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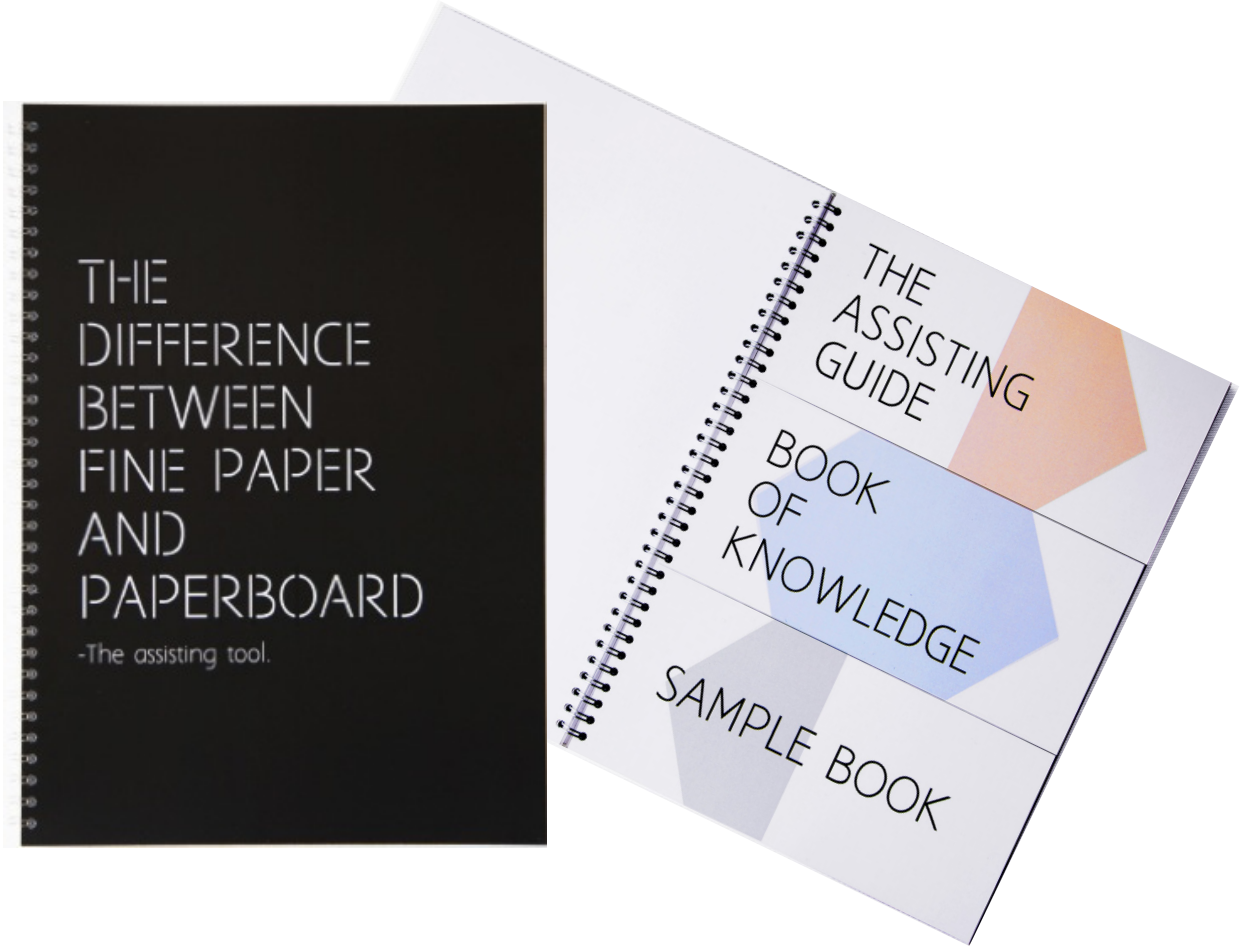

THE DIFFERENCE BETWEEN FINE PAPER AND PAPERBOARD

Development of an assisting tool for material decision

Master's thesis in the Master Degree Programme, Industrial Design Engineering

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Department of Product and Production Development
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Gothenburg, Sweden 2014

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Cover:
The new developed product, ”the assisting tool” that assists operators in the graphical and packaging industry during material decision for fine paper and paperboard applications.

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Abstract

The difference between fine paper and paperboard may at a first glance appear trivial. Unfortunately, if the properties of each material are not accurately defined and understood valuable resources, such as material, time and cost, can be wasted. Hence, this project, performed in collaboration with Iggesund Paperboard AB, aims to spread knowledge about the difference between fine paper and paperboard, and create an awareness about how to make, and the importance of, a conscious material decision for fine paper and paperboard applications, among operators in the graphical and packaging industry.

A conscious material decision implies a decision that is based on holistic knowledge about the fine paper and paperboard application development process, including the properties of fine paper and paperboard. During such a decision, important factors (e.g. durability, runnability, and environmental impact) that contribute to an optimal material for a specific application, and the comprehensive consequences of applying the material, are taken into account. Thereby, this decision results in an understanding of how to use minimum resources and gain maximum quality when developing a fine paper or paperboard application.

The chosen approach is to identify the current material decision procedure, and which factors and desired properties that are, and should be, considered for fine paper or paperboard applications in order to optimise the application throughout the development. This has been performed by conducting several theoretical and empirical studies, where the investigated operators are found in the graphical and packaging industry. Although, the primary focus during this project has been directed towards the operators within advertising agencies, as they are the weakest link in terms of lacking knowledge about the investigated manner. Also, they are the ones interacting with the entire graphical and packaging chain, including the customers of fine paper and paperboard applications. Thereby, the knowledge to perform a conscious material decision, throughout the graphical and packaging chain, could be provided by the transfer of knowledge from the operators within advertising agencies.

The goal is to optimise the material decision procedure by providing needed knowledge, to enable a conscious material decision, in a product. This product is supposed to serve as assistance for the primary users, i.e. operators within advertising agencies, when deciding material for fine paper and paperboard applications. In doing so, the operator will obtain enough knowledge to make conscious material decisions. Thereby, reduced time, cost and environmental impact can be obtained, together with an increased quality of the produced application.

The development process, of a product concept that provides a solution to the current lack of knowledge, resulted in a book that serves as an assisting tool for (primarily) operators within advertising agencies during material decision for fine paper and paperboard applications. Further, the tool acts as a link between the operators within advertising agencies, and the already existing information, i.e. fills the gap of knowledge in-between these two knowledge holders. This is performed by the assisting tool through the included fundamental knowledge about the fine paper and paperboard application development process, and the fostering of planning and communication.

Keywords: Fine paper, Paperboard, Assisting tool for material decision, New product development, User-centered design, Material decision book, Advertising agencies, Fine paper and paperboard applications.

15. Table of Content

Appendix

1. Introduction

The difference between fine paper and paperboard may at a first glance appear trivial. Unfortunately, if the properties of each material are not accurately defined and understood valuable resources, such as material, time and cost, can be wasted.This because an incorrect material decision can result in a fine paper or paperboard application not obtaining the desired properties. Thereby, the application could e.g. require to be completely redesigned, result in a more expensive printing process, or obtain a shorter life expectancy. All these scenarios lead to an increased use of material, time and cost, and also a reduced quality of the application.

Bearing this in mind, Iggesund Paperboard AB expressed a need to spread knowledge about the difference between fine paper and paperboard, along with the importance of making a conscious material decision among the operators in the graphical and packaging industry. A conscious material decision implies a decision that is based on holistic knowledge about the fine paper and paperboard application development process, including the properties of fine paper and paperboard. During such a decision, important factors (e.g. durability, runnability, and environmental impact) that contribute to an optimal material for a specific application, and the comprehensive consequences of applying the material, are taken into account. Thereby this decision results in an understanding of how to use minimum resources and gain maximum quality. Subsequently, finding a solution to provide this holistic knowledge can result in savings of our mutual resources in terms of e.g. reduced environmental impact, time and cost. Hence, in order to find a solution to the expressed need, it was crucial to understand the substrate behaviour of the operators within the graphical and packaging industry.

In this project fine paper and paperboard applications refers to:

- Books, Magazines & Brochures including cover, inlay, and binding.
- Printed sheets i.e. menu, flyer, poster, postcard, business card, and tag.
- Folded applications i.e. tab, menu, folder, postcard, and tag.
- Packaging including protective packaging, disposable packaging, aesthetic packaging, taint & odour proof packaging.

1.1 Purpose & Goal

The investigated operators in this project are limited to: customers of fine paper and paperboard applications, operators within advertising agencies, packaging engineers, printers, operators within graphic design and communication educations, operators within packaging engineering educations, purchasers of fine paper and paperboard, and merchants of fine paper and paperboard. However, the primary focus during this project is directed towards the operators within advertising agencies, as they are the weakest link in terms of lacking knowledge about the investigated manner. This fact was initially provided to the project team from Iggesund Paperboard AB at the beginning of this project. In addition, the operators within advertising agencies are the ones interacting with the entire graphical and packaging chain, including the customers of fine paper and paperboard applications. Thereby, the knowledge to perform a conscious material decision, throughout the graphical and packaging chain, could be provided by the transfer of knowledge from the operators within advertising agencies.

The purpose of this project is to:

(1) spread knowledge about the difference between fine paper and paperboard,

and

(2) create an awareness about how to make, and the importance of, a conscious material decision for fine paper and paperboard applications, among operators within (primarily) advertising agencies.

This in order to optimise the developed fine paper and paperboard application in terms of used resources and gained quality, through the applied material. The chosen approach is to identify the current material decision procedure, and which factors (e.g. durability, runnability, and environmental impact) and desired properties that are, and should be, considered for fine paper or paperboard applications in order to optimise the application throughout the development.

The goal is to optimise the material decision procedure by providing needed knowledge, to enable a conscious material decision, in a product. This product is supposed to serve as assistance for the primary users, i.e. operators within advertising agencies, when deciding material for fine paper and paperboard applications. In doing so, the operator will obtain enough knowledge to make conscious material decisions. Thereby, reduced time, cost and environmental impact can be obtained, together with an increased quality of the produced application.

1.2 Question formulation(s)

The question formulation, that has been the foundation throughout this development work with emphasis on the performed studies, is divided into a main question, and additional sub-questions identified by breaking down the main question. The conclusion in section 12. Conclusion, presents the answers to these questions, which has been obtained through carrying out the development work presented in this report.

1.2.1 Main question

1. How can we assist the operators within advertising agencies in making conscious material decisions for fine paper or paperboard applications, and thereby optimise the desired properties and quality of the application in terms of e.g. purpose, user experience and life expectancy, and used resources e.g. environmental impact, time and cost?

1.3 The Report

This report explains the implementation, result, analysis and development work that was carried out to reach a solution to the presented problem described in the introduction. The first two chapters in this report presents fundamental background theory that is needed to be understood in order to follow the development work. The first chapter treats the theoretical framework about the development process of fine paper and paperboard applications, and the next chapter describes the methods that were applied during this project.

The next chapters, after the theoretical parts, present the implementation, result and development work. The implementation begins with the performed studies, and ends with the implementation of the development of a final concept. The next following chapters present the result of the performed empirical studies, analysis of the results, the identified requirements, and the result of the steps in the new product development from idea and concept generation to the final developed concept.

The last chapters in this report present a discussion of the performed development work, conclusions, and possible future work.

2. Theoretical framework

This section provides the basic needed knowledge about fine paper and paperboard, the printing process and finishing options. The theory also involves terminology related to each section, which is fundamental in order to understand the methods and properties connected to the materials, printing process and finishing options.

2.1 Fine paper & Paperboard

This section presents the basic characteristics and construction of fine paper and paperboard, the main differences that distinguish the materials are also summarised in this section. Terminology related to material properties, the material production process, material surface properties, and environmental aspects can also be found in this section.

2.1.1 Differences between fine paper and paperboard

Paperboard often has a multi-layer structure (see figure 2.1) which gives a stiffness to the material that is greater than the single-layered cellulose fibre-based materials, such as fine paper (Iggesund Paperboard, 2010). Although, paperboard can be made in single- or multi-ply, but contains a greater proportion of long fibres than paper. A multi-ply construction provides the ability to vary the content of each ply, i.e. proportion of long and short fibres in the respective plies. Also, the type of pulping method, and the treatment of pulp to improve strength or bulk quality and distribution of broke in the structure can be varied, to reach different functionalities.

A three layered-ply gives the opportunity to enhance and optimise the surface characteristics in the outer ply, without losing stiffness and paperboard advantages that are built in the middle ply (Iggesund Paperboard, 2010). Hence, a dual ply will always lead to compromises of characteristics, in contradiction to a three layered or multi-layered paperboard. Further, the properties: bulk, strength, stiffness, surface smoothness, and various functional features (e.g. increased moisture resistance in surface or middle plies), are easier to optimise with a multi-ply construction without compromising.

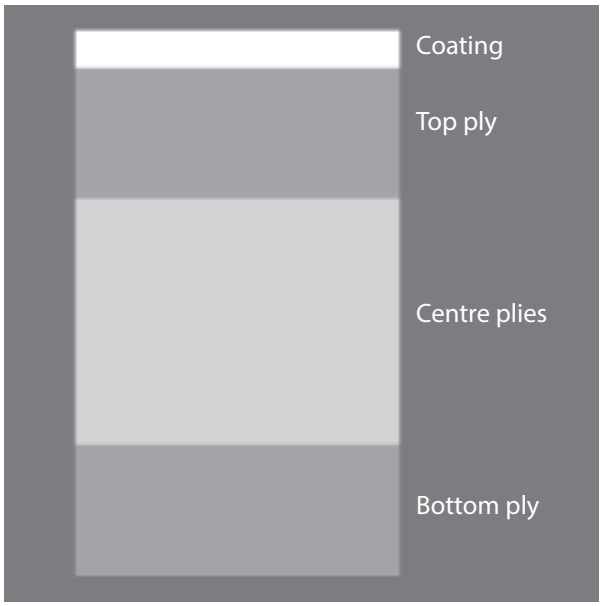


Figure 2.1 *Multi-ply construction.*

According to the ISO standardisation body, a paper product with a grammage that exceeds 200 g/m2 is called paperboard. In addition, the European Paper Industries (CEPI) defines paperboard when it exceeds 220 g/m2. In this project paperboard is defined as a cellulose fibre-based material that comprises of more than one layer, although it can still have a grammage below 200 g/m2.

2.1.2 Paperboard qualities

There are several different paperboard qualities, this section presents the most common paperboard qualities.

Solid Bleached Board (SBB) - Solid bleached board, commonly abbreviated as SBB, refers to a strong and dense paperboard made by primary fibres, also referred to as virgin fibres, and contains only bleached chemical pulp (see Figure 2.2). The primary fibres make SBB suitable for packaging of products that are flavour and aroma sensitive. This type of paperboard is also ideal for graphical applications that set high demands on the surface, such as good printing properties, and when finishing options, e.g. embossing and creasing, are desired. The surface is usually coated and this can be done either on both sides, or on one side of the paperboard (Iggesund Paperboard, 2010).

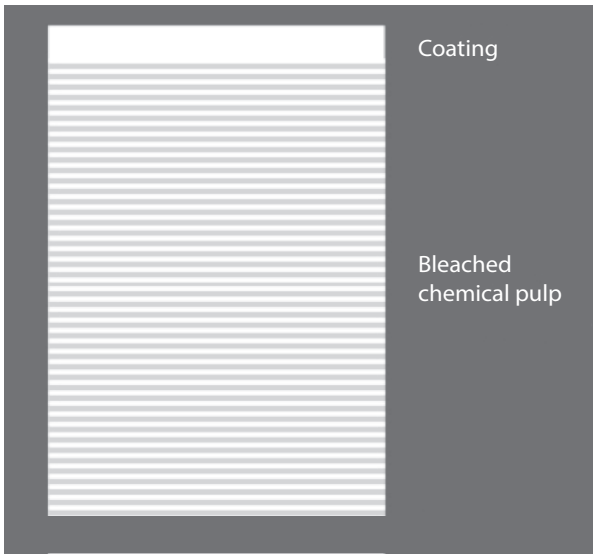


Figure 2.2 *Construction of SBB.*

Solid Unbleached Board (SUB) - Solid unbleached board, commonly abbreviated as SUB, is a paperboard that possesses high strength and is entirely made by unbleached chemical pulp, which gives a brown tone to the base board (see Figure 2.3). A layer of white, bleached fibres can be used on the surface along with coatings in order to get a white surface (Iggesund Paperboard, 2010).

Folding Box Board (FBB) - Folding box board, commonly abbreviated as FBB, is a stiff and strong paperboard with low density due to its construction. FBB is composed by both mechanical pulp in the middle layer, and chemical pulp in the outer layers (see Figure 2.4). The pulp in the middle layer influences the colour of the paperboard's back, which are cream (manila), due to the translucency of the chemical pulp in the outer layers. The paperboard's top layer is pigment coated and bleached and the grades that are fully coated provide a very good printing quality (Iggesund Paperboard, 2010).

White Lined Chipboard (WLC) - White lined chipboard, commonly abbreviated as WLC, exist in many different qualities. Due to this, it is difficult to provide generalised information about the physical properties of WLC. However, a low or intermediate stiffness and strength, and a medium density are general characteristic features of WLC. It is constructed by recycled fibres in the middle layer and usually a pigment coated liner or top layer made by bleached chemical pulp (see Figure 2.5). Mechanical pulp or bleached chemical pulp could also occur in an underliner or second layer of the paperboard (Iggesund Paperboard, 2010).

Duplex paperboard - Duplex paperboard is a term that refers to a multiply paperboard constructed by mechanical pulp in the middle layer. The top layer consists of bleached chemical pulp and the reverse side is made of either bleached or unbleached chemical pulp (Antalis[3], 2014).

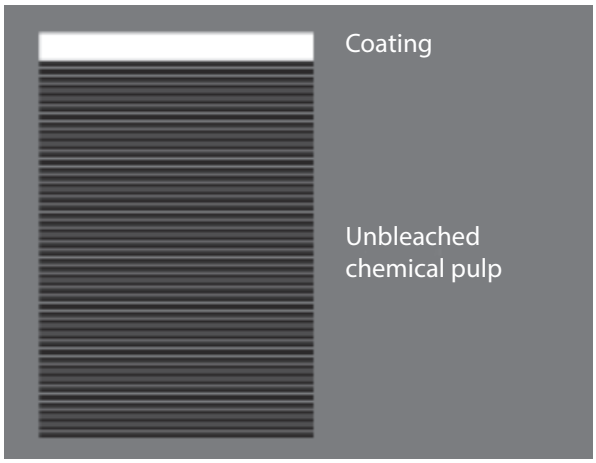


Figure 2.3 *Construction of SUB.*

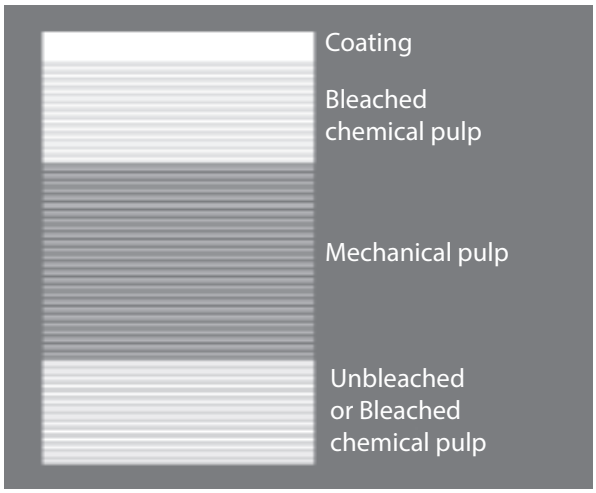


Figure 2.4 *Construction of FBB.*

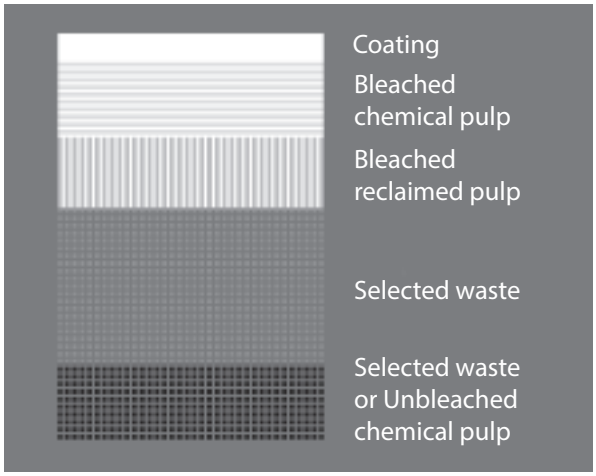


Figure 2.5 *Construction of WLC.*

2.1.3 Terminology: Material properties

The following terminology is fundamental to understand when developing fine paper and paperboard applications.

Fibre length - The length of the fibres used in a material is a vital parameter that relates to the materials obtained characteristics (Östlund1, 2010).

Long fibres - Long fibres results in a higher tensile strength, tearing resistance, fold strength, puncture strength, and rougher surface texture (see Figures 2.6 and 2.7). Although, long fibres can also result in variations due to poor formation which, in turn, results in uneven ink absorption and erratic adhesive bonding (Johansson, Lundberg & Ryberg, 2012; Östlund1, 2010).

Short fibres - Short fibres (see Figure 2.8) produces a smoother surface and higher opacity, and form weaker bond in comparison to long fibres (Johansson, Lundberg & Ryberg, 2012; Östlund1, 2010).

Recycled fibres - Fibres used in a material can also be re-used, the fibres are then called recycled fibres. Recycled fibres, subsequently, have the properties of the inherited fibre source. Although, re-pulping processes degrades and reduce the length of the fibres which results in reduced physical properties of the fibres. Recycled fibres can also be affected by extraneous contamination in terms of, for instance, water insoluble adhesives, plastic debris, and non-removable printing inks (Östlund1, 2010).

Virgin fibre - Virgin fibres are the opposite of recycled fibres i.e. fresh fibres and are also referred to as primary wooden fibre (Iggesund Paperboard, 2010).

Grain direction - The orientation, or direction, of the majority of the fibres in a material. The fibres are oriented in the same direction as the material was produced in, hence the machine direction (see Figure 2.9) and the fibre length are parallel (Iggesund Paperboard, 2010; Johansson, Lundberg & Ryberg, 2012).

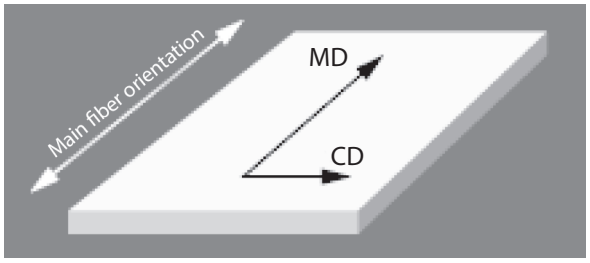


Figure 2.9 *Machine Direction (MD) and Cross direction (CD).*

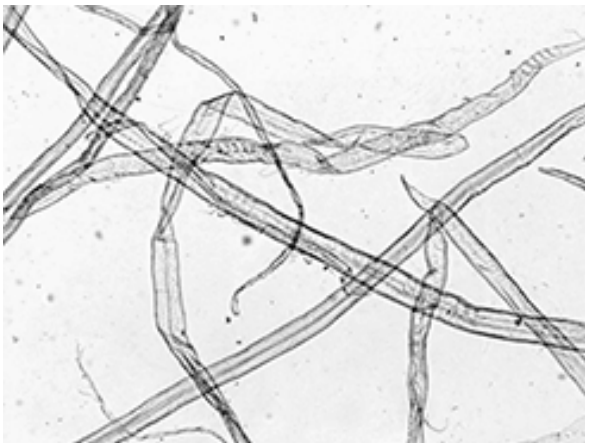


Figure 2.6 *Long & flat pine fibres.*

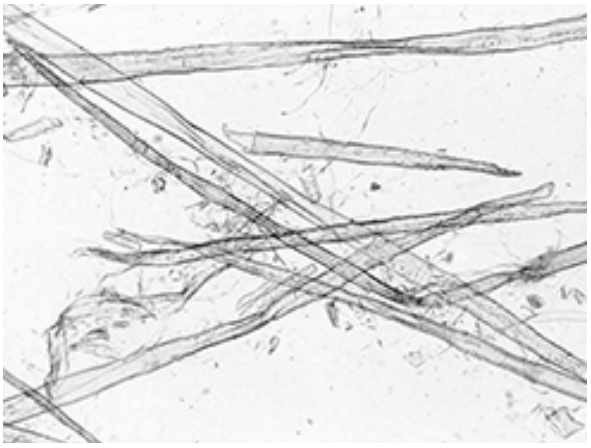


Figure 2.7 *Long & flat spruce fibres.*

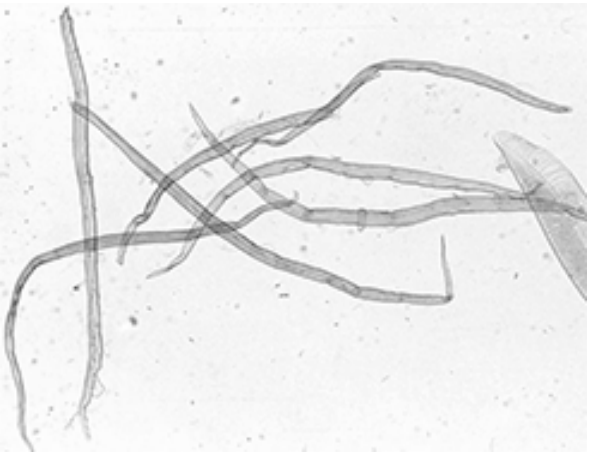


Figure 2.8 *Short and cylindrical birch fibres.*

Mechanical pulping - Mechanical pulp (see Figure 2.10) is produced by extracting cellulose fibres from the wood by grinding. Common for materials made out of mechanical pulp is high opacity, high bulk, high bending stiffness and dimensional stability. Although, using mechanical pulp results in a quicker yellowing of the material than when using chemical pulp, and it is also relatively weak. The characteristics of mechanical pulp are hard and rigid fibres, gained from the timber's high yield and presence of lignin. Newspaper is often produced from mechanical pulp (Antalis, 2014; Johansson, Lundberg & Ryberg, 2012; Östlund1, 2010).

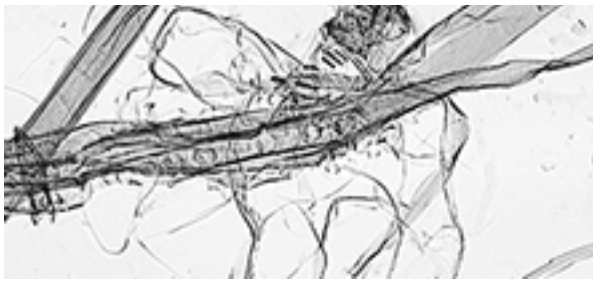


Figure 2.10 *Mechanical pulp.*

Chemical pulping - Chemical pulp is made by means of chemical separation of fibres by using alkali sulphate extraction that dissolves the lignin, and by that separates the fibre. Chemical pulping results in a reserved fibre length (see Figure 2.11). Common characteristics gained by using chemical pulp are high density, flexible and soft fibres, good creasing, embossing and cutting abilities, high whiteness, high brightness, good light stability, and high purity which provides good odour and taint protection (Antalis, 2014; Östlund1, 2010).

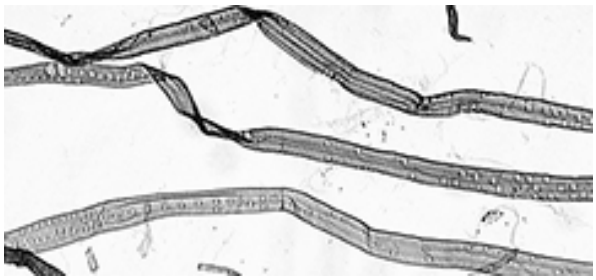


Figure 2.11 *Chemical pulp.*

Combined processes - The mechanical and chemical pulping can also be combined. The pulp is then referred to as semi-chemical, thermo-mechanical (Östlund1, 2010).

Wood-pulp material & Wood-free material - When a material consists of less than 90 % chemical pulp and over 10 % mechanical pulp it is usually referred to as wood-pulp material. Hence, wood-free material describes the opposite; a material that consists of over 90 % chemical pulp and less than 10 % mechanical pulp. However, the definition can vary between different countries. A wood-free material has a higher whiteness, surface strength and a longer life expectancy compared to a wood-pulp material. While a wood-pulp material has higher bulk and opacity than a wood-free material (Johansson, Lundberg & Ryberg, 2012).

Grammage - The grammage refers to the materials weight in grams per square metres or millimetres (g/m^2 or g/mm^2). This is sometimes expressed as grammage substance (Iggesund Paperboard, 2010; Johansson, Lundberg & Ryberg, 2012; International paper, 2013).

Thickness - The thickness refers to the distance between the surfaces two parallel sheets of material (fine paper or paperboard), and is measured in micrometre (µm) (Iggesund Paperboard, 2010; International paper, 2013).

Bulk - Bulk describes the thickness of the material in relation to its weight, i.e. how voluminous a material is. It can be measured in cubic centimetre per gram (cm3/g), or pages per inch (ppi). A material with high bulk (high cm3/g and ppi) is porous, thick and lightweight, and a material with low bulk is compact, thin and heavy. Two materials with equal bulk differs in stiffness, the higher the bulk the stiffer the material. It is common to strive a decreased grammage and increased bulk to obtain a stiff material to a lower distribution cost. Further, it is beneficial to have higher bulk when applying glue binding, since it facilitates the glues ability to penetrate the material if it is porous and hence increases the strength of the binding (Johansson, Lundberg & Ryberg, 2012).

Porosity - Porosity of a material related so the amount of air in the material which enables ink absorption. Print quality and the speed of ink drying are some of the properties that are affected by a material's porosity (Antalis, 2014; Torraspapel, 2008).

Stiffness - The stiffness of a material refers to the ability to endure bending forces, applied perpendicular to the material surface. It can also be defined as the force needed to deflect a material. It is measured in millinewtonmetre (mNm) (Iggesund Paperboard, 2010; International paper, 2013).

Bending resistance - See definition for 'Stiffness'. Bending resistance relates to the required force in order to bend a material to a 15 degree angle (Iggesund Paperboard, 2010).

Bending stiffness - See definition for 'Stiffness'. Bending stiffness increases with thickness or grammage. The construction of the material's layers and the composition of the fibres have a huge impact on

the bending stiffness, which is expressed in millinewtonmetre (mNm), and is measured at a bending angle of 5 degrees (Iggesund Paperboard, 2010; Östlund2, 2010).

Strength & Toughness - Toughness and strength can be measured in different ways. Stiffness, tensile strength and elasticity are some of the features that are used to define these properties. A material's toughness and strength are important when desiring to create e.g. complex structural shapes and embossing, and are influenced by a numerous of material characteristics e.g. grammage, thickness, moisture content, density and type of pulp. A material is generally stronger in the machine direction compared to the strength in the cross direction (Iggesund Paperboard, 2010; Iggesund Paperboard, 2011).

Tensile strength - Tensile strength refers to the resistance of the material to pull apart or rupture. This feature relates to the internal fibre and its joint strength. Tensile strength increases with increased basis weight. It is measured in force per square millimetre (N/mm2 or MPa). A low tensile strength increases the risk of the material splitting during processing (Johansson, Lundberg & Ryberg, 2012; Östlund2, 2010).

Surface strength - Surface strength is important during the printing process, it protects the surface from getting damaged and prevents the printing machine to pulling off small pieces of the material's surface. The surface strength is affected by surface sizing, the proportion and sort of binder in the coating, the kind of coating pigment, the treatment of the fibres and if long or short fibres are used (Johansson, Lundberg & Ryberg, 2012; Östlund2, 2010).

Tearing resistance - The tearing resistance refers to the force required to tear the material from an initial cut (see Figure 2.12) (Iggesund Paperboard. 2010). Tear strength increases with an increased basis weight and depends on the fibre length (Östlund2, 2010).

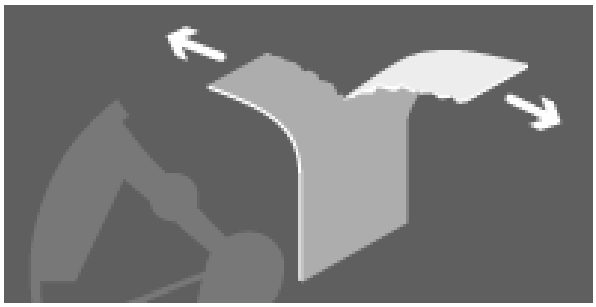


Figure 2.12 *Tearing resistance.*

Dimension stability - A material will shrink during drying, and due to the fact that paper and paperboard have a certain fibre direction, the materials' dimensional change will occur asymmetrically. While a material is exposed to changes in humidity, it has a tendency to change dimension (see Figure 2.13) to a larger extent in the opposite of the fibre direction, which could cause misregistration. Dimension stability describes a material's capacity to endure stress during manufacturing and in all directions, maintain its dimension while it is exposed to changes in humidity (Johansson, Lundberg & Ryberg, 2012; Iggesund Paperboard, 2010; Antalis1, 2014).

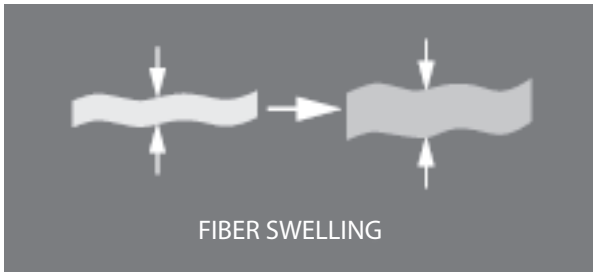


Figure 2.13 *A swelling fibre.*

Complex shapeability - In order to create complex structural shapes, by using e.g. different cutting methods, creasing and folding, some properties are necessary to consider. A material's surface strength, tearing resistance and strength are some of the properties that are important in order to achieve good foldability and to cut edges with good result (Iggesund Paperboard, 2011)

Creasability & Foldability - A material is expressed to have good creasability when it is not very sensitive to changes in the conditions during the creasing operation, and when it is possible to create narrow and deep creases and that the given shape of the crease is adapted and retained by the material (see Figure 2.14)(Iggesund Paperboard, 2011).

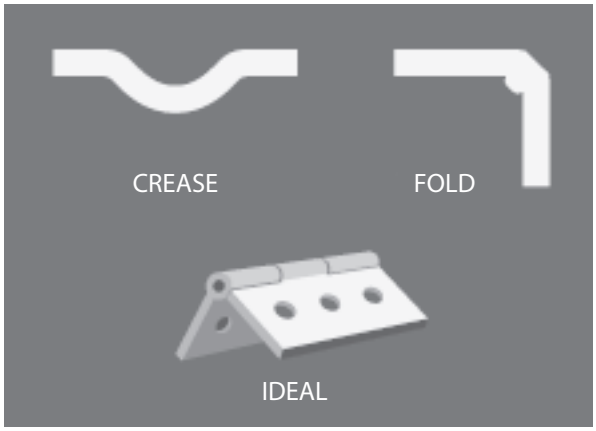


Figure 2.14 *A perfect crease and fold can be compared to a hinge.*

Taint & odour - A material's pulp, surface coating and printing ink are some of the properties that could affect a material's taint and odour neutrality. There are accredited laboratories that test if a material is taint and odour neutral (Iggesund Paperboard, 2010).

Durability - Durability refers to a material's resistance to aging i.e. withstands degradation during a long service life, and can be described as the materials ability to preserve its strength and withstand yellowing over time. What kind of pulp a material is made of affects the durability of a material. A material made by chemical pulp has a better durability compared to a material made by mechanical pulp, also referred to as wood-pulp (Inkjet Station, 2014; Johansson, Lundberg & Ryberg, 2012).

Material price - The price of a material can either be expressed in cost per grammage, or cost per processed product. The price often depend on the grammage, hence when comparing two different materials and one has twice as high basis weight it should approximately be twice as expensive (Johansson, Lundberg & Ryberg, 2012; Iggesund Paperboard, 2010).

2.1.4 Terminology: The material production process

There are several steps in the process of producing paperboard, which will affect the properties of the paperboard. This section presents terminology regarding the board-making process.

Bleaching - Bleaching is used to improve the whiteness, brightness and performance of the pulp, and is carried out by a chemical treatment (see Figure 2.15) (Antalis1, 2014).

Figure 2.15 *Unbleached and Bleached pulp.*

Fillers - To improve the opacity, softness and elasticity of a material fillers, such as calcium carbonate, titanium dioxide and clay can be added to the pulp (Johansson, Lundberg & Ryberg, 2012; Iggesund Paperboard, 2010).

Formation - Formation describes how evenly the material is constructed. A material has good formation when the structure is even, which is important in order to achieve good print result (Johansson, Lundberg & Ryberg, 2012).

Glazing - Glazing is a part of the material production process. It is used to obtain a higher gloss which is beneficial when desiring accurate image reproduction. Glazing reduces opacity and stiffness (Johansson, Lundberg & Ryberg, 2012).

Calendering - Calendering refers to when a paperboard is compressed between steel cylinders in order to increase the smoothness by decreasing irregularities in the material. It could however lead to a thinner material with less stiffness (Johansson, Lundberg & Ryberg, 2012; Iggesund Paperboard, 2010).

Surface sizing - Surface sizing (see Figure 2.16) refers to the operation when starch solution, that can be pigmented, is applied on one side or both sides of the material. This improves the strength, smoothness and printability properties (Östlund2, 2010).

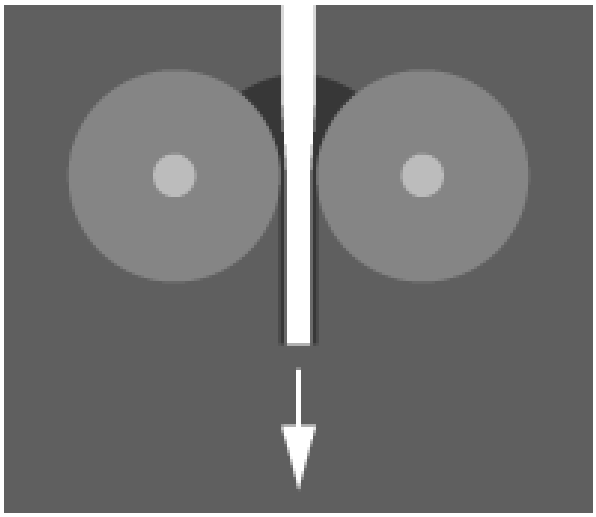


Figure 2.16 *Surface sizing.*

2.1.5 Terminology: Material surface properties

This section treats the terminology regarding different surface properties.

Surface structure, Roughness & Smoothness - The surface structure can be described as a three-dimensional landscape, i.e. a topographical pattern, on the surface. The structure depends on the used raw material, production process and finishing treatments. It is common to express surface structure as an unwanted irregularity in the surface, this is often expressed in terms of roughness. The surface structure of a material relates to the material's surface smoothness; a rough surface has low smoothness. However, an equal rate of surface smoothness does not necessarily imply an equal surface structure. Further, the surface structure and smoothness influence the general material appearance, printabi-

lity, varnishing gloss, and visual impact of laminated and plastic coated material. The smoother the surface the higher varnishing gloss and printing quality. Board smoothness is measured in Berndtsen's roughness number, milliliter per minute (ml/min), or ParkerPrint Surf, micrometre (µm) (Iggesund Paperboard, 2010; International paper, 2013).

Surface coating - Coatings contain binders and pigments and can be applied on the surface in one or multiple layers in order to improve the materials' printing properties and to obtain a higher surface smoothness (see Figure 2.17). Materials that are coated will absorb ink more uniform and faster compared to an uncoated material. The coated surfaces are available in matt, silk or glossy (Johansson, Lundberg & Ryberg, 2012; Iggesund Paperboard, 2010).

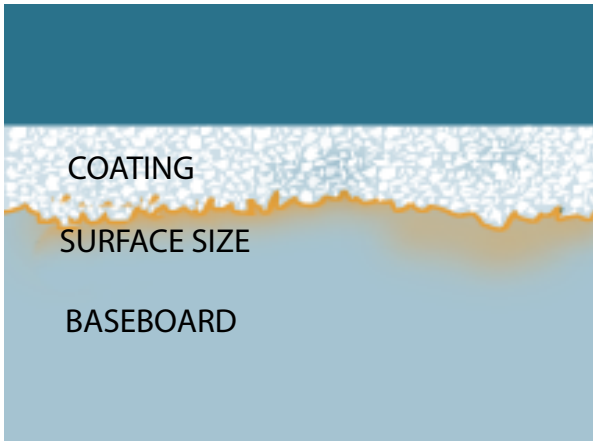


Figure 2.17 *A coated surface.*

Matt - A material with a matt coating provides a smooth surface with a non-reflective finish. Matt or uncoated surfaces are promoted when desiring high readability (Antalis1, 2014; International paper, 2013).

Silk - A surface coated with silk is beneficial when desiring both high image quality and readability (Johansson, Lundberg & Ryberg, 2012).

Glossy - A glossy surface is beneficial when high colour reproduction is strived, such as when having a high demand on image quality. However, it also results in a poor readability due to distracting reflections in the glossy surface. Gloss is measured in the percent (%) of light directly reflected at an angle of 75 degrees from a surface. The quantity of gloss can also be measured in terms of Gardner gloss units, the higher the number the higher the gloss (About.com, 2014; Antalis1, 2014; Johansson, Lundberg & Ryberg, 2012; International paper, 2013).

Uncoated material - A material that have not been coated is called an uncoated material. It is common that glue is applied to the surface of uncoated materials to enhance the surface strength. Uncoated materials are frequently used as notepaper, copy paper, and in copyback books (Johansson, Lundberg & Ryberg, 2012).

One-sided material - A one-sided material refers to a material with different characteristics of the back and front surfaces. For instance, it is common with one coated and one uncoated side of a sheet (Johansson, Lundberg & Ryberg, 2012).

Whiteness - Whiteness refers to an optical characteristic, and can be described as how much light that is reflected by a material's surface (Johansson, Lundberg, and Ryberg, 2012). Whiteness can be calculated in different ways but a common method is to use CIE-whiteness where three reflection values are measured in combination with standardized light. These values L*, a* and b* describe brightness and tints measured on a scale, where +a* stands for a red tint, -a* a green tint, +b* a yellow tint, -b* a blue tint and the brightness is measured in percent with black as 0 percent and white as 100 percent (see Figure 2.18) (Iggesund Paperboard, year unknown).

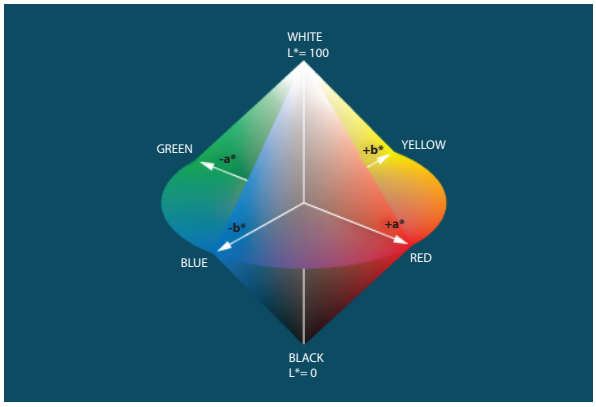


Figure 2.18 *Whiteness.*

Brightness - Brightness refers to how much light a material's surface reflects and is measured by using a lamp with a wavelength of 457 nanometres (nm). Brightness is often expressed as Y value or luminance in technical terms. During the manufacturing of a material, the brightness can be increased by bleaching, and adding pigments and colours. The brightness of a material affects its ability to produce prints with high contrast (Johansson, Lundberg & Ryberg, 2012).

Opacity - Opacity, often defined in percentage (%), is a measure of a material's translucence i.e. to what degree it is possible to see the print on an underlying page or on the reverse side of the same page (see Figure 2.19). A material has high opacity when it is not possible to see the print on the other side of the page (Antalis2, 2014; Iggesund Paperboard, 2010).

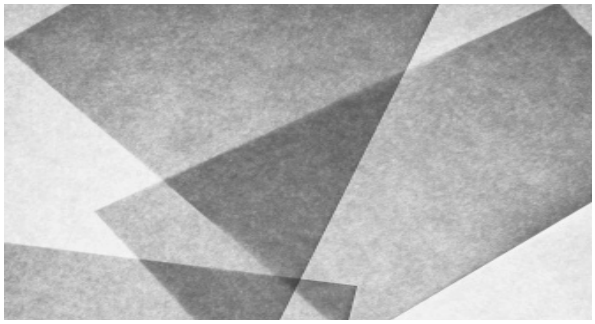


Figure 2.19 *Opacity.*

2.1.6 Terminology: Environmental aspects

This section present different methods used for bleaching of pulp, along with labels and terminology regarding environmental aspects.

TCF (Totally Chlorine Free) - Bleaching of pulp without using chlorine. The bleaching is performed by using ozone, oxygen or hydrogen peroxide (Johansson, Lundberg & Ryberg, 2012; Antalis1, 2014; NRDC, 2006).

ECF (Elemental Chlorine Free) - Bleaching of pulp by using chlorine dioxide, and without the use of elemental chlorine is referred to as EFC (Antalis1, 2014; Johansson, Lundberg & Ryberg, 2012).

Nordic Ecolabel "the Swan" - In the Nordic countries, the Nordic Ecolabel is an official ecolabel whose criterion treats: the use of energy and chemicals, the discharge to water, ground and air along with how waste is handled (Svanen, 2014).

