from their memory and utilize it in the work, but information is hard to share with other people.

Product should be identical regardless of the manufacturing location. The problem has been the know-how between the locations causing dissimilarities. In order to gain same outcome the manners have to be standardized and level of know-how has to be raised to equate between the units.

The new packing instructions take care of standardization of the packing to be made according to the approved way showed in the instructions. In this sense the instructions work as a means of storing the tacit information related to packing into a form of explicit information. The real challenge is still the understanding of instructions by a person from another culture who does not have the same knowledge beforehand.

Understanding has to be verified and that process is explained in the chapter 6: Development of the instructions. In order to get a more profound view to fabric business the thesis work is viewed in context with value chain and the effect of this thesis work is described in the value chain of a fabric. The junctions with business processes are also presented later.

5.1 Fabric value chain

The paradigm of a successful organization is the ability to supply a product or service with a price which customer is willing to pay and which is more than sum of costs. Thus the concept of value chain means creating value for a customer. The company is profitable when this added value exceeds the cost of performing the required activities (Porter 1990, 40).

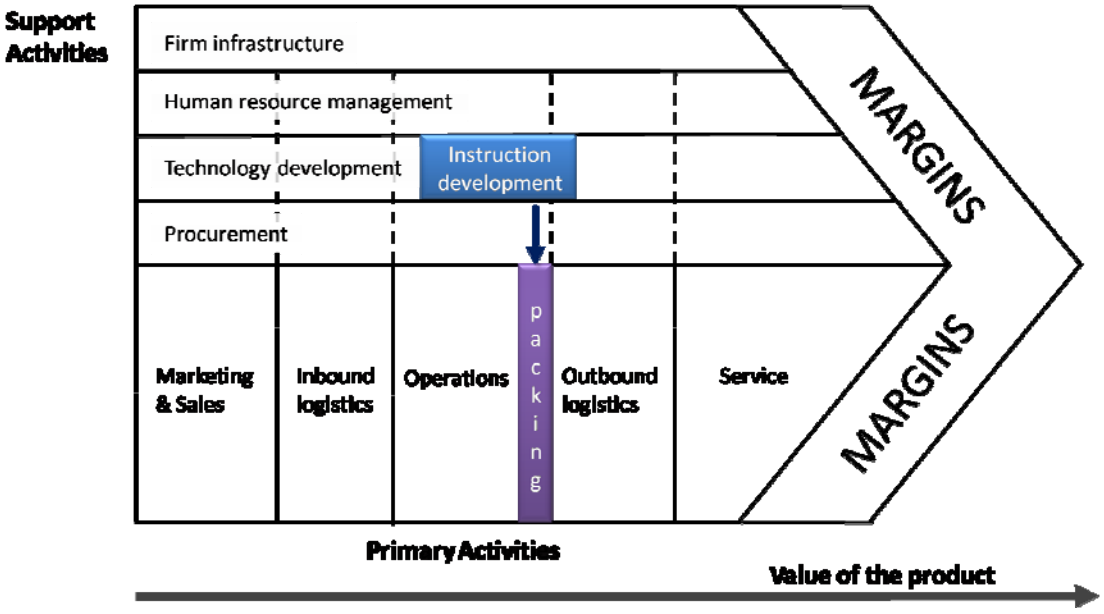
As the customer is interested in “the best bang for the buck”, the value chain should involve only value adding operations. Routine tasks should be automated and resources should be concentrated into value adding operations like good co-operation between different manufacturing and supplying phases. This means that the all the operations in the support activities shall somehow add value for the primary activities.

A good communication between sales and customer is necessary to find out the actual requirements and needs. One way to gain competitive advantage for the company is to

understand customer's business and needs and provide the customer with the best possible solution which can be a product or a service or a combination of them. The best possible solution does not always mean the highest quality product if a regular product performs as well in the customer's application. Sales should be able to show the benefits and the value of the recommended solution for customer so that he or she understands them, in order to provide customer with valuable expertise and to build up trust.

Porter's value chain model is a good way to represent company's operations and activities in a networked and value adding manner. The operations of a company form a complex network of relations and linkages. The model illustrates a general matrix of activities.

Picture 12 illustrates the value chain of a fabric and the thesis work as a part of it. The development of instructions is comprehended as development of technology linked to the packing activity which belongs to operations. As a matter of fact, the packing links the manufacturing operations to outbound logistics. By investing into the development of new and better instructions the amount of faults will decrease which leads to the reduction of reclaim costs.



Picture 12: The relations of the thesis work to the value chain (after Porter 1990, 41)

In the Porter's original model the marketing and sales is put between outbound logistics and service. In this work the marketing and sales is placed as the initial step because of its importance as a value-adder and because of the steering of production in fabric business. The sales start to generate value for a product when they find the right solution, in this case a right fabric, to profit the customer. At point of sale the product does not even exist, because all the fabrics are tailor made to the specifications.

In some cases a deal can be made concerning a product variant that has never been made before. In this case the link goes from the sales to the technology development where the R&D department has to find solutions how to produce it. Then the R&D provides procurement with specifications regarding the crude material needed. After procurement has made the deals with suppliers the inbound logistics can distribute crude material for operations, which is in this case the production. Because of this sales-oriented value adding it seems suitable in this context to place the marketing and sales as it is in the picture 12.

The make-to-order production has some characteristic features. Tailored products are made according to the order backlog and customers get specific delivery dates. Unit price is rather high and the product assortment is wide. The amount of products sold is relatively low and the delivery times are long (Ritvanen 2009, 5).These features represent well the manufacturing of paper machinery clothing.

This kind of make-to-order steered production needs the order from the sales before the production of the product can start. There are no standard paper machinery clothing dimensions and every fabric is more or less custom made to match the customer's machinery and the paper grade. The common variables for all fabrics are air permeability, yarn count, yarn diameter and weave pattern. The work and the challenge of the sales department is to find the right values for the variables for the machine positions to ensure the best possible outcome. For example runnability is important from the economical point of view but still the paper quality has to reach the objectives.

This thesis work serves the organization's ability to increase the value of a product by providing the packing operation with well documented and clear packing instructions regarding the machine positions requiring special packing solutions. Packing can either raise the value of fabric to the highest achievable level at the plant or it can plunge the value. Clear instructions improve profitability as work can be done quickly and correctly at once, without need for questions and waiting for answers. If a fabric is wrapped wrong side up, it cannot be installed. If a pipe the fabric is wrapped on is the wrong size, the fabric can't be installed. Just to mention a few possible mistakes, which incur a drop of the value experienced by customer.

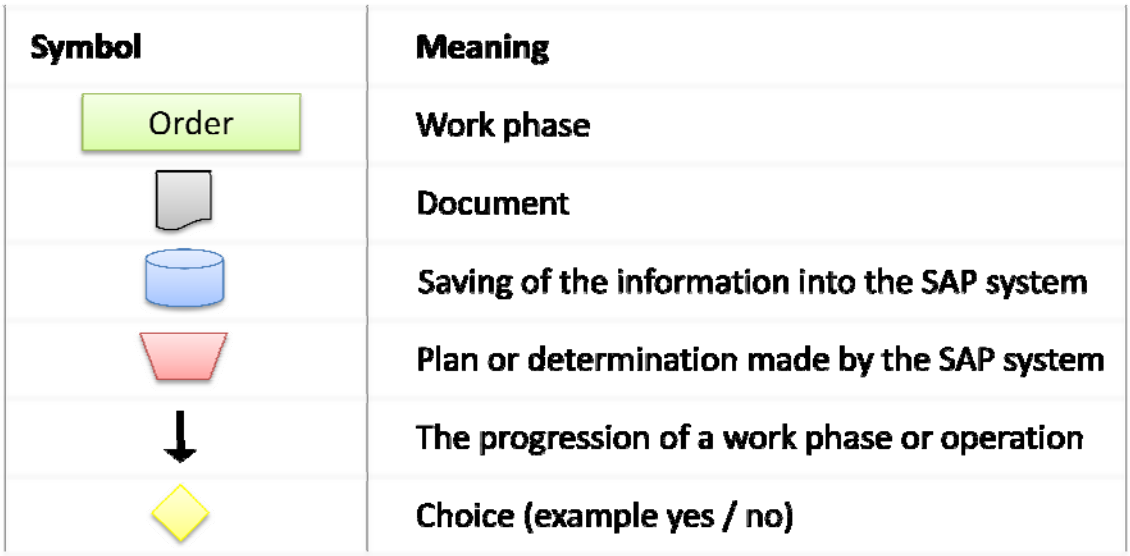
5.2 Process description

Well described processes are essential in an international company and enable functional operations of the organization. Activities can take place on three different continents around the world: customer and sales representative can be in United States, while sales and product management happen in Finland and production is located in China. Without well documented processes it would be hard to understand the different tasks and effects of different factors in the organization.

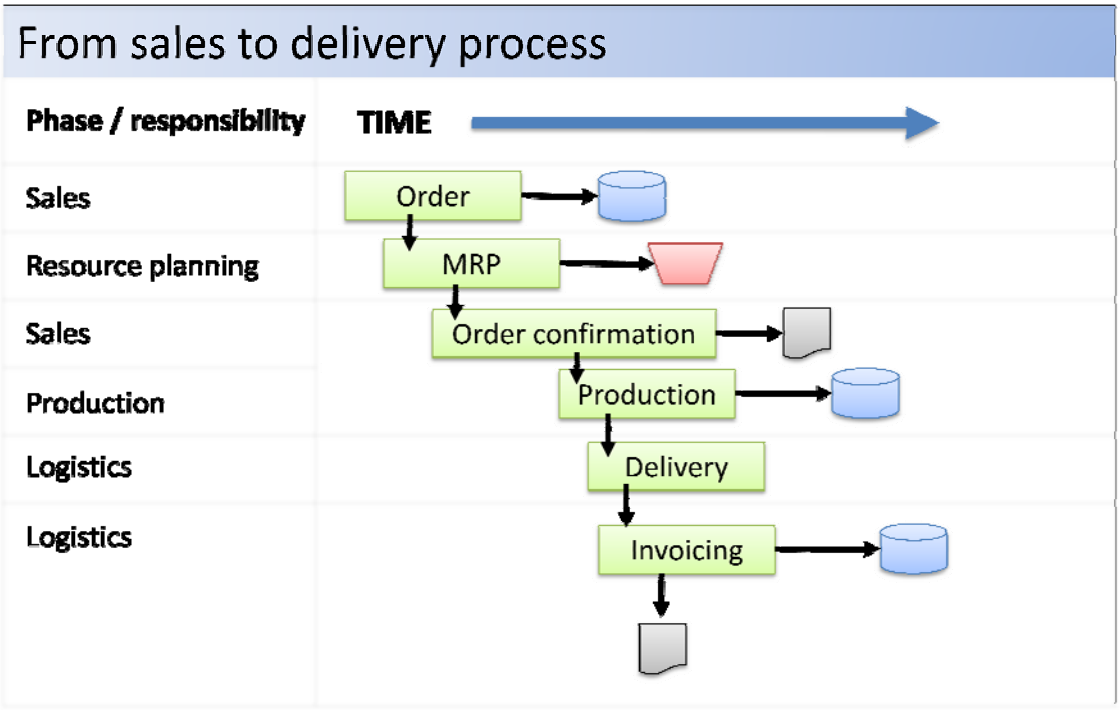
Describing of business processes is usually challenging. Various functions are connected to each other and data is saved and utilized from the information systems. Usually the following

phase needs an output from a previous function before. To describe all these relations in a single picture the deployment flow chart is very useful as a visual element. This flow chart is sometimes also called a swim lane flowchart. The frame forms a pool and the parallel lines separate the frame into swim lanes displaying different subprocesses.

Even complex business processes having multiple relations can be illustrated by using flowcharts. The picture 13 shows general symbols used in the flowchart in picture 14.



Picture 13: Definitions of the symbols used in the process description (Tamfelt laatukäsikirja, 26)

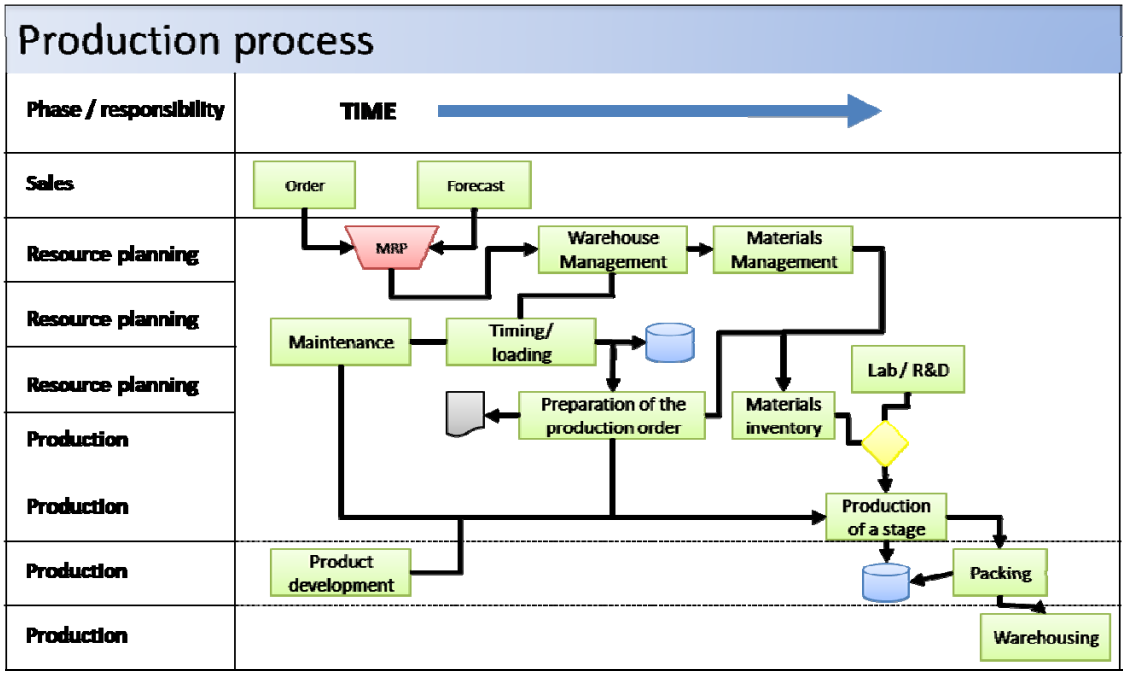


Picture 14: From sales to delivery process (Tamfelt laatukäsikirja, 32)

In general the 'from sales to delivery' -process starts from sales. A local sales representative has usually identified the customer needs and the customer has made an order. In this phase, it is crucial that the sales assistant is provided with the customer specific requirements concerning fabric and packing. Sales order cannot be created in the SAP system without flawless information about the customer's machine requirements.

In case of a new customer or a new position at old customer where fabrics have not been previously delivered it may need extra work to find out the requirements. It is even more difficult in those cases where the customer itself does not have the information available. Specific measures have to be checked from paper machine or from fabric storage. In event of a new customer position having needs differing from the standard packing; a special instruction has to be made for the production.

The materials resource planning is made as an automated MRP run in the night by SAP system utilizing the data entered in the previous phase. The production process flow chart is shown in the picture 15.



Picture 15: Production process of a paper machine fabric (Tamfelt laatukäsikirja, 35)

As mentioned, it can need hard work to get the customer-specific packing data. Order can be entered into the SAP system with probable packing measurements and assists. In some cases the information entered can prove false and it has to be corrected, thus altered. All these occurrences cause problems as the process do not proceed as planned and therefore negatively affects profitability.