FSC (Forest Stewardship Council) - FSC is a certification that should ensure that the material is taken from forests that are managed in a responsible way in terms of environmental, economical and social aspects (FSC, 2014).

ISO 14001 - ISO 14001 is a certification regarding environmental management system, which offers a framework to improve and control the company's environmental performance and impact (ISO, 2014).

2.2 The printing processes & Finishing options

In this section basic knowledge related to printing processes is provided, along with terminology related to the printing processes and finishing options.

2.2.1 The printing process

This section presents information about printing methods, printing ink, runnability and printability, which is good to be aware of in order to understand the printing process.

Printing methods - There are several printing methods that can be conducted. The most common printing methods are lithographic offset, flexography, and rotogravure. Other methods are commonly used in limited number of applications, and these are screen printing, digital printing, inkjet and electro photography. The different printing methods are suitable for different types of materials, format and numbers of copies, and provides different quality of the printed result (Johansson, Lundberg & Ryberg, 2012; Östlund3, 2010).

Printing ink - The printing ink, and its properties, differs depending on the printing process; transfer of an image from the printing surface to the substrate. Printing inks are liquids with various viscosities. When the inks are applied to a substrate, by a printing press, it must be converted to a solid structure to enable handling of the print and fulfilling of end-use specifications. This procedure is strived to be achieved as fast as possible, within the restraints of the printing process itself, and is called ink drying. Hence, the ink maker aims to produce inks that ensure high quality printing and optimal production speed including ink drying. The process can come about by physical and chemical manner, or a combination of both. There are five basic printing inks: lithographic and letterpress inks, flexographic and gravure inks, and screen inks (Leach & Pierce, 2007).

Runnability - Runnability is a common term among printers and converters, and refers to the printing and converting process itself. Good runnability is achieved when the printing job runs with high efficiency through the press and the finishing equipment. This also includes low down time and little material waste. Runnability is closely linked with economical aspects of the production, and varies for different materials. A material that causes stops in the production is said to have low runnability, and results in a higher cost. For packaging products, runnability also includes machine filling. Regarding post-press operations, runnability commonly depends on rub resistance; ink or varnishing is preserved throughout finishing operations and during product use, and minimum powdering (Antalis1, 2014; Iggesund Paperboard, 2010; Östlund2, 2010).

Printability - Printability refers to the materials ability to reproduce pictures, printed text and patterns. Printability depends on the fibres in the material, the forming and manufacturing methods, coatings,

and finishing operations. Most high-class paperboards have a so called pigment coating to enhance a good printability. A material's printability is also related to the type of ink and printing method that are used (Iggesund Paperboard, 2010).

Readability - In order to make it easy to read a printed text it should not be too high contrast between the material and the text. Due to this, a material with a slightly yellow tone can be suitable for applications with much text. To avoid reflections from the surface, and thereby enhance the readability, a matt or uncoated material can be used (Johansson, Lundberg & Ryberg, 2012).

Image quality - To obtain an image with high contrast, and clear and distinct colours, it is suitable to use a coated material preferable with a glossy coating, and with high whiteness (Johansson, Lundberg & Ryberg, 2012).

2.2.2 Terminology: The printing process

The following terminology is related to the printing process, which is important to understand in order to adapt the choice of material to the process.

Litographic printing (offset) - Litographic printing, commonly called offset printing, a printing plate is used in combination with ink and water. The ink from the printing plate is absorbed by a rubber blanket and is then transferred to the material (see Figure 2.20)(Johansson, Lundberg & Ryberg, 2012). There are different types of methods in offset printing, e.g. water-free offset, UV offset and direct image presses. The plates in waterless offset printing differs from the ordinary printing plates that can be used in offset printing, by using surface tension instead of water the non-image areas can be kept free from ink (Iggesund Paperboard, 2010). Offset can be used for a large amount of various applications, and is the most common printing method. Web-fed offset and sheet-fed offset are two different techniques of offset printing. For large print runs web-fed is suitable since the printing press uses rolls of paper to print on, instead of sheets of paper which is used for sheet-fed offset (Johansson, Lundberg & Ryberg, 2012).

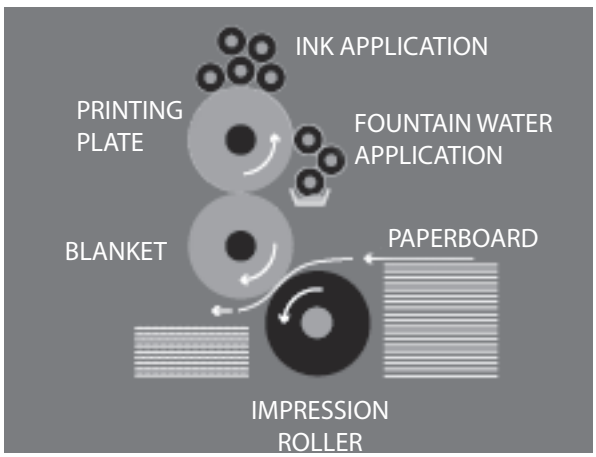


Figure 2.20 *Litographic printing.*

Flexographic printing - In flexographic printing the ink is transferred directly to the material from the printing surface made by plastic or rubber (see Figure 2.21). This method uses a difference in elevation in order to separate the non-printing areas from the areas that are going to be printed. Flexographic printing can be used when printing on materials that are flat or round (Johansson, Lundberg & Ryberg, 2012).

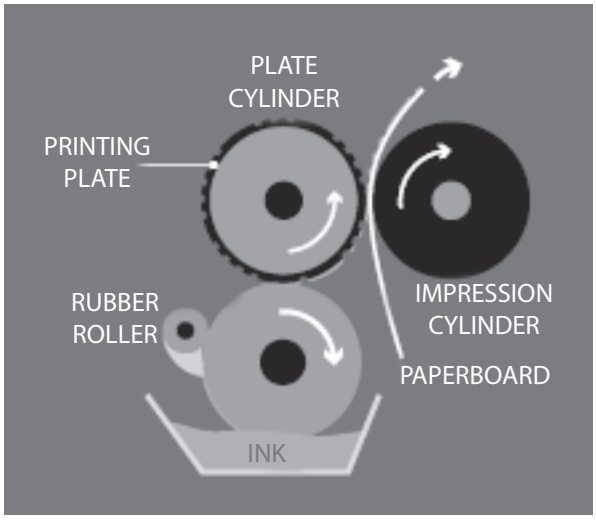


Figure 2.21 *Flexographic printing.*

Screen printing - In screen printing frames are used in combination with thin cloths that are stretched over the frames (see Figure 2.22). The cloths are used in order for the ink to be pressed through, by using a doctor blade, and then be transferred to the printing surface. This method can provide a print result with higher contrast compared to offset printing because it is possible to use a thicker layer of ink in screen printing. Screen printing can be used for printing on both round and flat materials (Johansson, Lundberg & Ryberg, 2012).

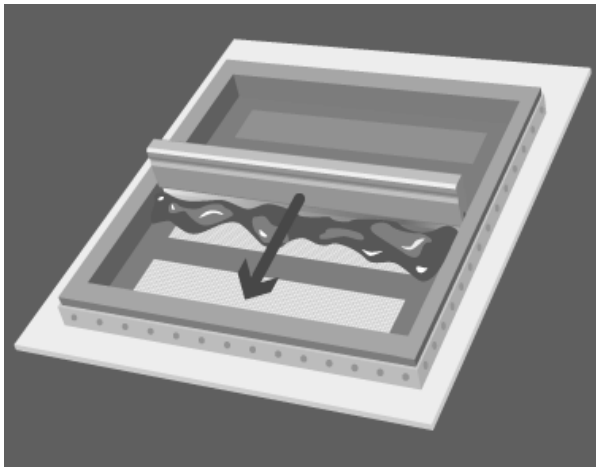


Figure 2.22 *Screen printing.*

Gravure printing - Gravure printing is suitable for large print runs because it is an expensive method which consist of a web-fed press that performs the printing at a high speed. In gravure printing a layer of copper is coated on a steel cylinder (see Figure 2.23), and the printing area on the cylinder is either etched or engraved which creates small wells that are then filled with ink. The ink is transferred to the material by using a rubber-coated impression cylinder that presses the material against the printing cylinder. It is necessary to use a coated or calendered material because this method requires an even surface (Johansson, Lundberg & Ryberg, 2012).

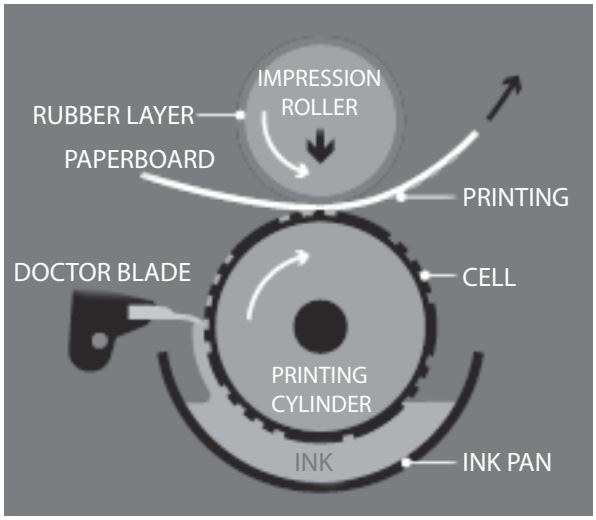


Figure 2.23 *Gravure printing.*

Digital printing - For digital printing a printing plate is not used, instead the printing is performed from a computer directly to the printing press. Hence, the cost for start-up is low and the content on each sheet can be varied, and hence unique. However, it has generally lower capacity compared to the printing presses that uses printing plates. There are various techniques for digital printing e.g. inkjet and xerographic (Johansson, Lundberg & Ryberg, 2012).

Inkjet - Small ink drops that are sprayed out from a moving nozzle is used for inkjet printers. Next to the nozzle some printers also have a UV light placed in order to make the ink dry faster. The cost of each print is high when using an inkjet printer, and it is a rather slow printing method. The technique can be used for desktop printers at home or at the office, and different printers provides various opportunities such as large-format printing (see Figure 2.24) and four colour printing that can be used when printing photos. Different materials will provide different tonal range and colour reproduction in an inkjet printer since the material will affect how much ink that can be applied and still have a good result without smearing (Johansson, Lundberg & Ryberg, 2012).

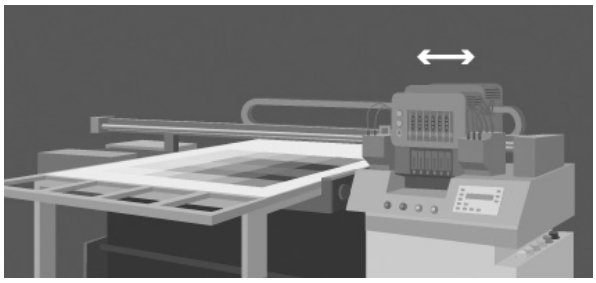


Figure 2.24 *The large format inkjet.*

Four colour printing - Four colour printing describes the printing process when using the four basic colours CMYK, i.e. Cyan, Magenta, Yellow and Key colour (black) (Johansson, Lundberg & Ryberg, 2012).

Binder - The binder refers to the component of printing ink that encapsulates the pigment, i.e. binds the pigment (Johansson, Lundberg & Ryberg, 2012).

Curling - Curling is the phenomenon displayed as a waviness in the printed material. It occurs when too much ink is used in combination with a rapid drying during heatset printing (Johansson, Lundberg & Ryberg, 2012).

Format - The format describes the size of the surface for e.g. a finished printed application. Common formats are e.g. A1, A2, A3, and A4 (see Figure 2.25) (Johansson, Lundberg & Ryberg, 2012).

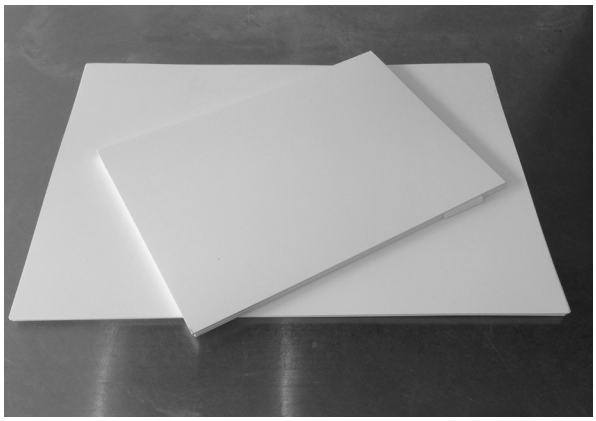


Figure 2.25 *A4 and A3 format.*

Absorption - Absorption refers to the material's properties that enable it to soak up and hold a liquid, e.g. water or ink. A material's ink absorption can be measured by using a certain ink and is expressed in % units (Johansson, Lundberg & Ryberg, 2012; Iggesund Paperboard, 2010; Neenah Paper, 2014).

Ink drying - The material's porosity, absorbency and pH along with temperature and humidity are some of the components that affect the speed in which the ink will dry on the material. The ink drying process is faster for a material with low absorbency, since the ink stays on the surface to a higher extent which allows the ink to dry faster than for a material with

high absorbency where the ink penetrates into the material. A material with a glossy coating has low absorbency and hence, the drying process is faster compared to other types of surfaces (Torraspapel, 2008).

Bleeding - Bleeding refers to the occurrence of two colours merging into each other. Bleeding is desired to be avoided, if this is not a deliberate feature, and is common when using inkjet printers. The ink drying time relates to the ink bleeding, meaning that a quick drying time results in none or little bleeding (Johansson, Lundberg & Ryberg, 2012).

2.2.3 Terminology: Finishing options

The following terminology is related to the various applicable finishing options for fine paper and paperboard applications.

Embossing/Debossing - Embossing describes a reshaping of the material, when parts of the material can either be raised (positive embossing) or lowered (negative embossing also referred to as debossing) (see Figure 2.26). The use of a material with long fibres reduces the risk of cracks being formed in the "edges" of the embossing (Johansson, Lundberg & Ryberg, 2012).

Figure 2.26 *Embossing (with partial varnishing) & debossing.*

Creasing and folding - Folding should be done along the fibre direction in order to avoid that the material is weakened and that cracks develops in the fold. A material's resistance to folding can be reduced by a creasing operation, i.e. a cut groove is created in the paperboard by using a creasing rule consisting of a rounded steel strip that is pressed along the material's fold line. This operation can also prevent the material from cracking during the folding. By creating narrow and deep creases it becomes easier to fold the material. Stiffness and strength affects a material's folding and creasing performance. For instance, high stiffness makes it easy to crease the material but the folding properties are affected because it is hard to create deep and narrow creases which, on other hand, is possible for a material with high strength, such as solid bleached board. A paperboard with multiply layers is optimal for creasing since the thin layers do not break in the fold line (see Figure 2.27) (Johansson, Lundberg & Ryberg, 2012; Iggesund Paperboard, 2010).

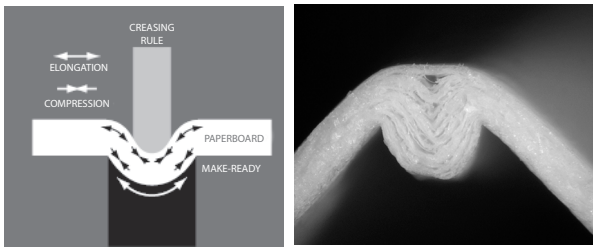


Figure 2.27 *Creasing operation & folding.*

Varnishing - Varnishing describes a surface treatment that can be applied either to a whole surface or to selected parts of the sheet (partial varnishing) (Johansson, Lundberg & Ryberg, 2012). This process can be performed either after printing or during printing (Iggesund Paperboard, 2011). Varnishing refers to when a glossy or matt surface is applied to the printed sheet in order to create special visual effects or to allow a faster off-press processing. Varnishing can also be applied to provide an added protection against wear and dirt. The matt varnish is invisible and is therefore suitable to protect the printed surface. Further, there are different types of varnish: dispersion varnish, oil based varnish and UV varnish, which provide different level of gloss and are applied in different ways, either in a varnishing machine or by a unit in an offset press. (Johansson, Lundberg & Ryberg, 2012).

Barriers - In order to create a barrier a material can e.g. be coated with various types of plastics, or laminated with foils or films (Iggesund Paperboard, 2013).

Lamination - A material can be covered with a protective layer of e.g. plastic, which is referred to as the laminate. Laminates can be shiny or matt and can also be used to improve the appearance of the application. The process is performed by using a laminating device. A coated and glazed material can be used to reduce the risk that air pockets are created under the lamination. To avoid air pockets it also requires a material with a smooth surface (Johansson, Lundberg & Ryberg, 2012).

Foiling - A foil could be applied to the material's surface in order to create an aesthetic effect. Foiling is done by using a warm plate that helps transfer metal or ink from the foil to the material's surface (Johansson, Lundberg & Ryberg, 2012).

Die cutting - A die can be used to cut a material into a new shape, or if the material should be given perforations. The die consists of a slot that is shaped in the desired way and then milled into a wooden slab which are pressed against the material (Johansson, Lundberg & Ryberg, 2012).

Laser cutting - By using laser cutting it is possible to create complex designs with extremely small details (see Figure 2.28). The laser operation gives a discolouration in a brownish tone on the material's reverse side, which is less noticeable for a material that is just lightly coated compared to a heavily coated material. The laser cutting operation will also work faster when the material is not heavily coated. However, it is possible to cover the discolouration by using printing. For creating very small details it is suitable to use a solid bleached board due to its strong network which provides high strength (Iggesund Paperboard, 2010).

Figure 2.28 *Laser cuting.*

Binding - Binding refers to the process of joining together several printed sheets (see Figure 2.29). Binding can be performed e.g. through staple binding, glue binding, spiral binding or sewn binding (Johansson, Lundberg & Ryberg, 2012).

Figure 2.29 *Several types of bindings.*

Spiral binding/Wire-O binding - Spiral binding/ Wire-O binding (see Figure 2.30) are methods used to combine loose sheets by using punching and spirals. This type of bindings enables the sheet to stay flat open (Johansson, Lundberg & Ryberg, 2012).

Figure 2.30 *A wire-O binding that is covered.*

3. Methods

This section presents the methods applied during the development work in this project, divided into data collection methods, analysis methods, idea and concept generation methods, and evaluation methods.

3.1 Data collection

This section explains methods used during collection of data.

Interview

An interview is an empirical data collection method, where the main purpose is to obtain information, and an understanding of a certain user situation from a user's point of view through discussion (Johannesson, Persson & Pettersson, 2004). The obtained data is treated as subjective information. An interview can be performed in a structured, semi-structured, or unstructured manner, meaning that the interview can follow predefined questions and topics, to being executed as a completely open conversation (Lantz, 2007; Kylén, 2004). The more structured the interview is, the more quantitative data is obtained. Contrary wise, the more unstructured the interview is, the more qualitative data is obtained (Johannesson, Persson & Pettersson, 2004).

Questionnaire

A questionnaire is an empirical data collection method, and can be interpreted as a structured interview where the interviewer is absent (Lantz, 2007; Kylén, 2004). The interviewee, or respondent, answers the questions in writing. It is referred to as an indirect method since no contact between the interviewee and the interviewer occurs. The main purposes of a questionnaire is to obtain a larger amount of data, reach respondents who are difficult to meet in person, and to validate previous findings (Ulrich & Eppinger, 2000). It is important to regard a proper phrasing of the questions in a questionnaire in order to obtain strived information. Pilot studies are important to perform in order to try out the questionnaire before distribution.

3.2 Analysis

This section presents the applied methods during the analysis.

Ishakawa diagram

The Ishakawa diagram (also denoted as the fishbone diagram) is a graphical tool used to structure and present relationships between cause and effects (Bergman & Klevsjö, 2001). The method assist in understanding possible connections between cause and effects, along with identifying factors that contributes to solutions. The procedure is carried out by first defining the main problem, then the main causes that affects that problem, and at last the possible causes to each main cause are identified.

KJ-analysis

KJ-analysis or relationship diagram is a method for compilation of gathered data from e.g. literature or user studies (Kaulino, 1999). The method's main benefit is that it provides an accessible overview of a large amount of data, where problematic areas are obtained during the analysis i.e. no predefinition of problems is needed. By categorizing and chunking similar data into groups, and further categorizing and naming the groups, the data is compiled into few themes. Hence, the method follows a bottom-up strategy i.e. begins with detailed matters and ends up with a comprehensive view.

Pareto chart

The Pareto chart displays the order of different factors contributing to an effect, according to their amount of influence (Bergman & Klevsjö, 2011). It is recommended to address the factor with the largest influence first to change and preferable improve the effect. The chart is constructed by creating rectangles for each factor, with the height equal to the amount of influence. The factors are displayed on the x-axis, while the y-axis displays the degree of influence. A line illustrating the degree of each factor's fulfilment of the effect, up to 100 %, is often drawn in the chart. The benefit from using a Pareto chart is that it displays the most serious factors clearly.

3.3 Idea and concept generation

This section presents the methods used during the idea and concept generation.

Brainstorming

Brainstorming is a method that is beneficial to apply during idea generation. The procedure is commonly carried out in a group, since this enables being inspired of each other which fosters ideas, and the aim is to think of as many ideas as possible. No criticism is allowed during brainstorming since this inhibits the creativity. The generated ideas can be further developed and combined by various participants during the brainstorming session to foster new ideas. It is important that all emerged ideas are considered and saved, and not evaluated during the brainstorming session (Österlin, 2010).

Expression board

An expression board is a collage comprised of, for instance, images, shapes, and colours, describing a certain expression (Warell, 2006). An expression board is commonly used as a mutual foundation to enhance communication during the development of a desired aesthetic expression. In addition, an ex-

pression board can also be used during idea generation to foster the generation of ideas (Warell, 2006).

3.4 Evaluation

This section presents the methods used during the evaluation.

Focus group

A focus group is a qualitative question-based method that involves one or more representative user groups, where the groups comprise of approximately five to fifteen participants (Johannesson, Persson & Pettersson, 2004). The method requires one moderator who leads the discussion in the group in terms of making sure that all participants get the chance to speak, and that the discussion follows the desired topic. Focus groups are often used in explorative purposes since the participants in the group can get influenced from each other and come up with unexpected results and ideas (Johannesson, Persson & Pettersson, 2004).

Kesselring matrix

The Kesselring matrix is beneficial to apply when evaluating developed concepts. This is performed by comparing the concepts in relation to an ideal concept i.e. a concept that fulfils all requirements completely. Each requirement is also given a weight factor, such as a weight from 1 to 5. The concepts are then scored, also 1-5, according to how well each requirement is fulfilled by the evaluated concept. The scores are listed in the Kesselring matrix along with the weighted score i.e. product of weight of requirement and score of concept. This results in a total sum that can be compared to the ideal concept (Johannesson, Persson & Pettersson, 2004).

Usability

In this report usability is defined in accordance with ISO 9241-11: ”The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”. Where effectiveness treats the extent to which the goal is achieved, efficiency treats the amount of effort that is needed to achieve the specific goal, and satisfaction treats the feelings that the user experiences during the usage of the product to achieve the specific goal (Norman, 2002).

4. Implementation

This section presents the procedure in which the new product development process was carried out. Throughout the implementation the underlying reasoning was the main question formulation:

"How can we assist the operators within advertising agencies in making conscious material decisions for fine paper or paperboard applications, and thereby optimise the desired properties and quality of the application in terms of e.g. purpose, user experience and life expectancy, and used resources e.g. environmental impact, time and cost?"

In order to answer the main question, a number of sub-questions was used as guidance during the project:

- Who makes the material decision for fine paper or paperboard applications, and how is this performed?
  - Which factors do the decision makers regard during material decision?
  - Can the decision makers' behaviour, i.e. material decision procedure, be changed? How?
- What are the consequences in terms used resources, when a non-optimal material decision is made?
  - Are the decision makers aware of those consequences?
- How can knowledge about fine paper and paperboard, and awareness about the importance of a conscious material decision, be spread among the decision makers?
- How can we express the possible savings obtained by making a conscious material decision in relation to used resources?
- How does the used material affect the desired application purpose, user experience, and end-result?

To enable the development of a well-adapted product that can assist operators within advertising agencies in making a conscious material decision, several studies had to be conducted. It was as a first step of great importance to understand the fine paper and paperboard application development process, with emphasis on the material decision procedure including the operators' regarded material properties and applied processes. Hence, a comprehensive range of operators with different professions that handled fine paper and paperboard, in the graphical and packaging industry, had to be investigated. Initially, extensive theoretical studies treating the illuminated materials were performed.

The implementation of the new product development of an assisting tool for operators within, primarily, advertising agencies when deciding material for fine paper and paperboard applications was divided into two major parts. These parts were: (1) Studies, analysis and identification of requirements, and (2) New product development including idea and concept generation, evaluation, and further development of a final new product concept (see Figure 4.1).

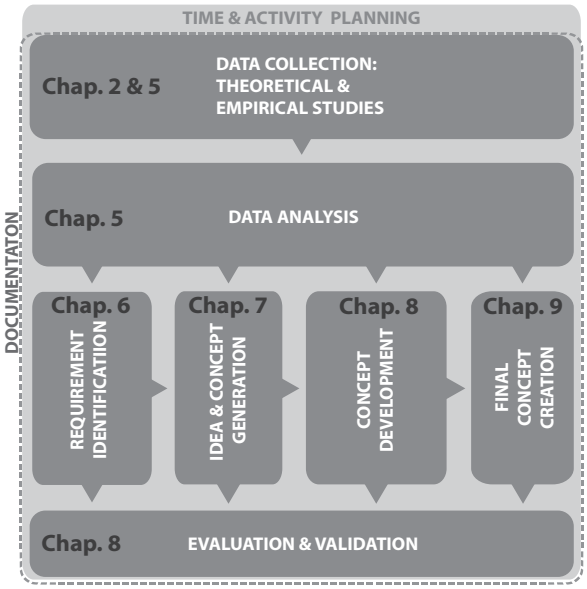


Figure 4.1 *The new product development process carried out during this project.*

To understand the operators' working process during the development of fine paper and paperboard applications, in the graphical and packaging industry, extensive theoretical and empirical studies were performed. Great emphasis was set on understanding the material decision procedure among the different operators and professions in the investigated industry. Also, the crucial factors contributing to a certain material decision was sought. The empirical study was carried out through performing several interviews, and distributing questionnaires to the operators in the industry. The obtained information from the performed studies was then compiled and analysed. This resulted in the identification of requirements that were listed in a requirement specification. Further, the requirement specification was used as a foundation during the new product development. The development was carried out in the following steps: idea and concept generation, formation of concepts, evaluation of concepts, further development of one concept until a final concept of an assisting tool for material decision was developed. In addition, several studies were conducted during these phases to enhance the development work.

4.1 Theoretical study: The graphical & packaging industry

Theoretical studies were performed to get an understanding of the treated subjects in the graphical and packaging industry. The study was carried out by searching for books, e-books, articles, and theses in Chalmers University of Technology's library database "Summon", Gothenburg's public library database "Gotlib", and Google's "search"-function. The studied literature comprised of information from producers of fine paper and paperboard, technical properties of fine paper and paperboard, articles about packaging and packaging materials, marketing theories regarding fine paper and paperboard applications, literature treating printing processes and finishing options, and course literature included in graphic design and communication educations. In addition to the literature research, Itunes' "App Store" and fine paper and paperboard merchants' web-sites were also investigated to find existing solutions and tools for material decision, in terms of mobile applications and software. The result of the theoretical study can be found in the chapter "2. Theoretical framework".

The theoretical study was carried out both at an initial phase, but also as an ongoing part throughout the new product development process. An initial study was vital to perform, since this enabled the following empirical study through an increased understanding of the operators' behaviour in the graphical and packaging industry.

4.2 Empirical study: The operators' knowledge & material decision procedure

The empirical study was divided into two parts: initial general interviews, and more in depth empirical studies comprised of both interviews and questionnaires. As the target group in this project was primarily operators within advertising agencies, the majority of the empirical studies were conducted with these operators.

To overview and understand the operators' behaviour in the graphical and packaging industry, several interviews were performed, compiled and analysed at an initial phase. The initial study also aimed to validate if there was, in fact, an actual need of an assisting tool during the material decision procedure, and if this need mainly was found among the operators within the advertising agencies. The in depth studies, comprising of interviews and questionnaires, aimed at filling informational gaps e.g. operators that could not be investigated during the initial interviews, and further identification of regarded factors during material decision. Also, a validation of the previous findings from the initial interviews was enabled through the further empirical studies. This section presents the implementation of the performed empirical studies, compilation of the obtained data, and the performed analysis of the empirical studies.

4.2.1 Initial and further interviews

During the interviews, it was important to regard a wide range of operators with different professions involved in the development process of fine paper and paperboard applications. This in order to obtain a proper understanding of how the development process is carried out, by obtaining information through diverse sources of information i.e. different point of views. The interviews primarily aimed at gaining information about the operators' knowledge about fine paper and paperboard, which factors that were regarded during the material decision for fine paper and paperboard applications, how the material decision was performed, and when the decision was performed.

The procedure of the interviews were carried out by following a template with predefined questions (see Appendix 1 - Interview template 1) and adding occasional probing, in accordance with the semi-structured interview methodology (see section "3.1 Data collection"). The project team alternated the interview questions in-between themselves to maximise the capturing of answers to the sought questions. It was not specified that the project was carried out in collaboration with Iggesund Paperboard AB during the interviews, because this was believed to negatively affect the neutrality of the interviewees responses due to influence. Also, during the initial interviews, mediating objects in terms of packaging in different paperboard qualities, and a fine paper and paperboard book[1] displaying printing properties and finishing options on both materials, were used to further encourage the interviewees' responses. At the second set of interviews, a questionnaire was given to some of the interviewees when needed instead of the mediating objects. This because it was recognised to be equally effective concerning the obtained responses, but less time consuming. Further, the interviews were held at the interviewees' company or school. The used language during the interviews was Swedish since this was the native language of the interviewees, and thereby the most comfortable for them to speak. This aspect was important to regard in order to minimize bias, misinterpretations and unspoken thoughts due to language barriers. Although, it was regarded that information could be lost during translation. However, it was concluded that this would not affect the findings significantly, and that even more information would be

1 *Iggesund Paperboard AB. (year unknown) (de) Fine Paperboard - Experience the difference with Invercote

lost if the used language was not comfortable for the interviewees to speak. Further, all conversation was audio recorded to enable full attention during the interviews, and thereby obtain maximum information along with minimizing the risk of bias due to faulty interpretation.

The following operators were interviewed at the initial set of interviews: five operators within advertising agencies in Gothenburg and Stockholm, one graphical design and communication teacher at Beckman's College of Design in Stockholm, two operators within printing agencies in Gothenburg, one packaging engineer in Veddige within medical packaging, one customer also acting as packaging engineer of food packaging in Stockholm, one packaging engineering teacher at Broby Grafiska College of Cross Media in Sunne, and one merchant of fine paper and paperboard at Antalis' store in Stockholm. To further investigate the knowledge about fine paper and paperboard in the graphical and packaging industry, and to find new potential interviewees to contact, the packaging fair 'Pack- & Emballagemässan 2013' in Stockholm was also visited at an initial phase. The relevant operators that were interviewed at the fair were printers, packaging engineers, and producers and merchants of fine paper and paperboard. These interviews were performed by asking a few questions about material decision for fine paper and paperboard applications, e.g. 'what is important to regard when deciding material for a fine paper or paperboard application?', 'which advantages do I get from using your material (fine paper or paperboard)?' and 'how do you experience the knowledge about fine paper and paperboard in the industry?', with additional probing. It is though important to illuminate that the operators representing each company at the fair, might not be the "right" person to ask the questions to. This because there often are employees from various departments that might not possess specific knowledge about the core business but merely work with customer interaction, at occasions such as fairs, representing the company.

The second set of interviews was performed in similarity with the procedure of the initial interviews as mentioned previously. Although, the questions were modified to treat more in depth questions (Appendix 2 - Interview template 2). A purchaser of fine paper and paperboard with core business in the food industry working with both packaging and direct advertising was interviewed during the further interviews. This was an area where information lacked from the previous interviews. Further, a professor within packaging technology at the Royal Institute of Technology in Stockholm was interviewed to obtain an understanding of current innovations within the packaging industry. Also, the knowledge provided to the students with various majors at the university, was strived to be obtained. Furthermore, four operators within advertising agencies in Stockholm were visited to find more information about the development process of fine paper and paperboard applications, along with validating previous findings and additional problematic areas. Also, a student within art directing at Bergh's School of communication in Stockholm, and a printer working at a large printing agency in Stockholm, were interviewed as well.

Compilation of interviews

The audio recorded data from the interviews were transcribed into a matrix categorized horizontally by the interview questions and vertically by the interviewees (operators). Further compilation of the data was then performed similar to the KJ-analysis methodology (see section "3.2 Analysis") i.e. by grouping the data within the horizontal categories in the general categories: background info, main applications produced by the operator, how the material decision is performed, when the material decision is performed, important material properties contributing to a certain decision, the difference between fine paper and paperboard known by the operator, the operators' knowledge about fine paper and paperboard, compromises during material decision, and additional information, but still keeping the separated vertical categorisation of the operators.

The data was then narrowed down even further by another categorisation of the horizontal categories (still keeping the different operators separated) into the following four topics:

(1) The operators' knowledge about fine paper and paperboard,
(2) Critical factors when deciding material,
(3) How the material decision is performed, and
(4) When the material decision is performed.

4.2.2 Questionnaire

To further validate the findings from the interviews and to reach a wider range of respondents, an additional questionnaire (see section "3.1 Data collection") was constructed (see Appendix 3 - Questionnaire). The questionnaire was translated in both Swedish and English, and sent out through graphical communication and advertising agency networks, graphical internet forums, and e-mailed to various advertising agencies, packaging engineers and printers around the world.

The questions in the questionnaire mainly originated from the findings from the initial interviews, but with more in depth questions about the material decision procedure. A lot of effort was put into constructing the questionnaire as clear as possible

to avoid bias due to respondents' misunderstandings caused by, for instance, ambiguous formulated questions. To ensure that the participants would understand the questions, several pilot-tests were performed until an optimal questionnaire was obtained. Also, a balance between free text answers and "closed" answers i.e. set alternatives and scales, were included. Google drive's function 'form' was used as a tool when constructing the questionnaire, which provided an accessible digital distribution.

Compilation of questionnaire
The questionnaire was automatically compiled by Google drive's function. The produced compilation was a matrix with the questions vertically, and answers from each respondent horizontally.

4.2.3 Analysis of the empirical studies
The four topics:

(1) The operators' knowledge about fine paper and paperboard,
(2) Critical factors when deciding material,
(3) How the material decision is performed, and
(4) When the material decision is performed

was further analysed by conducting suitable methods, presented in this section, to identify problem areas and requirements for improvement. The break down strategy of the data provided an understanding of the possessed knowledge of the operators in the industry, which factors that contributed to a certain material decision, and how and when the material decision was carried out in the fine paper and paperboard application development process.

Regarding the questionnaire, it only resulted in 7 replies and therefore could not be used as the indented source of quantitative information. Also, not all questions in the questionnaire were answered by the respondents, and the odd replies were not possible to probe, as being a questionnaire, which resulted in lack of reliability. Thereby, the obtained information was merely used as guidance, and to validate findings from the interviews during the analysis of the obtained interview results.

The operators' knowledge about fine paper and paperboard
The findings of what knowledge that was possessed or lacking, in the graphical and packaging industry was analysed by a categorisation of the obtained statements from the empirical studies. Each profession's lack of knowledge was categorised into the following categories: material properties, durability, environmental aspects, surface properties, the printing process, and finishing options & varnishing, with more in depth factors identified from the empirical studies listed in each category. The lack of knowledge within the professions was then visualised in a graphical visualisation to enable an easy accessible overview.

Critical factors during the material decision
The critical factors that resulted in a specific material decision were identified through an approach similar to the Ishikawa methodology (see section "3.2 Analysis"). For each profession e.g. customers, advertising agencies, and printers, the compiled statements from the interviews and questionnaires were transformed into factors such as "limited budget" and "prioritised application purpose". The factors were then categorised in main causes contributing to each factor such as "cost" or "quality". The analysis was performed by discussing the statements within the project team and compilation in a matrix, with each profession as heading of the columns, and the main causes as headings to the factors in the columns.

Further analysis was performed by colour coding the main cause-categories in the matrix. This was done according to their relation to the recognised fundamental causes: time (blue), cost (yellow), quality (pink) and environmental aspects (green). The fundamental causes were identified as the most critical parameters that were compromised between, during material decision. Originating from the colour codings, Pareto charts (see section "3.2 Analysis") were constructed for each profession, with the fundamental causes on the x-axis and the level of priority measured in percent on the y-axis.

How the material decision is performed
How the material decision is performed was analysed by constructing a graphic representation of the communication flow, originating from the statements from the interviews and questionnaires compiled into the topic. This was also related to the amount of knowledge possessed within each profession, and each professions amount of influence on the material decision. By conducting this strategy an understanding, and accessible overview, of problem areas could be recognized.

When the material decision is performed
When the material decision is performed, was analysed by categorising the time of when the material decision takes place in the development process of fine paper and paperboard applications. The time-categories were: early, half-way, late and varying. Further, in similarity to the Ishakawa methodology (see section "3.2 Analysis"), the statements from the interviews and questionnaires were transformed into factors e.g. "material-driven process" and "short deadline", contributing to when the material

decision took place. Each factor was then categorised under main causes e.g. "time" and "knowledge", recognized as a mutual cause to each factor. The different main causes with the belonging factors were then placed within their responding time-category based on the finding from the empirical studies. To enable the identification of which profession that corresponded to the respective main causes and factors, each factor was marked with the respective profession by an abbreviation, and the main causes were marked through colour coding. This analysis resulted in an identification of which professions that carried out their material decision, early, late, half-way or varying, and what factors and main causes that contributed to that behaviour.

4.3 Requirement specification

The identified requirements gained from the analysis of the theoretical and empirical studies were compiled in a requirement specification (see Appendix 4 - Requirement specification"). The specification was further divided into two main parts "1. General requirements (R) / Desired requirements (DR)" and "2. The assisting tool".

The first part, 1. General requirements (R) / Desired requirements (DR), treats the requirements that should be fulfilled by the development and distribution of the assisting tool. The latter part, 2. The assisting tool, treats the contents and order of the information provided by the tool. Thereby this part presents which information that should be included, and how the information is divided and ordered. The information in the tool is represented in the requirement specification by three main categories: 1. Introduction, 2. Main information, and 3. General information.

Further, the requirements in the first part were prioritised 1-5 according to their grade of importance, where 5 indicated the highest priority. An "Approach"-column was also added beside each requirement in both parts, describing the approach of how to fulfil the specific requirement. A "Solution"-column describing how the general requirements would be solved by the assisting tool, was then added in the first part to link the two parts together. In addition to the specified requirements, approaches and solutions, constraints were added to some of the requirements in a separate column in both parts. In addition, a "Requirement specifier"-column was added to each requirement in the first part to facilitate the understanding of the requirements' origin.

4.4 Idea and Concept generation

This section presents the procedure of the idea and concept generation, which was carried out in two steps: (1) the configuration of the assisting tool and (2) the technical solutions of the assisting tool.

4.4.1 The configuration of the assisting tool

An initial idea generation was carried out after the performed studies by originating from the requirements listed in the requirement specification, and additional findings from the performed studies. The idea generation mainly aimed at finding possible solutions to the configuration of an assisting tool that can be used when deciding material for the fine paper and paperboard applications. The conducted method during the idea generation was brainstorming (see section "3.3 Idea and concept generation") within the project team. An additional discussion with Iggesund Paperboard AB about possible configurations was also included in this idea generation. It was concluded that the assisting tool should be developed in a book configuration.

4.4.2 The technical solutions of the assisting tool

The technical solutions in the assisting tool were developed in three main phases: field study, development of a book draft, and development of an embodiment.

Field study

After establishing the configuration of the assisting tool i.e. a book, technical solutions, such as different embodiments, and how the content could be presented and arranged, were brainstormed. This procedure was initiated by performing a field study, during which existing technical solutions of various books were investigated. The study was mainly performed by visiting Gothenburg's city library and book stores.

Development of a book draft

Before starting the idea and concept generation of technical solutions a book draft was constructed in Adobe InDesign. This was performed by distributing, and rearranging the order of the information specified in "2. The assisting tool" in the requirement specification (see Appendix 4 - Requirement specification) on separate pages, with respect to usability such as how the information was optimal to be provided to the user. The amount of pages that the information would need was estimated by constructing a bullet list of the desired content. During this procedure, many ideas regarding how the content could be presented emerged. The book draft was then printed out to facilitate the subsequent idea and concept generation by e.g. enable building mock-ups, getting a better understanding of how the final book would turn out, and testing the various solutions in practice.

Development of an embodiment
After the book draft was constructed and printed, the four elements: Introduction, The Assisting Guide, Book of Knowledge and Sample Book, were identified and used as the foundation of the assisting tool. The elements originated from the constructed book draft, and were found through analysing how the content was needed to be displayed, such as in which order different information needed to be obtained. This approach simplified the idea and concept generation since the four elements could be arranged in various embodiments during brainstorming.

Possible technical solutions were identified during the brainstorming, and magazines, brochures and books were used to build mock-ups. The operators' material decision behaviour e.g. usage of the assisting tool during material decision and discussion, and how an optimal material decision procedure should be carried out was regarded during the procedure. Also, the manufacturing and distribution aspects were considered in order to foster low costs, and an easy production and distribution. This because a low cost manufacturing and distribution relates with the extent to which the knowledge is spread, i.e. a low cost product is afforded to be sent out to larger number of operators. The various arrangements that were constructed during the process of finding how the four elements was optimal to be arranged, and the subsequent technical solutions, could then be combined into different concepts of the assisting tool's possible embodiment. The procedure resulted in three concepts.

4.5 Concepts and concept evaluation
This section presents the implementation of the concepts and concept evaluation.

4.5.1 Concepts
The idea and concept generation resulted in the three concepts: folding system, two part system, and three part system (see section "8.1 Concepts").

4.5.2 Concept Evaluation
The three concepts were evaluated by initially consulting a printer in Gothenburg about manufacturing methods and possible issues regarding the manufacturing of the concepts. Questions about how complicated, and subsequently costly the manufacturing would be were asked to the printer. Further, a focus group (see section "3.4 Evaluation") was gathered consisting of students from the master Industrial design engineering at Chalmers University of Technology, who were knowledgeable in usability and design. During the focus group the three concepts were initially presented, and then discussed in an unstructured manner. The main topics during the focus group regarded usability and aesthetic appeal of the three concepts. From the focus group pros and cons could be recognised and considered during the evaluation. In addition to the inputs from different expertise, a Kesselring evaluation (see section "3.4 Evaluation") was performed to evaluate the concepts in comparison to their fulfilment of the requirements listed in the requirement specification part 1 "General requirements (R) / Desired requirements (DR)". The evaluation resulted in concept 3, three part system, being the best concept to further develop.

4.6 Further development: The assisting tool
The further development of concept 3, three part system, was carried out through several steps to develop the assisting tool as optimal as possible. The implementation of this procedure is presented in this section.

4.6.1 Consultation with publishing agencies
Two publishing agencies were consulted during the further development, one well established large agency and one smaller agency, both located in Stockholm. The main objective of the conducted consultations was to obtain recommendations regarding the assisting tool's configuration, e.g. formats with respect to least material waste, technical solutions with respect to desired functions, and popular features for books on today's market.

4.6.2 Merging solutions
To further optimise the chosen concept i.e. concept, 3 three part system, several features from the other concepts were merged with the chosen concept. This in order to optimise the fulfilment of the requirements where the concept scored low. Also, the highest scored features in the other concepts were taken into consideration during the further development of the chosen concept.

4.6.3 Specifying the concept in detail
When the desired configuration was entirely developed, exact details in the chosen concept were determined. First, an exact number of pages was set by reviewing the constructed book draft, and specifying desired samples that should be included in the sample book. It was revealed that the samples required more pages than the other two parts i.e. The Assisting Guide and Book of Knowledge, hence the required number of pages in the sample book was set and the other parts were adjusted in accordance. During the determination of the number of pages, the format of the assisting tool was also set. This was performed by regarding the pages ability to remain lying open, be optimised in terms of usability, and minimise waste of material. Furthermore, after the exact samples, number of pages, and format were

set, an investigation to find the optimal binding for the assisting tool was carried out. This was performed by regarding the use of the assisting tool, such as enabling the pages to remain lying open as the user desires when reading the information, and enabling an easy manufacturing. The performed studies i.e. consultation with publishing agencies and field studies, were used as a foundation during this process.

The next step was to find suitable material(s) for the assisting tool. It was identified during the performed studies that the assisting tool needed to be made of fine paper and/or paperboard, and thereby only these materials were investigated during this step. When regarding the chosen binding, it was concluded that the material for the assisting tool needed to possess rather high strength and hence paperboard was determined to be a better suiting material to apply than fine paper. Further, the paperboard material was desired to be an Invercote paperboard (produced by Iggesund Paperboard AB), since this project was performed in collaboration with the producers. Also, it was revealed, from the performed studies, that Invercote possessed the best material properties for this purpose. Subsequently, the following investigation of applicable materials originated from Invercote qualities, and the materials' stiffness, strength, tearing resistance, durability, printability, opacity and thickness, and also the content in the assisting tool along with desired features were regarded.

4.6.4 Graphic design

A graphic design study was then carried out to find inspiration to a graphic design that could attract operators within advertising agencies. The study was divided in two parts; first a field study was performed, in Gothenburg, by investigating several book stores, libraries, and clothing retail stores' lookbooks to identify graphic design trends and inspiration. After the field study, a web-search was conducted by surveying graphic design blogs to find inspirational features. These features were then transformed to fundamental shapes, colours and fonts and compiled in an expression board (see section "3.3 Idea and concept generation"). This approach simplified the development of the graphic design since it served as a mutual guideline for the project team during the rather subjective graphic design development. The development of the graphics was performed by applying design directly into the developed draft adjusted to the configuration of the further developed concept.

4.7 The assisting tool

A prototype of the developed concept was printed at a printing agency and bound with a spiral binding. The final result can be seen in section 10. The assisting tool.

5. Result & Analysis - Empirical studies

The findings from the performed interviews are divided into the four sections:

(1) The operators' knowledge about fine paper and paperboard,
(2) Critical factors when deciding material,
(3) How the material decision is performed, and
(4) When the material decision is performed.

Each section includes a summary at the end, and an analysis with conclusions of the most important identifications (see figure 5.1).

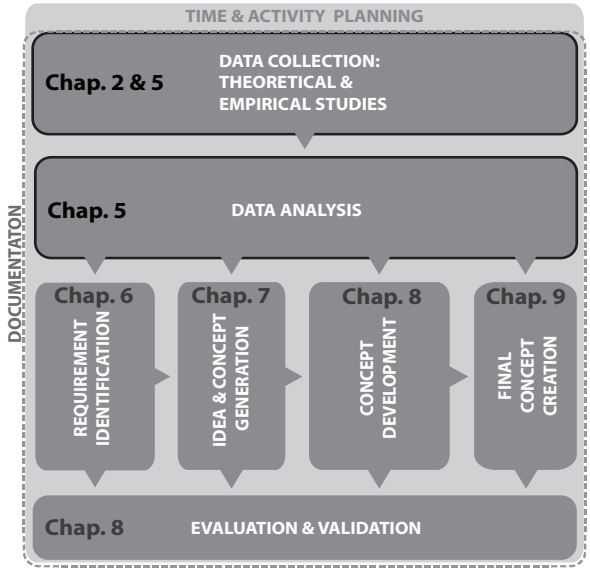


Figure 5.1 *The data collection and data analysis phases carried out during this project.*

The following operators were interviewed at the initial set of interviews: five operators within advertising agencies in Gothenburg and Stockholm, one graphical design and communication teacher at Beckman's College of Design in Stockholm, two operators within printing agencies in Gothenburg, one packaging engineer in Veddige within medical packaging, one packaging engineer of food packaging in Stockholm, one packaging engineering teacher at Broby Grafiska College of Cross Media in Sunne, and one merchant of fine paper and paperboard at Antalis' store in Stockholm. The packaging fair 'Pack- & Emballagemässan 2013' in Stockholm was also visited at an initial phase.

The following operators were interviewed at the further set of interviews: four operators within advertising agencies in Stockholm, a student within art directing at Bergh's School of communication in Stockholm, one purchaser of fine paper and paperboard with core business in the food industry, one professor within packaging technology at the Royal Institute of Technology in Stockholm, and one printer working at a large printing agency in Stockholm.

5.1 The operators' knowledge about fine paper and paperboard

The knowledge about fine paper and paperboard differed heavily between the different operators in the graphical and packaging industry, both between and within each profession. Although, the least knowledgeable operators were found to be the customers and the operators within advertising agencies. The following section presents the found knowledge divided into each profession in the industry. Also, the obtained information from the attended packaging fair 'Pack- & Emballagemässan 2013' is presented in the last paragraph of this section.

5.1.1 Customers of fine paper and paperboard applications

No customer of fine paper and paperboard applications was interviewed directly, although a lot of information about the customers was obtained implicitly through the various operators in the graphical and packaging industry at the initial interviews.

Initial interviews - Customers

It was found that the customers seldom possessed any knowledge concerning fine paper and paperboard in general, and therefore outsourced that procedure to the advertising agency, printer or packaging engineer depending on the project. Further, it was claimed by an operator within an advertising agency, that the customers often had poor knowledge about how different material finish could affect the application's end-result. It was also stated that the customers often lacked knowledge regarding time aspects i.e. how long time that was required both for the whole design process, and the time needed during the printing process. However, from a packaging engineer it was stated that the knowledge among the customers within big companies was rather good, this because these customers had their own departments for packaging development. In accordance with that, a packaging engineering teacher mentioned a big company within the food industry as an example of one company with good knowledge about materials.

According to operators within the packaging engineering industry, operators within advertising agencies, and a merchant, the customers were claimed to lack knowledge about environmental aspects. Further, it was claimed that the customers usually did not mention environmental aspects as a demand when deciding material. A merchant stated that the customer believed that a material with a white colour was worse for the environment than a material with brownish or yellow tone even though it could

in fact be the opposite. The packaging engineering teacher also confirmed the customers' lack of knowledge regarding environmental aspects, however it was stated that it existed an awareness that the materials should be recyclable.

5.1.2 Advertising agencies

Five operators within advertising agencies in Gothenburg and Stockholm, and one graphical design and communication teacher at Beckman's College of Design in Stockholm were interviewed during the initial interviews. Four operators within advertising agencies and a student within art directing at Bergh's School of communication in Stockholm were interviewed at the further interviews. This section presents the found possessed knowledge of these operators.

Initial interviews - Advertising agencies

In general, the level of knowledge regarding materials was considered to be very low among the operators within advertising agencies. This was a view supported by several operators in the printing industry, a teacher at a graphic design and communication education, a teacher at a packaging education, and by a merchant of fine paper and paperboard. The knowledge among the operators within the advertising agencies was primarily obtained from printers, producers and merchants of fine paper and paperboard, and the internet. Some operators also visited exhibitions and searched for inspiration in stores. Further, some operators had obtained knowledge about materials through education and others had learned through practice. When an important fine paper and paperboard application should be produced it was common to use books with samples of fine paper and paperboard to see various types of different materials. Several operators also used this type of sample book when the desired material was rarely used. Further, it was claimed by several operators that the choice of material and the type of printing process was, to a large extent, affected by the number of copies that was going to be produced.

Regarding source of knowledge, one operator within an advertising agency claimed that the agency only received information about fine paper from the printers, and no information about paperboard. The same operator also believed that "graphical" paperboard was a new product on the market, and could not describe the difference between fine paper and paperboard. In addition, a merchant stated that the operators within advertising agencies had very poor knowledge regarding the difference between fine paper and paperboard. According to the merchant, the operators often thought that it was just a difference in grammage between fine paper and paperboard. One operator in the printing industry also claimed that the operators often were confused about the meaning of an uncoated and a coated surface, that they could use the term uncoated when they in the reality meant a surface coated with a matt finish. Regarding the printing process, it was stated by an operator within advertising, that the printers often delivered a test before the whole order was created. This because the printed result, on a coated or uncoated material, could differ in terms of colour reproduction from what was seen on the computer screen. However, the operator claimed to have the knowledge regarding how the result would be when ordinary fine paper was used but not when "special" material qualities were used. According to the operator, when a high accuracy in the colour reproduction is desired, a coated surface should be used. This because an uncoated surface usually give a poor result in terms of contrast and the reproduction of a desired blackness. Further, this operator stated that the olfactory and tactile properties of a surface were important when deciding material.

One operator, who also had a background in the printing industry, stated that it was important to consider the size of an application to minimise waste of material. For instance, if a brochure was going to be produced it was recommended to adjust it according to the size of the used material sheet. The same operator also considered to have rather good knowledge regarding grammage, surface finish, applicable materials for finishing options, and printing processes. This also involved knowledge about different printers' costs and the printers' ability to perform certain tasks with good result. However, it was stated that the printers often had more knowledge about suitable materials for finishing options, and was therefore usually consulted regarding when this was desired. The operator sometimes also received information about different materials and knew that the cost could differ a lot between different qualities. It was claimed that the difference between fine paper and paperboard was the grammage and that paperboard probably had a grammage over 200 g/m2, and was beneficial to use for packaging. Regarding material decision, this operator commonly produced simple brochures and used fine paper with an uncoated or coated surface for the application. This operator had never used paperboard for printing. The operator claimed that the meaning of the term quality involved durability, long life expectancy of the application, good colour reproduction and no waste of printing ink. According to another operator, the choice of material often came naturally, this operator claimed that paperboard was suitable when, for instance, creating postcards due to good image quality and high stiffness.

Regarding surface properties, one operator clai-

med that the decision was based on either good image quality or a "certain feeling" when choosing between a glossy or a matt surface. It was stated that a glossy finish, for instance, was suitable for an album that required high image quality. A matt finish was preferred for a more rough feeling, for instance, when desiring a retro feeling. It was also stated that a surface with texture provided a more luxury result. When both good readability and image quality was required, a surface with silk coating was used. In addition, paperboard was claimed to be stiffer and to have a different grammage compared to fine paper, and could be used for applications with a long life expectancy. Fine paper, on the other hand, could be used for disposable applications. The same operator further explained regarding the printing cost (for the same kind of material and accompanying printing service), that it could differ between different printing agencies. The operator therefore compared the cost between different printers before deciding a printing agency to collaborate with. According to the operator, it was important to be observant since the printers sometimes changed the agreed material to a similar one, which the printer had in stock and wanted to get rid of. Further, it was stated that the printers usually required a couple of days to produce the printed application. Although, if the time was limited the printing process could be carried out quicker, but then it became very expensive. It was also claimed that the material decision sometimes was limited by the fact that the customers should be able to use their own printer. For instance, when a restaurant need the possibility to change the content in their menu on daily basis, the material has to enable printing in the restaurant's own printer. The operator did not use any assisting tool during the material decision procedure, but claimed that it would be beneficial to have such a tool. Also, it was explained that it could facilitate the communication with the printing agencies.

Another operator stated that, when stiffness was desired, the thickness and the grammage of the material were important properties to consider. The operator often used samples of material in order to investigate the manner and to find a suitable material. Further, a folder was provided as an example of an application when stiffness was important to consider. Furthermore, this operator believed that the difference between fine paper and paperboard was mainly a difference in grammage, and that paperboard had higher grammage but also could be coated on one side, and uncoated on the reverse side. It was further claimed that the choice of surface of a material often stood between either a silk or a glossy finish.

According to a printer, some larger advertising agencies were claimed to have a competence within the company that had good knowledge about materials. Although, the level of knowledge in general within the advertising agencies was claimed to be very low. An operator within advertising also stated that it was formerly common to have a specialist in printing technology at the advertising agency. Over time, however, this competence had disappeared from the advertising agencies in general, and the knowledge had now been transferred to the printing agencies instead. The operator, who also worked as a designer and art director, explained that a merchant of fine paper and paperboard, specialists in printing technology and printers, were consulted for information about materials. In addition to this it was stated that the merchant had good knowledge regarding environmental aspects, and that the material recommendations commonly included a material's environmental impact. Further, the operator claimed that a coated surface should be used to obtain high image quality. However, it was stated that an uncoated material surface could provide a certain "feeling", and if this was desired depended on the application's purpose. The whiteness of a material was expressed to be an important property to regard as well, it was further claimed that the whiteness of a material should be evaluated in daylight to get the right perception.

Regarding environmental aspects, the merchant claimed that many customers, involving advertising agencies, believed that it was better for the environment to use a fine paper or paperboard that had a brownish tone than a white material. This originated from the belief that a white material was chlorine bleached. In contrast to this, one operator within the advertising claimed that an uncoated and brownish material was not necessary better for the environment compared to a white material, but could despite this be selected because it looked more "environmental friendly". However, another operator stated that regarding environmental aspects the whole process had to be considered i.e. from the forestry and transportation to choices of colours in the printing process. Another operator claimed that the customers did not demand environmental aspects, but from the agency it was expected that large printing agencies had environmental certifications, such as ISO certifications.

Graphical design and communication education

It was recognised that the interviewed teacher at a graphical design and communication education, who also worked as a designer and art director, lacked knowledge about the difference between the materials. Subsequently, the teacher's courses did not involve information about materials, instead a collaboration with the fine paper and paperboard

merchant was introduced to educate the students regarding materials. In addition, the interviewed fine paper and paperboard merchant, who also was teaching students from different graphical design and communication educations, stated that the students in general lacked knowledge about the materials. Further, the teacher stated that the students sometimes also got information about materials from a producer of paperboard.

Further interviews - Advertising agencies

In similarity with the results from the previous interviews, the operators' (within advertising agencies) overall knowledge about material was rather poor. The operators' lack of knowledge was also confirmed by a printer who claimed that their customers, including operators within advertising agencies, could order material to a high cost without having any idea about what they actually ordered. This commonly resulted in the customers being disappointed with the end-result of the produced application. It was also stated that the printers' customers often lacked knowledge regarding the amount of time required for the printing process. Further, similar to what was found in the initial study, the operators´ knowledge about materials was mainly received from printers, merchants of fine paper and paperboard, producers of fine paper and paperboard, specialists in printing technology, material sample books and the internet. However, one operator at an advertising agency who considered to possess good knowledge about materials, claimed that the printers could recommend materials according to their gained profit i.e. not the best material with respect to the end-result of the application to be produced. This was also recognised from the previous interviews. For those operators who had an educational background, and thereby not only gain knowledge through practice, it was found to differ whether the educations had involved courses about materials or not.

Regarding the operators' lack of knowledge about materials, one operator within advertising could not tell the difference between fine paper and paperboard, and for what purpose each material was optimal to be used. The operator guessed that paperboard had a higher grammage than fine paper. In addition, it was explained that a specialists in printing technology worked within this operator's agency, and that they could consult this person regarding material decisions. Furthermore, in some of the advertising agencies, it was found to exist people who had much knowledge about fine paper and paperboard. For instance, a project manager with an educational background that involved a course about materials possessed knowledge about fine paper and paperboard. In addition, the operator within advertising, working as a production manager, claimed that the difference between fine paper and paperboard was the construction of the materials, where paperboard was stated to be constructed in several different layers, and fine paper merely with one layer. It was also stated that paperboard had higher stiffness and a higher bulk than fine paper.

Further, several operators working as art directors and the interviewed production manager claimed that they knew that the printed colours of the end-result could differ from what was displayed on the computer screen during the pre-printing stage. This is also a finding that arose during the initial interviews. However, in contrast to this, it was found that those who designed the applications, at the advertising agencies, often lacked knowledge regarding material properties. This, because they were claimed to focus on merely the creative visual development, which resulted in the designers lacking knowledge regarding how the material affects the end-result. Several operators, both within advertising and printing, claimed that it often occurred that the creator of the design was disappointed when the end-result was received. This due to the end-result not corresponding to, for instance, the desired colours on the computer screen. This commonly involved disappointment about image quality and colour reproduction.

In addition, most operators considered themselves to lack knowledge regarding what material that was appropriate for different finishing options and hence, often turned to the printers for help. Further, one operator thought that it was possible to prevent the colour on the surface from cracking by choosing a rather matt surface. Regarding when fine paper or paperboard was suitable to use, the knowledge differed between the operators. One operator who seldom used paperboard, claimed that paperboard only should be used for art and books. Regarding brochures, the operator in question considered it suitable to use fine paper with a grammage between 250-400 g/m^2 for the cover. For the inlay it was recommended that a lower grammage should be used, the operator mentioned a grammage of 100-120 g/m^2. It was also stated to be important that the grammage was not too low due to opacity and that materials with a lower grammage than 100 g/m^2 were suitable to use as copy paper, due to the low stiffness. In addition to this, another operator often used paperboard when creating business cards and stated that stiffness was an important property for this type of application. It was also stated that stiffness was very important, for instance, when creating a restaurant menu. It was claimed that the whole impression of the restaurant could be affected by the appearance of the menu, and that the menu should be able to remain upright when the user holds and

reads the menu.

Further, it was found that the overall knowledge about material properties within the advertising agencies commonly involved surface properties i.e. if the surface was coated or uncoated and the whiteness. Several operators stated that the desired whiteness of the material depended on what type of application that was going to be produced, and what type of feeling that was strived. Considering the term coated and uncoated, an operator in the printing industry stated that the advertising agencies often had an incorrect knowledge of what was meant by a coated or uncoated surface. It was claimed that a surface with a matt coating often was mixed up with the term "uncoated surface". This was also found during the interviews with the advertising agencies, were many of the operators used the term uncoated when they described a matt surface, some operators also used the term uncoated when referring to a silk coated surface. In addition, the operators' opinions differed regarding when an uncoated or coated surface should be used, and for what purpose. Some operators used an uncoated surface to obtain a texture and to add a certain feeling to the application. Most operators stated that the readability was better when using an uncoated surface, while one operator claimed the opposite. Although, the same operator also claimed that the readability always was rather good, regardless of the type of material and surface. Further, one operator mentioned that uncoated paper was used for graphical applications, or if it should be possible to write on the application. The view among the operators was more consistent regarding what surface properties that affected the image quality. Almost every operator claimed that a coated surface should be used to obtain an accurate image quality, some operators mentioned the surface properties "glossy" and "silk". Further, one operator claimed that it was the fibres in the material that influenced the image quality.

The overall knowledge about environmental aspects was related to the appearance of the material and ecolabels. Some operators also claimed that when considering environmental aspects, almost every material was labelled with the Nordic Ecolabel "the Swan". This ecolabel was usually enough for the advertising agency to ensure a material to have low environmental impact. Further, it was mentioned that it was important to consider the transport distances in order to reduce the environmental impact. Similar to this, another operator claimed that they knew that a material with a brownish tone sometimes was not an optimal choice in terms of environmental aspects. However, despite this, a material with a brownish tone was occasionally selected because it looked more "environmental friendly".

Graphical design and communication education

According to a student, that was studying to become an art director, the education did not contain much information about fine paper and paperboard. Due to this, the overall knowledge about materials was rather poor among the students. However, the student also illuminated that the graphic design education probably included more lectures about materials, than those who studied to become art directors. In addition to this, the same student claimed to have more knowledge about materials than the other students in the same educational program. The knowledge was gained from another education with focus on graphic project management. This education was stated to contain more courses about materials, and also involved information from the producers of fine paper and paperboard.

5.1.3 Printers

Two operators within printing agencies in Gothenburg were interviewed during the initial interviews, and one specialist in printing technology working at a large printing agency in Stockholm was interviewed during the further interviews. This section presents the possessed knowledge of these operators, and additional information about the printers, gained from various operators in the graphical and packaging industry.

Initial interviews - Printers

The printers' knowledge about materials are in general very good according to operators within advertising agencies, a merchant of fine paper and paperboard, a graphical design and communication teacher, and what has been found from interviews with two printing agencies. Subsequently, the printers were often used as sources of information by advertising agencies and other customers. However, it also occurred that the printer's level of knowledge regarding fine paper and paperboard was rather poor. Further, it was found that the printers' knowledge primarily was obtained through practice. Both interviewed printers' agencies were family businesses, and subsequently much of the knowledge about materials and printing processes were inherited in the family. In addition, operators within advertising claimed that many printers visited exhibitions to get information about new printing related techniques and materials.

Further, one of the interviewed printers who ran an offset printing agency had been in the graphical business for 26 years. This operator had also gained knowledge from a two-day long course about materials, which was expressed to have a very positive impact in terms of gained knowledge. Also, it was stated that, once a month the printing agency received a visit from the company's main supplier, which

provided information about new materials. The new materials were always tested in the machines before it could be stated whether it was a good material or not. The operator further claimed that a material must be tested before it was possible to determine the quality of the material. In addition, it was stated that not all materials could manage to being folded without cracking and due to this, the material had to be tested. According to the printer, the customers often did not take any responsibility regarding the end-result of the produced application, and assumed that the printer should know everything. In comparison to this, the operator with poor knowledge about materials, who had a small digital printing agency, stated that competitors had better knowledge about materials. The printer claimed that the low level of knowledge depended on lack of time, but despite this the operator was curious to learn more about fine paper and paperboard. Further, the operator used different suppliers and it was stated that it occurred that the suppliers could not answer all of the printer's questions about different materials. Questions regarding environmental aspects, and whether the materials could be used in the printer's machines were especially difficult to get information about. Regarding runnability, the operator further claimed, that it was not possible to use all types of materials in a digital printing press and that the surface was important for the runnability. In addition to this, a merchant of fine paper and paperboard claimed that, the printers had good knowledge in general but could lack knowledge about materials that rarely were used. The merchant stated that due to this, the printers could sometimes recommend a material that ran smooth through their machines and dried fast without being the optimal material for the application's purpose. It was further claimed that the printers could tell their customers that a desired material with an uncoated surface could not be used due to a long drying time.

The printer with 26 years of experience in the business claimed that it is a big difference between fine paper and paperboard, and that the cost per kilo was about twice as high for paperboard compared to fine paper. However, the cost depended on quality. A solid bleached board (SBB) could cost up to three times more per kilo than fine paper, according to the operator. What type of material that was chosen also depended on the number of copies, for instance, a less expensive material was often used for a large order. According to the printer, the price of the material represented almost 50 % of the total print cost when a large numbers of copies were produced. Further it was stated that paperboard could be coated on both sides, and that suitable applications for paperboard were, for instance, flyers, postcards and business cards. Both interviewed printers stated that stiffness was an important property when creating a business card. Furthermore, it was claimed that fine paper often was used for brochures. However, it was added that paperboard could be used for the cover, and that it should not be too large difference in grammage between the cover and the inlay. The same operator stated that different fibres provided different material properties. For instance, that a material with spruce fibres had a higher bulk than a material made from birch fibres. This because spruce fibres were longer than birch fibres. Due to this, it was claimed that materials with spruce fibres were stiffer in comparison to materials made out of birch fibres, when having the same grammages. This made it possible to choose a material with lower grammage but still obtain the same stiffness. According to the printer, the direction of the fibres was also an important factor to regard when finishing options were desired. This factor was, for instance, related to the performance of the creasing and folding operations.

Further, the operator also stated that there were differences between different kinds of paperboard qualities. For instance, a solid bleached board (SBB) had a higher bulk and hence, had higher stiffness at a lower grammage in comparison to other types of paperboard. It was also stated that if a surface should be printed with a black colour, a smooth surface was required to get a good end-result. Then, according to the printer, a SBB should be used due to its smooth surface, which provides an accurate image quality. This operator claimed that a silk coating was used for 80 – 90 percent of the produced applications in Sweden, because it offers both readability and accurate image quality. Although, if a glossy surface was used, the image quality was claimed to be more accurate, but at the same time it impaired the readability. The operator further expressed that this was a problem that was "created" in Sweden through heritage, since they only used glossy coatings in the United States. In addition, it was stated that it is absolutely possible to read texts on glossy surfaces as well as matt or silk. According to the printer, some glossy coatings could appear to be matt. Hence, it was stated to be important to read the information about brightness and bulk before ordering a material to get the desired material properties. The operator also stated that a glossy surface had a shorter drying time compared to an uncoated surface.

Regarding environmental aspects, the printer claimed that it was better to use materials with ISO labels than the Nordic Ecolabel "the Swan". Further, the printing agency paid a carbon offset, for each material order, to their merchant. Furthermore, it was stated that the knowledge among the customers was very poor regarding environmental aspects, and

that the customers could choose an uncoated material that looks "environmental friendly" even though it may be worse for the environment than a coated material. The operator with a small digital printing business did not have much knowledge about environmental aspects but at the same time found it interesting and wanted to learn more about it.

Further interviews - Printers

In similarity with what was found at the initial interviews, the specialist in printing technology possessed an overall good knowledge about materials. The interviewed purchaser within the food industry working at an advertising agency, who also had been working as a printer before, further supported that the printers possess overall good knowledge about materials. However, the purchaser stated that it was important to work with "the right person" in the printing business to ensure that the end-result was going to turn out as desired. This because not all printers were observant if, for instance, the surface cracked when the material was creased and folded.

Further, the specialist's knowledge was mainly received through practice and experience but also from an education at a graphical design school. The source of knowledge was mainly a merchant of fine paper and paperboard, who sent information regarding new materials approximately every three months. Regarding surface properties, the specialist claimed that a glossy surface should be used to receive an accurate image quality, while an uncoated or matt surface was beneficial when desiring high readability. However, to receive both high readability and image quality it was stated that a surface coated with silk could be used. A silk coating was considered for this purpose because its properties resulted in a combination between glossy and matt.

In addition, the specialist in printing technology stated that there are some materials that are better suiting for high runnability than others. The printing agency could try different new materials if the customer wanted, but preferred to use materials with high runnability which they knew worked in their machines. Otherwise it could cause stop in the machines, which led to high costs. However, according to a professor in packaging technology, some small printing companies lacked knowledge regarding which type of materials that had high runnability in their printing machines. Further, it was revealed that the printing company paid a carbon offset for all of the materials that they used. In addition, regarding different material's environmental impact, the operator did not believe that there were any differences between a brownish material that looked "environmental friendly" and a coated white material.

5.1.4 Packaging engineers

One packaging engineer in Veddige within medical packaging, one packaging engineer of food packaging in Stockholm, and one packaging engineering teacher at Broby Grafiska College of Cross Media in Sunne were initially interviewed. During the further interviews one professor within packaging technology at the Royal Institute of Technology in Stockholm was interviewed. Their possessed knowledge is presented in this section.

Initial interviews - Packaging engineers

According to the medical packaging engineer, and the food packaging engineer, paperboard was mainly used in their applications (packaging). Thereby these operators did not use fine paper. Hence, the operators' knowledge about materials was primarily concentrated within knowledge about paperboard. Further, the medical packaging engineer did not believe that fine paper existed in as high grammages as required for packaging. This operator also stated that paperboard had higher tearing strength and was more stable than fine paper. Tearing strength was claimed to be an important material property to regard when deciding material. The same operator used a table that displayed different material properties when deciding material.

The interviewed operators' knowledge was received both through practice and education. The packaging engineer within the food packaging industry had an educational background where one basic course treated information about materials, and stated that it did not provide much knowledge. The knowledge was mainly obtained from research during different school projects. In addition, the food packaging engineer had recently attended an education held by a producer of paperboard, which involved information about different materials and their printability. Despite this, the operator did not have much knowledge regarding readability and image quality because another department, developing the graphic and typography, was responsible for these parts. However, the operator claimed that the whiteness of a material was important in order to receive a good colour reproduction.

Both operators stated that different types of paperboard were used for different purposes. The medical packaging engineer mentioned that when developing a packaging for medical use, it was important to choose a material that could be embossed due to the need of braille on the packaging. Considering this, it was stated to be important that the material did not crack. In addition to this, solid bleached board (SBB) by Iggesund Paperboard AB was claimed to be a suitable material for embossing. This because it enabled a deeper embossing in comparison to

other paperboards. A material made by recycled fibres was claimed to be less suiting for embossing. The material with recycled fibres and a duplex-material by (former) Korsnäs AB were mentioned to be beneficial when desiring perforations. The operator further claimed that it was possible to investigate the type of paperboard quality by tearing it apart. If the paperboard had a yellow tone inside it was stated to be a duplex-material, and if the paperboard was white straight through it was a SBB. It was also stated that a material with recycled fibres were not better in terms of environmental aspects but could sometimes be used because of its low cost. In contradiction to this, the operator within the food industry claimed that a material with recycled fibres was better regarding environmental aspects than other materials. However, it was also stated that a material with recycled fibres was not suitable for food packaging and thereby needed a barrier which, in turn, would increase the environmental impact.

According to the packaging engineers, an expensive high quality paperboard was better when desiring a complex shape, because the less expensive paperboards tended to crack during creasing. High quality paperboard was also claimed to be suitable for luxury packaging e.g. cosmetics, and for packaging with high demands on the appearance. Further, the operator within the food industry claimed that the operators' knowledge and recommendations could be "lost" along the development process. This because of misunderstandings, and the involvement of many different stakeholders. It was also said that the easiest way to gain information about materials was to talk with the producers of the material. However, the suppliers did not always allow this. Further, another source of information was claimed to be the internet, advertising agencies and people within the company. The head of environmental issues and a material expert at the company was stated, by the operator within the food industry, to be people that possessed much knowledge about different materials. It was also stated that the operator sometimes felt that the suppliers did not provide enough information. Further, it could take too long time to gather the material information and material samples needed to enable the material decision. Furthermore, it was claimed that the suppliers' packaging constructions were trusted to be qualitative enough, such as, the creasing of a packaging being well produced.

Packaging engineering education

The teacher at an education in packaging engineering and graphical media production at Broby Grafiska in Sunne, explained that the possessed knowledge about materials was partly received through practice during former work and partly from education. The teacher had previously worked as a packaging engineer at a large company within the food packaging industry, and had studied at a graphical education that involved courses about materials. In addition to the graphical education, the operator had also received knowledge from other courses about materials, and during an apprenticeship.

It was claimed that the students at the education in packaging engineering sometimes ended up working at advertising agencies. The teacher further stated that much of the education involved practical work, and one third of the education was performed as an internship. In order to provide the students with information about the latest printing and converting technology the students had access to many different machines. It was furthermore stated that the education involved courses about material and construction. Also, visits from producers of fine paper and paperboard, and suppliers of colours who provided information about different printing inks, occurred. Further, the students had access to a lab, where they could test how different materials reacted in different environments and different humidity along with trying out the durability of the materials.

It was further claimed that the knowledge among the operators in the graphical and packaging industry was niched within the own profession e.g. packaging engineering or graphic design. For instance, it was stated that the designers did not know anything about printing, and that the repro department did not know anything about packaging engineering. The teacher had also held courses and seminars about materials for customers and agencies around the world. From this, it was recognised that the overall knowledge regarding material was poor around the world among the different operators in the industry. However it was claimed that the knowledge among operators in Europe was better than the operators' knowledge in, for instance, Mexico, Central America and the Far East. Further, it was stated that only coated materials with a gloss finish was used in the United States.

The teacher claimed that some people only regarded the difference in grammage when describing fine paper and paperboard. However, besides from that difference, it was stated that there also was a difference in the construction of the materials. It was claimed that paperboard could be constructed with different layers. According to the teacher it also existed different types of paperboard, for instance solid board, duplex and triplex boards. A solid board was described as a paperboard that was constructed by paper straight through and with less stiffness and strength than duplex and triplex boards due to the chemical pulp in the solid board. It was stated that paperboard made by chemical pulp had less st-

rength in comparison to a material made by mechanical pulp. However, a material made by chemical pulp had higher whiteness and a smoother surface according to the teacher. The desired whiteness was claimed to depend on the application's purpose, for instance, an unbleached material with a natural finish was sometimes desired in order to make the application look more "environmental friendly". However, the teacher pointed out that this type of material not necessarily was better regarding environmental aspects and that it was just a way to fool the consumers. Further, it was stated that the whiteness of the material comes from the white pigment in the coating and that more layers of coating or higher grammage would provide a higher whiteness of the material.

According to the teacher, it was important to not use a material with too high thickness when developing a brochure, because that would make it difficult to crease and fold the application. For the brochure it was also important to consider the grain direction, which should be in the rolling direction according to the teacher. Further, when developing packaging, it was common that the surface cracked during folding. The cracking was stated to depend on features such as, the surface sizing, the coating, and the fibres in the surface. It was also explained that cracking could be avoided by using a material with higher strength. The materials' strength was also important in order to produce complex shapes according to the teacher. Further, when developing a menu, it was stated that the stiffness of the material was important to regard. This because the menu should be able to stand straight up on the table, or be held by the user, without being bent or folded.

It was further stated that it was important to consider what type of material that runs smooth in the printing machines when deciding material. It was claimed that when performing gravure printing, it required a smooth surfaced material to enable a smooth pass through the cylinder during production. The drying time was stated to depend on the used technique, and the surface's absorption rate. For instance, the drying time was stated to be long when using a plastic laminate because the colour then did not penetrate into the paper properly. In these cases could e.g. a UV-colour be used, according to the teacher. When flexographic printing was performed, the drying time was affected by whether the colour was water-based or alcohol-based. Further, it was claimed that, when performing offset printing on a plastic surface alcohol-based colours had to be used because a water-based colour would not dry at all when applied on a plastic surface. Regarding embossing, the teacher believed that it was possible to emboss fine paper, but added that the result would probably not turn out great when using thin fine paper. It was also stated that the most important thing when using embossing was to prevent the surface from cracking. This was ensured by using a two-part tool; one part performing the embossing, and the other part serving as a resistance.

To obtain good readability, a matt surface was recommended and it was claimed that a glossy or coated surface could not be used. Further, it was stated that a semi-matt material could be used to obtain both readability and accurate image quality. When the different packages in different materials, i.e. the mediating objects, were shown to the teacher, it was stated that the solid bleached board (SBB) Invercote by Iggesund Paperboard AB had the best image quality compared to the other materials (FBB, WLC, SUB). It was also believed to be the most expensive one. The SBB was further claimed to be suitable for packaging of expensive products, e.g. perfume, Eau de Cologne or chocolate. The folding boxboard (FBB) (Incada by Iggesund Paperboard AB) was considered to be the second best in terms of image quality. It was also pointed out that the materials with an unbleached inside, i.e. white lined chipboard (WLC) and solid unbleached board (SUB), were least expensive and that WLC was a duplex paperboard, and also the least expensive of them all. WLC and SUB was further stated to be suitable for disposable packaging. For the purpose of creating food packaging, it was claimed that a lamination on the packaging's inside should be applied. It was added that the choice of material did not matter when laminations were applied.

Further interviews - *Packaging technology professor*

The professor in packaging technology at the Royal Institute of Technology had an educational background in solid mechanical engineering with major in paper, paperboard and other cellulose-based materials. Further, the professor's main focus was set on the materials' mechanical properties. Hence, the professor did not consider to possess much knowledge regarding printability and printing methods. However, the course held by the professor included printability and printing processes because those aspects were considered to be important for the end-result of an application. The professor's students were engineering students with different majors, for instance, in chemistry, product development or mechanical engineering.

Further, the definition of fine paper and paperboard could vary according to the professor, and it was claimed that it basically was the same material. Although, it was stated that paperboard was thicker, stiffer and had a grammage somewhere over 220-250 g/m2, while fine paper had a grammage

below that. It was also claimed that the different materials were used for different purposes. Further, quality was claimed to be a measure of the extent to which something is fulfilled in relation to user expectations, and due to this, quality was stated to be related to an application's purpose. The operator further stated that one of the most exclusive paperboards in Sweden was a solid bleached board (SBB), Invercote by Iggesund Paperboard AB. The price of this material was said to be twice as high in comparison to some paperboards made by recycled fibres. It was claimed that this paperboard, Invercote, had the best material properties compared to other paperboards and this due to it consisting of only virgin fibres, and having a smooth surface, which resulted in excellent image quality. The paperboard was further stated to be suitable for printing, packaging in general, but especially luxury packaging e.g. for whiskey, cigarettes, perfume and high quality chocolate. But in addition, the professor lacked knowledge regarding when SBB was more suitable than folding boxboard (FBB) and claimed that it depended on many different parameters. Further, it was stated that a cheap paperboard could cause trouble in the printing machines due to poor runnability, and that many operators in the graphical industry often lacked knowledge about this. In addition to this, when creating advanced packaging, the shear stiffness in the thickness direction, tensile strength and bending stiffness should be regarded according to the professor. It was claimed that cracks could occur between the fibres in the shearing direction.

Furthermore, according to the professor, the big companies within packaging development accounted for half of the packaging on the market. The small companies were claimed not to have enough resources for development. Further, it was stated that the small packaging companies and printing agencies had less theoretical knowledge than the big companies. Therefore, these operators were claimed to occasionally lack knowledge about runnability. Regarding environmental aspects, it was claimed that it was important to consider the entire value chain. In addition, water-based colours, which to a large extent are used in flexographic printing processes, was considered to be better for the environment than oil-based colours according to the professor. However, it was also stated that no printing process was claimed to be "environmentally disastrous". The professor also believed that some operators used a brownish material that looked "environmental friendly" even though it had no connection with a low environmental impact in reality.

5.1.5 Purchaser of fine paper and paperboard

No purchaser of fine paper and paperboard was initially interviewed. Although, during the further interviews one purchaser of fine paper and paperboard with core business in the food industry was interviewed.

Further interviews - Purchaser

The interviewed material purchaser working within the food industry had a former background as a printer. Due to the previous experience in the printing industry, the purchaser claimed to have good knowledge regarding printing process, runnability and how a material affects the end-result. For instance, the purchaser claimed to have knowledge about what factors that influence the printing costs. Further, the operator knew that the colours often could differ between the colours that were displayed on the computer screen during the design process and the printed colours applied on the end-result of the produced application. For applications that were going to be distributed by post, the purchaser stated that it was important to consider the materials' grammage to avoid an unnecessary expensive postage. In addition to this, when the application should be posted to the user, the format should also be adapted in order to fit through the slot of a letterbox.

It was claimed that paperboard was mainly used for their packaging or billboards but in addition to this, it was also stated that a solid board could be used for magazine covers. Regarding suitable materials for finishing options, the operator claimed that the foldability and creasing properties were much better with a high quality paperboard compared to a paperboard with lower quality, which could crack during folding. Further it was mentioned that a material with lower price often had a shorter life expectancy compared to a more expensive material. Invercote by Iggesund paperboard AB was mentioned as a paperboard with high quality and with good foldability and creasing properties. Due to the experience in the printing industry the operator also claimed that Invercote was better in terms of runnability than other paperboards, such as paperboards with recycled fibres. Further, Invercote was also claimed to be beneficial to use for cards that should be printed. This operator used Invercote G[2] for these applications, with a grammage of 250-300 g/m^2 for cards in sizes of A4 and A5. When the application was a brochure, the purchaser stated that fine paper, (Tom-Otto[3] or Multi-Art[4]) often was used and men-

2 Invercote G is a solid bleached board (SBB), produced by Iggesund Paperboard AB, with a triple coated printing side (Iggesund Paperboard, 2013).

3 Tom-Ottot is fine paper supplied by Antalis

4 MultiArt is fine paper supplied by Papyrus

tioned that a grammage of approximately 300 g/m^2 could be used.

Regarding environmental aspects, the purchaser mentioned that the advertising agency strived to purchase materials with the Nordic Ecolabel "the Swan" or the FSC certification, but that it was not always possible. The operator also stated that, in comparison to a white and coated material, it probably required more energy to produce an uncoated material with a brownish tone that is commonly perceived as "environmental friendly".

5.1.6 Merchants of fine paper and paperboard

During the initial set of interviews one merchant of fine paper and paperboard working at Antalis' store in Stockholm was interviewed. Additionally some implicit information about the merchants' knowledge was obtained from other operators during the further interviews. The possessed knowledge of the merchants is presented in this section.

Initial interviews - Merchants

The interviewed operators within printing agencies, advertising agencies and a graphical design and communication teacher claimed that the knowledge about fine paper and paperboard among merchants was in general very good. Subsequently, the operators commonly consulted merchants when information about materials was needed. The merchant in the initial interview had no educational background in the field, and had obtained the possessed knowledge about fine paper and paperboard through practice. The merchant also received information about new materials from the producers of fine paper and paperboard.

According to the merchant, the difference between fine paper and paperboard was that paperboard is constructed by different layers while fine paper is made up by only one single layer. It was claimed that the difference in construction made paperboard stiffer than fine paper, when comparing the materials with the same grammage. Further it was stated that in comparison to fine paper, paperboard had better durability and was more suitable for exclusive applications, and when finishing options e.g. embossing, punching and cutting, were desired. Furthermore, it was claimed that paperboard could be produced in low grammages, such as 160, 170, or 180 g/m2, and that many operators believed that these qualities were fine paper qualities. However, it was stated, by the merchant of fine paper and paperboard, that it indeed was paperboard due to the multi-layered construction.

Regarding finishing options, it was claimed that it was important to consider strength and the construction of the material in order to obtain a good result of an embossing. It was claimed that the paperboards' multi-layered construction enabled the use of emboss for small details. This because each individual layer then cracks a little, which prevents the surface from cracking i.e. the surface remains undamaged. In comparison to this, when using fine paper to an embossing the surface will crack to a greater extent, than paperboard, due to the single layered construction, and hence the result will not be as favourable. According to the merchant, a material that has a high bulk and made of recycled fibres, is the worst possible material for embossing since the surface would crack due to the material's low strength.

To receive a good image quality, the merchant stated that, the smoothness of the surface was important and therefore a coated surface should be used. The surface coating could be either gloss, silk or matt but it was illuminated that a glossy surface would result in a reduced readability. The merchant also claimed that a glossy coating was preferred by the printers due to the gained high runnability, including short drying time. According to the merchant, a matt surface could be used when desiring high image quality along with obtaining a good readability. However, a matt surface would provide a more blurred image, compared to a glossy surface that would display details in the image more accurately. Which surface that was recommended, was claimed to depend on the purpose of the application and what the customer desired. The merchant also claimed that an uncoated material would provide a different feeling of the application compared to a coated surface. In addition it was explained that an uncoated material could affect the runnability negatively, and increase the ink drying time. This in turn could result in a higher cost when printing on the material.

Further, different types of paperboard could be used for different purposes, and a solid bleached board (SBB) was stated to have a very high durability and resistance to aging due to the lack of wooden fibres. Invercote, a SBB by Iggesund Paperboard AB was mentioned as one of the premium materials, and was claimed to be constructed by the same type of pulp straight through along with having a great resistance to aging. However, it was claimed that a paperboard with wooden fibres provided higher stiffness and better opacity compared to a wood-free material, but that this type of material was not age-resistant, due to the presence of wooden fibres in the material. Furthermore, a SBB could, according to the merchant, be used to rather simple applications, such as for a cover of a brochure with glue binding, a magazine, or a book. The merchant further claimed that, due to lack of knowledge it was common that the operators, in the graphical industry, used a fine

paper to a book cover with higher grammage than the inlay of the book, instead of paperboard. Furthermore, if the end-result should be of high quality, durable and have a long life expectancy, paperboard should be used according to the merchant. The merchant explained that it was not necessarily more expensive to use paperboard compared to a fine paper. This because it was possible to use a lower grammage but still obtain the same stiffness as in a fine paper quality with higher grammage. Hence, due to the material being priced according to its grammage, it could cost equally to use paperboard instead of fine paper but obtain better material properties. The merchant also claimed that even though Invercote by Iggesund Paperboard AB was a more expensive material, it could be less or equally costly because of the possibility to use a lower grammage.

It was further claimed that fine paper was beneficial to use for applications such as the inlay of a magazine, to make it easier to flip the pages due to the fine paper's lower stiffness. What grammage that was suitable depended on how many pages the magazine should have, what size it should be, and what type of binding method that should be used. When creating a magazine it was also important to consider the grain direction in the material, the fold should be done along the grain direction according to the merchant. It was stated that when applying glue binding to a magazine, it was preferable to have an uncoated inside of the cover in order to get the best result when attaching the inlay to the cover. Further, the merchant claimed that when a material should be used for food packaging, the storage conditions had to be regarded during the material decision, such as storage in a freezer, or humid environment. Factors, such as, the image quality was claimed to be less important for food packaging that were desired to be durable in special storage conditions.

Regarding environmental aspects, the merchant claimed that it did not matter if it was fine paper or paperboard, but instead the whole material development process had to be considered. For instance, how much external energy the mills used, how the waste heat was used, forestry and transports had to be regarded to determine the environmental aspects of a specific material. It was also claimed that contrary to what many people believe, chlorine bleached paper or paperboard has not been produced in Sweden for approximately 45 years and does not exist in Europe. The merchant also stated that a material with recycled fibres was not the best choice regarding environmental aspects, and that a material with a high whiteness could be much better in terms of low environmental impact.

Further interviews - Merchants

A student at a graphical school used two merchants of fine paper and paperboards, Antalis and Papyrus, as sources of information and claimed that the merchants' knowledge about material was very good. In accordance with this, an operator in the printing industry also stated the information provided by Antalis were very good and that Antalis was used as the main source of knowledge.

5.1.7 The packaging fair: Pack- & Emballagemässan 2013

The knowledge among the producers and merchants of paper and paperboard, packaging companies and printers present at the 'Pack- & Emballagemässan 2013' varied heavily. An operator within a paperboard producing company did not have the knowledge about the difference between fine paper and paperboard. Another operator, also within a paperboard producing company, claimed that the packaging engineers lacked knowledge regarding fine paper and paperboard materials and their respective beneficial properties for certain constructions. Overall, most operators present at the fair confirmed the previous findings regarding the lack of knowledge concerning fine paper and paperboard related factors, such as the printing processes and material properties, within primarily advertising agencies.

5.1.8 Summary: the operators' knowledge about fine paper and paperboard

This section presents a summary of the operators' possessed knowledge and statements about fine paper and paperboard, which was found during the empirical studies.

Customers of fine paper and paperboard applications

- Lack knowledge about fine paper and paperboard in general.
- Lack knowledge about different material finish, and how it affect the application's end-result.
- Lack knowledge about time aspects regarding the printing process and creative process.
- Lack knowledge about environmental aspects, subsequently seldom set demands regarding this.
- Perceived a yellowish or brownish material, with rough surface as "environmental friendly".
- Lacked knowledge about whiteness i.e. bleaching methods, believed that a material with a white surface was bad for the environment.
- Customers of packaging engineers were claimed to possess knowledge about fine paper and paperboard.