When an order enters into production a production order is printed out, such packing information is usually printed out too. This way the packing information goes with production

order through the production stages mentioned earlier in the chapter 3. The altered data in the SAP system is therefore not available at packing stage if packing team is not notified that the information has been changed.

Another problem has been the availability of packing instructions in the process. Instructions were printed on paper and located in a file at the packing area. Customer positions having special wishes regarding the packing and thus special packing instruction were mainly remembered by experienced workers. Problems emerged when there was a new worker doing packing without having the knowledge or when the instructions were revised but the old hard copy was kept in the file.

The SAP and StreamServe systems enable plotting of a notice that an order utilizes special packing. This way the availability of instructions could be improved, as the production order notifies about special instructions and the instructions are available under customer data at the SAP system.

5.3 Implementation of the new instructions to the existing processes

As the actual process of instruction making did not change remarkably, the responsibilities were mainly retained as they were. Should the customer’s needs differ from the Tamfelt standard packing, a special packing instruction is made.

The sales manager, who is in charge of the deal, provides customer information needed for product manager. Product manager makes the instruction in English and Finnish according to the new template and transfers the file in the work folder in repository created for this use. The Chinese production manager translates the English text to Chinese and writes the same instructions in Chinese after the English and Finnish versions. Then the production manager moves the file into directory for translated instructions to permit the product manager to send the instruction for a translator to be checked if needed and to save the final instruction to the temporary place for instructions or to the SAP system with the customer position information.

6 Development of the instructions

Before the beginning of this work different instructions for packing of fabrics were in use at Tampere plant. There were three kinds of instructions regarding packing: packing info file text instructions in the SAP system, electronic instructions in pdf and ppt formats and paper versions of them in a folder at the packing site.

Some of instructions printed on paper were outdated and, especially bearing in mind summer workers and new employees, there were no indication on the production order about special instructions pertaining to packing.

A lot of instructions were documented about previously made cases to enable easy repeatability of the packing process. This was possible at the Tampere plant where experienced production planning, production, development, R&D and product managers are on the site. Global operations with the plant in China calls for well instructed and documented operation in advance and local personnel cannot be expected to nor allowed to make instruction on their own (Paavolainen 2010).

The development work was started by gathering the packing information from the SAP system. As the work was limited to North American customer positions, all the deliveries existing in the SAP over the past ten years regarding North America were examined and the special packing instructions were documented from ‘info file’ –field. There were around forty customer positions which needed special packing instructions in North America. The instructions were mainly in Finnish, so they were translated in co-operation with product manager Juha Paavolainen.

After the all Finnish instructions were translated, the work began with the development of new instruction template. Also the style of the instructions was altered to meet the recommendations of the standard SFS-EN 62079. This was considered as a good improvement of clarity considering the greenfield plant at Tianjin.

The instructions were formerly made to match the Tampere plant’s needs. As the production was now located in many countries, the instructions needed to be multilingual. The instructions were broad-minded and relied on the employees’ professional skills. These factors led to a situation where new instructions had to be developed. The next chapter illuminates the development method used during the work.

6.1 Agile development

Instructions having functional, higher quality illustrations were needed for easier and faster understanding of the instructions. To secure the desired outcome, the working directions, agile development process was utilized during the development of the instructions. In agile development an outcome fulfilling the specifications is produced and further refined according to

customer feedback. Agile development methods share common features, which are listed below (Parantainen 2007, 99-101):

1. Simple methods and tools are used. With even simple tools complex results can be produced.
2. Process is designed to be adaptive. Forecasting is impossible, so the designer has to be able to react to the change. The later the changes can be done, the more adaptive the process is.
3. Process is fast, which does not mean that the developer is allowed to be hurry and careless.
4. Working outcome is more important than documentation. It is good to have the outcome later on documented, but defunct outcome with good documentation is useless.
5. Customer is involved all the time through the project. The customer has to accept the outcome throughout the project. In that way the outcome matches the customer's needs perfectly.
6. The objective is to proceed in short periods, whose duration vary from one to eight weeks. In the end of every period some function or module shall be ready to be presented for the customer. Customer sees concretely the progression while the developers get feedback and stay interested.
7. Project group consists of motivated persons. Project manager assists and supports the group so that they can concentrate into their work.
8. Members of group understand that personal conversations are the most efficient way to share information among the group members.

These guidelines were followed and the outcome met the expectations. The all round office software Microsoft PowerPoint was chosen as tool over expensive publication and design software. The pictures made with it are a good example of the outcome.

Change is present all the time. In agile development change is welcome as responding to change goes over following the plan (Martinez 2010). After the model of the new template and illustration design was introduced for the executive group, valuable feedback and new ideas regarding the identification, cover page and other features was received. The interest group had new proposals throughout the development project and all the proposals were included to the final template. The development process of the template itself was fast and details were adjusted to equate the needs.

It was easy to adapt to the change when following the definition of demands instead of following a plan. A plan locks the ways of doing things to those decided in very beginning, while the definition of demands leaves methods open for change describing only what the outcome should eventually do. During development process entirely new and innovative ways of doing things can emerge, so it is wise to leave room for them.

Later on scrutinized the definition of demands could have been more precisely. Parantainen (2007, 273 – 283) presents a workable model of definition of demands as a step by step description how the outcome should perform during its utilization. For each step of utilization a separate description comprising:

- manuscript
- glossary
- good achievement
- initial data
- what can go wrong and how it can be corrected
- grounds and background information
- ideas and proposals

As only the author did all the development work of instructions, the outcome evolved to desired one without comprehensive definition of demands. In this case a more detailed description would not have given any remarkable additional value for the project, but even with two developers it would have been feasible to do a precise definition of demands to clarify the targets so that everyone understands them equally. In this work the demands for the instructions were primarily these following things: clarity, multilingualism, good availability (SAP), up-to-date (SAP) and added visual objects.

The documentation was made later on, after the approved outcome was ready. This prevented useless documentation. Users were involved through the project and gave ideas and approvals to solutions. The project was divided into different periods, like template development, image design, text writing and so on. The personal conversations were essential way of communication during the project.

6.2 Tools for developing instructions

The books that were found handling technical drawing and development of technical instructions were also very handy. ‘Guidelines for developing instructions’ from Inaba and Parsons can be sincerely recommended. The book has a lot of different ways to represent various technical drawings in instructional form.

‘*Koneenpiirustus korkeakouluja varten*’ by Pere (Finnish) proved to be also very helpful and gave a lot of ideas how to display complex technical objects in a simple and intelligible way.

There is a quantity of different publication programs for computers available. For the work Microsoft’s PowerPoint 2007 was chosen, although it is not software for publishing but for presentation. To reach the objectives, PowerPoint was no matter what considered to be the most suitable software. It comes with Metso standardized IT environment and thus it is available in all corporate computers. It supports also publishing to pdf-format for final instructions.

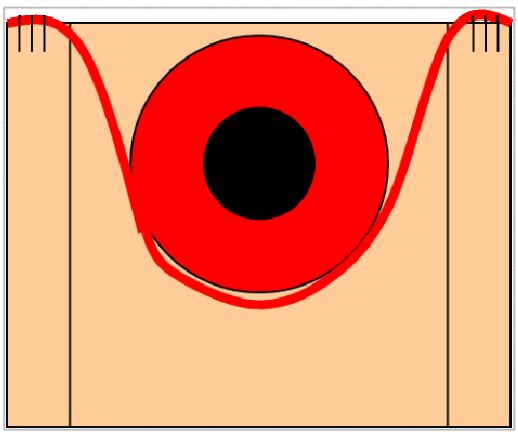
Microsoft PowerPoint 2007 has amended a lot from its previous versions what comes into graphics. Ability to draw three dimensional objects is warmly welcome. The possibilities are not so extensive in comparison to computer-aided design (CAD) or graphic design software, but the ease of use and intuitiveness favor PowerPoint in simple 3D graphic needs. Problems occurred with lack of literature regarding the new 3D drawing features, tough the intuitiveness substituted that deficiency. Pictures and designs made with PowerPoint are illustrated later in this chapter.