Advertising agencies

- Lack knowledge about fine paper and paperboard in general.
- Lack knowledge about the difference between fine paper and paperboard.
- Lack of knowledge about for what purpose fine paper and paperboard is optimal to be used.
- Lack knowledge about material properties because they focus on merely the creative visual development, which results in that the advertisers lacking knowledge regarding how the material affects the end-result.
- Lack knowledge about what material that is appropriate for different finishing options, turns to the printers for help.
- The overall knowledge about environmental aspects is related to the appearance of the material and ecolabels.
- Receive more information about fine paper, and less to none information about paperboard.
- Gain knowledge from merchants of fine paper and paperboard, producers of fine paper and paperboard, printers, the internet, education or practice.
- Lack knowledge about the time required for the printing process.
- The printing process relates to the number of copies of the application to be produced.
- When a high accuracy in the colour reproduction is desired, a coated surface should be used because an uncoated surface usually give a poor result in terms of contrast and the reproduction of a desired blackness.
- There is confusion about the meaning of an uncoated and coated surface.
- It is important to consider the size of an application to minimise waste of material. For instance, if a brochure is going to be produced it is recommended to adjust the application according to the size of the used material sheet.
- Paperboard is rarely used, but can be applied when desiring high stiffness and image quality.
- Quality involves durability, long life expectancy of the application, high colour reproduction and no waste of printing ink.
- Regarding surface properties, the decision is between glossy or matt coating and is based on desiring either good image quality or a "feeling".
- When both good readability and image quality is required, a surface with silk coating is used.
- The printers sometimes change the agreed material to a similar one that the printer has in stock and wants to get rid of.
- The printers can recommend materials according to their gained profit i.e. not the best material with respect to the end-result of the application to be produced.
- The printers usually require a couple of days to produce the printed application. If the time is limited the printing process can be carried out quicker, but then it is expensive.
- The material decision is sometimes limited by the fact that the customers should be able to use their own printer.
- It was formerly common to have a specialist in printing technology at the advertising agency. Over time, however, this competence has disappeared from the advertising agencies in general, and the knowledge has now been transferred to the printing agencies instead.
- Believe that it is better for the environment to use a fine paper or paperboard that has a brownish tone than a white material.
- Believe that a white material is chlorine bleached.
- It is expected that large printing agencies has environmental certifications, such as ISO certifications.
- Can order material to a high cost without having any idea of what they order.
- Lack knowledge about how materials can resist cracking during creasing and folding, which is especially desired when using coloured surfaces.
- A company's impression can be affected by the appearance of their fine paper and paperboard applications, they must therefore be durable and fulfill their functions.
- The overall knowledge about material properties commonly involve surface properties i.e. if the surface is coated or uncoated and its whiteness.
- It is known that the printability differs depending on surface properties.

Printers

- Possess much knowledge about fine paper and paperboard in general.
- Lack knowledge about materials that are rarely used. Can therefore recommend a material that runs smooth through the machines and dries fast, even if it is not the optimal material for the application's purpose.

• It is important to work with "the right person" in the printing business to ensure that the end-result is going to turn out as desired.

• The knowledge is primarily obtained through practice.

• Gain knowledge about new printing techniques, and fine paper and paperboard, from exhibitions, courses, their main suppliers, and merchants of fine paper and paperboard.

• Are used as sources of information by advertising agencies and other customers.

• New materials are always tested in the machines. There is no other way to determine a material's quality.

• The customers do not take responsibility regarding the end-result of the application to be produced; it is assumed that the printer knows everything.

• The suppliers cannot answer all of the printer's questions about materials. Questions regarding environmental aspects, and whether the materials can be used in the printer's machines are especially difficult to get information about.

• It is not possible to use all types of materials in a digital printing press.

• The material's surface relates to runnability.

• New materials that are desired by the customers can be tried out, but it is preferred to use common materials with high runnability that is known to run smooth in the machines. Otherwise it can cause stop in the machines, which implies high costs.

• It is a big difference between fine paper and paperboard; the cost per kilo is about twice as high for paperboard compared to fine paper. The cost depends on quality.

• The material decision depends on the number of copies to be produced. A less expensive material is used for large number of copies. The price of the material represents 50 % of the total print cost when large numbers of copies are produced.

• Different fibres provide different material properties; spruce fibres gives higher bulk than birch fibres, because spruce fibres are longer than birch fibres. Spruce fibres also give higher stiffness in comparison to birch fibres, when having the same grammage.

• It is possible to choose a paperboard with lower grammage but still obtain the same stiffness as a fine paper in higher grammage.

• The fibre direction is important to regard when finishing options are desired because it relates to the performance of the material when being creased and folded.

• A silk coating is used in 80 – 90 percent of the produced applications in Sweden, because it offers both readability and accurate image quality.

• Some glossy coatings can appear to be matt, it therefore is important to read the information about brightness and bulk before ordering a material to minimise getting the wrong material properties.

• Regarding environmental aspects, it is better to use materials with ISO labels than Svanen.

• The printing agency sometimes pay a carbon offset.

• The customers can decide an uncoated material because it looks "environmental friendly" even if it may be worse for the environment than a coated material.

Packaging engineers

• Paperboard is mainly used when developing packaging.

• Lack knowledge about fine paper, fine paper is believed not to exist in the high grammages required for packaging.

• Lack knowledge about printability because other departments are responsible for those parts.

• Paperboard has higher tearing strength and is more stable than fine paper.

• It is important that the material does not crack during creasing, folding, embossing etc.

• The knowledge is received through both practice and education.

• A table displaying different material properties is used when deciding material.

• Different type of paperboard is used for different purposes.

• A material for a packaging for medical use has to enable embossing due to the need of braille on the packaging.

• Solid bleached board (SBB) is suitable for embossing, since it enable a deeper embossing in comparison to other paperboards.

• It is possible to investigate the type of paperboard quality by tearing it apart. If the paperboard has a yellow tone inside it is a duplex paperboard, and if the paperboard is white straight through it is a solid bleached board (SBB).

• Materials with recycled fibres are not better in terms of environmental aspects but can someti-

mes be used because of its low cost.

- Recycled fibres are not suitable for food packaging, and thereby need a barrier if used. This increases the environmental impact.
- An expensive high quality paperboard is better when desiring a complex shape, because the less expensive paperboards tend to crack during creasing. High quality paperboard is also suitable for luxury packaging e.g. cosmetics, and for packaging with high demands on the appearance.
- The knowledge and recommendations can be "lost" along the way during the development process because of misunderstandings, and the involvement of many different stakeholders.
- The easiest way to gain information about materials is to talk with the producers. However, the suppliers did not always allow this.
- The suppliers did not provide enough information.
- It can take too long time to gather the material information and material samples needed to enable the material decision.

Packaging engineering education

- Students within packaging engineering gain a lot of info about materials from producers, and practice.
- The teacher possesses good knowledge about fine paper and paperboard, and the related subjects e.g. converting, manufacturing and printing ink.
- The knowledge among the operators in the graphical and packaging industry was niched within the own profession e.g. packaging engineering or graphic design. For instance, it was stated that the designers did not know anything about printing, and that repro department did not know anything about packaging engineering.
- Paperboard made by chemical pulp has less strength in comparison to a material made by mechanical pulp. A material made by chemical pulp has higher whiteness and a smoother surface.
- The desired whiteness depends on the application's purpose, for instance, an unbleached material with a natural finish is sometimes desired to make the application look more "environmental friendly". However, this type of material is not necessarily better regarding environmental aspects, and it is a way to fool the consumers.
- The whiteness of the material comes from the white pigment in the coating. More layers of coating or higher grammage provide a higher whiteness of the material.
- The most important thing when using embossing is to prevent the surface from cracking.
- Cracking can be avoided by using a material with higher strength.

Packaging technology professor

- Operators within packaging developing companies lack knowledge about different material properties and how they relate to certain desired functions, and information about new materials on the market.
- Possess much knowledge about materials' mechanical properties.
- Lack knowledge about printability and printing methods.
- Different materials are used for different purposes.
- Quality is a measure of the extent to which something is fulfilled in relation to user expectations.
- Quality relates to an application's purpose.
- A cheap paperboard can cause trouble in the printing machines due to poor runnability, many operators in the graphical industry lack this knowledge.
- Regarding environmental aspects, it is important to consider the entire value chain.
- Some operators use a brownish material that look "environmental friendly" even though it has no connection to a low environmental impact in reality.

Purchaser of fine paper and paperboard

- Have previous experience from the printing industry, and thereby possess good knowledge regarding the printing process, runnability and how a material affects the end-result.
- Knows that the colours often differ between the colours that are displayed on the computer screen during the design process, and the printed colours applied on the end-result of the produced application.
- For applications that are going to be distributed by post, it is important to consider the materials' grammage to avoid an unnecessary expensive postage.
- The format should be adapted to fit into the opening in a letterbox.
- Paperboard is mainly used for packaging or billboards.

- Solid board can be used for magazine covers.
- Regarding suitable materials for finishing options, foldability and creasing properties are much better in a high quality paperboard compared to a paperboard with lower quality which can crack during folding.
- A lower priced material often has a shorter life expectancy compared to a more expensive material.
- Invercote by Iggesund paperboard AB has high quality, runnability, and good foldability and creasing properties.
- When the application was a brochure, fine paper is used in grammages of approximately 300 g/m^2.
- Strive to purchase materials with the Nordic Ecolabel "the Swan" or the FSC certification, but it is not always possible.
- A white and coated material is believed to require less energy to produce, than an uncoated material with a brownish tone that commonly is perceived as "environmental friendly".

Merchant of fine paper and paperboard

- Possess good knowledge about fine paper and paperboard, and the differences between the materials.
- Gained knowledge about fine paper and paperboard through practice.
- Consulted when information about materials is needed.
- The difference in construction makes paperboard stiffer than fine paper when comparing the materials with the same grammage.
- Paperboard has better durability than fine paper, and is more suitable for exclusive applications, and when finishing options e.g. embossing, punching and cutting, is desired.
- Paperboard can be produced in low grammages, such as 160, 170, or 180 g/m2. Many operators believe that these qualities are fine paper qualities.
- Regarding finishing options, it is important to consider strength and the construction of the material in order to obtain a good result of an embossing.
- The paperboards' multi-layered construction enables the use of emboss for small details. This because each individual layer cracks a little, which prevents the surface from cracking i.e. the surface remains undamaged. In comparison to this, when using fine paper to an embossing the surface will crack to a greater extent, than paperboard, due to the single layered construction.
- A material that has a high bulk and is made of recycled fibres is the worst possible material for embossing since the surface will crack due to the material's low strength.
- To receive a good image quality, the smoothness of the surface is important and therefore a coated surface should be used.
- A glossy coating is preferred by the printers due to the gained high runnability, including short drying time.
- Which surface that is recommended, depends on the purpose of the application and customers' preferences.
- An uncoated material can affect the runnability negatively, and increase the ink drying time, this results in a higher cost when printing on the material.
- Operators, in the graphical industry use fine paper for book covers, with higher grammage than the inlay of the book, instead of paperboard.
- If the end-result should be of high quality, durable and have a long life expectancy, paperboard should be used.
- Fine paper is beneficial to use for the inlay in e.g. a magazine, to make it easier to flip the pages due to the fine paper's lower stiffness.
- Regarding environmental aspects, the whole material development process has to be considered in order to determine the material's environmental impact.
- Chlorine bleached fine paper or paperboard has not been produced in Sweden for approximately 45 years and does not exist in Europe.
- Recycled fibres are not the best choice regarding environmental aspects, a material with high whiteness can be much better in terms of low environmental impact.

5.1.9 Analysis: the operators' knowledge about fine paper and paperboard

From the performed studies it is identified that the main problem is that the operators, in the graphical and packaging industry, does not know how the material decision relates to obtained quality of the fine paper or paperboard application and the use of resources. This problem is found to have its root in the lack of knowledge about fine paper and paperboard in general, and the differences between the materials. Further, the lack of knowledge about the materials is found to impact the understanding of how different material decisions relates to durability of

the application, printing and converting process, finishing operations, and environmental impact. In addition, there is a significant lack of understanding about the printing process among the operators within advertising agencies and their customers. Knowledge regarding, for instance, how long time the process requires, and how the application can be customized in accordance with the process to obtain high quality to minimum resources, is found to be lacking among these operators. Hence, there is an ignorance of how to perform a conscious material decision, and subsequently a need to provide knowledge about this manner. Further, it is identified that the operators within advertising agencies and their customers are the ones that lack the most knowledge about both materials and processes, and hence are primarily the ones that needs to be enlightened (see Table 5.1).

The operators within printing agencies, however, possessed rather good knowledge about materials and the development process of fine paper and paperboard applications. Although, they were less knowledgeable concerning materials that seldom were used. In addition, the interviewed merchant of fine paper and paperboard possessed great knowledge about materials and the development process of fine paper and paperboard applications. Subsequently, the merchant recommended materials in a holistic manner. Unfortunately, the knowledge possessed by the merchant did not reach out to all operators in the industry. Hence, there is a need to spread knowledge about the importance of a conscious material decision, and how this is performed from a holistic point of view, i.e. not only providing information related to the specific operator's profession but also previous and subsequent operations.
In addition to this, it was found that the knowledge among the operators in the graphical and packaging industry was to a great extent niched within the operators' own professional field. As a result, it occur-

Table 5.1 *The operators in the graphical and packaging industry lack knowledge in several areas. However, the merchants of fine paper and paperboard, and the printers are found to possess knowledge within the areas.*

LACK OF KNOWLEDGE

MATERIAL PROPERTIES
- Grain direction
- Layer construction
- Fibers (Long fibres, Short fibres, Recycled fibres)
- Pulp (Chemical pulp, Mechanical pulp)
- Grammage, Bulk, Thickness
- Tearing resistance
- Shear resistance
- Complex shapeability
- Toughness
- Stiffness
- Strength (Tensile strength, Surface strength)
- Dimension stability
- Creasability & Foldability
- Opacity
- Taint & odour

DURABILITY

ENVIRONMENTAL ASPECTS

SURFACE PROPERTIES
- Whiteness, brightness
- Structure, Smoothness, Roughness
- Coated (Silk, Matte, Gloss)
- Uncoated

THE PRINTING PROCESS
- Printing techniques
- Runnability
- Printabiliy
- Format & Sheet

FINISHING OPTIONS & VARNISHING
- Laminations
- Embossing/Debossing
- Creaseing & Folding
- Die cutting & Laser cutting
- Binding

OPERATORS

ADVERTISING AGENCIES [AA]
EDUCATION ADVERTISING AGENCIES [EAA]
CUSTOMERS [C]
PACKAGING ENGINEERS [PE]
EDUCATION PACKAGING ENGINEERS [EPE]
PURCHASERS FINE PAPER OR PAPERBOARD [SPP]

red that the different operators possessed a diverse terminology which resulted in using different words when actually meaning the same thing. From this, it is concluded that the lack of knowledge can be derived to the operators' niched working procedure, meaning that each operator performed their own operations and then sent it further to the next operator instead of working parallel to each other and keeping a dialogue. This results in difficulties during communication which, in turn, results in misunderstandings. For instance, there is a frequent misuse of the term "uncoated" by the operators within advertising, since it is believed to imply a matt coated surface. Also, it occurred that the operators used faulty terms when discussing fine paper and paperboard i.e. they mixed up fine paper with paperboard. This ignorance in terminology was found to result in non-desired end-results, and higher use of resources. Hence, there is a need to foster a common terminology during communication, which can be obtained through holistic knowledge and understanding about the development process of fine paper and paperboard applications.

In addition to this, it is also of interest to mention that much of the needed knowledge already exists in, for instance, books, material specifications and on the internet, which was identified during the empirical and theoretical studies. However, the operators still lack knowledge, which leads to the conclusion that the most important approach in order to spread knowledge does not concern the particular information per se, but how this information is mediated. Hence, aspects such as amount of information, severity of the language, accessibility and rationality of the information, and of course also a careful consideration of which information that is presented, are of interest to consider.

Furthermore, the lack of knowledge about fine paper and paperboard is recognised to be of greater issue when there is an uncertainty of which material to make use of in the application to be produced. Although, it is also identified that operators tend to use fine paper when it is more suitable to apply paperboard. For instance, some operators were found to use fine paper for book covers, which results in lower durability in comparison to paperboard. Hence, there is a need to provide knowledge with emphasis on the difference between fine paper and paperboard and their suitable purposes, including the materials' relation to e.g. durability and applicability of finishing options. For instance, by selecting a material that performs well in the printing and converting machines, along with suiting the application's purpose without breaking before expected time, a lot of money can be saved and a high quality can be obtained. Also, the knowledge about fine paper was found to be better than the knowledge about paperboard, therefore it is beneficial to express the needed knowledge in terms of when it is suitable to apply paperboard. Further, it is important to illuminate the uncertainty when it is not clear that paperboard is a better option in terms of gained quality and reduced use of resources. Hence, there is a need to express the consequences and possible gain of a material decision in terms of quality, cost and time, to promote a conscious material decision.

Regarding the printing process, it was found that several operators within advertising lacked knowledge about the foundation of the printers' printing cost, and how materials relate to runnability and printability. Some operators also lacked knowledge about how the provided time for the printing procedure could affect the printing cost and end-result. The interviewed merchant of fine paper and paperboard, and the printers, stated that a material's runnability and the provided time to the printing procedure can affect the printing cost to a great extent. It was revealed that when a short time was provided to the printing procedure, a more expensive printing technique could be conducted in order to meet the set deadline. Further, the number of copies of the application to be produced was found to relate to the printing techniques and subsequently also the cost of the process. From this, it can be concluded that the operators within advertising, and their customers, need more knowledge about factors that influence the printing cost and quality of the application, which also can be related to an enhanced communication. If the operators within advertising obtained this knowledge, it could result in conscious material decisions adapted to the printing process, which implies a reduced cost and increased quality. In addition to this it was also revealed that the cost of an application could be significantly reduced if the design was adjusted to the printing process. For instance, it the application's format was adjusted to the sheet that ran in the printing press or converting machine. Hence, providing knowledge about these aspects can result in the operator regarding these manners during the development and thereby the cost can be reduced. It would also be of interest to promote a communication about these aspects with the printer, and preferably early in the development process due to the design freedom that is present at an early stage.

It was also found that several operators within advertising did not know which factors that were important to consider regarding environmental aspects, i.e. what contributed to a low environmental impact. Subsequently, environmental issues were rarely requested by the operators within advertising or by their customers. It was found that several prin-

ters took action regarding environmental aspects in their work when requested. For instance, they could use materials with lower environmental impact, such as materials with eco-labels, or they could compensate for their carbon emissions. Further, it was identified that many advertisers and customers perceived a yellowish surface as "environmentally friendly" in comparison to a white surface, which they believed was chlorine bleached. This implies that the knowledge about environmental aspects must be enhanced to enable a conscious material decisions that contributes to actual reduced environmental impact. This can be done through spreading knowledge about the materials.

Conclusions

- There is a need to spread knowledge about the importance of, and how to make, a conscious material decision, i.e. spread knowledge about the consequences of a certain material decision, and which factors to regard during the decision.
- Knowledge about fine paper and paperboard, and the related processes carried out during the development process of fine paper and paperboard applications needs to be provided.
- The knowledge primarily needs to emphasise the uncertainty regarding which material to make use of in a fine paper or paperboard application, and also be directed towards paperboard.
- The knowledge needs to reach primarily operators within advertising agencies and their customers.
- There is a need to provide a common terminology, and enhance the communication between the operators in the graphical and packaging industry.

5.2 Critical factors during the material decision

The most important factors that contributed to a certain material decision differed between the operators in the graphical and packaging industry. The following section presents the critical factors regarded by the operators in the industry during the material decision procedure.

5.2.1 Customers of fine paper and paperboard applications

No customer of fine paper and paperboard applications was interviewed directly, although a lot of information about the customers' prioritised factors during material decision was obtained implicitly through the various operators in the graphical and packaging industry at the initial and further interviews.

Initial interviews - Customers

It was identified during the initial studies that the customers most commonly prioritised cost, time and the end-result of the produced application. Hence, the customers wanted a satisfying end-result to a minimum cost and time. However, it was claimed, by an operator within advertising, that the publishing companies were the ones of the interviewed operator's customers who most frequently recognised the benefit from using a more expensive material. The smaller publishing companies were the most willing to use a more qualitative material, while the bigger publishing companies were more sensitive to changes in cost according to the operator.

Further interviews - Customers

During the further interviews it was, in similarity with the initial interviews, found that the cost, time and end-result of the produced application were highly prioritised factors by the customers. It occurred that the customer's demanded applications the next day, according to an operator within advertising. However, in contradiction to this, another operator claimed that customers seldom provided only one day and further explained that the customer understood that the development process took time. In addition, it was stated that the customers often expressed that they wanted the product the next day. However, when it was explained to the customers that providing a slightly longer time could result in a reduced cost, it often led to the customers accepting a postpones deadline according to the operator. Further, it was found that the customers' knowledge about fine paper and paperboard, in general, was limited. This resulted in the customers suggesting materials that were not always applicable to use due to printing and manufacturing aspects. In these cases, an alternative material was often recommended to the customers. Although, it was found that the customer always had the final opinion regarding which material to use, since they provided the budget. It was stated that customers sometimes declined ideas that were too expensive. However, if the added value of the idea along with the desired material could be explained to the customer, an increased budget could be accepted. Although, this was not always the case.

Furthermore, in similarity to the initial interviews regarding big publishing companies possessing knowledge about fine paper and paperboard, it was claimed by an operator within advertising that customers from big companies commonly understood the importance of a conscious material decision. Further, it was stated by a printer that customers could be disappointed with the end-result of the produced application if the colour reproduction of the print did not correspond to the colours displayed on the

screen (where the graphics were developed). It was further claimed that the customers seldom regarded environmental aspects, but sometimes wanted the end-result of the produced application to look "environmental friendly". In addition it was stated, by the interviewed printer, that customers usually prioritised cost over environmental aspects during material decision. However, environmental actions such as paying a carbon offset, was appreciated by the printer's customers. It was further stated, by the printer, that the customers desired high performance of the end-results e.g. "perfect" 90 degree corners and no cracks in the material especially in the creases, when it comes to packaging.

5.2.2 Advertising agencies

Five operators within advertising agencies in Gothenburg and Stockholm, and one graphical design and communication teacher at Beckman's College of Design in Stockholm were interviewed during the initial interviews. Four operators within advertising agencies and a student within art directing at Bergh's School of communication in Stockholm were interviewed at the further interviews. This section presents these operators' regarded factors that contributes to a certain material decision.

Initial interviews - Advertising agencies

Regarding the advertising agencies, the critical factors that contributed to a certain material decision, were primarily cost and time due to the customers' provided budget and time. The time included the material delivery time, and the cost referred to both the cost of raw material but also of the accompanying manufacturing processes e.g. printing and finishing operations. Although, in addition to the customer's regarded factors, the operators within advertising commonly prioritised the number of copies and material properties, such as surface smoothness and grammage, when deciding material. The prioritisation of material properties were prioritised differently depending on the application that was going to be produced. In addition, it was stated by one operator that whiteness was a consistent factor when deciding material. This was though claimed to be merely a personal preference, that was associated with quality for the operator. Further, an operator within advertising that had a background with a lot of practical experience claimed to regard grammage, surface properties, and printing processes, during material decision.

It was furthermore expressed that the customer sometimes was willing to increase the budget by using a more expensive material if the application's quality increased. It was tough necessary to communicate and convince the added value to the customer, and the customer had to understand this in order for the budget to be increased. It was further stated, by an operator within advertising, that the material did not significantly affect the graphic design if the produced fine paper or paperboard application was going to be a book. In addition, another operator within an advertising agency claimed that the material was not an essential factor relating to the end-result of a fine paper or paperboard application at all. Further, it was explained that when developing books, the factors creasability and durability were prioritised. It was though claimed that the material in general was of great importance regarding colour reproduction, and to enable the desired printing process. However, it was explained that the material did not have to be the exact quality, but merely had to possess certain desired properties.

Further, environmental aspects were in general not regarded when deciding material, unless the customer demanded this which seldom was the case. Although, one operator stated that environment aspects were indeed demanded by the customers, and subsequently the first parameter to consider when deciding material. Whether a material had a low environmental impact was determined by checking for ecolabels.

Further interviews - Advertising agencies

During the further interviews it was found that the most critical factors that resulted in a certain material decision were commonly time and cost. The customer's various demands were also found to be a dominating factor contributing to certain material decisions.

It was stated that each development project of fine paper and paperboard applications, performed by the advertising agencies, often was carried out during short deadlines. This because they responded to short provided time from the customers, and also commonly demands with short notice. Further, it was explained that the consequence of a short provided time could result in not all operators being involved at all stages in the development process. This could lead to a material decision that was not applicable for the application that was going to be produced, due to the material decision being performed by the ignorant operators. One operator within advertising explained that it often occurred that tasks were postponed which resulted in very small margins, that led to the printer getting the least time to perform their work. In the events when short deadlines were provided, the used material was usually the ones that were available i.e. the material that the printer kept in house or had available in short notice. It was stated, by an operator within advertising, that the printers often purchased large material orders since they could receive a discount, and these

materials were what the printers recommended and kept in house. In addition to this, the use of an alternative material was claimed to affect the end-result of the produced application negatively due to e.g. a lower grammage than desired could reduce a strived luxury feeling. An alternative material was sometimes used when there occurred misunderstandings in the communication between the different operators involved in the development process, or when a material was out of stock. However, the latter occurrence was claimed not to affect the end-result considerably since the customers did not put a lot of appraisal in the material decision.

Regarding quality, it was explained that the haptic feeling of the material was of high importance. This was an aspect that could not be understood through merely reading material data specifications. It was stated that the haptic feeling was a second impression after the visual elements. Further, it was explained that, whether quality or cost of a material was prioritised depended on the customer, and that the application's purpose determined the material decision. For instance, if the product had short life expectancy e.g. brochures or flyers distributed at a fair, a less expensive material was often used. The reversed event was explained by another operator; if a less expensive material was used, the life expectancy of the application was regarded since less expensive materials usually were less durable. One operator did though claim, that a material with the lowest price was not used even if minimal cost was strived. This because the operator prioritised capturing quality of the end-result which was explained to relate to the used material. It was further stated to be worth in the long run, and that the fine paper or paperboard application reflects the company, and how it is perceived by a potential customer. This operator also explained that it was a great difference between a poor material and a qualitative one with respect to the end-result of the produced application. It was stated that a qualitative material had a higher grammage and possessed a certain resilience.

It was also found during the further interviews, that business cards needed to be rigid, and durable to fulfill its purpose. Regarding products with focus on images, it was claimed that the colour reproduction was the most important factor. Furthermore, an operator claimed that uncoated materials had lower ability to reproduce colours accurately. This knowledge was obtained through experience, the uncoated material was instead claimed to be beneficial when wanting to achieve other strived features not involving high demands on accurate colour reproduction. It was also found that when developing direct advertising, such as advertisement posters beside escalators that only were viewed quickly, less effort was put on quality and accurate colour reproduction. Hence, the application's purpose was related to the material decision. The operator in question further stated that they put more effort into their magazines and subsequently used a more qualitative material. It was stated by an operator within advertising that fine paper was used for the book's inlay and paperboard for the cover. Another operator stated that the grammage used for the covers usually were 250-400 g/m2, and the body 100-170 g/m2. It was also claimed to be important to regard the opacity of the material so that graphics would not show through the page. The stiffness was also taken into account when deciding which grammage to use. Aspects related to the specific customer, such as the customer's company orientation, graphical profile and style, were also regarded factors that were reflected in the material decision.

Further, it was claimed that digital printing often was used when applications had to be completed in a hurry. Although, the applied printing technique was stated to result in an increased price if a large number of copies was going to be produced, in comparison to other printing techniques. However, if the number of copies were less than 500, digital printing was claimed to be the most economical printing technique. Further, it was found from one operator, that web-fed offset once was used for a large number copies due to economical reasons. However, it was stated to be difficult to find desired materials on roll, and that there were much more to choose from among the regular sheet formats. Further, it was explained that the material on roll was first printed with a base tone to obtain the desired feeling i.e. a desired experience of the application in totality perceived by all human senses. In addition to this, it was explained by another operator within advertising that it existed certain materials that were more suitable for specific printing machines. These materials were claimed to be better with respect to the end-result of the produced application, in comparison with the materials that were produced to operate in several different printing machines. It was also explained that the visual design, e.g. graphics and embossing, often were adjusted according to the machines in order to streamline the manufacturing process.

In addition to this, it was stated that the larger the number of copies, the more important the material decision became. This because a large amount of material quickly resulted in a big expense. It was stated by one operator that the expensive materials were discarded from the material alternatives, at an initial phase, when large amount of copies were going to be produced. However, it was illuminated that the end-result should not be affected significantly by using a less expensive material. It was also

common that lower grammages were chosen to reduce the material costs. Further it was stated that, the larger the number of copies the more important it became with samples of the prints, before proceeding with the entire production. It could occur, when larger productions were developed, that an operator within advertising was present during the printing process to enable adjustments during the procedure. Furthermore, it was stated that customers sometimes ordered larger number of copies than needed to get quantity discounts. Although, it occurred that only half of the produced applications were used which resulted in the customer throwing away those applications that were not needed. Subsequently, they did not save on costs at all, but merely contributed to a waste of resources.

Regarding a material's environmental impact, this was seldom an aspect considered by the customers. Sometimes it was demanded that the application should be perceived as "environmentally friendly", but whether the material and printing processes in fact had a low environmental impact was not of importance from the customer's point of view. One operator within advertising stated that they seldom produced large amount of copies and therefore did not regard environmental aspects, the operator also claimed to lack knowledge regarding this manner. Further, it was stated that bigger companies had more knowledge about environmental aspects. Another operator within advertising stated that environmental aspects were not regarded, but that it was assumed that all materials were approved regarding this manner. Further, it was explained that, whether a material was approved from an environmental perspective was recognised by labels such as the Nordic Ecolabel "the Swan" or FSC certifications.

Graphic design and communication education

The art director student from Bergh's School of communication in Stockholm, explained that an ongoing project originated from a sustainability and health focus. The material decision was therefore decided to be a natural "coloured" unbleached material, since it was perceived to correspond well with the theme. It was further claimed that the main factors regarded during the material decision was the visual perception and subsequent perceived "feeling" of the application, but that sustainable adaptability was considered. Further, the possibility of a pure white material being the best choice from an environmental point of view was elaborated by the art director student. This was, though, claimed to not be perceived as "environmentally friendly" by the customers. It was further stated that the customers had the final opinion regarding material decision, meaning that if the customer wanted an application to in fact be environmentally adapted or merely be perceived to be, was decided by the customer. If the latter statement was the desire, the material decision originated from perception and "feeling" of the material and not from facts. Further, it was stated that whether a material was perceived as luxury depended on the application's purpose and context. It was also claimed that a higher grammage gave a more luxurious expression.

5.2.3 Printers

Two operators within printing agencies in Gothenburg were interviewed during the initial interviews, and one specialist in printing technology working at a large printing agency in Stockholm was interviewed during the further interviews. This section presents the operators' regarded factors that contribute to a certain material decision.

Initial interviews - Printers

The printers commonly valued quality of the end-result besides cost, meaning that they did not to produce something that was merely low priced and not of a qualitative outcome. Although, cost was of significant importance when deciding material. It was also stated that time was a vital factor contributing to a certain material decision, since their customers (usually advertising agencies) often had short deadlines. However, It was claimed by the printers that they never cut back on quality to gain profit, but it occurred that the printers decided material that favoured what they had in stock. However, it was also found that the printers did not have the ability to keep materials in stock due to high costs. Availability was therefore an important factor underlying the printers' material decision. Further, it was explained that their customers usually could adjust the given time within reasonable time frames. It was stated, by the printers, that the advertising agencies prioritised cost and time over quality, and that the big companies were the ones who were the most sensitive to cost. In addition, it was stated that material and manufacturing aspects, such as fibre orientation, stiffness, drying time and runnability, were important factors when deciding which material to use. Environmental aspects were seldom regarded during material decision, however, it was claimed to be considered regarding the printing processes.

Further interviews - Printers

The specialist in printing technology interviewed during the further empirical studies, explained that the customers needed to compromise between the aspects: high quality, short time and low cost, where two of the aspects could be obtained. For instance, a high quality and quick result could be obtained to a high cost, even if all three aspects, of course, were strived by the customers. The reason that the customers did not provide a longer time was believed, by

the specialist, to be due to lack of knowledge about how long time a proper printing process needed. Another reason was that customers had difficulties in foreseeing what printed applications that would be needed in the near future, and when it was obvious the applications could be required in short notice. This was, for instance, common within clothing retail before sales, that were regulated by their selling rate, since they needed ads in their stores during sales. Further, it was claimed that cost always was the most important factor determining a certain material.

Regarding the printing process, the specialist in printing technology explained that the ink drying time did not affect the cost of the printing job, regardless of the material's drying time. Although, when printing e.g. a book cover, it was explained that the ink drying time was included in the process cost since it was printed on both sides. The applications that were merely printed on one side, could just be placed in the drying room and dry by themselves with no manpower needed. This was not the case for double-sided printed applications. It was further explained that the ink drying time depended on how the printing process was performed. Furthermore, it was said that printing an initial sample before printing the entire production seldom occurred, in contradiction to back in the days when this always was performed and sent to the customer, who had to accept before performing the printing procedure. Today it was enough with a pdf-document that displayed the result to the customer. It was claimed that the customer's requirements in general were lower today in comparison to previously. It was stated to be all about time and cost today.

Regarding quality during the material decision, it was claimed to relate to the application's purpose. For instance, if high accuracy in the image reproduction was strived a material with a glossy coating was more suitable. For high readability, contrary wise, an uncoated or matt coated material was better to use. Further, it was explained that 90% of all printed applications were produced on materials with a silk coating since the properties of the silk coating served as a combination between a glossy and matt coating. However, it occurred that images were printed on uncoated or matt coated surfaces as well, since it resulted in a certain desired feeling. Further it was explained, that whether fine paper or paperboard was recommended depended on the application's purpose, and subsequently the needed material properties.

It was also stated that the most frequently used materials were the fine paper qualities Galleri art[5] (coated) and Scandia[6] (uncoated). Those materials were explained to be optimised for applications that are supposed to be flipped e.g. inlays/pages in a book. The materials were further expressed as soft and flexible due to the fibre's orientation, but also a bit thicker. Paperboard in the same grammage as Gallerie art and Scandia, were explained to be suitable for packaging while being more stable due to the tangled fibres. Further, the printability was claimed not to depend on whether fine paper or paperboard was used. It was stated that the runnability differed between materials even if they were developed to be suitable for offset printing i.e. Litographic printing. It was claimed that 99,9% of the printing was performed on materials that were customized to the specific printing technique. If the customers requested materials that were known to have low runnability, alternative materials were often suggested. This because it was stated to be expensive with machine breakdowns, since it not only included costs to repair the machine but resulted in lost process time. In addition to this, it was stated by an operator within advertising that the printers usually recommended materials according to their gained profit.

Regarding environmental aspects, it was stated that the customers sometimes requested that the application should be perceived as "environmental friendly". Further, it was explained that the customers perceived materials in natural, grey or brown shades that were uncoated and had a rough surface, as "environmental friendly". It was stated that most materials that the printer used along with the printing processes were approved according to the Nordic Ecolabel "the Swan" and ISO 14001. The specialist in printing technology also expressed that whether a material was coated or not, does not influence its environmental classification. Further, some customers, primarily fashion brands, were claimed to demanded visible ecolabels on their printed applications. The specialist in printing technology further added that they payed a carbon offset.

5.2.4 Packaging engineers

One packaging engineer in Veddige within medical packaging, one customer also acting as packaging engineer of food packaging in Stockholm, and one packaging engineering teacher at Broby Grafiska College of Cross Media in Sunne were initially interviewed. During the further interviews one professor within packaging technology at the Royal Institute of

5 Galleri art is fine paper produced by Sappi Fine Paper Europe (SFPE)

6 Scandia 2000 is fine paper produced by Lessebo Bruk AB

Technology in Stockholm was interviewed. Their regarded factors that contributed to a certain material decision are presented in this section.

Initial interviews - Packaging engineers

Concerning the packaging engineers, the critical factors resulting in a certain material decision originated from the application's purpose such as desired functions, and the subsequent strived material properties. The most commonly expressed material properties were: tearing resistance, whiteness, and creasability. The expensive materials were claimed to have better creasing properties while the cheaper materials had a tendency to crack. Further, cost of the material was claimed to be a dominant factor, and manufacturing aspects were highly regarded as well. However, the manufacturing aspects mainly concerned the packaging construction, meaning that it had to enable machine production which seldom related to the material used. The packaging engineer working within the food industry explained that there often were conflicting requirements that needed to be compromised. For instance, there was a conflict between the benefits from using recycled fibres and the need of excellent fluid barriers and health requirements. Further it was claimed that environmental aspects were important to regard when deciding material. However, it was debated whether operators within the packaging industry tried to make it look like their packaging had low environmental impact through the use of a brown- or yellowish material. Further, it was stated that this kinds of material decisions were not significantly more beneficial from an environmental point of view. In addition, it was stated that recycled fibres were used when a low cost was strived such as for disposable packages.

Packaging engineering education

The operator within the packaging engineering education valued material properties, manufacturing process and the packaging's purpose. The regarded material properties that was stated were: surface properties e.g. colour reproduction and readability, durability in different environments such as in damp environments, folding and creasability, strength, coatings, and thickness.

Further interviews - Packaging engineers

During the further interviews a professor within packaging technology at the Royal Institute of Technology was interviewed. The professor stated that a packaging produced in a large amount was strived not to be restricted by a specific material. Instead of specifying and deciding one optimal material for the packaging, a material property specification was constructed. This because it enabled to choose a material that possessed the desired properties to the lowest cost independent of the material supplier. Hence, this was stated to be a strategy to push prices. However, it was also claimed that the operators constructing the material property specifications lacked knowledge regarding that manner, since new materials and subsequent knowledge was continuously developed.

Further, it was stated that desired parameters for a packaging in general were: stiffness, surface properties and bending ability. Also, the properties contributing to resistance to crack during creasing and folding were of high importance. In addition, it was stated that whether a material that enabled to be creased in two different directions, possessed the feature due to the strength of the fibres or the bonding in between, was not known to an enough extent to enable elaboration of this feature. Further, the shear in the thickness direction i.e. resistance to fracture in between the fibres, was stated to be an important factor to regard when striving to develop complex packaging. Although, it was stated that there were no effective methods to estimate this parameter. Further, the parameters tensile and compressive strength were claimed to be important. Furthermore, shear stiffness was stated to be an underestimated important factor that provided beneficial properties for packaging and embossing. It was explained that the lack of knowledge regarding parameters resulted in prioritising the wrong requirements, as they were related to the actual desired parameter. In addition to this, it was believed, by the professor within packaging technology, that printers probably considered whether they should print on a material with high whiteness or a more "environmental friendly"-looking material, without obtaining any actual difference in environmental impact.

Regarding quality in a material, it was expressed to relate to material properties that were linked with runnability. Runnability was further explained to treat process oriented aspects, such as running with high reliability. The operators within design and packaging design were claimed to not consider runnability during their development of fine paper and paperboard applications. It was further stated that this aspect became apparent and subsequently regarded if the decided material was not applicable for the machines during manufacturing. In addition to this, it was claimed that Iggesund Paperboard's paperboard Invercote possessed better properties than other materials since it is the most luxury one, with high whiteness and only consists of virgin fibres i.e. no recycled fibres. It was further explained that this results in an optimal printing surface and beneficial material properties. These properties were claimed to be suitable for luxury products such as perfume, liquor, or chocolate packaging.

Packaging engineering education
Within the packaging engineering education it was stated, by the professor in packaging technology at the Royal Institute of Technology, that environmental aspects were important to regard. However, the packaging development process, including materials was claimed to contain a wide range of aspects throughout the value chain; from forest to recycling, as hence difficult to cover entirely. Some aspects regarding printing-oriented environmental aspects were included in the education, such as compounds of the printing ink. Although, the education originated from a holistic view, and hence not all aspects of the packaging development process could be regarded.

5.2.5 Purchaser of fine paper and paperboard

During the further interviews a material purchaser working within the food industry was interviewed. The main purchased materials were applied in packaging, advertising distributed directly to the consumers i.e. direct advertising, and magazine productions.

Further interviews - Purchaser
It was stated by the material purchaser within the food industry that they produced rather simple fine paper and paperboard applications e.g. direct advertising, posters and food packaging. This often resulted in cost being the most important factor when deciding an idea to proceed with for the application, and hence a low cost material was also used in these cases. It was further explained that their direct advertising often had a short life expectancy i.e. approximately a few days up to a couple of weeks. Also, it was not typical that embossing, varnish and film laminations was applied to their advertisement or posters. This because it was expensive and not necessary for applications with short life expectancy, although it could occurred at special occasions when a bigger budget was provided. Furthermore, it was found that they did not care about minor colour differences between the concept displayed on the screen and the printed application. It was claimed to be a common occurrence that the printed end-result differed in terms of desired colour shades. The purchaser further stated that, as long as the printed colours were not completely different from the desired ones, such as green instead of red, it did not matter if the colour reproduction was not accurate. Instead, the conveyed message of the fine paper or paperboard application was prioritised.

However, it was explained that an expensive material could be used if it generated a higher profit than a less expensive material. For instance, if a less expensive material resulted in a cost of SEK 1 million and profit of SEK 1,1 million, and an expensive material resulted in a cost of SEK 2 million and a profit of SEK 4 million, the expensive material was chosen. It was further explained that the development always aimed at increasing the market share, this was done by improving the material decision in terms of e.g. quality, whiteness and finishing options. It was also stated that poor paperboard qualities often broke after a few folds back and forth. These things often occurred when only regarding an as low material cost as possible. In addition to this, it was stated that an excellent end-result such as perfect 90 degree corners on the food packaging, in comparison to mediocre corners, was not strived since this was not prioritised by the foodstuff consumers. Again, it was claimed to be more important to convey a message to the customer, even if the packaging was not perfect. This was also due to the large amount of food packaging produced, it was claimed to merely be too expensive to produce a perfect food packaging. Further, it was stated that, using a more expensive material for a food packaging resulted in the product in totality being rather more expensive which affects the consumer end-price. The price of the consumer price could increase by up to 40%.

Further, the purchaser expressed 'quality' as: "when one exceed or tangent the customers' expectations", this was claimed to originate from a SI-standard. However, it was claimed that the customers' expectations were difficult to foresee. It was further stated that environmental aspects were very important. It was explained that they had a department that handled sustainability aspects, and that they were the ones who imposed requirements for the material decisions. For instance, they only accepted materials with the Nordic Ecolabel "the Swan", however this requirement was sometimes neglected. Further, it was stated that their contracted printers also were demanded to have the environmental license approved by the Swan. It was also claimed, by the purchaser, that the customers did not set demands regarding environmental aspects. It was though explained that ecolabels, as mentioned, and transport distances were regarded. Further it was stated that the money gained by printing abroad was sometimes equal with the shipping costs, and hence there was no profit generated by this action. Furthermore, it was stated that they sometimes produced applications with a perception of being "environmentally friendly" by using uncoated materials. This was claimed to be rather comic, and further it was believed to be more energy consuming to produce uncoated paper along with printing on it. Materials were also coloured, in some cases, to receive a desired feeling of recycled material and thereby be perceived to have less impact on the environment.

In addition, it was explained that silk coatings were most frequently used. Although, the material was decided with respect to the application's purpose and desired feeling. For instance, an uncoated material was used in a food magazine because it evoked a desired feeling, and differentiated from the common food magazines. The prioritised factors that was revealed when the purchaser filled in the questionnaire were: colour reproduction, surface properties, gammage, thickness, applicability for finishing options, and customer demands.

5.2.6 Merchants of fine paper and paperboard

During the initial interviews a merchant of fine paper and paperboard, working at Antalis in Stockholm, was interviewed to obtain an understanding of important regarded factors during the material recommendation.

Initial interviews - Merchants

The merchant most commonly prioritised the application's purpose, such as the life expectancy of the application, which surface properties such as whiteness, opacity, roughness and coatings that were desired, if finishing options were going to be applied, which thickness that was desired, and if high printability was desired. Also, environmental impact and manufacturing aspects were highly prioritised factors when recommending an optimal material to a customer. Further, it was explained that paperboard was better to use if many finishing options were going to be applied on the application. Furthermore, it was claimed that the materials manageability was important. This with great respect to the printing process, where aspects such as runnability including ink drying time, cutting, and binding were stated to be essential factors that needed to be considered during material decision.

5.2.7 Summary: Critical factors during the material decision

The highest prioritised factors are summarised in this section.

Customers of fine paper and paperboard applications

- Cost
- Time
- End-result
- Feeling

Advertising agencies

- Customer demands
- Cost
- Time and availability
- Material properties corresponding to desired feeling or printability
- Application purpose and end-result
- Life expectancy
- Finishing options
- Number of copies
- Printing technique and runnability

Graphic design and communication education

- Material properties corresponding to desired feeling
- Application purpose and end-result

Printers

- Quality
- Printing technique
- Number of copies
- Material properties in relation to runnability
- Time and availability
- Cost
- Printability
- Environmental aspects (to certain extent)

Packaging engineers

- Material properties in relation to functions
- Durability and resistance to crack
- Life expectancy
- Application purpose
- Cost
- Manufacturing

Packaging engineering education

- Cost
- Material properties
- Durability and resistance to crack
- Finishing options
- Application purpose

Purchaser of fine paper and paperboard

- Cost
- Application purpose
- Material properties in relation to gained profit
- Environmental aspects
- Quality

Merchants of fine paper and paperboard

- Application purpose
- Functions
- Durability
- Quality
- Material properties
- Printing technique
- Number of copies
- Environmental aspects
- Availability

5.2.8 Analysis: Critical factors during the material decision

The regarded factors that contributed to a certain material decision were found to vary between the different operators and professions in the graphical and packaging industry (see Table 5.2 & Table 5.3). It was also recognised that the factors were niched within the operator's own profession. For instance, the operators within advertising commonly regarded aesthetic material parameters, such as surface structures and tones, that favored the visual elements of the application. The packaging engineers, commonly regarded stiffness and strength that resulted in desired functions in the packaging, while the printers regarded material properties with respect to their machines, that enhanced runnability and printability. Further, whether the operators made a conscious material decision, based on facts or not, varied heavily. However, the found factors regarded by the operators during the material decision, are recognised to relate to four mutual fundamental aspects, which are: time, cost, quality and environmental impact. Hence, providing the right knowledge about important factors to regard to make a conscious material decision, would result in savings of resources i.e. time and cost, and obtaining a higher quality in the end-result including environmental aspects. Although, the important factors to regard during material decision and how these should be prioritised by the operators can be debated.

When further comparing the prioritisation of the four aspects (time, cost, quality and environmental aspects) in the context of each profession, it seems like a higher prioritisation of quality-related factors commonly corresponds to the possessed amount of knowledge about materials (see Figure 5.2). Where quality-related factors are, for instance, high durability, low environmental impact, or high printability. As an example, the packaging engineers, who possess rather much knowledge about materials and their relation to certain functions and processes, were found to prioritise material properties that resulted in a higher quality of the produced application. Subsequently, there is also a relation between which material properties that results in a higher quality, and the application to be produced. For instance, during the material decision for a packaging it is important to regard the material properties that enables creasing and folding without cracking, along with being durable and endure the desired life expectancy. However, when producing a printed sheet those material properties are prioritised differently. Hence, it is important to provide the needed knowledge about factors to regard with respect to the application to be produced, since the prioritisation of material parameters varies depending on this.

However, there is an overall need of understanding how different functions and processes are related to the material decision. For instance, what contributes to higher durability, runnability, printability or performance of finishing options. Also, the relation between how these functions and processes relates to the use of resources and the obtained quality, is needed to be understood by the operators. From the interviews it can be concluded that knowledge concerning the following subjects needs to be provided: the importance of making a conscious material decision, how to make a conscious material decision, the consequences of a certain material decision expressed in used resources and gained quality, the difference between fine paper and paperboard, material properties, surface properties including coatings, printing techniques, runnability, printability, durability, finishing options, environmental impact, and the relation between these factors.

Table 5.2 *The factors regarded (by customers, advertising agencies, education advertising agencies and packaging engineers) during material decision for fine paper and paperboard applications can be found in this figure. It can be seen that the regarded factors somewhat differs in-between the professions. The different factors are also found to relate to the fundamental aspects of time (blue), cost (yellow), quality (pink), and environmental aspects (green).*

Table 5.3 *The factors regarded during (by education packaging engineers, printers, merchants and purchasers) material decision for fine paper and paperboard applications can be found in this figure. It can be seen that the regarded factors somewhat differs in-between the professions. The different factors are also found to relate to the fundamental aspects of time (blue), cost (yellow), quality (pink), and environmental aspects (green).*

EDUCATION PACKAGING ENGINEERS

Cost
Quality not prioritised

Material properties
Prioritised strength
Prioritised surface:
-Printability
Prioritised crease- and foldability:
-Resistance to crack (corners)
Prioritised durability:
-Withstand environments
Prioritised finishing options
Prioritised stiffness
Runnability

Material properties less important
Prioritised visual design

Quality
Strived application purpose:
-Reflect the contents
-Reflect the brand

PRINTERS

Runnability
Prioritised price
Prioritised time

Printing process
Prioritised material properties
Short provided time

Cost
Limited budget
Quality not prioritised

Time
Short deadlines
Quality not prioritised
End-result not prioritised
Prioritised availability
Prioritised runnability

Availability
Prioritised time

Quality
Price not prioritised
Prioritised end-result

Material properties
Prioritised end-result
Strived application purpose:
-Feeling
Prioritised surface:
-Readability
-Printability
Prioritised stiffness:
-Fiber properties
Prioritised ink drying time
Prioritised finishing options:
-Fiber orientation
Prioritised runnability

Environmental aspects
Price not prioritised
Prioritised customer demand

Environmental aspects less important
Prioritised price
No customer demand

MERCHANTS

Material properties
Prioritised durability:
-Resistance to aging
Prioritised finishing options
Prioritised end-result
Prioritised application purpose:
-Printability
-Feeling
Prioritised surface:
-Opacity
-Whiteness
-Coated/Uncoated
-Roughness
Prioritised crease- and foldability
Prioritised barriers:
-Food packaging
Prioritised strength
Prioritised bulk
Prioritised purchaser's demands:
-Purchaser's knowledge
Prioritised runnability

Time
Material is ordered late

Availability
Prioritised time

Application purpose

Environmental impact
Prioritised material properties
Short transports of material
Prioritised production of material

Environmental aspects less important
No customer demand

PURCHASERS

Cost
Printability not prioritised
Prioritised conveying of message
Prioritised customer demand
Quality not prioritised
Short life expectancy

Application purpose

Material properties
Prioritised profit:
-Increase quality
-Increase whiteness
-Include finishing options
Prioritised durability:
-Endure purpose
Prioritised colour reproduction
Prioritised surface properties
Prioritised grammage
Prioritised thickness
Prioritised finishing options
Prioritised feeling

Environmental impact
Eco-labels desired
Transport distances regarded

Environmental aspects less important
Desired to look "environmental

Cost
Time
Quality
Environmental aspects

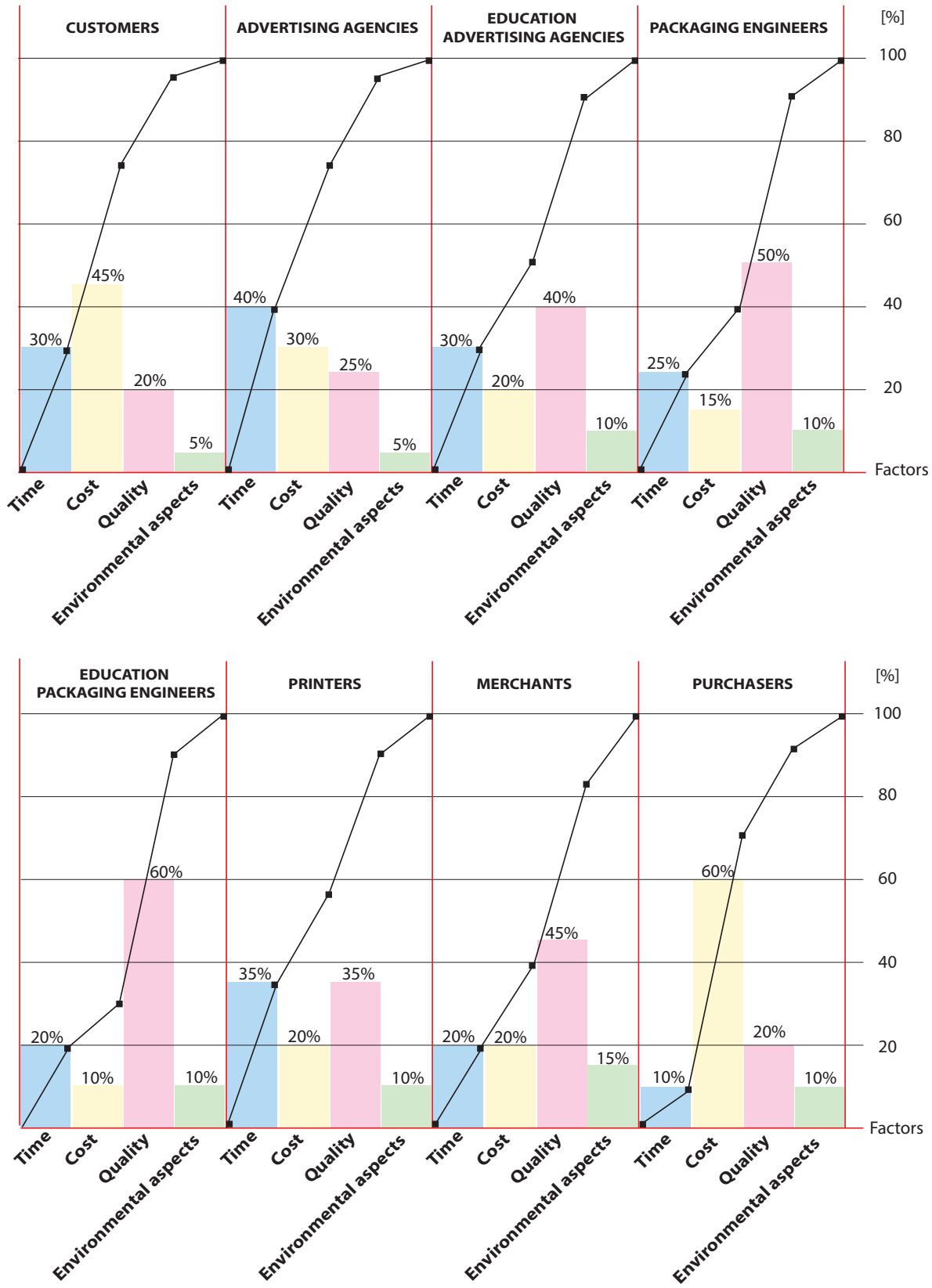


Figure 5.2 *The figure presents the prioritisation of the four fundamental aspects: time, cost, quality, and environmental aspects, within each profession.*

Further, it is also important to provide knowledge about how to obtain, and the importance of obtaining, quality through the material decision even if this is not prioritised in the application to be produced. Also, it is important to explain that a more expensive material, might not necessarily be equivalent with a higher cost if a holistic view is considered such as regarding runnability, printability and durability of the application. Instead the contrary phenomenon, applying a less expensive material, can in fact result in a higher cost and longer needed time, due to lower runnability, printability and durability. As an example, the material decision for a low budget printed sheet, e.g. direct advertising, might not be consciously made since it is believed not to have an impact on the lower quality application. Merely cost was found to be considered when deciding material for these applications. However, by understanding how to gain an optimal end-result in relation to the money spent through a certain material decision, it could enhance the application's conveyed message and generate new/more customers, and subsequently increase the profit. Further, it was found during the interviews that the used material for e.g. a menu or business card, reflects on the impression of the company and thereby how the customer perceives the company. It was also found that when poor material decisions were performed it resulted in more work for the employees. For instance, it occurred that a less durable material was applied for price tags in food stores, this resulted in the tags breaking and falling off and thereby had to be reattached, i.e. more work for the employees and subsequently higher costs and more time needed. These aspects further establishes the importance of making a conscious material decision with emphasis on quality in relation to the money spent.

In addition, as a consequence of the lack of knowledge about a material's environmental impact, the advertisers seldom set demands on environmental aspects. Subsequently, the customer did not set demands on environmental aspects either, which also is an example of how the knowledge is transferred between operators. Although, it frequently occurred that applications were desired to look "environmental friendly". Hence, there is a need to mediate the importance of regarding environmental aspects during material decision, and which factors that needs to be regarded. By including information about this, it could increase the awareness of how to assure a low environmental impact for a certain application through the material decision. Also, there is a need to foster demands on environmental aspects to assure that this is regarded during material decision and communication.

Conclusions

There is a need to provide the right knowledge about important factors to regard to enable a conscious material decision.

- There is a need to relate the important factors to regard with the application to be produced.
- There is a need to provide an understanding of how different functions and processes are related to the material decision.
- There is a need to provide an understanding of how the material decision relates to the use of resources and the obtained quality.
- There is a need to provide an understanding of the relation between a qualitative material and the gained profit.
- There is a need to provide an understanding of the importance of regarding, and how to regard, environmental aspects.

5.3 How the material decision is performed

Regarding the how the material decision procedure is performed, it was found to vary among the operators in the graphical and packaging industry. The following section presents how the material decision is performed by the investigated operators in the industry.

5.3.1 Customers of fine paper and paperboard applications

No customer of fine paper and paperboard applications was interviewed directly, although a lot of information about the customers' material decision procedure was obtained implicitly through the various operators in the graphical and packaging industry at the initial interviews.

Initial interviews - Customers

The customers were found to commonly outsource the material decision procedure to operators within advertising, printers, or merchants of fine paper and paperboard. However, an operator within advertising claimed that, when book covers were developed in collaboration with big publishing companies, the publishing company itself possessed the needed knowledge regarding material decision since they had printers working at their company. However, the material decision could occasionally be discussed between the advertising agency and the company's own printers if necessary. Further, it was stated that the publishing companies also had material purchasers, who narrowed down the variety of materials to use for the fine paper and paperboard applications.

5.3.2 Advertising agencies

Five operators within advertising agencies in Gothenburg and Stockholm, and one graphical design and communication teacher at Beckman's College of Design in Stockholm were interviewed during the initial interviews. Four operators within advertising agencies and a student within art directing at Bergh's School of communication in Stockholm were interviewed at the further interviews. This section presents the operators' material decision procedure.

Initial interviews - Advertising agencies

It was found during the initial interviews that advertising agencies most commonly inquired external assistance from primarily printers, in order to decide an appropriate material for fine paper and paperboard applications. It was stated that customers sometimes expressed their ideas concerning the desired end-result, that the advertising agency subsequently could refine and develop. The developed concept was then communicated by the advertising agency, including desired finishing options, to the printer. The printer, in turn, proposed different suitable materials and manufacturing solutions based on cost, availability, and their printing processes. It was also found that some advertising agencies asked the printers about new materials, and printing techniques. This because it was important to understand the existing possibilities to enable an optimal fine paper or paperboard application development. Further, it was stated that it sometimes was needed to explain possible solutions to their customers or why certain solutions were not possible. It also occurred that certain material decisions were discussed with the customer. Although, it was claimed that the material decision usually was not prioritised when discussing the fine paper and paperboard application development with the customer. Further it was found that the material decision was a procedure that needed assistance since the operators within advertising agencies already had many work chores to regard. Hence, it was neither prioritised to put effort into the material decision nor to perform this independently.

It was further claimed that the advertising agencies commonly asked for job estimates from several printers before deciding which one to use, with the cost as settling factor. However, it was expressed by the advertising agencies that the printers sometimes were not clear about what they based the cost of their services on, this had in some cases resulted in confusion and problems. When a printer finally was chosen a sample of the print was sometimes demanded before proceeding with the full numbers of copies. This because the advertising agencies needed to feel and see for themselves how the result would turn out, since this was difficult to foresee regardless of how clear the communication has been.

Furthermore, it was claimed that the merchants, producers and suppliers of fine paper and paperboard often provided information about materials and samples to the advertising agencies, which were beneficial to use as a tool when communicating ideas to the printers. The samples were also used by the advertising agencies alone to get a grasp of applicable materials and how they would reflect the strived end-result, such as image quality or embossing. However, when deciding on a material, the printer's expertise was claimed to be needed in most cases, and in particular when embossing or high demand on colour reproduction was desired. Further, it was found that no advertising agency used any aid, such as a software program, when deciding material. Although, the Internet was frequently used to find information about materials and inspiration. In addition to this, there was, though, one advertising agency that had the knowledge to decide material without external assistance. This operator had a background with a lot of practical experience, e.g. from working at a printing company, and with packaging development.

Further interviews - Advertising agencies

During the further interviews an even more in depth description of the material decision procedure was obtained. The material decision was stated to be performed by using material sample books, and asking merchants and printers for information and dummies, similar to the procedure described during the initial interviews. It was further stated, by one operator within advertising, that the printer was decided first, and then the material. An important factor when deciding which printer to collaborate with, was claimed to be the relationship with the printer. It was stated that it should be easy to communicate and that the printing process should run quick and smooth. Further, one advertising agency said that they often collaborated with printers abroad due it being more affordable. It was claimed that it could reduce the price up to 50%, however, more time was required instead. Furthermore, if the selected printer could not provide a desired material, a similar material was often used instead. Also, it was stated by another operator that their customers sometimes had contracts with printers, and hence, collaboration with these printers was required. In addition, another operator claimed that they collaborated with various printers depending on the project, and that they could change printer due to lack of desired material. It was also claimed that the printer sometimes outsourced projects to other printers, commonly printers abroad.

Regarding using alternative materials, it was stated that it could affect the end-result negatively. For instance, if the grammage was lower than desired it could result in the application not being perceived as luxury. This occurrence was also claimed to be a consequence of misunderstandings in the communication. In addition to this, one operator said that the printers often recommend standard materials, and the properties of these were learned by heart through experience. Although, questions about material and printing costs were frequently asked to the printers. Further, it was explained that procurements often was performed regarding quality of, for instance finishing options, and cost. Further, another operator stated that the packaging for foodstuff rarely was produced in Sweden due to economical reasons. The most packaging applications were instead produced in other parts of Europe and China.

Regarding the development of the visual elements, it was explained that an original often was created from a desired inner feeling of what the application should convey. Due to this the material decision was claimed to be an obvious choice, since it should match the overall purpose of the application. For instance, it was explained that a yellowish material have a more luxurious feeling than a white one, this was claimed to be something that one "just knows". Further, this operator used material sample books to find suitable materials, but also based a lot of the material decisions on experience from previous projects. In addition, another operator stated that a strived feeling of a material often was described to a specialist in packaging technology, who in turn, recommended some alternatives. Furthermore, it was stated that during the material decision, the graphic design and strived feeling of the end-result was kept in mind along with the application's purpose. However, during the material decision the surface properties: coated or uncoated, were mainly elaborated. Also, the features colour reproduction and readability were considered during the material decision. The thickness and grammage of a material was explained to be relevant if the product should run in a copier machine. The configuration of the application's purpose was also stated to be regarded during material decision, for instance, if the application was going to be a book, features such as opacity was considered. In addition, an operator stated that it was important with high quality, and that repro department was conducted, along with demanding colour samples and making repeated adjustments when developing books. Whiteness was further expressed to be related to the feeling of an end-result.

Regarding the development of graphic design for fine paper and paperboard applications, it was described that it required many adjustments and testing of the colours on samples. This was also recognised from the initial interviews. Although, it was further stated that it was not always possible to produce initial samples due to the limited time provided for the development work. In addition to this, it was explained by another operator within advertising, that sample printing was not performed since it did not reflect the actual feeling of the application, and merely was misleading. It was stated that a sample print was performed on a random coated material, and not the actual material. Instead, experience was claimed to be necessary to foresee an end-result such as an uncoated material giving a more subdued expression. It was also added that sample printing was an expense, and hence avoided due to that. In contradiction to this, it was found, from another operator, that sample prints gave a hint of how the end-result would turn out. It was further explained that some customers demanded a sample of the printed application before proceeding with the entire production. However, this demand was far from common, the majority of the customers were claimed to trust the printer and did not interfere in the process. Although, if an idea regarding the application was difficult to explain to the customer, samples were often used. Further, it was stated that when high-end applications were produced, samples of the result were often provided before proceeding with the full production. Furthermore, it was claimed, by another operator, that there seldom occurred any errors in the initial printed samples, and that it was enough to just view the pdf-files i.e. no samples were claimed to be needed.

In addition, it was explained that some projects originated from similar graphics, such as projects with loyal customers, where the images and colours were known to be approved from previous projects. However, projects could also treat completely new knowledge such as developing a rather different label for a bottle.This project was stated to differ a lot from common project since the operator needed to investigate what was possible to apply before proceeding with the graphic design. Hence, the development of the label was driven by techniques, machine capacity and material properties which were needed to be investigated in advance. Further, another operator expressed a desire to put more effort into material decision, and explained that this was not possible due to limited time and lack of interest from the customer's point of view. It was claimed that the customers seldom debated over material decisions. One operator within advertising, did though, prioritise material decision, and always kept this in mind during the development work. This operator believed that the quality of the applications was very important. It was further stated that the customer did not understand the benefit from choosing a

more qualitative material when only verbally explained, the customer needed to see and feel the material in order to understand the value of this material decision. Due to this, the operator claimed to always bring samples of materials when discussing material manners with the customer. However, it was stated by this operator that during the development work it is important to try out the materials, and this was done beyond only using the material books. In addition, another operator within an advertising agency explained that their project manager lacked knowledge regarding material decision. This resulted in the manager promising features that were not possible to produce. The problem was then transferred to the production manager.

Regarding customers that demands high quality e.g. accurate colour reproduction, certain feeling and resilience in the material, it was stated that high performance materials from well established brands were used. It was stated by an operator within advertising at a rather small agency, that when new customer relations were initiated, the work usually originated from job estimates with specified time and cost. In contradiction to this, when projects were carried out in collaboration with loyal customers time and cost were seldom set in advance. However, if a large number of copies was going to be produced the customer often demanded an approximate cost and time in advance. It was also said that the event of a desired material being out of stock was often taken into account during the planning of the project, and hence this occurrence did not cause any surprises. When finishing options, such as embossing or partial varnishing, were included in the application, the printer was often consulted for more information regarding appropriate materials. This fact was also identified during the initial interviews. Further, it was stated that the desired surface property in terms of roughness, coated or uncoated etc. was explained to the printer, and used as an originating factor when deciding material. If a unique material was desired, samples of that material was often demanded, to investigate if the material's properties matched the desired ones.

Regarding packaging products, it was explained that the customer decided material for these applications. It was further said that the customer commonly collaborated with the packaging producers when deciding material. Hence, the material was often set before the graphic design of the packaging. Further it was stated, by an operator within an advertising agency, that it was common that the end-result differed from the desired one due to a poor material decision in terms of printability. This was not identified until the product was printed. Furthermore, when a graphic design for a packaging was developed, it was explained that the surfaces (which were going to be designed) was set out at an initial stage. The dimensions of these surfaces were calculated by a packaging engineer before the advertising agencies were contacted. It was explained that the specialist in packaging technology informed about the material loss during creasing and folding i.e the material that is lost due to the creases taking up material when being produced, which had to be regarded when developing the graphic design. In addition, it was stated that folders could crack in the creases, and when these were in a dark colour it was very obvious. However, which factors to regard in order to avoid this occurrence were not known, and subsequently how to avoid this occurrence was stated to be tested through trial and error.

No assisting tool, such as a software, was used during material decision, which also was recognised from the initial interviews. However, it was stated by one operator that they used tools, developed by fine paper and paperboard merchants, some years ago. These tools contained tables with material indices and cost. It was further explained, by this operator, that these tools were not needed today and that the needed information could be obtained from material sample books.

Graphic design and communication education

The interviewed student, that was studying to become an art director at Bergh's School of communication in Stockholm, mainly performed graphic design related tasks. It was explained that projects often aimed at developing concepts and campaigns. Further, it was stated that their current project was carried out in collaboration with a retail chain. In this project, it was claimed that material was prioritised, and always a present factor during the project. The material decision was explained to originate from the retailer's (customer's) focus, and in this case that concerned a health and environmental focus.

Further, it was found that the art director student did not know where to turn in order to purchase the desired materials. However, the material merchants Antalis, Papyrus, Matton and Kreatima was claimed to be consulted regarding material decision. This often resulted in their material decision originating from the stores selection of materials. In addition to this, it was claimed that the main task within the student's education was to design the visual elements, and that repro department were the ones who commonly decided material. Further, it was stated that the development work often was carried out within teams, and a dialogue regarding material was held with the designer of the original.

Regarding assisting tools for material decision, it

was stated that this was not used. Including material sample books. Instead, merchants were consulted as mentioned earlier, along with research on the internet. Also, previous experience and used materials were often regarded when deciding material.

5.3.3 Printers

Two operators within printing agencies in Gothenburg were interviewed during the initial interviews, and one specialist in printing technology working at a large printing agency in Stockholm was interviewed during the further interviews. This section presents the operator's material decision procedure.

Initial interviews - Printers

The printers were found to gain knowledge about how to decide optimal materials for different applications through practical experience i.e. by trying out different materials and printing processes. It was stated that new materials always were tried out before it was added to their material recommendations, since this was the only way to tell whether a material was good or not. Further, it was claimed that it is impossible to measure a material's quality e.g. resistance to cracking during creasing, without practical testing. The merchants of fine paper and paperboard were primarily the ones who introduced new materials to the printers. In addition, it was claimed by an operator within an advertising agency that the printers usually attend fairs to get information about materials and printing techniques, their gained knowledge was then transferred to the advertising agencies.

When deciding on a material the printer often considered the finishing options that were going to be performed, and therefore regarded the fibre orientation as a very important factor. For instance, it was stated that horizontal brochures needed to have reversed fibres in order not to crack during folding. Further, it was claimed that most producers of fine paper and paperboard set the margins too low regarding a material's ability to be creased. This to make sure that the material did not crack during creasing, hence it was often possible to crease materials with even higher grammage than was stated by the producers according to the operator. One of the interviewed printers only performed digital printing. This operator claimed that efficiency was the most important parameter concerning printing processes and material decision. Further, this operator explained that it was too expensive to keep a stock with a lot of materials, and therefore always kept only five standard materials in house. Furthermore, it was stated that the customer decided between the material's surface properties silk, gloss or matt, upon which the printer then decided which material to use. It was also claimed by an operator performing offset printing, that the material decision was based on both the customers' wish and runnability. Further it was found that the big companies usually asked many questions before proceeding with a printing job, it was stated that the printer then assisted the company in similarity to a consultancy service.

Further interviews - Printers

During the further interviews it was explained, by the specialist in printing technology at a big printing agency i Stockholm, that the most common customers today were direct customers from marketing departments. This was said to be a change, since it previously had been advertising agencies, graphic designers and photographers who were the most frequent customers of the printers. These operators, in turn, had customers within, for instance, marketing. It was further explained that customers often lacked knowledge regarding materials in general, and subsequently they were not familiar with the terminology regarding material properties. This caused confusion and misunderstandings. For instance, a customer could express a demand for a matt surface which is a coated material, but actually mean an uncoated material since this is perceived as matt. Further, it was stated that customers often expressed that they wanted a "thicker" material, but could not refer to how thick material they wanted. However, it was claimed that customers in general seldom decided material, and that the printer recommended a material in the job estimate, and assumed that the customer knew what they were agreeing to. It occurred that the customer asked for dummies or samples if they were unsure about a recommended material.

The specialist in printing technology further explained that they kept materials in stock before, but nowadays they rather ordered the materials just in time for their everyday production, due to economical reasons. It was stated that they also discarded all leftover material from the printing process instead of keeping it in stock, this also due to the high cost of keeping a storage. Although, it was also stated that few frequently used qualities were kept in stock as their in-house materials. The specialist in printing technology further explained that they purchased their materials from Antalis[7]. Material orders were usually purchased before 11 a.m. every day, and delivered during the afternoon or the next day. However, some qualities were not available in short notice, but this was claimed to be apparent when placing the order since those materials were marked out with further delivery information. It was also

7 Antalis is a distributor, available around the world, of packaging solutions, paper, and visual communication products for professionals (Antalis[4], 2014).

added that the printing agency had another agency located in another city where they kept a large stock.

In addition, it was stated that the material books with samples that the advertising agencies used, sometimes contained materials that were not produced anymore. This resulted in the operators within advertising desiring materials that were unavailable. In some cases similar materials could be recommended, but it also occurred that the operators within advertising had to completely rethink their idea. It was expressed, by the specialist in printing technology, that there exists a lot of different material qualities, which was perceived as confusing. Regarding new materials, that sometimes were demanded by customers, the printer explained that these often had to be tried out before applying them to the applications. The material then turned out to be either applicable for the desired end-result, or not. It was expressed that it would be beneficial to have a department at the printing agency, that constantly tired out new materials, and developed material indices. Although, this was not possible due to lack of time. In addition, no assisting tool was used when deciding suitable materials for certain applications, it was expressed that "we just know".

5.3.4 Packaging engineers

One packaging engineer in Veddige within medical packaging, one customer also acting as packaging engineer of food packaging in Stockholm, and one packaging engineering teacher at Broby Grafiska College of Cross Media in Sunne were initially interviewed. During the further interviews one professor within packaging technology at the Royal Institute of Technology in Stockholm was interviewed. Their material decision procedure is presented in this section.

Initial interviews - Packaging engineers

At the initial interviews it was explained that the packaging engineers most commonly calculated the required material properties, originating from the application's purpose and functions, in order to decide material. It was stated that, recycled fibres were used when the packaging to be produced should have a low cost, and not due to environmental aspects. Regarding disposable packages, it was claimed that the material did not matter and that any material would do since the package is quickly thrown away. When the desired properties of a material were identified, the material was decided by using tables, datasheets, consulting their material purchasers or material experts, and additional internet searching. No aid in terms of a software was used during the material decision approach. However, a need for an assisting tool comprising information about material properties was expressed. Further, it was found that material samples were crucial in order to enable a material decision, due to it being vital to try out the materials before making the selection. It was also stated that seminars about materials sometimes were held at the company which one could choose to attend.

In the food industry, it was stated that the customers sometimes set demands on certain materials associated with desired functions. The customers were also claimed to request materials with low environmental impact. In addition to this, it was claimed by another packaging engineer that the customers who demanded certain materials always had the final decision in the matter. Further, it was stated that the customers lacked knowledge about the processes carried out by machines, which caused difficulties when discussing material decisions. According to one packaging engineer, a material that was decided upon was ordered from cooperating material suppliers. It was also stated that the material purchasers, at the company, were the ones who had the final opinion regarding material decision, and that they sometimes lacked knowledge. Further, it could occur that a desired material was out of stock or not able to be delivered in time. At situations like these an alternative material with similar properties could be used instead. However, some packaging engineers claimed to always keep a stock with the most frequently used materials to avoid this kind of situations.

Further, it was expressed by several packaging engineers to be inconvenient with the many operators involved in the material decision procedure. It was claimed to be time consuming and that it could cause misunderstandings. It was also stated that there seldom was given an occasion for discussions about materials due to it being a too detailed phase in relation to the packaging development process. In addition, it was expressed that knowledge about materials were lacking in several professions, such as among the operators at the advertising agencies.

Packaging engineering education

Regarding the operators within the packaging engineering education, it was explained that the students gained knowledge about applicable materials for certain end-results through practise. This was done by testing various materials in their machines and investigate how it turned out. Education about fine paper and paperboard was most commonly provided by lecturers from the producers of fine paper and paperboard, since they were claimed to possess the sharpest knowledge about that manner.

Further interviews - Packaging engineers

The packaging technology professor at Royal Institute of Technology, explained that when a common

packaging was developed, merely one suitable material was not preferred to be decided. Instead, it was more beneficial to specify material properties, and decide materials based on these. This because it enabled purchasing suitable materials to a minimum cost. However, it was further explained that many operators within the packaging industry lacked knowledge regarding which parameters that controlled the desired material properties. In addition to this, it was stated that large packaging producing companies had the resources to investigate material properties. However, many companies did not possess these resources and subsequently lacked knowledge. It was also explained that a lot of operators were involved in the packaging development process. This in conjunction with lack of knowledge resulted in great problems that affected time, cost and quality negatively, which also was revealed during the initial interviews. It was further illuminated, by the professor, that some producers of machines for fine paper and paperboard applications did not understand the properties of the materials.

5.3.5 Purchaser of fine paper and paperboard

During the further interviews a material purchaser working within the food industry was interviewed. The main purchased materials were applied in packaging, advertising distributed directly to the consumers i.e. direct advertising, and magazine productions.

Further interviews - Purchaser

The purchaser within the food industry stated that the material decision was performed by different operators, depending on the project. It was claimed that a cross-functional team performed the material decision. Further, it was explained that a strategic agency expressed desired material properties, and that the purchaser, production manager, sometimes an operator performing graphic design, and the customer discussed this manner. It was furthermore stated that the production manager usually discussed the material decision with the customer by providing samples and information. The customer often listened to advice if they got the opportunity to receive them. It was also claimed that a dialogue between the designer of the original and the printer was set up, this because it was believed to be better if they understood each other. In addition to this, it was stated that the main information usually was obtained from the printers and material purchasers, and that the production manager lacked knowledge regarding materials. Further, it also occurred that the printer decided material, and the accompanying fine paper or paperboard merchant e.g. Svenskt papper/Map[8], Papyrus, Multi-art by Papyrus, Tom-Otto by Antalis. A printer was chosen according to their expertise, meaning that if an embossing was desired, a printer who had experience of this was selected. This because it was believed that an end-result with higher quality would be obtained. When direct advertising was developed it was stated that they purchased their material on their own and delivered to the assigned printer. However, if a printed sheet application was going to be produced, they did not purchase the material on their own.

Regarding fine paper, it was claimed by the purchaser that the merchants constantly tried to increase their prices. However, the printers collaborating with the purchaser's company usually bought fine paper from other merchants when this occurred. It was stated that there always was one merchant who offered a competitive price. However, it was explained that the material cost of fine paper in general was rather small in relation to the provided budgets of the different advertising projects carried out at the purchaser's company. It was stated that the cost for their printed products were about SEK 20-30 million per year, and that the material accounted for one third of that cost. It was further claimed that this was a small amount of material in relation to what a big printing agency consumed. Also, it was explained that the cost of the material was about 50% of the total budget when it comes to direct advertising, this did though include the printing process.

Regarding paperboard it was stated to be used in their packaging, billboards, and magazine covers. Further, it was stated that solid board often was used in their magazine covers. The purchaser within the food industry further explained that if only cost was regarded when deciding material, it usually resulted in lack of durability, and subsequently broke after a brief service time. Further, it was explained that it was the producer of the foodstuff that decided material for the packaging. However, if an application was produced on their own behalf, such as their own foodstuff, it was usually the printers who got the task to decide material for the packaging. Although, it did happen that the purchasers were consulted when a packaging was produced within the company. At situations like these, cost was always a present factor and whether a more expensive material was chosen depended on the application that was going to be produced. A "perfect" end-result, in terms of perfect 90-degree corners on their packaging, was seldom strived. However, it was stated that the creative professionals e.g. graphic designers, copywriters and art directors, often desired a high quality result.

Further, the purchaser explained that fine paper and paperboard applications were produced with more effort for big campaigns, bakery and catering adver-

8 Antalis is the current name of the former Svenskt papper/Map

tisement. It was stated that more freedom regarding materials was obtained at these events, and samples often were used during these projects. In addition, it was claimed that it otherwise seldom occurred that they demanded a first print on a sample since it was too expensive. It was also explained that a material had to be ordered at least six weeks in advance, this knowledge was not possessed by every operator at the interviewed purchaser's company. It was also claimed that they sometimes used the paperboard quality "Invercote G[9]" for postcards in A5 or A6 format. This because the obtained result was better, and it was stated to add value to the application. No assisting tool was used during the material decision procedure, it was claimed that old knowledge was applied instead.

5.3.6 Merchants of fine paper and paperboard

During the initial interviews a merchant of fine paper and paperboard, working at Antalis in Stockholm, was interviewed to obtain an understanding of the material recommendation procedure.

Initial interviews - Merchants

The merchant of fine paper and paperboard stated that the printers lacked knowledge about fine paper and paperboard "at a deeper level". The printers were claimed to have good knowledge concerning the different qualities' runnability and printability performed by their machines, but lacked knowledge about the qualities that they did not use as frequently. This could therefore lead to the printer making an incorrect material recommendation to their customer. Further, It was also found that the merchant of fine paper and paperboard had a material selection tool on their website. The tool provided applicable materials to the aimed application's purpose by letting the user distribute ten points between ten desired parameters e.g. low cost, high stiffness and good opacity. The tool then generated suitable materials originating from the customer's prioritisation of parameters. It was claimed that the tool worked excellent if the user strived a scientific material decision.

Furthermore, it was found that the merchant's customers often had requirement specifications containing desired material properties. However, the requirement specification usually contained a lot of requirements; approximately eight requirements. Due to this, the merchants commonly recommended the customer to narrow it down to two or three main properties. It was common that the customer had to compromise between different requirements. This procedure was often carried out through a dialogue between the merchant and the customer. Regarding food packaging, It was stated that it generally was the packaging's purpose that preceded the desired material properties, e.g. resistance to damp, and not the material properties in terms of printability or strength.

5.3.7 Summary: How the material decision is performed

A summary of the material decision procedure is presented in this section.

Customers of fine paper and paperboard applications

- The material decision procedure is outsourced to operators within advertising, printers, or merchants of fine paper and paperboard.
- Big publishing companies can possess the needed knowledge to perform the material decision on their own.
- The material decision is occasionally discussed between the advertising agency and the customer.
- The publishing companies has material purchasers, who narrows down the variety of materials to choose from.

Advertising agencies

- Commonly inquired external assistance from primarily printers, to decide an appropriate material for their fine paper and paperboard applications.
- Merchants, producers and suppliers of fine paper and paperboard often provide information about materials and samples, which are beneficial to use as a tool when communicating ideas to the printers.
- The internet is frequently used to find information about materials and inspiration.
- The material decision is a procedure that needs assistance since the operators within advertising agencies already have many work chores.
- The developed design concept is communicated by the advertising agency, including desired finishing options, to the printer. The printer propose different suitable materials and manufacturing solutions based on cost, availability, and their printing processes.
- Questions about material and printing costs are frequently asked to the printers.
- The printers are sometimes not clear about what they base the cost for their services on, this results in confusion and problems.
- Some operators ask the printers about new

9 Invercote G is a solid bleached board (SBB), produced by Iggesund Paperboard AB, with a triple coated printing side (Iggesund Paperboard, 2013).

materials and printing techniques because it is important to understand the existing possibilities to enable an optimal development of a fine paper or paperboard application.

- No assisting tool, such as software programs, are used when deciding material.
- There is a need to use all senses to investigate how the result will turn out, since this is difficult to foresee regardless of how clear the communication has been.
- A similar material is used if a desired material is not available.
- Using alternative materials can affect the end-result negatively. For instance, if the grammage is lower than desired it can result in the application not being perceived as luxury. This occurrence is a consequence of misunderstandings in the communication.
- The relationship with the printer is very important. It should be easy to communicate and the printing process should run quick and smooth.
- The development of the graphic design for fine paper and paperboard applications require many adjustments and testing of the colours on samples. Although, it is not always possible to produce initial samples due to the limited time provided for the development work.
- There is a desire to put more effort into material decision, although this is not possible due to limited time and lack of interest from the customer's point of view.
- The material decision is an obvious choice, since it should match the overall purpose of the application.
- Sample printing is an expense, and avoided due to that.
- It is sometimes needed to explain possible solutions to customers, or why certain solutions are not possible. If an idea is difficult to explain to the customer, samples are used.
- The customer does not understand the benefit from choosing a more qualitative material when this is only verbally explained, the customer need to see and feel the material in order to understand the value of this material decision. One operator always brought samples of materials when discussing materials with the customer.
- The material is often set before the graphic design of a packaging.
- It is common that the end-result differs from the desired one due to a poor material decision.
- How to avoid cracks during creasing and folding is tested through trial and error.

Graphic design and communication education

- The material is prioritised, and always a present factor during some projects.
- The material decision originates from the customer's company profile.
- Does not know where to purchase desired materials.
- Material merchants are consulted regarding material decision, this often results in the material decision originating from the stores selection of materials.
- The main task is to design the visual elements, the repro department decides material.
- The development work is often carried out within teams, and a dialogue regarding material is held with the designer of the original.
- No assisting tools are used during material decision.

Printers

- The printers decide optimal materials for different applications by trying out different materials and printing processes.
- New materials are always tried out before being added to the printers' material recommendations, since this is the only way to tell whether a material was good or not.
- The merchants of fine paper and paperboard are primarily the ones who introduce new materials to the printers.
- When deciding material the desired finishing options are regarded.
- Efficiency during the printing process is very important when deciding material.
- The customer decides between the material's surface properties, upon which the printer then decides which material to use.
- The material decision is based on both the customers' wish and runnability.
- Big companies usually ask many questions before proceeding with a printing job, the printer then assisted the company in similarity to a consultancy service.
- Customers lack knowledge regarding materials in general, and subsequently are not familiar with the terminology regarding material properties. This cause confusion and misunderstandings.

- Customers seldom decide material, the printer recommended a material in a job estimate, and assume that the customer know what they are agreeing to.
- Customers ask for dummies or samples if they are unsure about a recommended material.
- Does not keep materials in stock due to economical reasons, order the materials just in time for their everyday production instead.
- The material books with samples, that the advertising agencies use, sometimes contain materials that are not produced anymore.
- In some cases similar alternative materials, to the desired material, are recommended.
- Customers sometimes have to completely rethink an idea if it is not applicable.
- It exists a lot of different material qualities, this is confusing.
- It would be beneficial to have a department, at the printing agency, that constantly try out new materials and developed material indices. This is not possible due to lack of time.
- No assisting tool is used when deciding suitable materials for a certain application.

Packaging engineers

- Most commonly calculate the required material properties, originating from the application's purpose and functions to decide material.
- Use tables, datasheets, consult their material purchasers or material experts, and search the internet to find desired material.
- No aid in terms of a software is used during the material decision.
- Recycled fibres are used when the packaging to be produced should have a low cost, and not due to environmental aspects.
- The material does not matter when developing disposable packaging.
- A need of an assisting tool comprising information about material properties is expressed.
- Material samples are crucial to enable a material decision, due to it being vital to try out the materials before making the selection.
- In the food industry, the customers sometimes set demands on certain materials associated with desired functions.
- The customers or material purchasers have the final decision regarding which material to use, these operators lack knowledge.
- The customers lack knowledge about the processes carried out by machines, this cause difficulties when discussing material decisions.
- It is inconvenient with the many operators involved in the material decision procedure, since it is time consuming and causes misunderstandings.
- When a common packaging is developed, merely one suitable material is not preferred to be decided. Instead, it is more beneficial to specify material properties, and decide materials based on those.

Packaging engineering education

- Decides applicable materials for certain end-results through practical testing.

Purchaser of fine paper and paperboard

- The material decision is performed by different operators, depending on the application to be produced.
- A cross-functional team perform the material decision.
- When the material decision is discussed with the customer samples and information are usually provided.
- The customer often listens to advice if they get the opportunity to receive them.
- A dialogue between the designer of the original and the printer is set up, this because it is better if they understand each other.
- It also occur that the printer decide material, and the accompanying fine paper or paperboard merchant.
- A printer is chosen according to their expertise, meaning that if an embossing is desired, a printer who has experience of this is selected.
- If only cost was regarded when deciding material, it usually results in lack of durability, and subsequently the application breaks after a brief service time.
- The producer of the foodstuff decides material for the packaging.
- If an application is produced on the company's own behalf, such as their own foodstuff, it is usually the printers who get the task to decide material for the packaging.
- The purchasers are consulted when a packaging is produced within the company.
- Cost is always a present factor and whether a more expensive material is chosen depends on the application that is going to be produced.

- A "perfect" end-result, in terms of perfect 90-degree corners on a packaging, is seldom strived.
- It seldom occurs that a first print on a sample is demanded since it is too expensive.
- A material has to be ordered at least six weeks in advance, every operator does not possess this knowledge.
- A certain paperboard quality is used for postcards in A5 or A6 format because the obtained result is better, and it adds value to the application.
- No assisting tool is used during the material decision procedure.

Merchants of fine paper and paperboard

- The printers lack knowledge about fine paper and paperboard qualities that do not have high runnability. This can lead to incorrect material recommendations to their customers.
- Had a material selection tool on their website, the tool provided applicable materials to the aimed application's purpose by letting the user distribute ten points between ten desired parameters. The tool then generated suitable materials originating from the customer's prioritisation of parameters.
- Customers desire too many material properties, the merchants commonly recommends the customer to narrow down the number of desired requirements to two or three main properties.
- It is common that the customers have to compromise between different requirements. This procedure is often carried out through a dialogue between the merchant and the customer.
- Regarding food packaging, it generally is the packaging's purpose that precedes the desired material properties, e.g. resistance to damp, and not the material properties in terms of printability or strength.

5.3.8 Analysis: How the material decision is performed

It was found that the operators within advertising agencies commonly turned to the printers, and merchants or producers of fine paper and paperboard, for assistance during the material decision procedure. Questions about e.g. materials, printing and converting processes, surface properties, and finishing operations could be asked, since the advertisers frequently lacked knowledge about these aspects. The operators also commonly searched for information about materials in various mediums, such as tables, books and on the internet. In some cases, the operators were found to completely rely on the printer to make the optimal material decision for their applications. It was even found that the operators occasionally ordered materials without being aware of what they actually ordered. Further, it was identified that not all printers possessed accurate knowledge about materials, and that the possessed knowledge was concentrated to the materials that the printers frequently handled. Subsequently, it occurred that the printers did not recommend the most suitable material to provide maximum quality in relation to the application's purpose. Instead the printers could recommend a material that, for instance, favoured their own profit, had high runnability in their machines, or was desired to get rid of. Hence, there is a substantial need of assistance during the material decision procedure, which can be obtained through an assisting tool containing information about needed knowledge to perform a conscious material decision. Although, it is important to carefully adjust the amount of information, and which information that should be included in order to enhance the use of the tool, and differentiate the tool from common material information configurations. An increased knowledge about materials would also facilitate the communication, such as the negotiation with the printers, which minimises the occasions of obtaining a non-desired material and subsequent an end result which differs from the desired.