When added clarity is desired, three dimensional exploded view is suitable. Exploded view is practical in those occasions where complex assembly drawing literacy is not expected from readers such as in installation instructions (Pere 2004, 126).

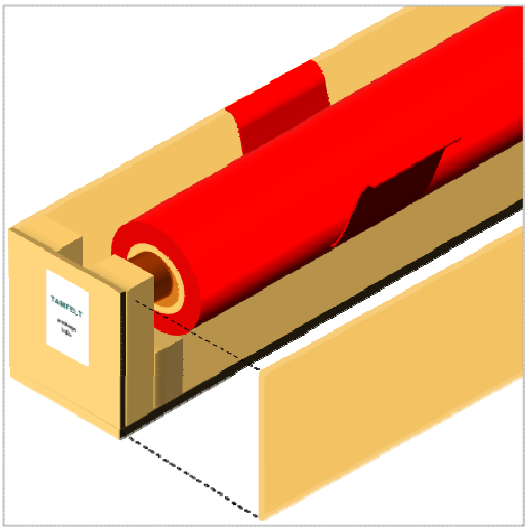
Pictures in the instructions in use at Tampere plant were mainly two-dimensional. Efforts were made to keep on that way, simultaneously trying to show every detail in even more distinct way bearing in mind the new users of the instructions. The size of an instruction became impractical when there were countless pictures from different angles from various parts. The following pictures show the clear difference in clarity and intelligibility.

Picture 16 shows the former model of illustrations in the instructions. The view from side shows well the fabric, center supporting and box. The board structure holding the pipe inside the fabric roll would fuzzy the picture, so the capacity of representing details in the 2D pictures is rather limited. In addition the novel users of instructions could comprehend the picture in many distinct ways depending on their work experience, education and other factors. The 3D image is much more explicit.

A lot of pictures are needed to represent the equivalent amount of details and information of the picture 17 by using 2D pictures. Although for persons not having former experience from different packing methods the 3D picture is probably still more clear and intelligible. Therefore the 3D view was chosen as the main type of illustration in the instructions.



Picture 16: A 2D view of a supporting



Picture 17: The same supporting in 3D

Another problems were the new products and packing variants that were not been produced so far and thus they did not exist. It was impossible to take a photograph to instruction as it was taken before, because the instructions needed to be ready to be used in the other side of the world. Three dimensional modeling was the solution for this problem, also. Photographs also contain a great number of unnecessary information, like background, which causes clutter and makes the pictures obscure. Clutter is decreased by preferring the 3D models.

To ensure the quality of instructions and easy repeatability of instruction preparing process, it was natural to use a standard. Therefore the standard concerning preparation of instructions, EN 62079 approved by CENELEC, was used a reference. As the mentioned standard is the single standard used in this work, the standard is later referred briefly only as the standard. The standard covers all the important features of a good instruction and it was used as a reference during the development work among the other literature.

The standard recommends writing instructions in a form that is readily understandable by an ordinary person. As users of instructions diverge from each other by the means of nationality, culture, age, work experience and education it is necessary to use distinct expressions in the language.

In multilingual instructions each language should be readily distinguished from the others keeping the translated text and the relevant illustrations together (SFS-EN 62079:2001, 29). This note is important and the matter came out also during the development. Therefore the basic instruction consists of three instruction sheets, every one having a different language but identical illustrations.

The standard communication principles were followed when preparing the instructions. The sequence of text follows the procedure step by step which supports the sequential packing procedure with the help of illustrations. The information is kept as simple as possible and it is expressed in consistent terms in the set of instructions. One instructive sentence contains only one command or at most a small number of closely related commands, for example “Mark the number of the fabric to the both ends of the box” (SFS-EN 62079:2001, 49-51).

An effort was made to keep the style clear, direct and unambiguous. Verbs are used in active voice instead of passive. Commands are used instead of weaker forms to keep up the assertiveness. Action verbs are used rather than abstract nouns and style of speaking is kept direct rather than telling what could be done (SFS-EN 62079:2001, 51). In the instructions these rules were followed and the instructions expressed using imperative tense.

The table 1 shows well the differences between recommended and deprecated forms of speaking.

Table 1: Examples of styles (SFS-EN 62079:2001, 51)

Principles	Recommended	Deprecated
Use the active voice	Turn off power	Be sure that the power has been disconnected
Be assertive	Do not remove tabs	You should not remove the tabs
Use action verbs	Use, keep, avoid	Utilization, maintenance, avoidance
Speak directly	Pull black lever towards you	Users will pull the black lever away from the machine

To assure legibility there are certain definitions to be taken into account when designing an instruction. To ensure best possible legibility, type and size of instructions shall be as clear and large as possible. The standard recommends to avoid type sizes less than 9 point in continuous text and to use not less than 12 point for headings and other information needed to read often. (SFS-EN 62079:2001, 51)

Heading is 30 point high while subtitle is 22 point. These sizes enable easy and fast identification of a right instruction. Type size of continuous text varies depending on the amount of instructions on a same sheet, however not less than 14 point types are used.

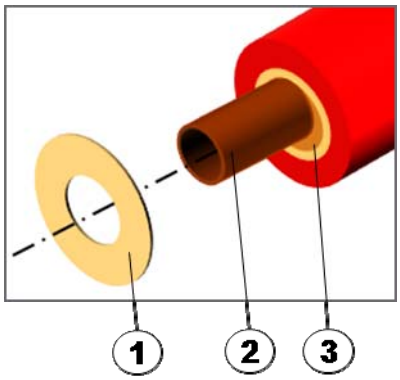
When designing the background the brightness contrast should be kept as high as possible. The higher the contrast between background and text, the easier the text is to see and read. A high contrast ratio can be achieved by using black text on a white background, which results to around 80% contrast when the text is printed on a good paper (SFS-EN 62079:2001, 52). Therefore the color of the commands in the instructions was kept black and the standard white background was used which led to the best achievable contrast ratio.

According to the standard the pictures shall be high quality. In this case the high quality means that pictures shall be clear despite of type of a picture. Photographs, line drawings and other can be utilized, but they have to be clear. Text and illustration is to be used together supporting each other whenever it is appropriate. Illustrations should be added with written detail to enable the location and identification of the parts (SFS-EN 62079:2001, 53). These precepts were taken into account when designing the illustrations.

The picture 18 shows an example of a detailed assembly view. It shows the objects and parts addressed in the text beside the picture. As the task involves assembly, the view is selected to be an exploded view. The instruction could be constructed to show each step of assembly, but this practice was rejected, since the space for the instruction was limited mainly to one sheet and the extensive use of graphics may lead to situation where the instruction becomes too cumbersome to use.

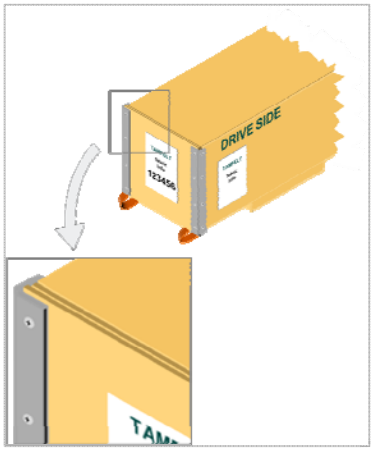
A good balance between illustrations and descriptive text was reached for, as the proper use of graphics allows the text to be simple, direct and easy to comprehend (Inaba et al. 2004, 39). The reason to use numbers instead of actual names is the scannability and the ductility. It is much easier to find a number instead of text as the user has to read every text to find the right

one. Also the multilingualism leads to the use of numbers instead of texts as it is feasible to use the equal picture in every instruction sheet regardless of the language. The picture 18 shows also an example of locators and numbers used in the pictures.