In addition it was found that the operators within advertising agencies commonly used material sample books to enable the use of all senses when discovering suitable materials for their applications during the material decision procedure. It was found to be important to e.g. tear, fold, feel and smell the material in order to investigate whether the material was consistent with the desired feeling or not. Samples of prints was also demanded, in some cases, to get a better insight to an end-result before proceeding with an entire production. From this it can be concluded that the assisting tool needs to be, or contain to a certain extent, physical materials that enables investigation through all human senses. It is also important to regard the format of the assisting tool to enable a convenient use and storage. Further, it was found that sample books also were used when discussing materials, with both printers and customers. In addition, it was common that misunderstandings occurred due to the varying level of possessed knowledge among the operators (see Figure 5.3). The material decision was also claimed to be time consuming due to many operators being involved. Further, it was recognised that the customers frequently outsourced the material decision procedure to the operators within advertising. Although, the customers had the final say in which material to apply, which required a discussion between the ad-

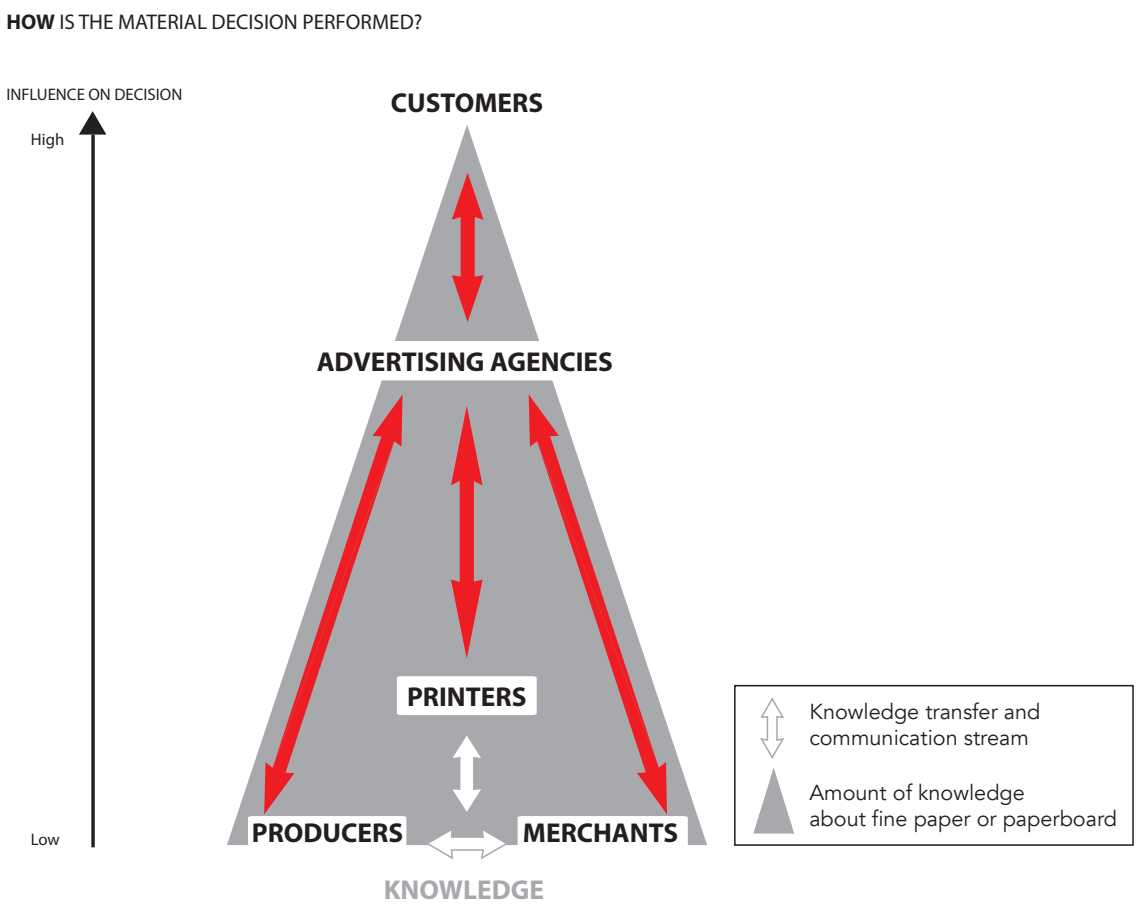


Figure 5.3 *The figure presents the amount of knowledge possessed within each profession, and how the different operators within each profession communicate i.e. transfer knowledge. It is also recognised that the operators with little knowledge have a larger influence on the material decision.*

vertiser and customer. Bearing this in mind, it would be beneficial to develop an assisting tool with emphasis on enhancing the communication and reducing misunderstandings. An assisting tool that provides knowledge that is easy to obtain, could preferably serve as a foundation during communication with various operators. This could also make the material decision less time consuming due to an enhanced understanding. Although, to succeed in developing such a tool, it would be needed so set emphasis on usability, such as clearness of the information in the tool, and how to enhance the knowledge transfer from advertiser to customer.

Furthermore, the most common responses among the operators within advertising was that the material decision originated from an inner feeling and depended on the application's purpose. Hence, the regarded material properties during the material decision are highly subjective among these operators. Further, this inner feeling was also a contributing reason to the perception of a material with low environmental impact being yellowish or brownish and having a rough surface. Bearing this in mind, the provided knowledge and how this is provided in the assisting tool must also be adapted to the operators' own working process, i.e. to the operator's subjectiveness, but still serve as guidance towards a conscious material decision. An approach that would capture this, but also promote an optimal material decision with respect to the use of resources and gained quality, would be to provide enough knowledge regarding materials and processes for the operator to make a conscious material decision of own choice. Hence, the assisting tool for material decision would benefit from displaying the consequences of applying certain materials, in combination with pure facts regarding specific material properties and processes. For instance, material samples that treats e.g. different surfaces' and how they reproduce images, in combination with information about environmental aspects and runnability would be beneficial to include. This approach would enhance the material decision by transferring the underlying factors of the decision from being based on merely inner feelings and perceptions, to actual facts and knowledge about the obtained result, but still let the operator perform a material decision of own choice which

supports the subjectiveness.

It was also found that operators within advertising, commonly desired materials that were not produced anymore when using material sample books during the material decision procedure. This occurrence resulted in the printer or merchant recommending an alternative material. Although, the result when using an alternative material was found to seldom be completely satisfying. From this it can be debated that an assisting tool for material decision, should not include exact material qualities but merely information about different materials' possessed properties e.g. stiffness, strength and smoothness. This approach would also fosters an understanding of the underlying relation between material parameters and obtained features of the end-result e.g. creasability, printability or durability. Also, it enables more alternative materials since desired material properties can be listed instead of specific qualities. In addition to this, it was found that the customers of the merchant of fine paper and paperboard commonly had many requirements regarding material properties. This resulted in the material properties having to be prioritised and narrowed down. Regarding this, it would be beneficial to provide knowledge about which factors that are most important to regard with respect to the application to be produced in order to provide maximum quality to the use of minimum resources.

Further, the merchant of fine paper and paperboard possessed knowledge within several stages in the development process of fine paper and paperboard applications, such as the creative process, printing process, and finishing operations. Subsequently, the merchant recommended materials optimised in terms of e.g. desired aesthetic elements, the application's purpose, number of copies, and printing techniques. Also, a low environmental impact was regarded, with respect to the application's development process and purpose in a holistic manner. From this, a relation between the operator's extent of holistic understanding, and a higher obtained quality of the end-result along with a decreased use of resources is identified. Hence, the assisting tool need to provide holistic knowledge about important factors that need to be regarded with respect to the entire development process of fine paper and paperboard applications. However, it is important to develop the tool in a manner that "forces" the operator to obtain certain information that otherwise would be skipped e.g. printing-related information and material properties. This in order to foster an optimised material decision adapted to every stage in the development process, and thereby obtain savings in terms of cost and time, along with an optimised end-result.

Conclusions

- There is a need to provide assistance during the material decision procedure. This can be provided through an assisting tool containing information about needed knowledge to enable a conscious material decision.
- There is a need to set emphasis on the usability of the tool, such as amount of information, clearness of the information, and which information that should be included in the assisting tool.
- The provided knowledge and how this is provided in the assisting tool must also be adapted to the operators' own working process.
- There is a need to differentiate the tool from common material information configurations.
- The assisting tool needs to be, or contain to a certain extent, physical materials that enables investigation through all human senses.
- It is important to regard the format of the assisting tool to enable a convenient use and storage.
- It is preferred if the assisting tool could serve as a foundation during communication with various operators, and make the material decision less time consuming through an optimised knowledge transfer.
- The assisting tool should not treat exact material qualities but merely (theoretical and practical) information about different materials' possessed properties.
- The assisting tool need to provide holistic knowledge about important factors that need to be regarded with respect to the entire development process of fine paper and paperboard applications.

5.4 When the material decision is performed

When the material decision takes place in the development process of fine paper and paperboard applications differs between the operators and professions in the graphical and packaging industry. Although, both positive and negative consequences are found for either an early or a late material decision procedure. The optimal time of the material decision, in the development process, is identified to depend on the application to be produced.

5.4.1 Customers of fine paper and paperboard applications

No customer of fine paper and paperboard applications was interviewed directly, although a lot of information about the customers was obtained implicitly through the various operators in the graphical and packaging industry at the initial interviews.

Initial interviews - Customers
At the initial interviews, it was stated by an operator within an advertising agency, that customers often demanded applications in the last minute i.e. provided short deadlines. This resulted in the material decision being carried out late in the development process. These projects usually concerned flyers and brochures for fairs that were going to take place in the near future. However, it was also claimed that many customers understood that the development of fine paper and paperboard applications took time, in order to produce something qualitative, and hence provided more time to the projects. Although, during these projects the material decision commonly was carried out at various times depending on the project.

Further interviews - Customers
During the further interviews the customers of fine paper and paperboard applications were claimed, by an operator within advertising, to often demand applications in the last minute. This occurrence was common regarding printed applications to fairs, in similarity to what was found during the initial interviews. Hence, customer's short deadlines often resulted in a late material decision.

5.4.2 Advertising agencies
Five operators within advertising agencies in Gothenburg and Stockholm, and one graphical design and communication teacher at Beckman's College of Design in Stockholm were interviewed during the initial interviews. Four operators within advertising agencies and a student within art directing at Bergh's School of communication in Stockholm were interviewed at the further interviews. This section presents when the operators' performs their material decision.

Initial interviews - Advertising agencies
When the material decision was performed, was found to differ among the operators within advertising agencies at the initial interviews. The main reason for making a material decision late in the process was that the customer had short deadlines and demanded applications with short notice. It also occurred that the design was prioritised before the material. Further, it was found that the operators lacked knowledge about materials in general along with the benefits from deciding a material early, and the subsequent consequences of a late material decision. One operator stated that the material decision was performed in connection with the settlement of the number of copies to be produced i.e. rather late in the process. Many operators who made a late material decision claimed that it would be more beneficial to perform the decision earlier in the process.

There were also operators within advertising agencies who performed the material decision early. This because they had experienced that a late material decision could cause problems such as long material delivery times, resulting in an exceeded deadline or having to use an alternative material. Using an alternative material was claimed to sometimes affect the strived end-result negatively. In addition to this, one operator claimed that it was important not to promise anything to the customer before checking the availability of the material with the printer. Although, a material being out of stock was identified as a minor problem from the advertising agencies in general, and claimed to be a rare occurrence due to the printers keeping a large material stock. Further, the operators who made an early material decision had also experienced the benefits from this in terms of adjustability of colour frames, and ensuring a desired feeling or surface property by ordering the wanted material early. Furthermore, it was stated that an early material decision was performed due to the procedure of the development process carried out at the firm as such. Also, one operator had a background within printing, and therefore claimed to decide material at the start of every project and kept it in mind throughout the development process. It was also stated by various operators that the material decision could take place at different stages depending on the project.

Graphic design and communication education
Within the graphical design and communication education at Beckman's College of Design in Stockholm, it was stated that projects sometimes originated from a set material. This because they usually had collaborations with printers or producers of fine paper and paperboard. It was claimed that a material driven process could be beneficial due to the accompanying restriction of creativity which enabled a narrowed down ideation

Further interviews - Advertising agencies
During the further interviews it was found that, when the material decision was performed varied among the operators within advertising agencies, in similarity to previous findings. The operators who performed the material decision late in the process claimed that this was disadvantageous because materials often has to be ordered in advance, which required unavailable time, and hence an alternative material had to be used.
The alternative material usually was a material that the printer had in house. Further, it was stated that the material decision was carried out late in the process due to short customer deadlines, or customers demanding products in short notice. This is also an aspect recognised from the initial interviews.

One operator within advertising who had a diverse profession, and knowledge within both design and printing, claimed to decide material early. It was stated that an idea of the strived end-result of the application was developed at an initial phase, originating from the customer's restrictions such as colours and graphical profile. The initial idea was then used as a basis when finding the optimal material as early on in the project as possible. Another operator stated that it was better to decide material early in the process because then it was possible to adapt and adjust colour profiles according to the material.

Regarding graphical design of packaging, it was found that the material could be decided either by the customer, the packaging engineer or the operator within the advertising agency. If the advertising agency decided material it was stated that this was performed in connection to the first idea of the strived end-result. The typography, material and strived feeling was then communicated to the customer at an early phase in the project. In the cases when the customer decided material this was stated to be performed before the project reached the advertising agency. The advertising agency was then assigned to merely create the graphic design.

Graphic design and communication education - Student
The operator at Bergh's School of communication in Stockholm, stated that when the material decision was performed varied depending on the project. This because it sometimes was beneficial to originate from a set material, and sometimes the other way around i.e. deciding material accordingly to the graphical design. It was claimed to depend on the application that was going to be produced. The project was at an initial phase analysed and then a working procedure, with either a late material decision or an early decision, was determined.

5.4.3 Printers
During the further interviews a specialist in printing technology, working at a large printing agency in Stockholm, was interviewed. This section presents when the specialist performs the material decision, and when it is believed, by the specialist, to be optimal to perform the decision.

Further interviews - Printers
The interviewed specialist in printing technology, at a large printing agency in Stockholm, said that it was beneficial to decide material as early on in the development process as possible. Preferably during the ideation, since the chosen material and subsequent printing process could be optimised by adjusting the graphical design accordingly. For instance, it was stated that a format that was just one centimetre smaller could reduce the cost of the printing process by a lot, due to a maximised number of e.g. pages, could be fitted and printed on one sheet. Unfortunately, there was seldom any time to debate over these aspects.

Further, it was found that the customers of the specialist in printing technology often wanted the printed applications to be ready in a very short time. In addition, some customers had a good communication with the printer while others did not. It was expressed that the relationship to the customer was very important; the better relationship the better communication and end-result. The reason for not having a "good" relationship and communication with the printer was claimed to be because of limited time. The printers were today merely consulted when the application was going to be printed, which is too late if any changes would be beneficial to propose. This was expressed to be a poor occurrence, due to the knowledge transfer between the two parts being of vital importance to optimise the result of the developed application.

5.4.4 Packaging engineers
One packaging engineer in Veddige within medical packaging, one customer also acting as packaging engineer of food packaging in Stockholm, and one packaging engineering teacher at Broby Grafiska College of Cross Media in Sunne were initially interviewed. During the further interviews one professor within packaging technology at the Royal Institute of Technology in Stockholm was interviewed. When their material decision procedure is performed is presented in this section.

Initial interviews - Packaging engineers
Among the packaging engineers, the material decision was mainly performed early due to the material being of vital importance for the packaging construction. Further, it was stated that an early material decision provided adjustability in functionality which was claimed to be beneficial. Furthermore, an early material decision was claimed to be vital to ensure an execution within the set deadline of the development project. It was found that the many operators involved in the material decision process caused problems due to many of them lacking knowledge, which caused the process to be more time consuming and complex.

Education packaging engineers
From the interview with the packaging engineering teacher at Broby Grafiska College of Cross Media in Sunne, it was claimed that the material decision was performed later in the school projects in comparison to the professional projects. This because they developed most constructions in software programs before the material decision took place. However,

the beneficial aspect of an early material decision providing adjustability in functionality was reflected in the education.

Further interviews - *Packaging technology professor*
The professor within packaging technology at Royal Institute of Technology in Stockholm, stated that the material needed to be decided early in the project if the packaging was going to be complex or unique. It was claimed that it would not be possible to proceed otherwise. Further, it was explained that, when the material decision was optimal to be performed was included in the lectures. However, it was stated that it was difficult to determine an optimal material decision time since it was claimed to depend on the application to be produced.

5.4.5 Purchaser of fine paper and paperboard

During the further interviews, a purchaser of fine paper and paperboard working at an advertising agency with core business in the food industry was interviewed.

Further interviews - Purchaser
The material purchaser expressed it to be problematic that there were many operators involved during the material decision process. It was also stated that the purchase unit at their company was understaffed, and hence lacked capacity to perform the material purchasing as desired. Further, it was explained that this operator wanted to be involved at an earlier stage in the development process of fine paper and paperboard applications. Although, it was added that the development sometimes originated from a set material.

5.4.6 Merchants of fine paper and paperboard

A merchant of fine paper and paperboard working at a store in Stockholm was interviewed during the initial interviews.

Initial interviews - Merchants
The merchant of fine paper and paperboard stated that it was better if the material decision was performed rather early in the development process. This because an earlier decision resulted in finding a better material for the application in terms of material properties and the subsequent end-result. The merchant also believed that the material decision procedure took place too late in the development process in general. Regarding the customers of fine paper and paperboard applications, it was revealed that they lacked knowledge about the development process and therefore demanded applications in a short time and notice.

5.4.7 Summary: When the material decision is performed

A summary of when the material decision is performed, and underlying factors for this, is presented in this section.

Customers of fine paper and paperboard applications

- Often demand applications in the last minute i.e. provides short deadlines, which results in the material decision being carried out late in the development process.
- Some understands that the development of fine paper and paperboard applications takes time, and hence provides more time to the projects.

Advertising agencies

- When the material decision is performed differs among the operators within advertising agencies, and the time of the decision depends on the project.
- The main reason for making a material decision late in the process is that the customer has short deadlines and demands applications with short notice.
- It also occurs that the design is prioritised before the material, which results in a late material decision.
- Lack knowledge about materials in general, along with the benefits from deciding a material early, and the subsequent consequences of a late material decision
- The material decision is sometimes performed in connection with the settlement of the number of copies to be produced i.e. rather late in the process.
- Many operators who make a late material decision claim that it would be more beneficial to perform the decision earlier in the process.
- An early material decision is performed because a late material decision can cause problems such as long material delivery times, resulting in an exceeded deadline or having to use an alternative material.
- The alternative material usually is a material that the printer has in house.
- An early material decision enables adjustability of colour frames, and ensuring a desired feeling or surface property by ordering the wanted material early.
- An early material decision is performed due to the procedure of the development process carried out at the firm as such.

- One operator, with background in printing, decides material at the start of every project and keeps it in mind throughout the development process.
- One operator did not promise anything to the customer before checking the availability of the material with the printer.
- One operator with a diverse profession (design and printing) decides material early, an idea of the strived end-result of the application is developed at an initial phase. The idea is then used as a basis when finding the optimal material as early on in the project as possible.
- The material can be decided either by the customer, the packaging engineer or the operator within the advertising agency when packaging is developed. If the advertising agency decides material it is performed in connection to the first idea of the strived end-result. If the customer decides material it is performed before the project reach the advertising agency.

Graphic design and communication education

- Projects sometimes originates from a set material, due to collaborations with printers or producers of fine paper and paperboard
- A material driven process can be beneficial due to the accompanying restriction of creativity that enables a narrowed down ideation.
- Depends on the application whether material is decided early or late
- The project is at an initial phase analysed and then a working procedure, with either a late material decision or an early decision, is determined.

Printers

- It is beneficial to decide material as early on in the development process as possible, preferably during the ideation. This because the chosen material, and subsequent printing process, can be optimised by adjusting the graphical design accordingly.
- A format that is just one centimetre smaller can reduce the cost of the printing process by a lot, due to a maximised number of e.g. pages, can be fitted and printed on one sheet. Unfortunately, there is seldom any time to debate over these aspects.
- The customers often want the printed applications to be ready in a very short time
- The relationship to the customer is very important; the better relationship the better communication and end-result.
- The reason for not having a "good" relationship and communication with the printer is because of limited time, the printers are today merely consulted when the application is going to be printed.
- The knowledge transfer between the printer and customer is of vital importance to optimise the result of the developed application.

Packaging engineers

- The material decision is mainly performed early due to the material being of vital importance for the packaging construction.
- An early material decision provides adjustability in functionality, which is beneficial.
- An early material decision is vital to ensure an execution within the set deadline of the development project.
- The many operators involved in the material decision process cause problems due to many of them lacking knowledge, which cause the process to be more time consuming and complex.

Packaging engineering education

- The material decision is performed later in the school projects, in comparison to the professional projects, because they develop most constructions in software programs before the material decision takes place.
- The beneficial aspect of an early material decision providing adjustability in functionality is reflected in the education.
- The material needs to be decided early in the project if the packaging is going to be complex or unique.
- When the material decision is optimal to be performed is included in the lectures. However, it is difficult to determine an optimal material decision time since it depends on the application to be produced.

Purchaser of fine paper and paperboard

- It is problematic that there are many operators involved during the material decision process.
- The purchase unit is understaffed, and hence lack capacity to perform the material purchasing as desired.
- Wants to be involved at an earlier stage in the development process of fine paper and paperboard applications.
- The development sometimes originates from a set material.

Merchants of fine paper and paperboard

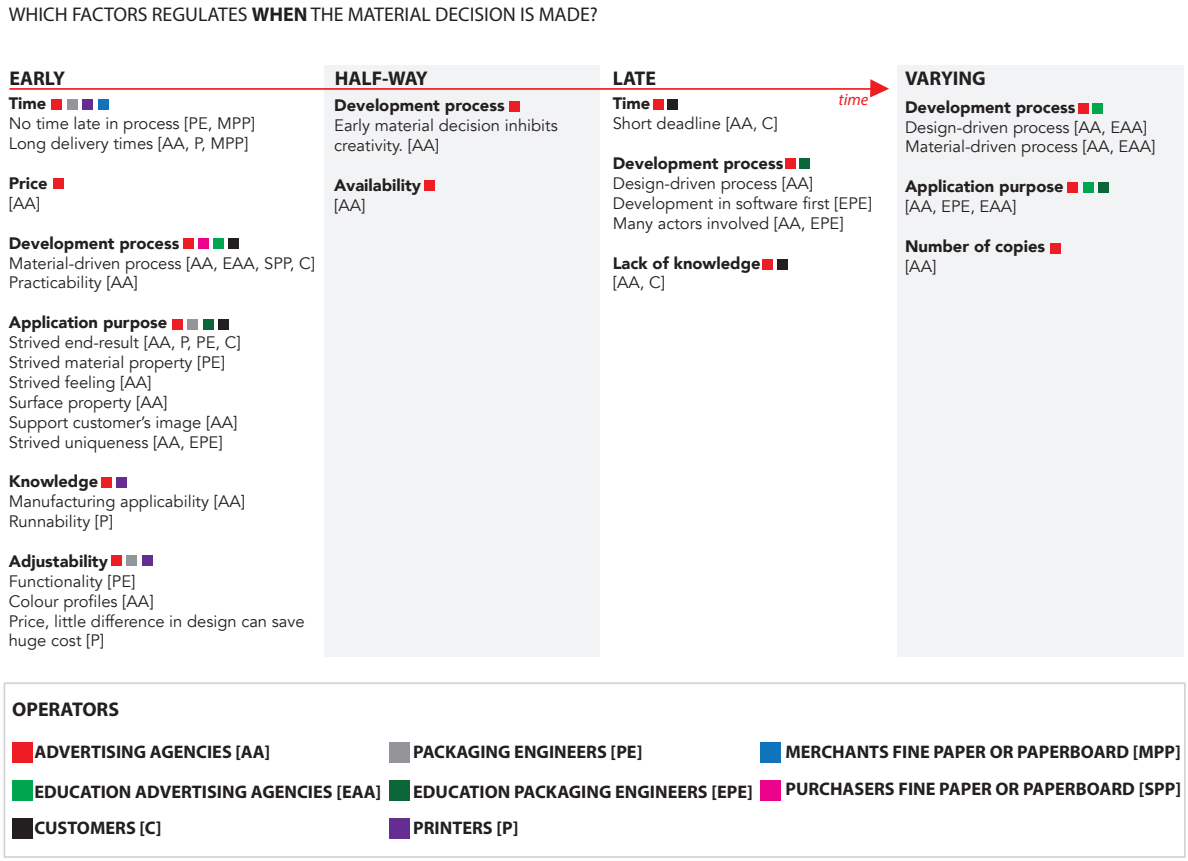
- It is better if the material decision is performed rather early in the development process, because an earlier decision results in finding a better material for the application in terms of material properties and the subsequent end-result.
- The material decision procedure takes place too late in the development process in general.
- The customers of fine paper and paperboard applications lack knowledge about the development process and therefore demand applications in a short time and notice.

5.4.8 Analysis: When the material decision is performed

When the material decision procedure is carried out was found to vary in the graphical and packaging industry due to different reasons. Factors such as time, knowledge and desired adjustability resulted in an early material decision, while short time, lack of knowledge and prioritised creative process commonly resulted in a late material decision (see Table 5.4).

It is though recognised that the time of the material decision always relates to the application to be produced. For instance, during packaging development the material was usually decided early since the material was vital for the application, while the contrary event was common within advertising agencies since the creative process was prioritised. In the latter event, it was also found that the material could be set at the same time as the number of copies were determined i.e. often late in the process. This could result in having to apply an alternative material which was found to affect the end-result negatively, and in some cases increase the cost. Although a late material decision did not prohibit the creative process which in turn sometimes was desirable. However, if the desired design could not be applied due to the needed material not being available, one can debate whether a late material decision does or does not prohibit the creative process. In addition, it was found that an early material decision enabled adjustments of e.g. colour frames and design, in accordance with the selected material, which favoured the end-result in terms of quality as well as used resources. It was for instance found that if a desired format was designed just one centimetre smaller, it could reduce the cost of the printing process by a lot.

Table 5.4 *The figure presents when, in the development process of fine paper and paperboard applications, the material decision is performed within the different professions. It is recognised that there are varying reasons for an early, half-way, late, or varying material decision.*



This because an optimal number of e.g. pages, could be fit and printed on each material sheet i.e. minimum material waste occurred. Further, it was found that an early material decision assured that the project would be executed within the set time and that the desired end-result would be obtained.
It can be concluded that there is no optimal time to perform the material decision, since this depends on the application to be produced and the project's time frame. It can though be recognised that regarding the material early on in the development process is beneficial, since the end-result and used resources relates to the selected material and when this is selected. Although, in order to enable an early material decision, there is a need to foresee requirements of the application to be produced. For instance, required material properties, desired printing technique, desired finishing options, format and number of copies, are needed to be known when deciding material. This because, these aspects regulates which material that is optimal for the application in terms of gained quality and used resources. Hence, to enable the operators to regard the material decision early in the development process, there is a need to enhance their ability to plan and foresee future activities early in the development process. However, there is a vast lack of knowledge regarding aspects that are not restricted within the specific operator's profession, and due to this there is a need of communication. The more competences that are consulted the more holistic knowledge can be gained. Hence, an assisting tool that provides important factors that needs to be discussed, or figured out, and when to do this, is needed. Succeeding in filling the gap of knowledge could result in a lower cost and reduced time. This because the operators then are able to do the right things right from the beginning, along with being able to optimize the application in a holistic sense which increases the quality of the end-result.

In addition, it was found that the material sometimes needs to be ordered 6-8 weeks in advance. Hence, during a short project it would be beneficial to carry out a material-driven process i.e. originate from a set material that is affordable and available. Although, in order to find such a material, communication is needed. It was also found that the relationship with the printer and the communication between printer and e.g. advertiser, relates to the quality of the end-result. Hence, an enhanced communication and knowledge about the consequences of deciding material early, or late, would be beneficial to provide. For instance, by deciding material early in the process there is more time to discuss, along with more material options due to less time pressure. Bearing this in mind, it could have many positive effects if the assisting tool illuminated the importance of planning the material decision along with initiating collaborations and communication early in the development process.

Conclusions

- There is no optimal time for when the material decision should be carried out, although it is important to foster an understanding of the consequences of an early or late material decision.
- There is a need to provide an understanding of the importance of planning future activities in order to obtain optimal quality to minimum resources.
- There is a need to provide an understanding of the importance of initiating collaborations and discuss uncertainties as early on in the development process as possible.
- There is a need to enhance the communication, and subsequent knowledge transfer between the operators in the graphical and packaging industry.

6. Requirement specification

This part presents the identified requirements (see Figure 6.1). The recognised findings from the theoretical and empirical studies, and the conclusions from the analysis was transformed into requirements in a requirement specification (see Appendix 4 - Requirement specification). The selection of information in the part "2. The assisting tool" is based on what is needed to be understood to enable conscious material decisions, with emphasis on the most important information.

A summary of some of the most important requirements:

1. General Requirements

1.1 Spread knowledge about the importance of making a conscious material decision

1.2 Enable conscious material* decisions
-1.2.1 Enhance communication
-1.2.2 Maximise knowledge transfer

-1.3 Minimize material decision time
-1.3.1 Optimise usability

1.4 Assist during material decision
-1.4.1 Provide information about materials

1.5 Attract advertising agencies

1.6 Display material properties
-1.6.1 Display finishing options and surface properties
-1.6.2 Enable testing material in practise
-1.6.3 Product should not depend on available material qualities

1.7 Be contained

1.8 Be made of fine paper and paperboard

1.9 Be adjusted to mechanical manufacturing

2. The assisting tool

1 INTRODUCTION
1.1 Basic info: Why the information is directed towards paperboard and advertising agencies

1.2 The differences between fine paper and paperboard

1.3 The importance of making a conscious material decision for fine paper and paperboard applications

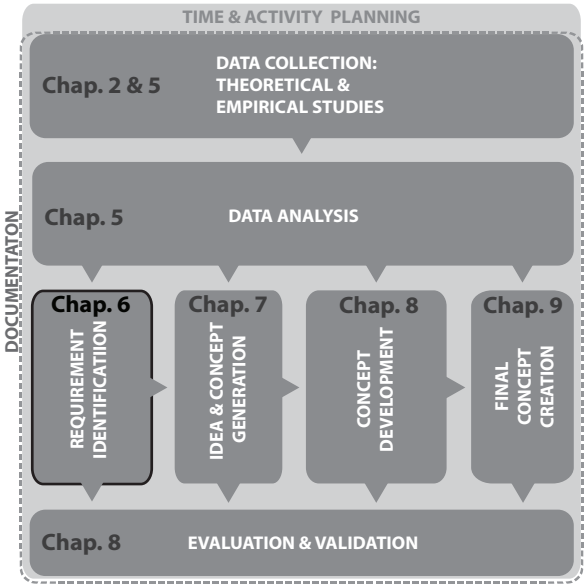


Figure 6.1 *The requirement identification phase carried out during this project.*

1.4 How the assisting tool is used
2 MAIN INFORMATION
2.1 Important factors

2.2. Categories of application's purposes

3 GENERAL INFORMATION
3.1 Durability

3.2 Paperboard: FBB, SBB, SUB, WLC

3.3 Material properties

3.4 Surface properties

3.5 Barriers

3.6 Printing process
-3.6.1 Printing techniques
-3.6.2 Runnability
-3.6.3 Printability
-3.6.4 Format & Sheet

3.7 Finishing options & Varnishing:

3.8 Samples

7. Idea & Concept generation

The idea and concept generation (see figure 7.1) was performed in two steps i.e. the configuration of the assisting tool and the technical solutions in the assisting tool. The result of the idea and concept generation is presented in this section.

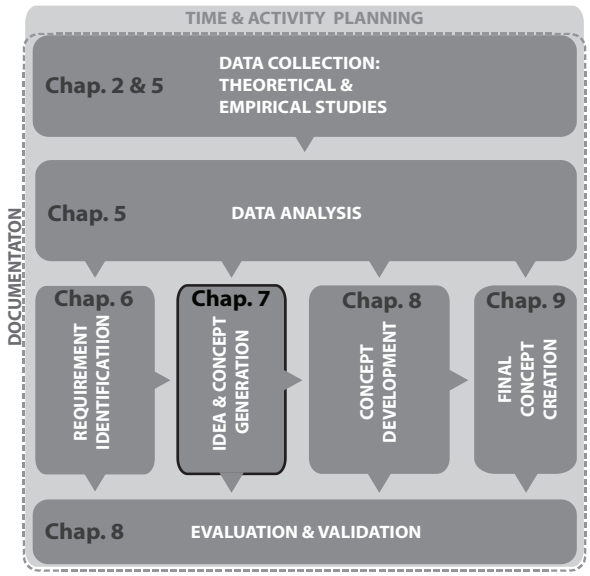


Figure 7.1 *The idea and concept generation phase carried out during this project.*

7.1 The configuration of the assisting tool

It was recognised during the initial ideation that the assisting tool during material decision for fine paper and paperboard applications, must be a physical product. This originated from the requirements of needing to include samples, enabling the operators to try out materials in practice, and displaying applied prints, finishing options and surface properties. Also, the requirement that the tool needs to be made of fine paper and paperboard was an underlying aspect, since the underlying message through developing a product about fine paper and paperboard out of those materials was believed to be effective. Further, this was believed to provide a redundancy between the different senses when obtaining the information during the user interaction with the product. Hence, ideas about developing a software application that suggested appropriate materials from the users' inputs of desired material properties, and application purpose, were discarded. This kind of solutions had also been found as existing tools during the studies, for instance, Antalis had this kind of tool on their web-site and various similar mobile applications were found in Itunes' App Store. Further, it was found during the empirical studies that no operators used any of the existing software tools during material decision. Thereby the conclusion of not developing a software tool was decided.

The idea of developing a book containing information and recommendations about which material to use, between fine paper and paperboard to obtain desired properties to an application, was found. A book concept was also an initial idea from Iggesund Paperboard AB which was discussed at an early phase in the development work. Further, it was identified that the information contained in the assisting tool (see Appendix 4 - Requirement Specification, "2. The assisting tool"), should not be divided into separate non-attached parts since the parts then could be misplaced. This, in turn, would destroy the tool since parts of the information i.e. the needed knowledge, could get lost. A book was therefore determined to be the optimal configuration of the assisting tool for material decision.

7.2 The technical solutions in the assisting tool

The technical solutions in the assisting tool was developed in three main phases: field study, development of a book draft, and development of an embodiment.

Field study

The performed field study regarding applicable technical solutions mainly resulted in an understanding of how the embodiment e.g. format, cover and thickness, of the book affects the handling and usage. It was also found that the credibility related to the embodiment. For instance, a thin book with a rather flexible cover was perceived as less credible, which can have a negative effect on whether the information is embraced and further trusted. In addition, features of uniqueness was investigated during the study, such as what makes a book stand out (see Figure 7.2).

Developing a book draft

Several ideas regarding the content of the tool emerged during the construction of the book draft. These ideas were:

1. Preface

It was found that a preface should be included in the tool. This because background information that is beneficial to obtain and adds value to the user, but not necessarily is a must, could be presented in this section. This idea originated from requirement 1.1 "Basic info: Why the information is directed towards paperboard and advertising agencies" from part 2 in the requirement specification (see Appendix 4 - Requirement specification).

Figure 7.2 *The figure presents some of the existing technical solutions, and inspirational findings from the field study.*

2. Prioritisation of important factors with respect to application & categorisation

The idea of illuminating the most important factors to regard during material decision, with respect to the application to be produced was recognised. The aim of this idea was to assist the operator in prioritising the most important factors to regard for a certain application in terms of gained quality. Further, this approach was believed to promote important factors that often were neither considered nor prioritised by the operators during the development of certain applications, such as stiffness when developing a menu, or creasability for a folder. It was also believed that this approach would optimise the obtainment of information about the important factors through an increased usability in terms of clearness.

The applications included in the tool were established by investigating the frequently expressed applications during the empirical studies i.e. cover, inlay, binding, menu, flyer, poster, postcard, business card, tag, tab, folder, and protective, disposable, aesthetic and taint & odour packaging. To further foster an even higher usability of the tool the applications were categorized into the main categories: Books, Magazines & Brochures (cover, inlay, binding), Printed sheets (menu, flyer, poster, postcard, business card, tag), Folded applications (tab, folder, menu, postcard, tag), and Packaging (protective, disposable, aesthetic, taint & odour). Categorising different application purposes was also a requirement in the requirement specification. In addition, each category was given an introduction to why the illuminated factors were important to prioritise to enhance the understanding, e.g. durability in a book cover since it extends the life expectancy of the application, protects the inlay and increases the user experience.

3. Check-list

In addition to the most important factors for certain applications, there are also general important factors to regard for each category and not just for the specific application (see requirement 2.1 “Important factors” from part 2 in Appendix 4 - Requirement specification). To convey this to the user, a list of the important factors was constructed and named “Check-list”, and included in each category. This approach was believed to guide the user to quick and easy find the important factors to regard during the material decision. It was also believed to enhance the users willingness to read further about the factors in another section of the book.

However, as the Check-list contained important factors that concerned: (1) the application to be produced directly, and (2) the process in which the application should be manufactured and additional

environmental aspects, a separation of these factors was made. The first part was meant to be used as a foundation for own establishment of the project's restrictions, and thereby enhance the actor's planning of the project and subsequent execution of the material decision procedure. The second part was recommended to be discussed with, for instance, the assigned printer since these factors varied depending on desired printing technique and assigned printing agency. Hence, an as accurate information as possible adjusted to the specific application to be produced could only be obtained through discussion. This approach was also believed to facilitate the communication between operators by providing discussion topics through the check-list and other information in the tool. This approach also provides a mutual terminology, which reduces the events of misunderstandings.

4. The title and cover

It was inevitable for ideas regarding the title of the book, and the design of the cover, to not come into mind. First and foremost, it was concluded that the cover needed to be in a paperboard material since this was found during the studies to be the most appropriate material due to e.g. obtained durability. It was also recognised from the studies that it was most difficult to obtain a high quality print in a dark colour, since it demanded excellent surface properties of the applied material. From this, the idea of printing the cover in black emerged, since this could further display the excellent quality of paperboard. This was also believed to promote the awareness of applying a durable material when desiring a high performance in the obtained result. It was further established that the title should be white, since the contrast would make the cover clear and also stand out. In addition, since it was desired to foster an understanding of the difference between fine paper and paperboard, it was decided that the title should be cut out by either laser or die cutting. This because paperboard possessed properties that enabled this feature, and by applying this the user could obtain a practical example of this property.

Regarding, the name of the title it was concluded to be divided into a main title: "The difference between fine paper and paperboard", and a secondary title: "The assisting tool". This because it was believed to be beneficial if it was easy for the user to understand the conveyed message of the book by merely reading the titles. The secondary title was decided to be embossed with a silver foil lamination to further foster the awareness of possibilities with a durable material, and also to add uniqueness to the tool.

Developing an embodiment

After constructing and printing the book draft, the development of technical solutions was carried out. This was performed by initially identifying four fundamental elements that made up the assisting tool by originating from the printed book draft. The four fundamental elements were:

1. Introduction

This part contain information that the user needs to obtain before reading the latter parts, such as, why a conscious material decision is important, what is meant by a conscious material decision, and how the assisting tool is used. The preface is also included in this part.

2. The Assisting Guide

This part serves as the core of the assisting tool, and contain assisting information that is needed during material decision. Information about e.g. which factors that are important to regard during the material decision for a certain application is included in this part. Further, the identified applications in their respective category, including the check-list are contained in this part.

3. Book of Knowledge

This part contain more comprehensive information of the important factors, and thereby provides theoretical knowledge to the user. This information is linked to the factors in The Assisting Guide.

4. Sample Book

This part contain samples of different materials, that displays various material properties and applied finishing options. This part is beneficial to study while using The Assisting Guide and the Book of Knowledge.

By further studying the four identified elements' content, it was concluded that the introduction needed to be arranged in a manner that "forced" the user to read the information before proceeding with the other parts. Furthermore, it was established that The Assisting Guide and the Book of Knowledge were important to display simultaneously since these elements are linked together through the provided information. The Book of Knowledge was also recognised to contain the knowledge that mosto operators lack, hence it was recognised to be of great importance to arrange this part in a manner that promotes reading. The Sample Book was concluded to be beneficial, but not necessarily a must, to see simultaneously as The Assisting Guide and the Book of Knowledge. Originating from these identifications, the rearrangement of the elements to find an optimal embodiment began, and mock-ups were built from magzines, brochures and books.

8. Concepts & concept evaluation

This part presents the concept development and the concept evaluation (see Figure 8.1). The three concepts that were developed are: folding system, two part system, and three part system. More information about the concepts is presented in this section. The concepts were evaluation to find the most optimal concept to further develop, the result from the evaluation of the concepts is presented in this section.

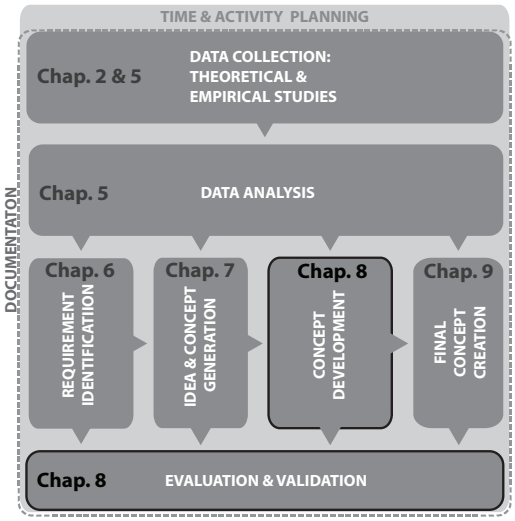


Figure 8.1 *The concept development and evaluation phases carried out during this project.*

8.1 Concepts

This section presents the three developed concepts: folding system, two part system, and three part system.

8.1.1 Concept 1: Folding system

The folding system was designed to optimise the uniqueness of the assisting tool, to attract operators within advertising agencies. The fundamental embodiment comprised of three books i.e. introduction and The Assisting Guide, Book of Knowledge, and Sample Book. Although, when viewing the book from above, in its folded stage, it had the same embodiment as any common book (see Figure 8.2). In addition, the format of this concept was significantly smaller that the other concepts due to it enabling an own book for the information in each part (The Assisting Guide, Book of Knowledge, and Sample Book) of the assisting tool.

How to use the folding system

1. When starting to read the book, the user first finds the introduction (see Figure 8.3).

2. When flipping the pages through the introduction, the user ends up at the description of how this assisting tool works (see Figure 8.4). This page lies just

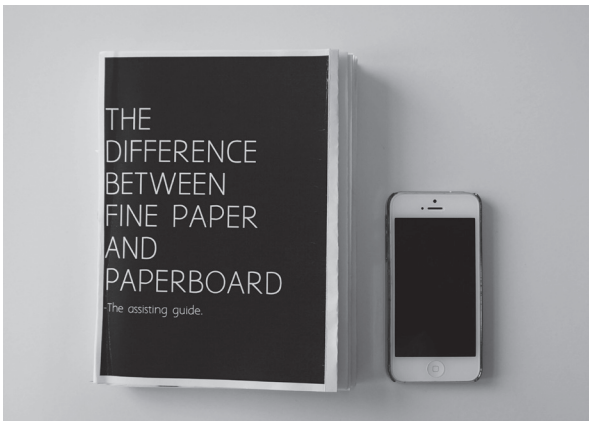


Figure 8.2 *Concept 1: Folding system, the front view.*

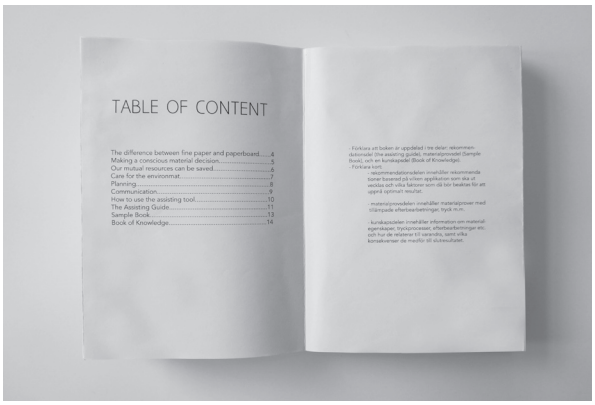


Figure 8.3 *Concept 1: Folding system, the introduction.*

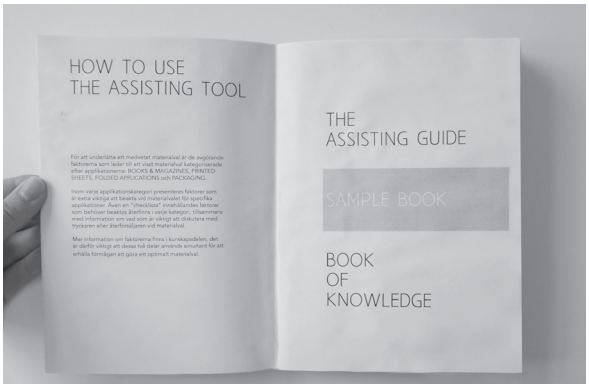


Figure 8.4 *Concept 1: Folding system, the description of how to use the assisting tool.*

Figure 8.5 *Folding system, the page found before entering The Assisting Guide, Book of Knowledge, and Sample book.*

above the folded part containing The Assisting Guide, Book of Knowledge and Sample Book (see Figure 8.5).

3. When unfolding the folded part by unfolding twice (see Figure 8.6), the three books (The Assisting Guide, Book of Knowledge and Sample Book) are displayed and can be read as any other books (see Figure 8.7).

Regarding the construction, the three books are attached to each other through the books "Book of Knowledge", and "Sample Book" being placed in an inner pocket inside of the main cover, similar to a folder (see Figure 8.8). This enables the books to be taken out if needed, for instance, if samples are discussed with the customer, or if the user wish to read just one of the books in a more convenient manner.

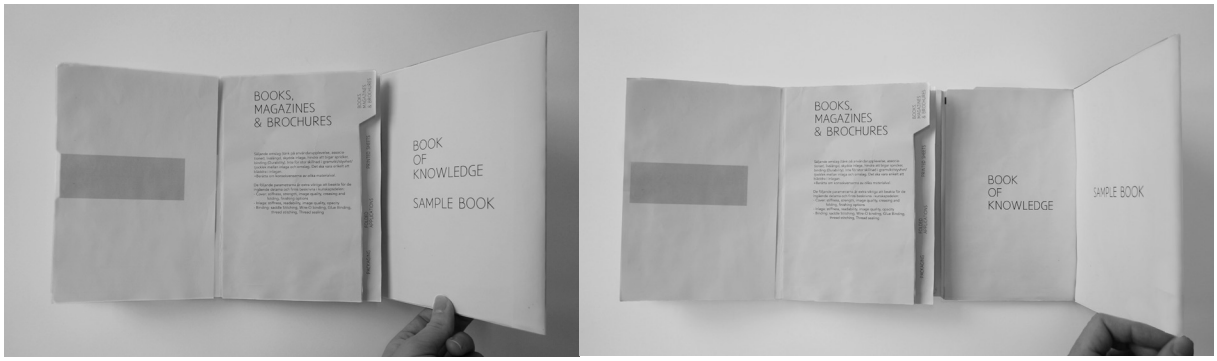


Figure 8.6 *Folding system, unfolding the three divided part and revealing The Assisting Guide, Book of Knowledge, and Sample Book.*

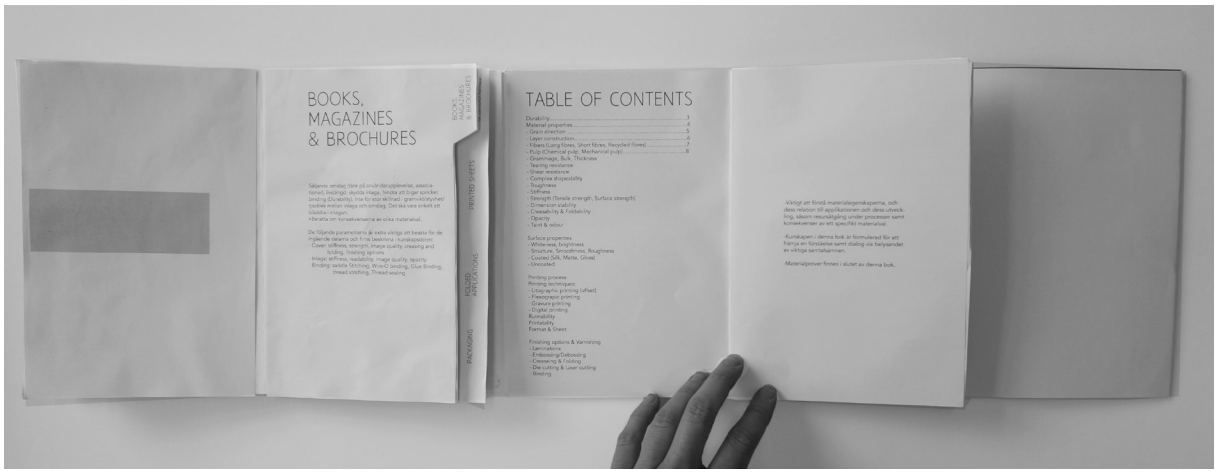


Figure 8.7 *Folding system, the entirely "open" stage of the folding system with all parts revealed.*

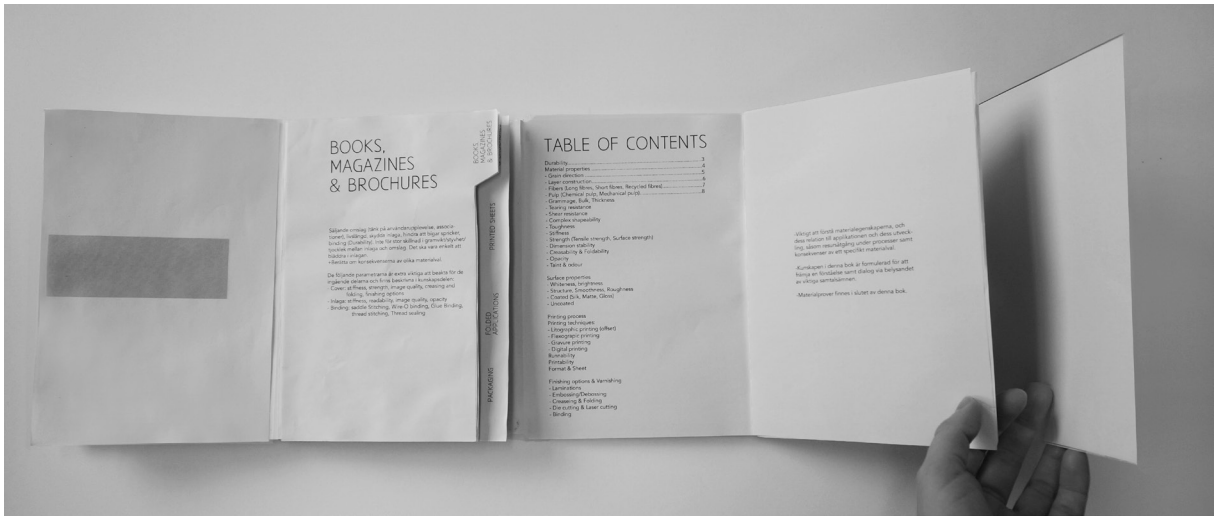


Figure 8.8 *Concept 1: Folding system, the "pockets" enabling each part being separated.*

8.1.2 Concept 2: Two part system

The two part system consisted of two books. One main book containing the introduction, The Assisting Guide and Book of Knowledge, while the other book contained the samples i.e. Sample Book. The Sample Book was placed in a folder on the inner back of the cover in the main book (see Figure 8.9). In similarity with all three concepts, when viewing the two part system from above, it looks like a common book (see Figure 8.10).

Figure 8.9 *Concept 2: Two part system, the placement of the Sample Book.*

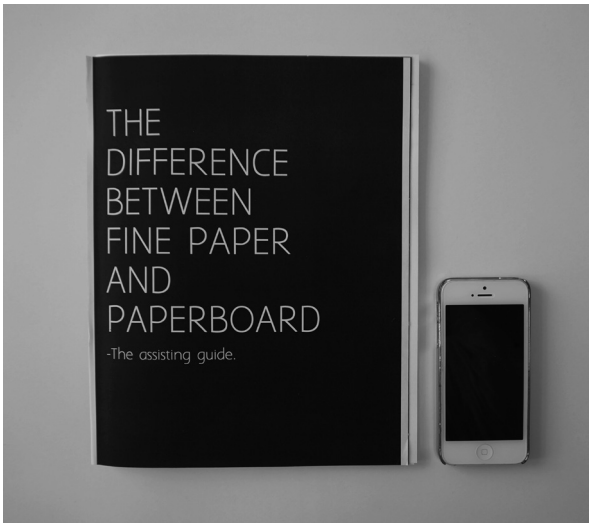


Figure 8.10 *Concept 2: Two part system, the front view.*

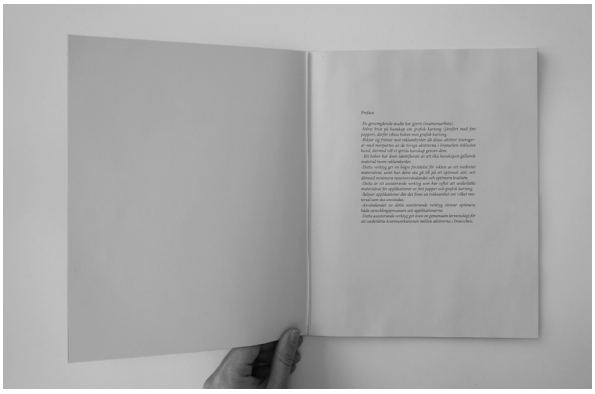


Figure 8.11 *Concept 2: Two part system, the introduction.*

How to use the two part system

1. When starting to read the book, the user first finds the introduction (see Figure 8.11).

2. After completing the introduction, i.e. ending up at the description of how the assisting tool works, the next pages are divided into two different books (see Figure 8.12). These two books are The Assisting Guide, and Book of Knowledge.

3. This embodiment enables the user to flip through the different categories in The Assisting Guide, and at the same time flip through the theory in the Book of Knowledge (see Figure 8.13). Thereby the user can construct "own" spreads that are desired to obtain the needed information to perform a conscious material decision.

4. The Sample Book can be used as any other book, while being merely a book of its own.

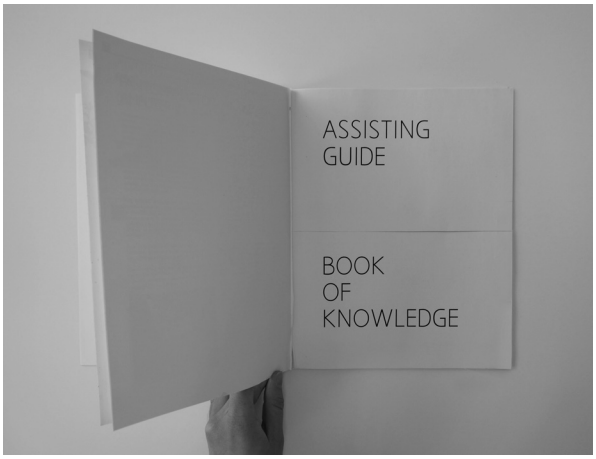


Figure 8.12 *Concept 2: Two part system, the two divided parts i.e. The Assisting Guide and Book of Knowledge.*

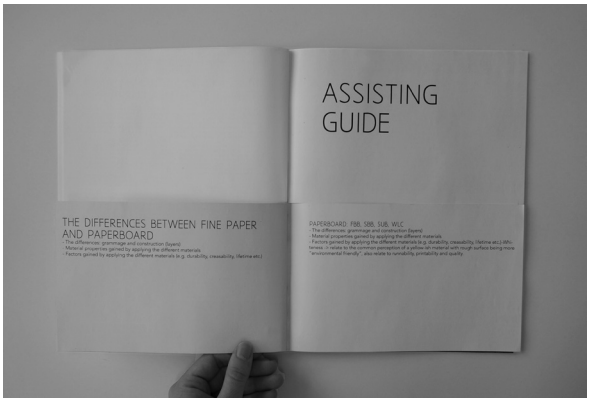


Figure 8.13 *Concept 2: Two part system, the usage of the two divided parts.*

8.1.3 Concept 3: Three part system

The three part system is comprised of merely one book (see Figure 8.14), but is otherwise very similar to the two part system.

How to use the three part system

1. The concept of this book also contains an introduction that needs to be flipped though before ending up at the description of how the tool works (see Figure 8.15).

2. When turning page after the description, the three books: The Assisting Guide, Book of Knowledge, and Sample Book, are revealed (see Figure 8.16). This embodiment allows the user to see all three parts simultaneously.

3. An "own" spread can be constructed by combining the three parts. Thereby information about prioritized important factors with respect to the application to be produced, theoretical information about the factors, and samples displaying different factors, can be obtained simultaneously (see Figure 8.17).

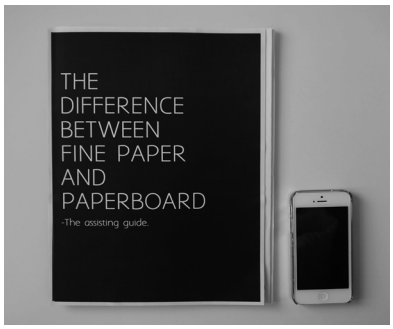


Figure 8.14 *Concept 3: Three part system, the front view.*

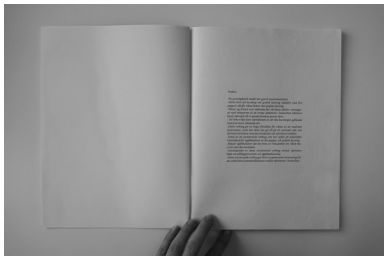


Figure 8.15 *Concept 3: Three part system, the description of how to use the assisting tool.*

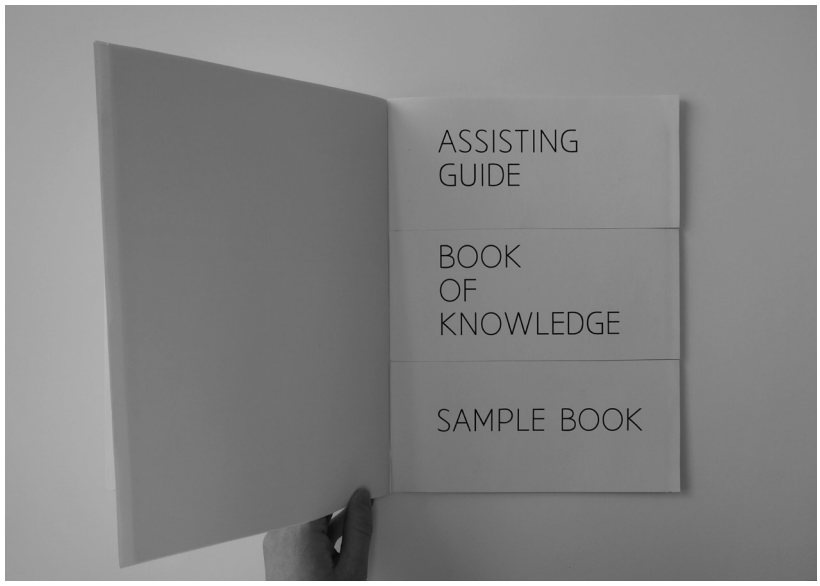


Figure 8.16 *Concept 3: Three part system, the three divided parts i.e. The Assisting Guide, Book of Knowledge, and Sample Book.*

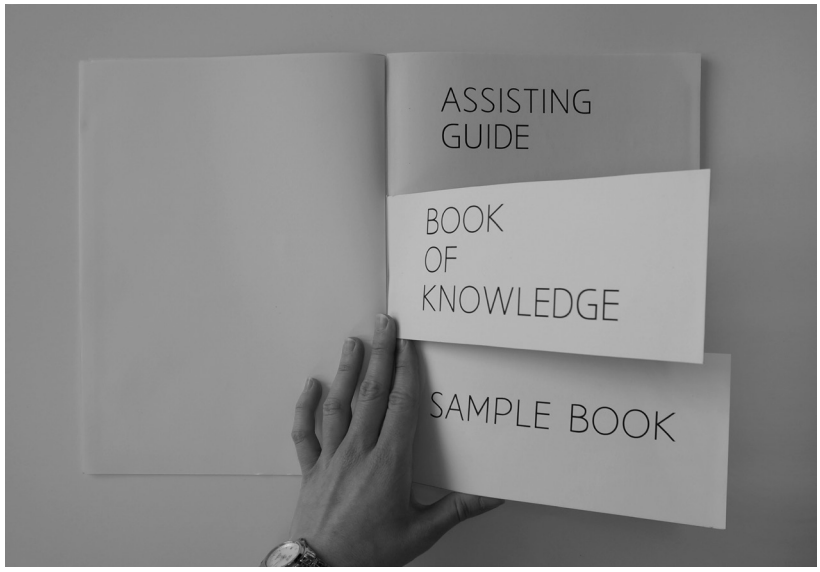


Figure 8.17 *Concept 3: Three part system, the usage of the three divided parts.*

8.2 Concept evaluation

During the evaluation of the three concepts, a printer was initially consulted, a focus group was gathered, and a Kesselring evaluation was performed.

8.2.1 Consultation with printer

From the consultation with the printer it was found that concept 1, the folding system, probably would be difficult to produce, and thereby would imply an expensive production. The printer further explained that concept 2, two part system, and concept 3, three part system, were possible to manufacture at a significantly lower cost than concept 1.

8.2.2 Focus group

The participants in the focus group perceived it to be beneficial to divide the information into different parts. This because it provided a possibility for the user to adjust what information that should be displayed simultaneously though flipping up different pages in the different parts. In addition to this, an idea of including a ribbon, similar to ribbons in bibles, was expressed by a participant in the focus group since it will make it easier find specific pages or spreads. It was also appreciated that there was an introduction in the beginning of the tool that explained why the subsequent parts should be considered.

Regarding concept 1, the folding system, it was considered to be more complex and due to this, result in a lower usability than the two other concepts. This because of the uniqueness in the design, i.e. that the parts had to be unfolded several times in order to access the content. However, it was stated that this concept was perceived as more scientific due to the rather high thickness, which was a consequence of the the books being folded and piled together. In addition it was stated that, if the book was intended to be used everyday, as a reference book, the user would probably learn how to use it after a brief time. Thereby, the usability would not be a major problem. Although, it was expressed that the handling of the book could be rather inconvenient due to the large space it occupied, and the many foldings.

Regarding concept 2, two part system, it was considered to have good usability due to the simple structure that was easy to understand. It was stated that the concept could facilitate communication with other operators, for instance a customer or printer, since it was possible to take out and display the samples. However, it was stated that, when the Sample Book was possible to remove and used separately, there was a risk of the user merely using the Sample Book and not reading the other parts. This would result in the user not obtaining the important information comprised in the assisting tool.

Regarding concept 3, three part system, this was the participants' preferred concept. It was claimed to have the best usability, along with a structure that provided the highest chance of all parts, and thereby all information in the book, being taken into consideration during the material decision. It was further claimed that the book was easy to use since the structure was clear and possible to quickly overview. Thereby, the possibility to see all parts simultaneously could be provided which enhances the assistance during material decision.

8.2.3 Kesselring matrix

The Kesselring evaluation resulted in concept 3, three part system, being ranked with the highest total score, as being scored highest in the majority of the requirements (see Table 8.1 - Kesselring matrix). It was, for instance, found that the concept possessed excellent usability. This can be derived to the structure of the concept that makes the tool easy to understand, and enables the user to see needed information in different parts of the tool simultaneously. Although, for the requirement regarding enabling testing materials in practise, the concept was ranked the lowest. This can be related to the fact that the Sample Book is attached to the tool, in contradiction to the other concepts where the Sample Book can be used separately from the tool. Enabling separating the Sample Book enhances the possibility to test the material samples in practice. Attached samples could also have a negative impact on the possibility to enhance communication with, for instance, customers and printers. This because the material samples are not as easily accessible, in comparison to when they can be used separately from the tool. Although, parts that are not attached to the tool can be misplaced which is the downside of the detached samples. Also, when the samples are detached from the tool, it increases the risk of the samples not being saved, and the complete tool can thereby not be used for a longer time. This aspect resulted in the highest score for concept 3 regarding that the tool is desired to be contained.

Another important factor that contributes to a high or low usability is the format of the tool. For instance, how easy the tool is to bring along to e.g. meetings with customers, and how manageable it is to use in the everyday work, are related to the format and needs to be considered when evaluating the usability of the tool. The formats for both concept 2, two part system, and concept 3, three part system, was rather similar, and did not markedly affect the usability. Although, the amount of information on each page is found to be rather limited due to the tools being split in two respective three parts. However, this was not considered as a problem, since the number of pages could be adjusted to the content. Regarding

Requirements	Priority	Ideal		Concept 1		Concept 2		Concept 3	
		Weight	Total	Weight	Total	Weight	Total	Weight	Total
1.1 Spread knowledge about the importance of making a conscious material decision	5	5	25	3	15	5	25	5	25
1.2 Enable conscious material* decisions	5	5	25	5	25	5	25	5	25
1.2.1 Enhance communication: - Advertising agency to customer - Advertising agency to printer - Advertising agency to packaging engineer - Advertising agency to producer of material* - Advertising agency to merchant of material*	5	5	25	4	20	5	25	4	20
1.2.2 Maximise knowledge transfer	5	5	25	4	20	5	25	5	25
1.3 Minimize material decision time	5	5	25	3	15	4	20	5	25
1.3.1 Optimise usability	5	5	25	2	10	4	20	5	25
1.4 Assist during material* decision	5	5	25	5	25	5	25	5	25
1.4.1 Provide information about materials*	5	5	25	5	25	5	25	5	25
1.5 Attract advertising agencies**	4	5	20	4	16	5	20	5	20
1.6 Display material* properties	5	5	25	5	25	5	25	4	20
1.6.1 Display finishing options and surface properties	5	5	25	4	20	4	20	4	20
1.6.2 Enable testing material* in practise	5	5	25	5	25	5	25	3	15
1.6.3 Product should not depend on available material qualities	5	5	25	5	25	5	25	5	25
1.7 Be contained	4	5	20	3	12	3	12	5	20
1.8 Be made of fine paper and paperboard	5	5	25	5	25	5	25	5	25
1.9 Be adjusted to mechanical manufacturing	5	5	25	2	10	4	20	5	25
*Material refers to fine paper and paperboard **Attraction is subjective, hence this is a strived requirement									
Sum		80	390	64	313	74	362	75	365
Average			4,88		3,91		4,53		4,56
Rank					**3**		**2**		**1**

Table 8.1 *The figure presents the result, in a matrix, of the performed Kesselring evaluation. Concept 3, three part system was found the be the concept that best fulfilled the listed requirements.*

the format of concept 1, folding system, it is in its folded stage in a convenient format that is easy for the user to carry or store. However, when the concept is unfolded it takes up a large space which can lead to low usability and manageability, not least if the user does not have a table to put it down on. This complex structure and usage also affects the material decision time. Bearing these aspects in mind, the score given for the requirement of optimised usability was rather low for concept 1.

Considering the concepts' ability to enable conscious material decisions, this is fulfilled through the contents in the tool which is included in all three concepts.The scores were consequently equally rated for the concepts. Although, the concepts ability to spread knowledge about the importance of making a conscious material decision was given a significantly lower score for concept 1, folding system. This because of the poor usability of the tool, and the expensive manufacturing which is believed to inhibit the ability to produce a large number of tools and thereby reduce the spread of knowledge.

Concerning the requirement of the tool needing to be adjusted to mechanical manufacturing, concept 3, three part system, was found to be easiest to produce and thereby given the highest score. This because it is basically produced in the same way as a regular book, although the difference is that parts of the book is divided into three. Concept 2, two part system, was given the second highest score since this is produced in similarity with concept 3, although a separate book for the samples and a holder for this Sample Book is additionally needed to be produced and placed. Concept 1, folding system, got the lowest score regarding applicability for mechanical manufacturing due to the complex construction and many different parts, which resulted in an overall bottom rank for concept 1.

9. Further development: The assisting tool

This section presents the result of the further development of the chosen concept i.e. concept 3, three part system. The last paragraph presents the final concept of the assisting tool (see Figure 9.1).

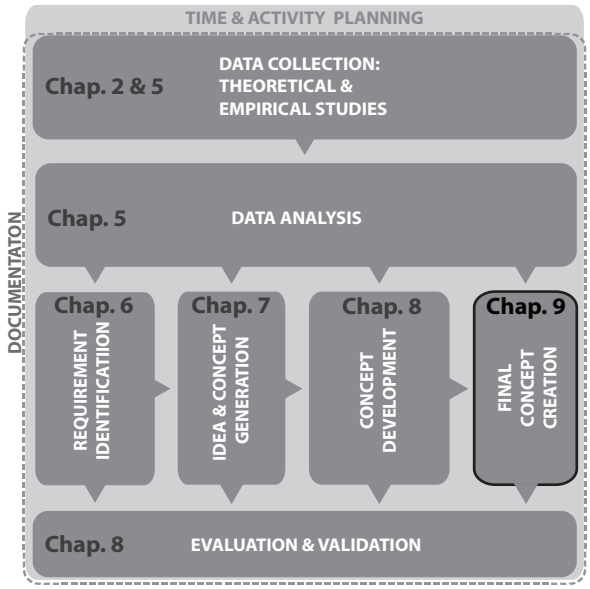


Figure 9.1 *The final concept creation phase carried out during this project.*

9.1 Consultation with publishing agencies

Several findings from the consultation with the two publishing agencies were obtained. It was revealed that the cover of a book is a very important part in terms of marketing purposes and the entire perception of the book. Further, it was found to be important to regard the number of pages and material when determining the most suitable binding for the book. It was additionally explained that different bindings of books resulted in different abilities for the book to remain laying open. It was also found that there should not be too much difference between the material for the inlay, and for the book cover. Furthermore, it was claimed that the tearing resistance and stiffness were important to regard for the inlay in order to maximise the usability when turning the pages. It was also found that there was no correct surface property in terms of readability or image quality, instead it was claimed that the desired feeling was the most important for a specific result. In addition, it was stated that the material waste was an important factor to regard when determining the format for the book. It was further explained that it existed several standard-formats that resulted in minimal material waste.

9.2 Merging solutions

From the evaluation it became clear that concept 3, the three-part system, was the concept that best fulfilled the requirements and due to this was chosen for the further development. However, it was also seen that this concept had received a low score in the Kesselring evaluation (see Table 8.1) regarding the requirement that the samples should be able to be tested in practice. Further, it was identified from the evaluation that the other two concepts had technical solutions that fulfilled this requirement better. It was recognised that the reason for the higher score regarding this manner was because the other concepts enabled detaching the Sample Book from the assisting tool. Although, having a detached Sample Book could result in disadvantages such as the risk of the user not reading the information in the other parts of the assisting tool, but merely using the Sample Book. Thereby, in the further development, it was determined that the Sample Book should be attached to the assisting tool, but also enable being detached through perforating each sample. Further, a pocket for samples that has been torn off was decided to be included on the inner back of the book cover, in similarity to concept 2. This to enable saving the detached samples and thereby letting the assisting tool remain complete. In addition it emerged during the focus group, that it would be beneficial to include ribbons, similar to the ribbons in a bible, in the assisting tool. This in order to further facilitate the usability since the ribbon enables to easily find specific pages or spreads.

9.3 Specifying the concept in detail

This section presents the details of the further development of concept 3, three part system. Specifications regarding the following features were determined during this step: exact material samples in the Sample Book, format, number of pages, material and binding method.

9.3.1 Samples

A specification of the samples that should be included in the Sample Book was determined during the specifications of details for concept 3. The recognised 22 samples are the following:

- ***5 samples, Whiteness***. One fine paper sample, one solid bleached board sample, one solid unbleached board sample, one folding boxboard sample, and one white lined chipboard sample displaying the materials' whiteness.
- ***4 samples, Stiffness & Grammage.*** One fine paper sample with high grammage, and one paperboard sample with lower grammage but the same stiffness as the fine paper sample, demonstrating how the stiffness is higher in relation to grammage in paperboard. One fine paper

sample in the same grammage as a paperboard sample, further demonstrating how the stiffness is higher for paperboard.

- ***5 samples, Printability (Image & Text).*** One fine paper sample and four paperboard samples with equal stiffness as the fine paper. The fine paper sample should be coated with silk, and three of the paperboard samples should be coated with silk, matt and gloss, and one of the paperboard samples should be uncoated. All five samples should be printed with the same image and text. This will demonstrate different available coatings, the difference between a surface with a matt coating and an uncoated surface, and printability.
- ***2 Samples, Embossing/Debossing.*** One fine paper sample and one paperboard sample with an embossing or debossing, demonstrating the difference when applying this finishing options to the materials.
- ***1 Sample, Embossing & Hot foil stamping.*** One paperboard sample with an embossing and hot foil stamping. Place this sample after the paperboard sample with an embossing.
- ***2 Samples, Creasing & Folding.*** One fine paper sample and one paperboard sample with equal (high) stiffness and creases. These samples should be printed in black to further demonstrate how fine paper can crack when being creased and folded.
- ***1 Sample, Varnishing.*** One paperboard sample with a print and partial varnish, displays how the varnishing can give a certain feeling.
- ***1 Sample, Die cutting/Laser cutting.*** One paperboard sample with a die cut or laser cut pattern, displays the paperboard's excellent properties when applying these finishing options.
- ***1 Sample, Lamination.*** One paperboard sample with an aluminium lamination, displays how laminations can be applied to paperboard.

9.3.2 Format

The format of the assisting tool was decided to be the standard A4 format (210 X 297 mm) since it would result in little material waste. The rectangular A4 format (with the longest edge vertically) was also found, from several tests, to be the most suitable in terms of usability with emphasis on the three smaller divided parts (The Assisting Guide, Book of Knowledge, and Sample Book) being stiff enough to enable comfortable and easy turning of the pages. The stiffness also contributed to a feeling of quality. It was further identified that the A4 format enabled much information on each page, but at the same time did not result in each page in the three-divided part being too long in the horizontal direction and thereby "lose" stiffness (see Figure 9.2). The decided A4 format was also recognised to be optimal when desiring to bring the assisting tool to various meetings, and when using the tool since it would not take up too much workspace. Although, the format needed to be sufficiently large to contain the needed information in the assisting tool with respect to an appropriate font size that fosters a high readability. Further it was established that The Assisting Guide and Book of Knowledge should be 100 mm each vertically, and that Sample Book should be 97 mm vertically, to provide enough space for the needed information contained by the tool.

9.3.3 Number of pages and material

The number of pages in the book was determined to a total of 66 pages i.e. 33 sheets. The distribution of information on the pages and the set material was determined as following:

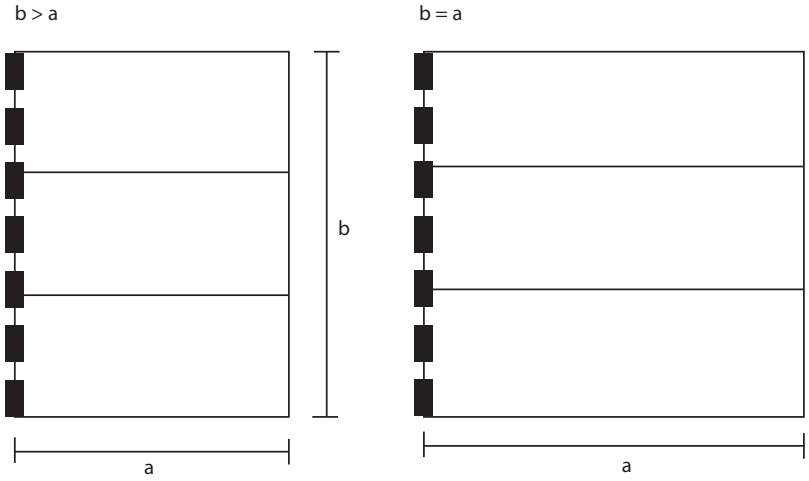


Figure 9.2 *The figure presents how the format affects the stiffness of each page in the three divided parts. If a=b the pages will be less stiff and require a stiffer material, if a<b the pages will appear stiffer and hence more manageable.*

- ***1 sheet, front cover (paperboard).*** Printed in black, with die cut or laser cut title "THE DIFFERENCE BETWEEN FINE PAPER AND PAPERBOARD", and the secondary title "The Assisting Tool" embossed and hot foil stamped.

- ***1 sheet, "white title text" (fine paper in same grammage as front cover).*** This page serves as the white title text since the front cover is laser or die cut. It is determined to be made of fine paper since this feature is discussed in the introduction of the book when presenting the difference between fine paper and paperboard.

- ***7 sheets, introduction (7 sheets fine paper).*** Since the pages in inlay should be easy to flip, and the decided format is A4, the introduction is suitable to be made in fine paper.

- ***23 sheets, each for "The Assisting Guide" (paperboard), "Book of Knowledge" (paperboard) and "Sample Book" (fine paper and paperboard).*** These 23 sheets are divided into three (exact measures, see section "Format"), the Sample Book comprises different materials as explained in section 9.3.1 Samples. The decided material is paperboard for these pages since these parts are shorter vertically and thereby a smaller part is fixed in the binding. This results in a larger bending moment which, in turn, puts higher demands on the strength of the material in comparison to the fine paper pages in the introduction.

- ***1 sheet, back cover (paperboard, same quality as front cover).*** The inner pocket on the inner back of the cover, assigned for samples that have been torn off, should also due to desired uniform thickness, be placed in level with the Sample Book. This because the torn off samples that are placed in the pocket, then still can provide an even thickness of the entire assisting tool when it is closed.

9.3.4 Binding

As previously described, the three part system is based on the user being able to flip through the different parts (The Assisting Guide, Book of Knowledge, and Sample Book) simultaneously, and thereby obtain needed information. Although, the binding becomes of vital importance to make the usage of the tool efficient, i.e. enabling the pages and spreads to remain lying open as the user wish. Hence, during the investigation of bindings the main requirement was that the desired spreads should remain lying open without the user needing to hold the pages with their hands. From the performed consultations with publishing agencies, and the field studies regarding technical solutions, it was found that a spiral binding was the most satisfying in terms of the desired requirements.

9.4 Graphic design

The graphic design in the assisting tool was developed by originating from the desired expression compiled in the constructed expression board (see Figure 9.3). It was desired to develop a timeless and simple design to enable the tool being attractive to a wide range of users. Hence, the colours were determined to be rather light to give a mild expression. Although, it was still desired to include prints that would display the properties of the fine paper and paperboard materials in the pages (see Figures 9.4-9.8).

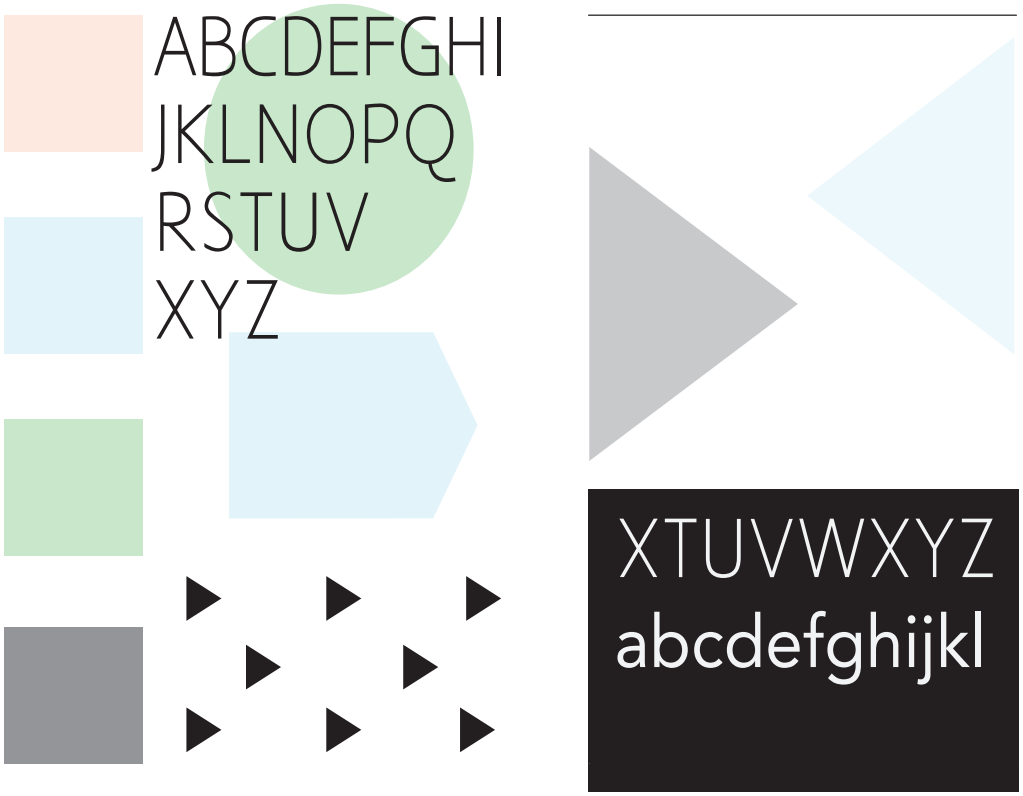


Figure 9.3 *The figure presents the constructed expression board that served as a foundation during the development of the assisting tool's graphic design.*

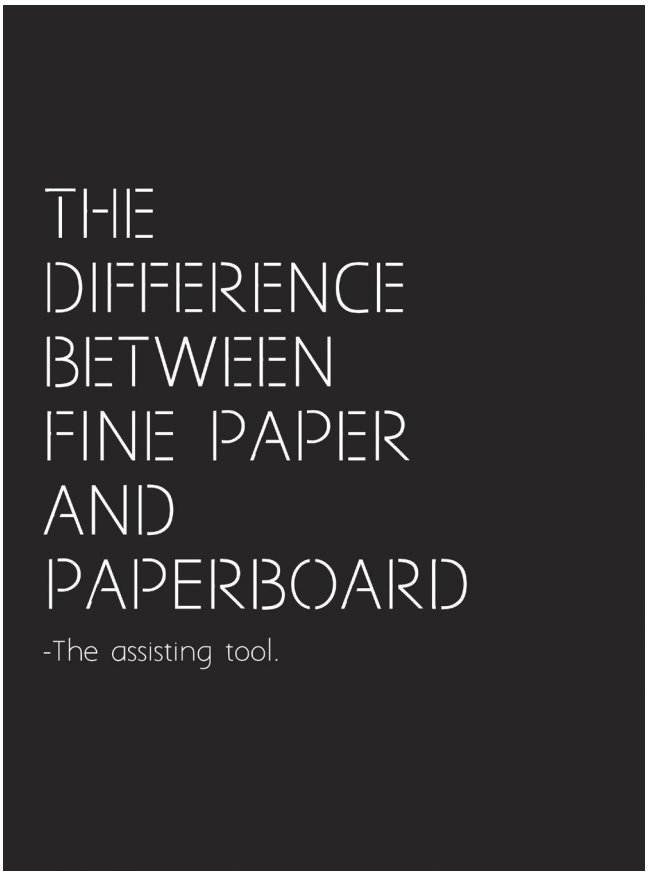


Figure 9.4 *Graphic design, the cover.*

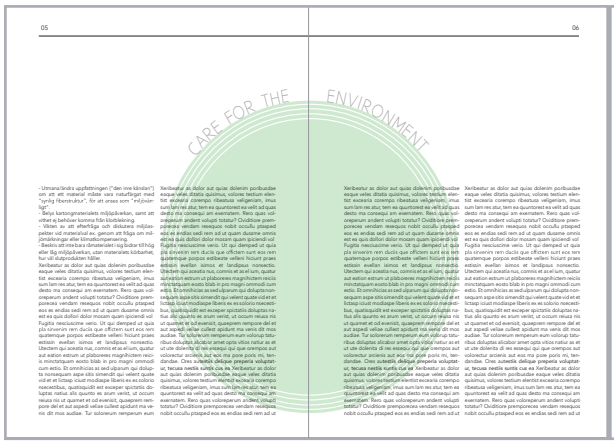


Figure 9.5 *Graphic design, a spread "care for the environment".*

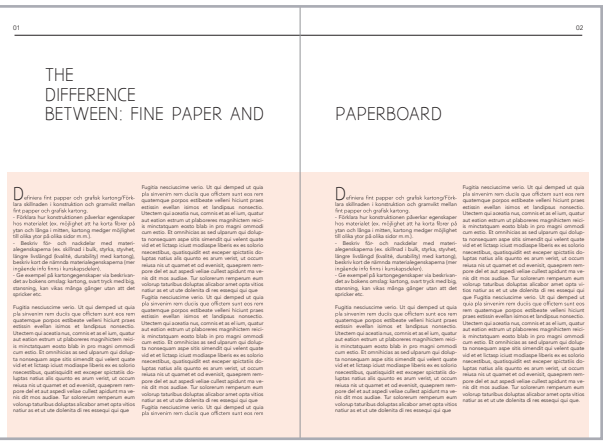


Figure 9.6 *Graphic design, a spread "the difference between fine paper and paperboard".*

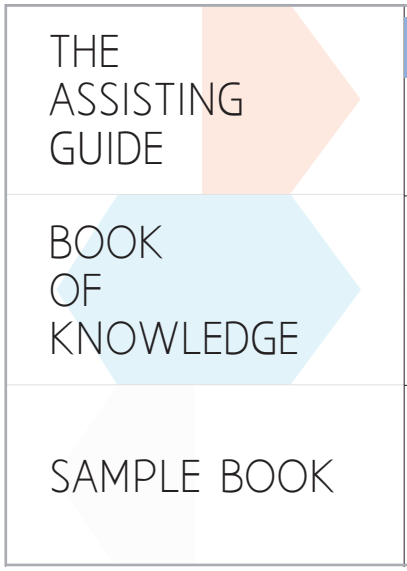


Figure 9.7 *Graphic design, the covers of the three divided parts: The Assisting Guide, Book of Knowledge, and Sample Book.*

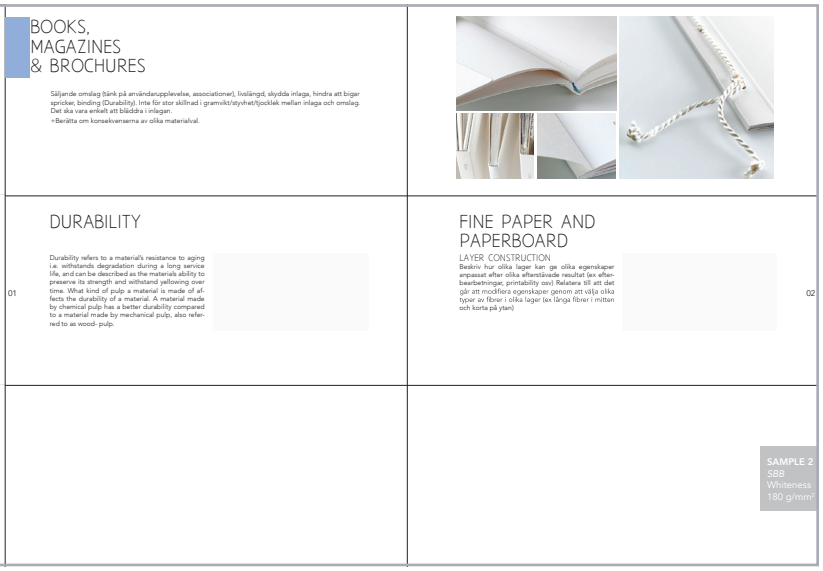


Figure 9.8 *Graphic design, a spread in the three divided part.*

10. The assisting tool

This section presents the final prototype of the developed concept of an assisting tool during material decision for fine paper and paperboard applications (see Figures 10.1-10.5).

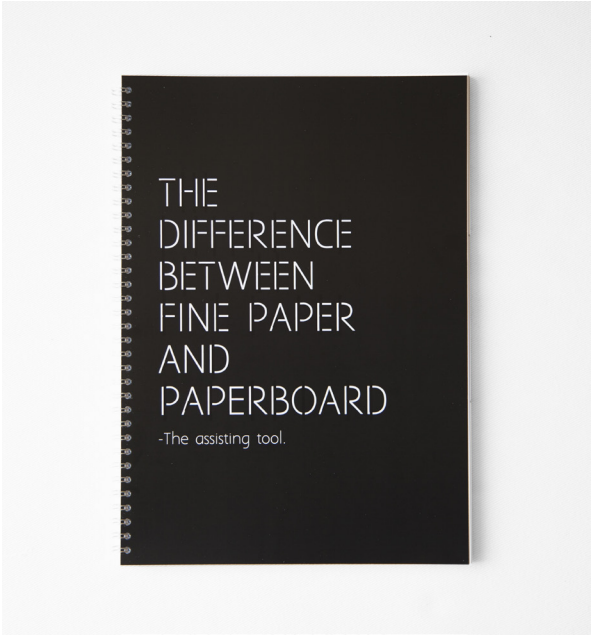


Figure 10.1 *The cover of the assisting tool, although this cover is only printed and not laser.*

Figure 10.2 *The spiral binding enables the pages in the assisting tool to remain laying open as the user desires.*

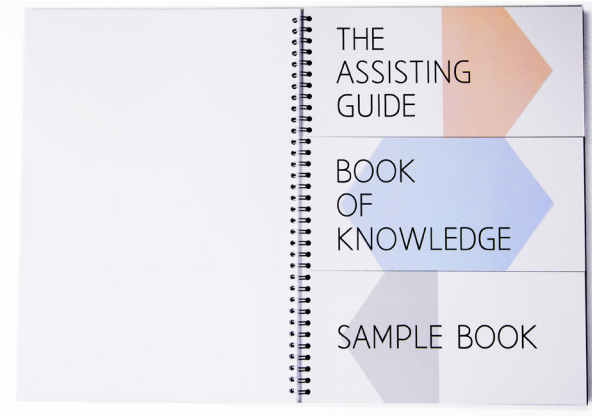


Figure 10.4 *The covers of the three divided parts: The Assisting Guide, Book of Knowledge, and Sample Book, printed on paperboard.*

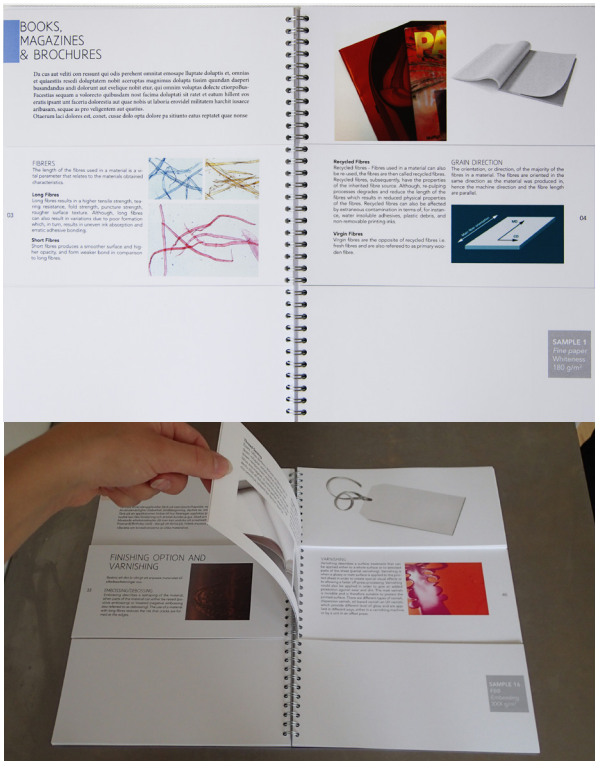


Figure 10.5 *A customised spread in the three divided parts in the assisting tool.*

Figure 10.3 *The introduction in the assisting tool, printed on paper.*

11. Discussion

This section treats the project team's thoughts and reflections about the performed work presented in this report.