Picture 18: Locators with numbers

In compliance with the standard SFS-EN 62079:2001 the illustrations or detailed parts of illustrations used in the instructions are repeated in the relevant parts of the instruction material as needed to assist the user. The picture 19 illustrates a repetition of the corner, which is hard to distinguish from general view.



Picture 19: Locator and detailed view showing the reinforced edge and the double plywood

Tail of a sweep arrow is placed at a specific location, in this case the end of the box, and the head points at the point of interest. This method saves the space on the template and enables the use of several pictures as only the relevant parts of illustrations are to be shown.

6.3 Multilingualism and Chinese culture

Due to the trend of globalization many companies need to upscale their operations into global scale in order to maintain their market share and profitability in the tensioning markets.

The new instructions needed to be readable in every Tamfelt PMC plant using the local language of the workers. First attempts were made by using the existing Finnish instructions as bases by adding the space for English and Chinese translation. In no time it was clear, that the

readability of the instructions vanished. A totally new template for instructions had to be developed. Inaba et al. 2004 point out the same observation in the book: “In a bilingual presentation, procedures are most effective when there is a continuous flow of instructions in each language, that is, not disrupted by instructions in the second language” (Inaba et al. 2004, 27).

Model of the new template had to be designed carefully in order to prevent misunderstandings and other cultures had to be taken into account in the development of the illustrations and the textual instructions.

China is changing rapidly and many people from rural countryside are migrating to urban cities to earn a living. International companies have set up factories in business parks and competition for jobs is tough. On the other hand, it is hard for the companies to find skilled and educated workforce, as the migrating people lack industrial experience and those who have the experience change employers easily.

The industrial sites are greenfield plants and thus lack the know-how associated to manufacturing, which makes the instructions an essential part of verifying the end product quality and learning of the know-how.

Western culture and languages interest the Chinese and the growing metropolis are becoming a mixture of old Chinese heritage and western lifestyle with traditional buildings and customs together with western style high-rises and franchising restaurants.

Economic growth in China is booming. China has joined the group of high quality product producers. The level of know-how is growing and the quality of the cars, electronic appliances and clothes is amending all the time. Chinese do not know the word for giving up as they see the problems only as challenges and work hard to achieve the goal (Saraste 2008, 88-91).

Superstition characterizes the Chinese culture. It has much to do with the phonetics of words: some numbers are dread as they sound same as calamities and some foods are desirable on a table as they sound like good things. Also fireworks are popular in China, as their purpose is to drive away evil spirits. This is still a notable part of modern China and it affects life of myriad of people every day (Saraste 2008, 48-49).

Because of workers do not and are not expected to speak English at the plants in Tampere and Tianjin, there had to be instructions available in the native language. English was chosen for the common language for foremen to ensure uniformity of the instructions in the local language and in English. The master instruction was written in English and then translated into Finnish and Chinese.

In China concern with ‘face’ is present. The face has to do with self-respect, dignity and reputation. One can ‘lose face’ by acting inappropriately. One can also cause the counterparts to lose face by embarrassing them, disagreeing sharply, showing disrespect or criticizing them in public. Causing a loss of face can deteriorate the relationship between persons. Mutually one can give face to his counterpart by using polite forms of address and showing respect. Giving face is a good way to build up a relationship. In case of mistake one may be able to ‘save his face’ with a humble apology (Gesteland 2002, 173).

This cultural heritage was taken into account when approaching the production manager at Tamfelt Tianjin plant. When contacting a senior professional, phrasing and communication has to be deliberate in order to build a solid relationship and to avoid causing a loss of face. The loss of face can be caused quite easily by misunderstanding in case email and phone are the only ways to communicate. As agile development recommends, the personal face-to-face conversations are ultimate way of communication in terms of misunderstanding avoidance and effective and intelligible communication. Unfortunately the face-to-face conversations are not always possible due to the constraints as time, distance and costs.

Translation to Chinese was made by local production manager Mr. Dong at Tamfelt Tianjin PMC unit. The instructions included plenty of special terminology related to paper machinery and fabrics so this practice was utilized instead of interpreter or translation office. The amount of text to be translated was also tolerable to translate along with regular tasks.

Mr. Dong had worked for Tamfelt since 2002 and he had wide experience in dryer fabrics. He also knew paper machine concepts and more importantly, he had installation experience. His written and spoken English was good so it was easy to discuss the things to be taken care of in the translations.

6.4 The new instruction template

According to studies, human beings have two information channels: visual and textual. They complement each another and thereby the outcome should be closer to the desired than if only one channel would be used (Lammi 2007, 31).

One of the common problems of instructions is that too much information is fit into too small space. As a result, different things do not stand out from each other and the essential disappears (Lammi 2007, 30). The amount of information should be adapted to the space available.

These cognitions have been utilized in the new template and there is a general picture that shows the procedure with a glance and a text field which describes the instructed packing sequence in details. As the left side usually attracts the attention, the picture is located on the left side. The dimensions reserved for the text and picture stay always constant. If the event to

instruct is so complicated that the representing in the reserved area is unfeasible, multiple pages shall be used to represent the event feasibly.

As a part of Metso Corporation, it was natural to use the Metso standard template. The template is designed by professionals and it included the Metso communication style like layout, colors, logo and typography after the Metso visual guidelines.

To reach the goals with increased clarity, a layout with place for picture on the left and explaining text on the right was chosen. Heading names the document type which is in this case always the same; special packing instruction. Subtitle shows the full customer name, the applied paper machines and positions and the SAP customer number. The full customer name is very important information, as there can be many paper mills located in the same district and the mills are usually referenced by the name of the district, which easily causes misunderstandings.

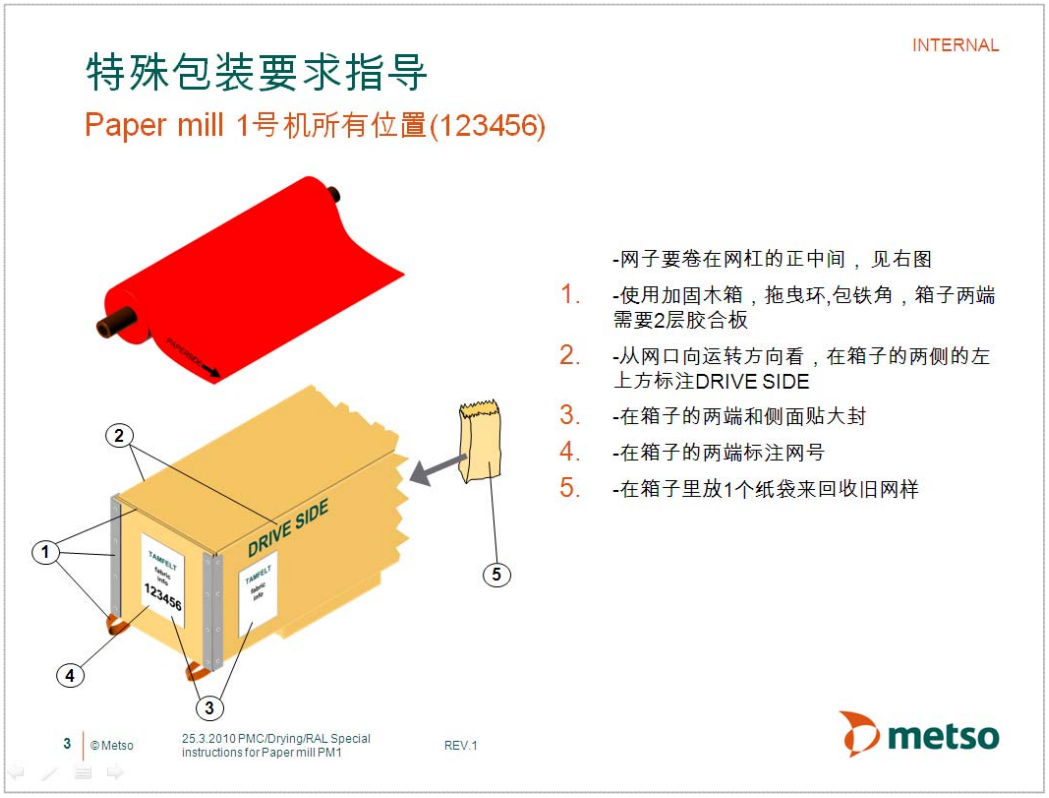
For increased lucidity, work stages are divided and every stage is numbered in the performing order. Footer shows the data needed for document identification that is also recommended in the standard: page number, date of issue, organization and abbreviation of the name of the publisher. Revision number is also conveniently located in the middle of the foot.

A projection close to isometric projection was chosen for illustrations because it views the all three sides of an object in a single picture. In consequence the space needed to represent the object is minimized.

The following picture 20 shows the new instruction template.

Picture 20: Example of the new packing instruction template in English

The picture 21 below shows the same instruction in Chinese language for local workers at Tianjin.

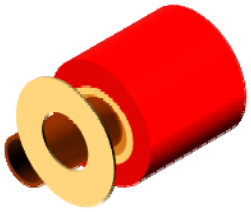


Picture 21: New instruction template in Chinese

The new template has such a difference to the old ones, that instruction composing guidelines were compiled to implement the new instruction template as a part of the existing order-delivery process.

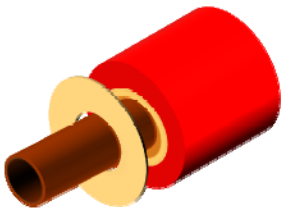
PowerPoint 2007 has also ability to make animations using the objects on slides and experiments using this feature were made, but the software is not sufficiently advanced to show the phases naturally. Problems occur for instance when flange is taken on the pipe. In the real world the part of the flange behind the pipe is invisible as the pipe is in the front. The software handles parts as individual objects that are either above or below each other.

The picture 22shows the problem: objects within each other do not show up properly. This feature can be bypassed by using two objects to represent one in the pictures as shown in the picture 23, but it cannot be bypassed in the animations.



Picture 22: Flange plate is viewed incorrect; part of the flange should be invisible.

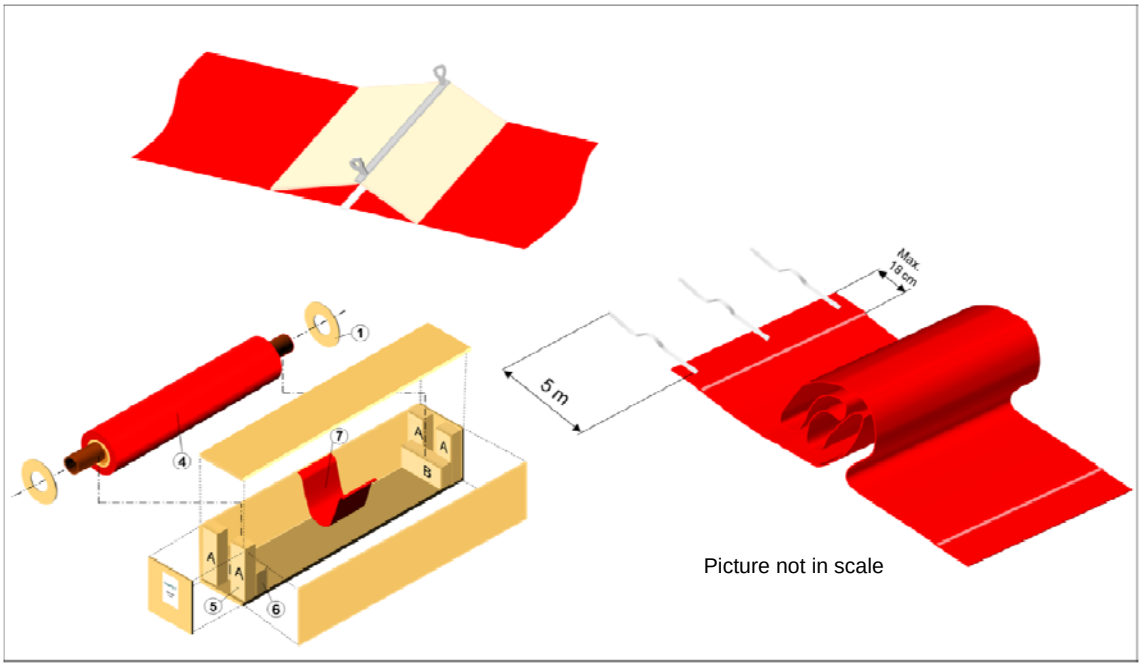
The pipe in the picture 23 is made from two different objects: one pipe is below and behind the flange and similar pipe is located over and in the front of the flange.



Picture 23: The flange plate is viewed properly; part of the flange is invisible below the pipe

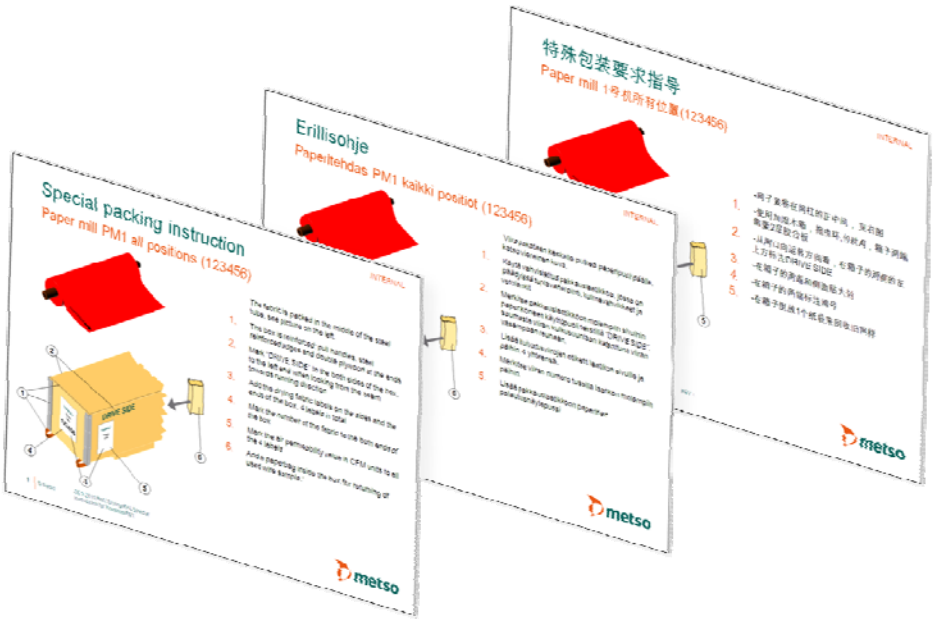
This deficiency prevented the use of the animations in instructions viewed on a computer. Anyhow it is also feasible to keep the instructions simple as possible to enable the agile instruction making in the future.

Despite the limitations described, practically all of the pictures needed could be made using the variety of image processing and drawing tools of the software. The picture 24 shows examples of pictures drawn with PowerPoint



Picture 24: Examples of complex three dimensional images drawn using PowerPoint 2007

After all the basic version of the instruction is a very compact instruction consisting of three pages in different languages, still providing all the information needed to pack the fabric according to the customer's wish. The configuration of multilingual instructions is shown below in the picture 25.



Picture 25: Illustration of a common instruction where each language has the same issues in the three languages needed in global operations

6.5 Evaluation of the new instructions

Like any newly developed product or service the instructions needed to be tested to ensure the easy legibility and intelligibility.

The SFS-EN 62079 standard includes in annex C a good checklist for evaluation. The checklist was consulted and the legibility, text and terms, language, illustrations, graphical symbols, numbers and the use of colors were checked after finishing all the instructions.

As it will be mentioned later on in the benchmarking-chapter, instructions were also tested with people from different field of industry. This procedure pointed out problems and questions arise in minds were noted and instructions were developed further by paying attention to the mentioned questions.

To be sure that all the translations were identical, the Chinese translation needed to be verified by a person knowing the Chinese language. A trusted and familiar interpreter was used at Tampere plant to verify the translation to prevent the possibility of a misunderstanding.

Understanding of the instructions was verified also with the native production manager at Tianjin plant by asking in the phone to explain in own words what the English instruction text tells to do.

6.6 Benchmarking

In a development process it is good to compare the result, which is in this case the instruction template, to something similar outside the familiar organization to further refine the outcome.

According to Xerox, benchmarking means continuous measuring of products, services and practices against toughest competitors and other leading companies. Benchmarking term includes a comparison of operations and development towards the best practice. According to one definition the benchmarking is learning from the best know-how. At that point a concept relating to learning organization, benchlearning, has been connected to benchmarking (Lecklin 2002, 182).

Benchmarking is done to identify better methods of working, the right target level and new practices and ideas. The process can be utilized also to remove biases and to learn best practices (Lecklin 2002, 182).

Benchmarking can be categorized into three groups:

1. Internal
2. External
3. Operational

Internal benchmarking means the comparison and measurement between profit centers inside the same company. Threshold to start the benchmarking process is low in this option and therefore it was a suitable way to get on. External means that the competitors and other companies operating in the same field of business are benchmarked. Own practice is compared to best practices in the field. One-to-one benchmarking relationship can be hard to attain as the rival is afraid of the business secrets to be exposed. Operational benchmarking extends the review point of view further. The best process practice is searched also outside the own field of business. (Lecklin 2002, 183-184)

A combination of the internal and operational benchmarking was used in this work. As the author had good connections to the Metso location nearby, the company to be benchmarked was a unit from Metso mining and construction business line: Metso Minerals, Inc., Tampere Works. Origins of the works date back to 1915 and the paths with Tamfelt have met at the beginning of this year, so there were presumably a lot of good practices to share in every respect.

The ideas and notions that came out during the session regarded version management, instruction designing responsibilities and the related know-how in organization, documentation of the designing process and the guidelines to be followed.

There were also talks about using discrete pictures (pictures before and after the work phase) in every phase of the packing for increased clarity when a challenging package is in question.

Because of the far more robust products, the instruction template could not be directly benchmarked with Mining and construction’s instructions, but they gave a good outlook to well designed instructions (Hellsten 2010).

Intelligibility was tested by going through the instructions to persons unfamiliar with the professional field of paper machine clothing. It pointed out the need of more explicit expressions, as the ones used could be misunderstood. In any case, compared with the old instructions the new instruction template was discovered to be a clear remediation, particularly the improved illustrations (Rantanen 2010).

The directions in use were examined widely and the most interesting practice to benchmark was the three dimensional interactive assemblage instruction display. At the beginning of a task it showed the tools and parts needed. After that stages were gone through step by step and the things and warnings to be taken into account were displayed concurrently. 3D models viewed in the show came straight from the PDM system. That kind of interactive instruction to be used in fabric packing could be a next evolution step on the path of development.

7 Availability and use of the instructions

The availability of documents is a very important matter, as there is no value to produce documents if the latest ones are not easily available for the users. As noted, the earlier instructions were often distributed via email or they were outdated paper versions in a file. The availability was considered as a highly important issue and the procedures for instruction storing and distributing were build up.

The information security was utilized to prevent the unauthorized modification of the documents and to provide users with latest up-to-date versions of the instructions. Efforts were made to implement the instruction storing feature to SAP system, but the integration rush with Metso systems put strain on the IT department which resulted to delaying of the implementation process.

7.1 Information security

Aim of information security is to secure computers and software and data within against as many expected and unexpected risks as possible.

Information security is divided into following information security services: confidentiality, authenticity, indubitability, integrity and usability.

Confidentiality's goal is to ensure that the data system can be used only by eligible users. Authenticity assures that all members, example users, information and data, of the data system can be identified reliably. Indubitablity's objective is that all events and transactions happened in the data system can be attested later on. Integrity takes care that data is not changed without a change event of user with sufficient permissions. Usability means that data is always available for users (Ruohonen 2002, 2-3).

Usually the term 'information security' is understood as a way to prevent the valuable data to leak to one without permission. The packing information relating to fabric packing is not as sensitive as business secrets. The different rig types and fabric change ways are well known in the industry. The information security can be comprehended in this context in a different way: it secures that there is the latest and the reliable version available, preventing the availability of the outdated and false information.

To ensure the usage of latest instructions, revision numbering was added to documents for easy identification of an up-to-date instruction.

7.2 SAP utilization

The SAP R/3 is proved to be accepted standard in many key industries. Corporations like Audi, Braun, Kemira, Merck, Microsoft, Nokia Mobile Phones and Samsung entrust their operations on the SAP R/3 –system (Curran & Ladd 2000, xxviii-xxvx).

Some of the vantages of the SAP R/3 system are scalability and expandability. The SAP R/3 can be used within an organization comprising of dozens of people and as business expands it can be upscaled to serve thousands of users. The system is modular and modules according to company's needs can be taken into operation. It also makes possible the creation of customer specific features and thus the system can be implemented to various different industries sharing different end-products and ways of steering of the production.

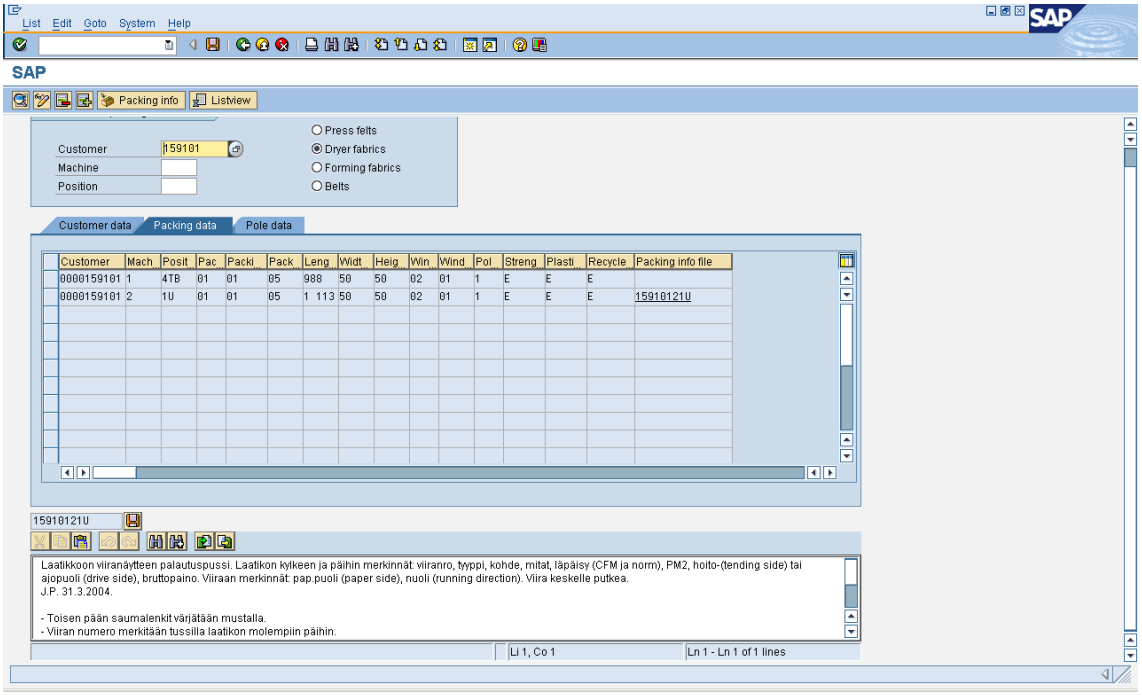
Tamfelt Corporation uses the SAP R/3 system having customer tailored special features like MRP for packing materials and customer database including paper machine position data.

The instructions needed to be available in the context of paper machine positions. These positions and the position data were stored in the SAP system, so it was considered as a natural place to store the instructions too.

The IT department at Tamfelt worked on making the saving of the instructions into SAP possible, but the modification of the system took so much time during the integration to Metso systems that the task could not be accomplished during the thesis work. Consequently the SAP system is not that flexible as regards to implementation of new features, but the flexibility has more to do with scalability when the number of users varies.

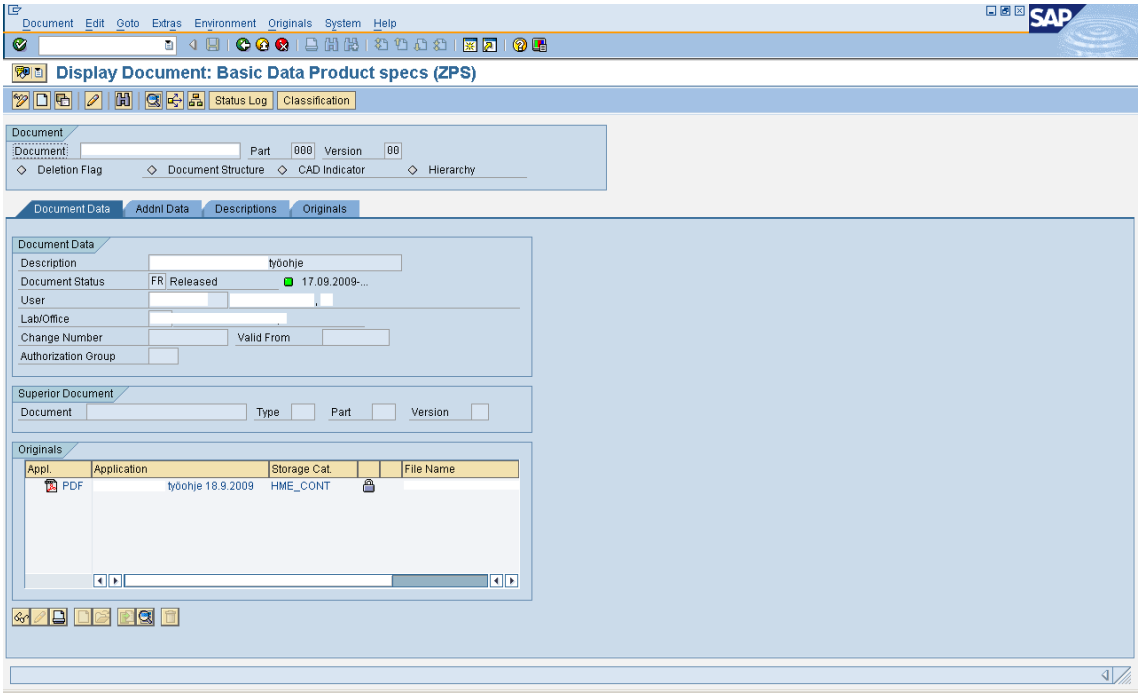
At the beginning the SAP-system only held inside written packing instructions or packing notes. The system in use is global and all Tamfelt locations worldwide have access into it. It was noted to be the best place to store the instructions, because it is used in order handling and the instructions can be saved and revised during order entering process.

The SAP-system unfortunately was not able to store files to the context of certain paper machine position. This view is illustrated in the picture 26: the box on the bottom takes in only letters.



Picture 26: SAP view - ZCU transaction shows written packing info file, if available

After selecting the product group button and the customer by entering the customer ID number to the given field, the ‘Packing data’ –tab shows the measurements of the packing. The picture 27 shows the situation in future. The feature already is in use for example at press belt unit, and it is expected to be soon implemented at dryer fabrics, too.



Picture 27: Example of an instruction saved into SAP database

The instruction is to be saved in to the ‘Originals’ –section, where it is downloadable for every dryer fabric SAP user. To assure use of the latest version of an instruction, the file name will include revision number and issue date.

7.3 Network repository and revisioning

As the possibility to save the special instructions was not implemented to the dryer fabric SAP section and the implementation took bit longer than expected from the SAP support team, a temporary solution was developed. A real time repository for special instructions was introduced with access from Tianjin, China and Tampere, Finland.

Local network communication rates are usually many times higher compared to remote connections and it was also the situation in this case. Therefore the repository was located on a network directory at Tianjin plant. This method was utilized to permit the fast use and download of instruction locally where they are needed. The upload of instructions took a longer time from Tampere but it improved usability and revisioning in Tianjin.

The repository consisted of three different directories: one for instructions to be translated, one for translated instructions to be checked and one for final instructions approved to production after verification.

The change of domain from Tamfelt’s own to Metso’s one caused short unavailability of the network repository in the Tampere end, but it was soon corrected by adding the rights for the users logged in to the Metso domain.

This repository proved to be a workable way of doing the translation work and therefore it was retained as a part of the translations process of instructions.

8 Summary

The goal was to develop globally understandable instructions to benefit the paper machine fabric factories in Finland and in China. A totally new instruction template was created by utilizing standards, best business practices and literature. Both the commissioner and the author are satisfied to the results as the customers can now be served better as the risk of mispacking or missing seaming assist is minimized.

There is plenty of literature concerning the instruction development. This work highlights the main points and aspects to be taken care of in the instructions. The main improvement was the upgrade of illustrations from two dimensional to three dimensional. This clarified the pictures and enabled the greater amount of details to be used in one picture. The second large enhancement was the separation of languages to own sheets to improve legibility. The importance of instructions was rationalized financially.

A updated, extensive and visual set of special instructions for North American customer positions are now available in English, Finnish and Chinese, which was the purpose at the beginning. The translation process from English to Chinese was tested to be workable. The instruction template was benchmarked and it proved to be clear and up-to-date.

What comes to the instruction availability, the target was to get instructions easily available in the context with customer machine position data in the SAP system. Due to workload of the IT department at Tamfelt caused by the Metso integration this target was not met. However the functionality is soon expected to be available also for the dryer fabric special packing instructions in question.

9 Conclusions

Focus of global economic growth is moving towards the emerging markets. In order to maintain profitability the production needs to be upscaled from local to global scale to respond the market situation. The services business is growing it's significance in the paper machine business.

Starting of production in a greenfield plant in the middle of the emerging markets is challenging. All the know-how has to be brought in via different means. The instructions have fundamental role in this learning process. They guide all the important operations as materials resource planning, logistics, quality management and so on. The old instructions are not workable anymore in the global playing field. New instructions need to be clear, explicit and ultimately multilingual and –cultural in order to add value in the value chain.

Instructions turned out to be a necessary piece of supervision of work in China. There correct and explicit instructions are important for the production. If the instructions are unclear the work will not be done, and if there is not an instruction, an applied solution is likely to be made. All these reasons favored the development of new explicit instructions.

The new instructions have pointed out many benefits. By making a product ready at once, the lead-time becomes faster and the reliability of delivery is improved. New template clarifies the instruction making as the format offers readily designed places for images and text. The need to explain defects and lacks is reduced notably hence the support personnel of production and sales are able to concentrate their time to their primary work. These all enhance the performance of dryer fabric operations and minimize the troubles of installation caused by packing.

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