11.1 The project in general

This project originates from a rather extensive problem involving a lot of different professions, and thereby needs. Bearing this in mind, a great proportion of the development work has been focused on understanding the different professions in the graphical and packaging industry and their varying work procedures. Hence, it has been crucial for the project team to understand the theoretical framework treated in the industry including the comprehensive properties of fine paper and paperboard. Also, the investigated operators' expertise has been vital to understand to enable empirical studies, and the development of a well-adapted assisting new product. In addition, as being a large area to investigate a lot of information has been required to gather, compile and analyse. Finding a suitable approach to manage this kind of large information to obtain a general picture has been rather difficult and thereby taken up a great part of the project.

Further, this project is believed to involve a more comprehensive development than the common projects carried out by the project team during their studies in Industrial Design Engineering at Chalmers University of Technology. This because the new product development has consisted of establishing how to solve the current problem in the industry through identifying needed information, grouping this information, and presenting this information in a well-adapted new product. However, the work has also involved the fundamental construction of the information contained in the new product, which is the differentiating part of the development work that contributes to the project being more comprehensive than the common projects carried out by the team.

11.2 Studies, Result & Analysis

The fact that the operators' work procedures varies to a great extent, and depends on the application that they (at the moment) produce, has been a difficulty throughout the project. This because it affected the project team's ability to make valid conclusions as the varying work procedures inhibited the ability to recognise patterns. Further, the operators in the investigated industry are rather pressured by time, which made it troublesome to find interviewees that were willing to participate in the empirical studies. In addition to this, as the main goal of the work has been to provide the knowledge to make a conscious material decision, many and in-depth questions had to be asked to the interviewees in order to identify what knowledge that needed to be provided. Hence, there was a vast conflict between the time-pressured operators in the industry, and the amount of questions that needed to be asked which inhibited the development work.

The large amount, and depth, of needed information to enable the development work also affected the possible ways to collect information. For instance, the constructed and distributed questionnaire was developed to obtain as much information as possible, with a short required respondent-time. Although, this approach did not result in a success since this data collection method i.e. the questionnaire, still needed to include a rather large number of questions in order to gain any valid information that could facilitate the development work. Further, as the operators' work procedures varied heavily, it was difficult to formulate questions in a manner that would enable the respondents to answer independent of which application that they produced, and at the same time generate the needed information. Hence, it can be concluded that the development work to a large extent depended on the various operators' in the industry, and their willingness to participate in the empirical studies.

However, it could though be concluded from the empirical studies, that a lot of different factors contributed to the operators' working procedures. It was further recognised that there was no general right or wrong, and that the operators' material decision to a large extent was based on subjectiveness. This finding was a decisive factor that made up the foundation of the chosen approach of how to solve the present problem regarding material decision. Further, the identification of this fact is believed, during the reflection of the development work, to have a very positive effect on the decided solution. This because it directed the development work towards a general solution, which for the purpose of this project is very appropriate since the new product aims to spread knowledge to a wide range of operators in the industry. Hence, by developing a general solution the product will not be limited to only one specific user group, and thereby it can be adapted to more users.

Regarding the requirement specification, the added "approach" and "solution" columns to the requirement specification simplified the development work significantly. This because the extended requirement specification could be used to keep track of whether, and how, each requirement was fulfilled. Also, as the new product being a book, this construction of the requirement specification enhanced the listing of needed information in the book, since the requirement specification was developed in similarity to a

table of contents. Hence, the customised construction of the requirement specification enhanced the ability to manage the large amount of gathered information from the studies and relating the information to the identified needs. In addition, this method to capture and summarise a large amount of information was believed to be a great approach in general since it often occur, in product development projects, that there are many aspects that need to be considered. Hence, a great learning from the performed project was how to modify common methods to be more adaptable to the own development work, and thereby enhance the ability to perform the development along with the generated result.

11.3 Concept development

The idea and concept generation was a smaller part of the project since the performed comprehensive study resulted in identifying the fundamental need i.e. more knowledge about how to make a conscious material decision. This finding restricted the number of possible solutions since it was clear that the new product needed to be some kind of informative material containing the needed knowledge. Hence, the larger part of the idea and concept generation treated the needed information that should be included in the product. During this work, a great difficulty concerned how to narrow down the information in the Book of Knowledge, since the needed information is to a large extent dependent on the different operators involved in the specific application development process. Further, great emphasis was set on differentiating the new product in terms of both configuration and contained information from existing informative products. This was also a rather arduous procedure since the product should provide a balance between accessible information that is easy to grasp, but still serve as a foundation for a conscious material decision i.e. contain rather much information.

In addition, the problem regarding the difficulties in finding possible interviewees remained during the evaluation of the developed concepts. The ideal case would be to carry out usability tests to find an optimal solution. Although, a correct usability test would take rather much time to prepare and further execute. However, by constructing a focus group comprised of master students that were studying Industrial Design Engineering is, though, believed to provide valid input during the evaluation of concepts. This because the developed product is a book with emphasis on the user obtaining the contained information, which does not actually regard the exact information per se, but merely how a user would interact with the product and whether the user does this in the intended manner.

11.4 The assisting tool

By developing an assisting tool adapted to the operators' varying work procedures that contains needed information about the importance of, and how to make, a conscious material decision, the current lack of knowledge can be reduced. As the operators' work procedures are varying, the assisting tool provides general and fundamental needed knowledge to enable a conscious material decision procedure. Further, the tool also treats the development process of fine paper and paperboard applications, and promotes discussions in-between the operators in the industry to provide needed knowledge. This also enhances the spread of knowledge in the industry through the word of mouth. Also, promoting discussions in-between the operators in the industry, results in a transfer of more knowledge than the actual tool can contain. Hence, as the main problem being to provide more knowledge to the operators in the graphical and packaging industry, to enable conscious material decisions, this solution is believed to be successful.

The conducted approach is believed to enhance the tool's adaptability to the users' varying work procedures. By developing a general solution that promotes discussion and illuminates consequences, it enables the user to perform a material decision of own choice, but based on knowledge. Supporting the operators' own behaviour during the development work, results in the tool not "forcing" a change in the operators' behaviour, but merely directs them towards a conscious material decision based on facts. Hence, the tool does indeed spread needed knowledge concerning the conscious material decision, and thereby provides an increased understanding about the importance of, and how to make, a conscious material decision. Further, the tool is believed to fill the existing gap of knowledge between the operators in the industry and the existing information (e.g. material sample books, technical material or production books, and suppliers' web-pages). This because the new product serves as a link between these two parts by both supporting the operators' subjectiveness but also providing needed knowledge. Hence, the tool evokes an awareness of important factors to further discuss and investigate, and thereby becomes a unique and complementing product to the existing solutions. Hence, the configuration and content in the new product, i.e. the assisting tool, is believed to have a positive impact on the graphical and packaging industry.

Further, the assistance during the material decision enables the operators to understand possible savings of resources, and how the fine paper or paperboard application can be optimised through the choice of material. The configuration and embodi-

ment of the assisting tool is of vital importance to evoke the user to interact with the assisting tool. Further, the contained information i.e. amount of information, selection of information, and severity of the terminology, is crucial to foster a change in the material decision behaviour. Furthermore, as the tool contains: guidance with respect to the application to be produced, theoretical information about material properties and the development process of fine paper and paperboard applications, and samples displaying consequences of certain material decisions, it results in the tool fostering an understanding of how the material decision relates to the obtained end-result of the produced application.

Furthermore, the interpretation regarding whether the graphic design of the new product is attractive is, of course, subjective. However, it is believed that the graphic design is vital in order to attract operators within advertising agencies. The graphic design is also a great differentiating factor from common informative books, or sample books. Hence, to set emphasis on developing a proper graphic design has been of great importance in order to attract the operators within, primarily, advertising agencies. The graphic design also enhances the user experience since it makes the product more amusing to use. However, despite the graphic design originating from investigations of popular elements from today's market, it is still a very abstract and a subjective development and thereby difficult to validate in terms of being appealing or not.

12. Conclusions

The main conclusion from the performed studies is that there is a current lack of knowledge about the importance of, and how to make, a conscious material decision, among the operators in the graphical and packaging industry. This lack of knowledge can be derived to the ignorance regarding the material properties of fine paper and paperboard, and the extensive fine paper and paperboard application development process. This, in turn, results in an ignorance regarding how the material decision reflects on the use of resources and the obtained quality in a fine paper or paperboard application. In addition, it was concluded that the operators within advertising agencies, and the customers of fine paper and paperboard applications were the ones lacking the most knowledge regarding this manner. It was also found that the material decision procedure, including the regarded factors during this performance, was to a great extent individual and depended on the application to be produced, along with being a highly subjective process.

Hence, the developed assisting tool is adapted to the operators' work procedure and serves as assistance during the material decision by providing needed knowledge. The tool is directed towards operators within advertising agencies, and can be used to reinforce the foundation of a specific material decision during discussions. In addition, the assisting tool also enhances the operators' ability to discuss the material decision through an increased amount of knowledge. This enables the operators to make conscious material decisions through obtaining information, contained by the assisting tool, about the importance of, and how to make, a conscious material decision. Further, it reduces the events of misunderstandings in-between the many operators involved in the fine paper or paperboard application development process, along with the non-optimal material decisions. Thereby possible savings of resources e.g. time and cost, and the optimisation of the fine paper or paperboard application through the material decision can be understood, and subsequently achieved.

13. Future work & opportunities

The assisting tool that is developed in this project can be improved through further development of details, and more comprehensive evaluations. First and foremost, the book draft needs to be completed by constructing the full texts that should be contained in the tool. Further, the samples in the "Sample Book" needs to be reviewed, and specified, with respect to the constructed texts. This because the transfer of knowledge, from the use of the tool, would be enhanced if there were referrals in the text to the different samples since this provides a combination between theoretical and practical knowledge.

After fully completing the tool with the desired texts and samples, it would be beneficial to perform a usability study during which the users' interaction with the tool can be evaluated. Aspects such as how long time that is required to find and understand needed information, how well-adapted the tool is to various work procedures and operators, and whether the included information in the tool should be supplemented or reduced can preferably be investigated. Also, evaluations regarding the users' experience can benefit the tool in terms of ensuring that the intended operators would, in fact, use the assisting tool.

In addition, features such as including tabs for each category in "The Assisting Guide", and for each main field in "Book of Knowledge", would further enhance the users ability to quickly find needed information. Although, in doing so it also adds another step to the manufacturing of the tool, which increases the cost of the tool. Thereby, it might affect the number of operators that can obtain the assisting tool, and subsequently the extent to which the needed knowledge is spread. Lastly, the binding of the tool would benefit from further investigation e.g. by consulting experts within this area, when the tool is fully developed, about the best technique to bind the tool with respect to cost, usability, and aesthetic appeal.

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Appendix

Appendix 1. Interview template 1

This section presents the interview templates from the initial empirical study.

Utbildningar: Grafisk design och förpackningsutvecklare

Vad har du för bakgrund i branschen?

Vilka utbildningar har ni där man lär sig om grafiskt papper, grafisk kartong och förpackningsutveckling?

Hur är utbildningen upplagd? (Praktiskt, teoretiskt?)
-Samarbetar ni med många olika företag?

Hur sker materialvalet av grafiskt papper eller grafisk kartong?

Vad har ni för kurslitteratur som behandlar materialval för grafiskt papper och grafisk kartong?

Använder ni något verktyg för att välja material?
-Hur skulle detta kunna förbättras?

Lär ni ut vilken tryckmetod som passar olika material, samt olika storlekar på tryckupplagor?

Vad anser du vara skillnaden mellan grafiskt papper och grafisk kartong?

Vad bör man främst titta på om man vill uppnå bra:

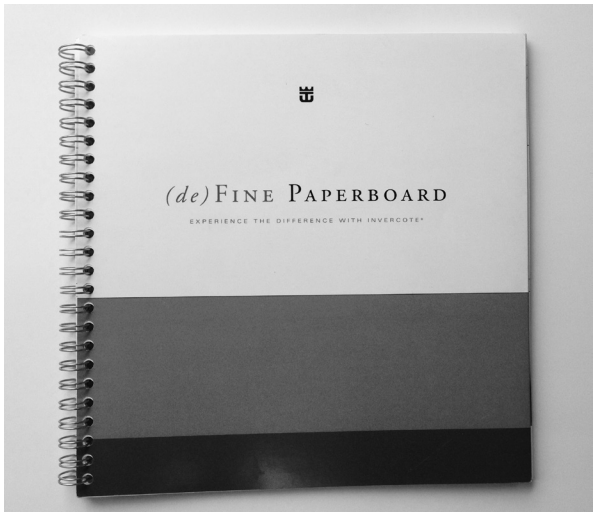
- Läsbarhet?
- Bildåtergivning?
- Bigning och vikning?
- Sprickfria hörn?
- Prägling?
- Styvhet i materialet?
- Vithet?

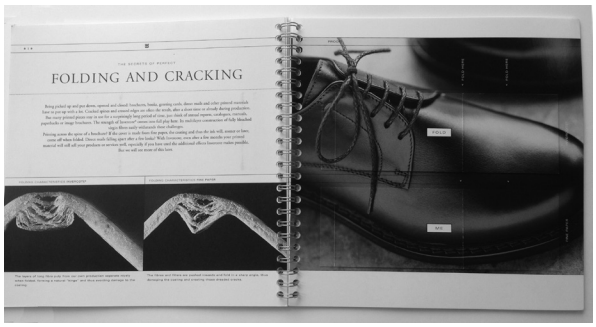
-Hur skiljer sig detta mellan grafiskt papper och grafisk kartong?

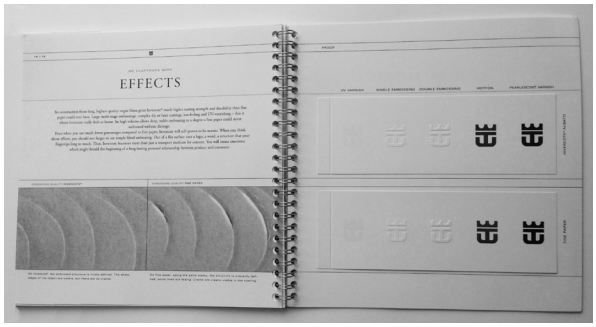
-Vad skiljer sig mellan grafiskt papper och grafisk kartong när det kommer till tryck?
(ex. torktid, färgåtergivning, vithet?)

-Hur mycket (ex. pengar, tid, slutresultat) vinner man på att ha kortare torktid?

[Frågor när vi visar katalogen med material]
s.9: Vad tror du att detta är för material?
Vad tror du att det är för gramvikt?
Vilken skillnad är det på materialen? styvhet, färgåtergivning, bigningsmöjlighet?
Vilken tror du spricker först om man viker de?



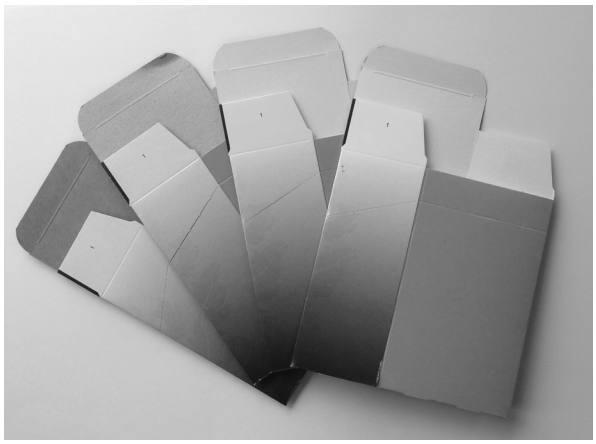




Vilka fördelar och nackdelar ser du med de olika materialen?

s.13: Vad anser du om vitheten på dessa olika material?
Vad är främst viktigt att tänka på gällande vithet?
Hur mäter man vithet?

s.15: Vilka av dessa efterbearbetningar anser du vara bäst resultat?
Vad tycker du skiljer mellan dessa?



[Visa våra kartonger (OBS! nervända)]
Vad tror du att dessa är för material?
Vad skiljer dem åt?
(styvhet, åldrande, fibrer, färgåtergivning, bigning, kvalitet på hörn, syfte att vara säljande)

Hur viktig är en produkts förpackning?

Hur viktig är grafisk design i förhållande till "ren" förpackningsdesign?

Vilket material (papper/kartong) lämpar sig bäst för följande produkter:

- Förpackning (finare ex. dator, parfym)?
- Förpackning (engångs, slit och släng ex. tvål)?
- Förpackning för mat/choklad?
- Meny?
- Reklamblad/flyer?
- Broschyr?
- Visitkort?

Vad uppfattar du vara viktigast vid materialval för grafiskt papper och grafisk kartong?
(ex. pris, kvalitet, miljövänlighet, livstid, andra egenskaper?)

När i utvecklingsprocessen borde materialvalet ske? Varför?

Hur viktigt är det att materialet är ålderbeständigt, och för vilka produkter?

Vilka är de mest kritiska efterbearbetningarna där materialvalet spelar stor roll?

Hur skiljer sig de olika kvalitéerna mellan olika grafiska papper och grafisk kartong?

Hur uppfattar du att kunskapen är idag inom den grafiska marknaden gällande materialval?
-Har det förändrats med tiden?
-Vad anser du vara mest problematiskt beträffande kunskapen hos folk i branschen?
-Hur skulle man kunna förbättra kunskapen?

Förpackningsutvecklare
Vad har du för bakgrund i branschen?

Vad går er versamhet ut på? Vilken typ av förpackningar gör ni (främst)?

Hur viktig är en produkts förpackning?

Hur får ni era produkter att synas i förhållande till era konkurrenters produkter?
-Är det främst förpackningsdesign, grafisk formgivning eller materialval (alternativt en mix av dessa) som väcker uppmärksamhet/ger önskvärt intryck?

Hur går ni tillväga när ni tar fram en ny förpackning? Vilka aktörer ingår/tvärfunktionella team?

Vad är viktigt att tänka på vid utvecklingsarbetet av en förpackning?
(Användarvänlighet, Innovation, Pris etc.)

Hur tänker ni kring materialval (grafiskt papper och grafisk kartong) till en förpackning? Vilka faktorer spelar in vid val av material? (Coated/uncoated, matte/Glossy, Opacity and weight) → Readability, image quality, Image and readability)
-Hur viktigt är läsbarhet och färgåtergivning?

Hur går ni tillväga när ni väljer material (grafiskt papper och grafisk kartong)? Vem väljer material?

Hur mycket kunskap har ni kring olika material (grafiskt papper och grafisk kartong), och hur det påverkar slutresultatet?

Upplever ni att era kunder har kunskap kring materialval (grafiskt papper och grafisk kartong)?

När i utvecklingsprocessen sker materialvalet? När vore idealt?

Vilka/vilket material (grafiskt papper och grafisk kartong) används främst i förpackningar? Vad är skillnaden mellan grafiskt papper och grafisk kartong?

Var har ni fått er kunskap från? Vem frågar ni när ni behöver mer kunskap?

Händer det att ni väljer ett annat material än det ni önskar på grund av långa leveranstider? Blir det onödigt dyrt ibland p.g.a. ex. tidspress?

Vet ni vilken tryckmetod som passar olika material (grafiskt papper och grafisk kartong), samt olika storlekar på tryckupplagor? Eller är det tryckeriet som rekommenderar?

När ni använder tryck, vet ni vad tryckeriet baserar sitt pris på? (Material, Tryckmetod, Torktid o.s.v.)

Hur arbetar ni med upplevelsen/känslan vid användandet av era förpackningar? Är det en viktig del?

Är era förpackningar “dyra” att ta fram? Hur dyra är de i förhållande till produkten förpackningen är ämnad för?

Är det viktigt att använda “miljövänligt” material? Vad anser du vara “miljövänligt”? (materialet, processer..?)
Vad finns det för svårigheter i utvecklingen av en ny förpackning? (svårt att förutsäga pris, miljöpåverkan..?)

Använder ni ofta efterbearbearbetning såsom prägling o.s.v.?
-Anpassar ni då materialvalet till detta?
-Vet ni vad som gör ett visst material passande för olika efterbearbetningar?

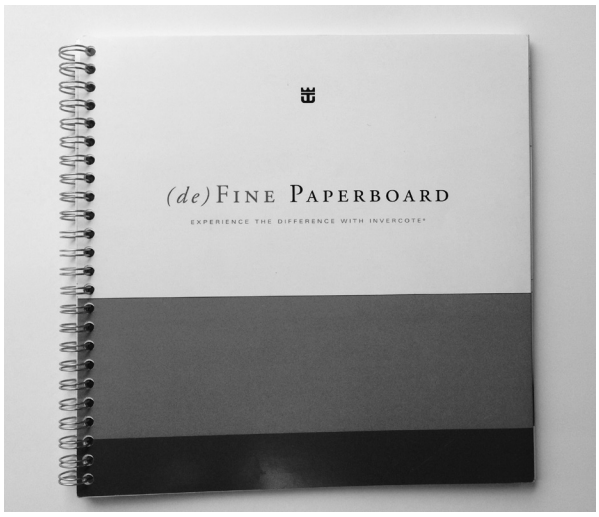
Vad bör man främst titta på om man vill uppnå bra:

- Läsbarhet?
- Bildåtergivning?
- Bigning och vikning?
- Sprickfria hörn?
- Prägling?
- Styvhet i materialet?
- Vithet?
- Lång livstid?

-Hur skiljer sig detta mellan grafiskt papper och grafisk kartong?

-Vad skiljer sig mellan grafiskt papper och grafisk kartong när det kommer till tryck?

(ex. torktid, färgåtergivning, vithet?)



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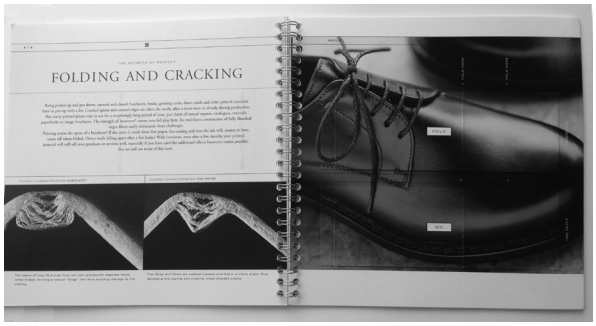
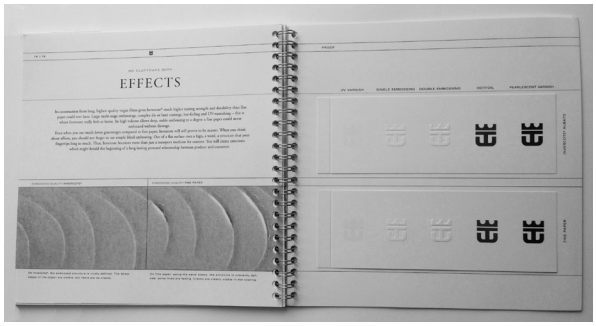


s.13: Vad anser du om vitheten på dessa olika material?

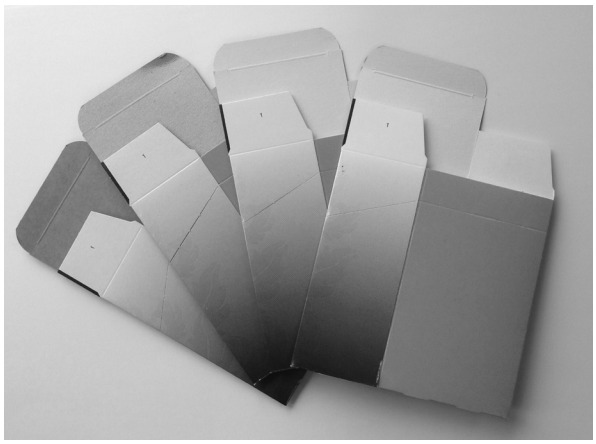
Vad är främst viktigt att tänka på gällande vithet?

Hur mäter man vithet?



s.15: Vilka av dessa efterbearbetningar anser du vara bäst resultat?

Vad tycker du skiljer mellan dessa?



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Hur viktig är en produkts förpackning?

Hur viktig är grafisk design i förhållande till "ren" förpackningsdesign?

16..1

Vilket material (papper/kartong) lämpar sig bäst för följande produkter:

-Förpackning (finare ex. dator, parfym)

-Förpackning (engångs, slit och släng ex. tvål)

-Förpackning för mat/choklad

-Meny

-Reklamblad/flyer

-Broschyr

-Visitkort?

Reklambyråer
Vad har du för bakgrund i branschen?

Hur mycket har du lärt dig om grafiskt papper och grafisk kartong i din utbildning?

Vad arbetar du i huvudsak med? Vilka produkter skapar ni? (reklamblad, förpackning, böcker..)

Hur väljs materialet för era produkter?

-Uppfattar ni att kunden anser att pris eller kvalité är viktigast?

-Anpassar kunden sig efter pris?

-Anpassar kunden sig efter tid?

-Hur påverkar storleken på upplagan valet av material?

Vilka material (grafiskt papper eller grafisk kartong) är de typsika för specifika trycksaker?
(ex. vilket material är vanligast för reklamblad, affischer, förpackningar, broschyrer?)

Vilka faktorer tänker du främst på vid val av material?
(pris, miljö, upplevelse, tryckegenskaper, livstid, produktionsteknik..)

Är det viktigt för er vilket material som används? Varför? (miljö, pris…?)

Vet du vad skillnaden mellan grafiskt papper och grafisk kartong är?

Använder du några verktyg/metoder som kan assistera vid val av material?
(Tryckeriet som rekommenderar?)
När i utvecklingsprocessen sker materialvalet?

Händer det att ni väljer ett annat material än det ni önskar på grund av långa leveranstider?

Hur mycket kunskap har du kring olika material och hur det påverkar slutresultatet? (t.ex. läsbarhet, bildkvalitet, färgåtergivning - Coated/uncoated, matte/Glossy, Opacity and weight) → Readability, image quality, Image and readability)

Vet ni vilken tryckmetod som passar olika material samt olika storlekar på tryckupplagor? Eller är det tryckeriet som rekommenderar?

Vilket tryckeri använder ni?

När ni använder tryck, vet ni vad tryckeriet baserar sitt pris på? (material, tryckmetod, torktid o.s.v.)

Brukar ni använda efterbearbetningar såsom ex prägling, bigning o.s.v.?

-Anpassar ni då materialvalet till detta?

-Vet ni vad som gör ett visst material passande för olika efterbearbetningar?

Tänker ni något kring bläcket som används vid tryck? Hur påverkar bläcket kvalitén på slutprodukten?

Hur viktig är produktens miljöpåverkan för er/kunden? Brukar detta efterfrågas? Handlar det då om tillverkningen (företagets miljöarbete) eller att mateiralet i sig är “miljövänligt”?

Vad gör ett material “miljövänligt”?

Är det ni eller kunden som bestämmer vilken “känsla” produkten skall kommunicera?

Hur viktig är visuell design i förhållande till materialval?
-Vilket sinne är viktigast: väcka uppmärksamhet (visuellt), känsla (taktilt) etc.?

Tryckerier
Vad har du för bakgrund i branschen?

Har du lärt dig mycket om grafiskt papper och grafisk kartong, samt deras egenskaper?

Vilka är era kunder? (Reklambyrå, förpackningsutvecklare etc,)

Vem väljer material som ni ska trycka på? Frågar kunder ofta om råd?

Hur upplever du att kunskapen är hos era kunder?

Uppfattar ni att kunden anser att priset eller kvalitén är viktigast?
-Brukar kunden anpassa sig efter pris?
-Brukar kunden anpassa sig efter tid?

Vilka egenskaper hos slutprodukten brukar kunden efterfråga?

Hur viktigt är produktens miljöpåverkan för er/kunden? Brukar detta efterfrågas?
-Handlar det då om tillverkningen (företagets miljöarbete)?
eller att pappret i sig är “miljövänligt”?
Vad gör ett material “miljövänligt”?

Köper ni in stora lager med material eller beställer ni vid efterfrågan?
-Får ni specialpris när ni köper mkt på en gång?

Väljer ni material främst beroende på pris, kvalité, eller andra egenskaper?

Händer det att ni väljer ett annat material än det ni önskar på grund av långa leveranstider, slut i lager?
Händer det att slutprodukten då blir dyrare, sämre, annorlunda än tänkt?
-Vilka köper ni främst ifrån?

Hur mycket kunskap har ni kring olika material och hur det påverkar slutresultatet?
(Coated/uncoated, matte/Glossy, Opacity and weight) → Readability, image quality, Image and readability) (flatness, dimension stability → finishing operations)

Har ni faktortjänst?
Vilka parametrar anser du vara viktigast för att få god:
-läsbarhet?
-färgåtergivning (bildkvalitét)?
-en kombination av dessa?

Vilken tryckmetod brukar ni oftast använda?
-Vad ger detta för olika resultat (torktid, kvalité, färgåtergivning etc.)?

Utför ni även efterbearbetning (ex. embossing, creasing and folding)?
-Varierar ni material beroende på vilken efterbearbetning som skall utföras?

Hur stora upplagor brukar ni oftast trycka?
-Varierar ni tryckmetod efter storlek på upplaga?

Vilka parametrar påverkar främst priset på slutprodukten?

Varierar torktiden mycket beroende på materialval?

Känner ni till några verktyg/metoder som kan användas för att assistera kunden vid val av material?

Anpassar ni bläck efter material?

-Hur mycket påverkar typen av bläck slutresultatet?

-Vad består bläcket av?

-Jobbar ni mot att använda "miljövänligare" tillsatser i bläcket? Efterfrågas detta av kunden?

Grossister/Återförsäljare av papper och/el kartong
Vilka är era kunder?

Vad har ni för kunskap om grafiskt papper och grafisk kartong? Bakgrund?

Hur mycket kunskap har ni kring olika material och hur det påverkar slutresultatet?
(Coated/uncoated, matte/Glossy, Opacity and weight) → Readability, image quality, Image and readability)

Hur assisterar ni era kunder när de ska välja material?

Känner ni till några verktyg/metoder som kan användas för att assistera kunden vid val av material?

Hur brukar kunder gå tillväga när de ska välja material? Vilka vet/vet inte vad de vill ha?
Hur gör ni när ni köper/väljer kvalitéer?

Vem och vilka faktorer styr vilka kvalitéer ni köper in?

Händer det att ni väljer ett annat material än det ni önskar på grund av långa leveranstider från tillverkare?

Hur viktigt är priset när kunden väljer produkt?

Vilket material är populärast för ex. förpackningar eller trycksaker?

Hur påverkar ordrarnas storlek valet av material?

Hur viktig är produktens miljöpåverkan för kunden? Brukar detta efterfrågas?

Appendix 2 - Interview template 2

This section presents the interview templates from the empirical study.

Professor förpackningsteknologi

Vad har du för bakgrund inom branschen?

Vad har du för utbildning om grafiskt papper och grafisk kartong?

Vad är din nuvarande jobbtitel?

Vad går dina föreläsningar ut på? Vilken typ av grafiska papper- och kartongprodukter inriktar du dina föreläsningar på?

Vilket/-a utbildningsprogram läser dina elever?

------SEPARAT FORMULÄR TILL INTERVJUOBJEKTET----------

5. Vilka egenskaper tittar ni främst på vid val av material till dessa produkter?

	(Inte alls)					(Mycket viktigt)
Läsbarhet	1	2	3	4	5	6
Bildåtergivning	1	2	3	4	5	6
Ytegenskaper	1	2	3	4	5	6
Vithet & Ljusstabilitet	1	2	3	4	5	6
Formbarhet (komplexa former)	1	2	3	4	5	6
Styvhet	1	2	3	4	5	6
Rivstyrka	1	2	3	4	5	6
Gramvikt	1	2	3	4	5	6
Tjocklek			1	2	3	4	5	6
Lämpligt för efterbearbetning	1	2	3	4	5	6
Åldersbeständighet	1	2	3	4	5	6
Körbarhet	1	2	3	4	5	6

Annat/Kommentera

_____

6. Rangordna faktorerna nedan utefter deras prioritet vid val av material!

	(Inte alls viktigt)					(Mycket viktigt)
Pris	1	2	3	4	5	6
Tillgänglighet	1	2	3	4	5	6
Miljövänligt	1	2	3	4	5	6
Materialegenskaper	1	2	3	4	5	6
Kvalité	1	2	3	4	5	6
Kundens begäran	1	2	3	4	5	6

Annat/ Kommentera

_____ ----------

Kan du kortfattat beskriva skillnaden mellan grafiskt papper och grafisk kartong som du känner till?
När används vad?

-Vad bör man främst titta på om man vill uppnå bra:

Läsbarhet, Bildåtergivning, Bigning och vikning, Sprickfria hörn, Prägling, Styvhet i materialet, Vithet, Lång livstid, Tryckprocesser (runnability).

-Hur skiljer sig detta mellan grafiskt papper och grafisk kartong?

När är det optimalt att välja material under utvecklingsarbetet av grafiska papper och kartongprodukter? Varför?

-Finns det några för- eller nackdelar med detta?

-Vet du om aktörerna som arbetar med grafiska papper och kartongprodukter väljer material vid rätt tidpunkt? Varför tror du att de väljer material när de gör?

-Vet du hur kunskapen beträffande materialval ser ut i branschen?

Vet du om det är någon kunskap som borde förbättras gällande materialval?

(Avgörande/viktigt att veta för att…)

Hur går man tillväga när man väljer material? Vilka parametrar bör man främst ta hänsyn till? ***(miljösaspekter: tillgänglighet, runnability: process, materialegenskaper: slutresultat..)***

-Vem väljer material? Är det rätt person? *(Hur mycket påverkar du, respektive kunden, materialvalet?)*

-Hur påverkar materialvalet slutresultatet?

- Ex. prägling, bigning o.s.v.?
  - Hur anpassar man materialet för att optimera detta?
- Uppfattar du att pris eller kvalité är viktigast i branschen?
  - Vad anser du vara kvalité hos ett material, slutresultatet?

-Anser du att det är viktigt att lägga fokus på materialvalsprocessen? Varför?

- Hur lång tid anser du vara optimalt att lägga på ett materialval?
- Vad styr tidsramen?

-Vem frågar du när du behöver mer kunskap om material (grafiskt papper/grafisk kartong)? (utbildningar, grossister..?)

- Är detta bra informationskällor?
- Kan deras kunskap förbättras?

Vet du vilka material (papper/kartong) som är typiska för specifika trycksaker, ex. vilket material är vanligast för reklamblad, affischer, förpackningar, broschyrer etc.? Varför?

-Hur mycket kunskap har du kring tryckprocesser?

Formbarhet (komplexa former)	1	2	3	4	5	6		
Styvhet	1	2	3	4	5	6		
Rivstyrka	1	2	3	4	5	6		
Gramvikt	1	2	3	4	5	6		
Tjocklek			1	2	3	4	5	6
Lämpligt för efterbearbetning	1	2	3	4	5	6		
Åldersbeständighet	1	2	3	4	5	6		
Körbarhet	1	2	3	4	5	6		

Annat/Kommentera

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6. Rangordna faktorerna nedan utefter deras prioritet vid val av material!

	(Inte alls viktigt)					(Mycket viktigt)
Pris	1	2	3	4	5	6
Tillgänglighet	1	2	3	4	5	6
Miljövänligt	1	2	3	4	5	6
Materialegenskaper	1	2	3	4	5	6
Kvalité	1	2	3	4	5	6
Kundens begäran	1	2	3	4	5	6

Annat/ Kommentera

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Kan du kortfattat beskriva skillnaden mellan grafiskt papper och grafisk kartong som du känner till?

När används vad?

-Vad bör man främst titta på om man vill uppnå bra:

Läsbarhet, Bildåtergivning, Bigning och vikning, Sprickfria hörn, Prägling, Styvhet i materialet, Vithet, Lång livstid, Tryckprocesser (runnability).

-Hur skiljer sig detta mellan grafiskt papper och grafisk kartong?

Hur får ni era produkter att synas i förhållande till era konkurrenters produkter?

-Är det främst förpackningsdesign, grafisk formgivning eller materialval (alternativt en mix av dessa) som främst väcker uppmärksamhet/ger önskvärt intryck?

Vad är viktigt att tänka på vid utvecklingsarbetet av en ny förpackning?

(Pris, Upplevelse, Hållbarhet, Miljöpåverkan, Livstid etc.)

-Vad finns det för svårigheter i utvecklingen av en ny förpackning?

(svårt att förutsäga pris, miljöpåverkan..?)

Hur går ni tillväga när ni tar fram en ny förpackning?

Vithet & Ljusstabilitet	1	2	3	4	5	6		
Formbarhet (komplexa former)	1	2	3	4	5	6		
Styvhet	1	2	3	4	5	6		
Rivstyrka	1	2	3	4	5	6		
Gramvikt	1	2	3	4	5	6		
Tjocklek			1	2	3	4	5	6
Lämpligt för efterbearbetning	1	2	3	4	5	6		
Åldersbeständighet	1	2	3	4	5	6		
Körbarhet	1	2	3	4	5	6		

Annat/Kommentera

_____

6. Rangordna faktorerna nedan utefter deras prioritet vid val av material!

	(Inte alls viktigt)						(Mycket viktigt)
Pris	1	2	3	4	5	6	
Tillgänglighet	1	2	3	4	5	6	
Miljövänligt	1	2	3	4	5	6	
Materialegenskaper	1	2	3	4	5	6	
Kvalité	1	2	3	4	5	6	
Kundens begäran	1	2	3	4	5	6	

Annat/ Kommentera

_____

Kan du kortfattat beskriva skillnaden mellan grafiskt papper och grafisk kartong som du känner till?

När används vad?

-Vad bör man främst titta på om man vill uppnå bra:

Läsbarhet, Bildåtergivning, Bigning och vikning, Sprickfria hörn, Prägling, Styvhet i materialet, Vithet, Lång livstid, Tryckprocesser (runnability).

-Hur skiljer sig detta mellan grafiskt papper och grafisk kartong?

Hur får ni era produkter att synas i förhållande till era konkurrenters produkter?

-Är det främst förpackningsdesign, grafisk formgivning eller materialval (alternativt en mix av dessa) som främst väcker uppmärksamhet/ger önskvärt intryck?

Vad är viktigt att tänka på vid utvecklingsarbetet av en ny förpackning?

(Pris, Upplevelse, Hållbarhet, Miljöpåverkan, Livstid etc.)

-Vad finns det för svårigheter i utvecklingen av en ny förpackning?

(svårt att förutsäga pris, miljöpåverkan..?)

Hur går ni tillväga när ni tar fram en ny förpackning?

-Eftersom ni jobbar med matförpackningar, anpassar ni ofta material efter att de ska hålla för mat och ej ge ifrån sig smak, lukt m.m.?
-Vilka aktörer ingår/tvärfunktionella team? *(Förpackningsutvecklare, AD etc.)*

-Samarbetar ni med någon reklambyrå eller är det bara ni inom företaget?

-Vilka aktörer svarar ni mot, har de önskemål om material (återkommande önskemål)?

-Saknar de någon kunskap om material (återkommande frågor)?

När i utvecklingsarbetet av era produkter sker materialvalet?

-När kommer förfrågningar om material? (ex. från förpackningsutvecklare)

-Finns det några för- eller nackdelar med detta?

-Är materialvalet satt innan förpackningskonstruktionen, grafiska designen är bestämd?

-Upplever ni att dessa aktörer har kunskap kring materialval? (sätter de krav/önskemål om material?)

Känner du att det är något dessa aktörer borde veta om materialval som de inte vet? (Får ni ofta samma typ av frågor?)

Hur går ni tillväga när ni väljer material?

-Vem väljer material? Är det rätt person?

- *Hur mycket påverkar du materialvalet?*
- Hur mkt får förpackningsdesignern, grafiska designern påverka materialval?

-Känner du att du har kunskap att välja material, och hur det påverkar slutresultatet?

- Brukar ni använda efterbearbetningar så som t.ex. prägling, bigning o.s.v.?
  - Anpassar ni då materialvalet till detta?
- Uppfattar du att **kunden, övriga aktörer** anser att pris eller kvalité är viktigast?
  - Vad anser du vara kvalité hos ett material, slutresultatet?
- Anser **ni** att pris eller kvalité är viktigast?
- Anpassar kunden sig efter pris?
- Anpassar kunden sig efter tid?

-Hur lång tid spenderas i dagsläget på materialval?

-Vad styr tidsramen för materialval?

-Skulle du vilja förändra mängden tid som spenderas på materialval?

-Var har ni fått er kunskap ifrån/vem frågar ni när ni behöver mer kunskap? (utbildningar, grossister..?) Är du nöjd med din informationskälla?

-Vart vänder ni er om ni vill ha information om nya material? (mässor, papperstillverkare, grossister, internet..?) Är du nöjd med din informationskälla?

-Köper ni in stora lager med material eller beställer ni vid efterfrågan?

-Får ni specialpris när ni köper mkt på en gång?

-Händer det att ni väljer ett annat material än det ni önskar på grund av långa leveranstider? Blir det onödigt dyrt (för kunden) ibland p.g.a. ex. tidspress el. dyrare material?

-Riktar ni materialvalet mot det som finns på lager?

-Vilka köper ni främst ifrån?

Använder du några verktyg/metoder som kan assistera vid val av material?

-Använder du någon specifik informationsbok, materalprovsamling, datablad..? Vad innehåller dessa, saknas något? Är det något som är extra bra?

Hur påverkar storleken på upplagan valet av material?

-Vet ni vilken tryckmetod som passar olika material samt olika storlekar på tryckupplagor? Eller är det tryckeriet som rekommenderar?

-Vilket tryckeri använder ni?

-När ni använder tryck, vet ni vad tryckeriet baserar sitt pris på? *(Material, Tryckmetod, Torktid o.s.v.)*

-Tänker ni något kring bläcket som används vid tryck? Hur påverkar bläcket kvalitén på slutprodukten?

Är miljöaspekter viktiga för er, vid valet av material?

-Vad anser du vara ett korrekt miljöval gällande material (grafisk kartong / grafiskt papper)?

-Skiljer sig olika tryckprocesser ur miljösynpunkt?

Hur viktig är produktens miljöpåverkan för er/kunden?

-Brukar detta efterfrågas?

-Handlar det då om tillverkningen (företagets miljöarbete) eller att pappret i sig är ett bra miljöval? Eller tryckprocesser?

Hur arbetar ni med upplevelsen/känslan vid användandet av era förpackningar? Är det en viktig del?

-Är det ni som bestämmer vilken "känsla" produkten skall kommunicera?

-Hur viktig är visuell design i förhållande till materialval?

-Hur dyra är era förpackningar (el. materialet) i förhållande till produkten förpackningen är ämnad för?

Reklambyråer

Vad har du för bakgrund inom branschen?

Har du någon utbildning om grafiskt papper och grafisk kartong?

Vad är din jobbtitel?

Vad går er versamhet ut på? Vilken typ av produkter gör ni där ni använder grafiskt papper eller grafisk kartong?

Vilken typ av kunder har ni?

------SEPARAT FORMULÄR TILL INTERVJUOBJEKTET----------

5. Vilka egenskaper tittar ni främst på vid val av material till dessa produkter?

	(Inte alls)						(Mycket viktigt)
Läsbarhet	1	2	3	4	5	6	
Bildåtergivning	1	2	3	4	5	6	
Ytegenskaper	1	2	3	4	5	6	
Vithet & Ljusstabilitet	1	2	3	4	5	6	
Formbarhet (komplexa former)	1	2	3	4	5	6	
Styvhet	1	2	3	4	5	6	
Rivstyrka	1	2	3	4	5	6	
Gramvikt	1	2	3	4	5	6	
Tjocklek		1	2	3	4	5	6
Lämpligt för efterbearbetning	1	2	3	4	5	6	
Åldersbeständighet	1	2	3	4	5	6	
Körbarhet	1	2	3	4	5	6	

Annat/Kommentera

_____

6. Rangordna faktorerna nedan utefter deras prioritet vid val av material!

	(Inte alls viktigt)						(Mycket viktigt)
Pris	1	2	3	4	5	6	
Tillgänglighet	1	2	3	4	5	6	
Miljövänligt	1	2	3	4	5	6	
Materialegenskaper	1	2	3	4	5	6	
Kvalité	1	2	3	4	5	6	
Kundens begäran	1	2	3	4	5	6	

Annat/ Kommentera

_____

Kan du kortfattat beskriva skillnaden mellan grafiskt papper och grafisk kartong som du känner till?

När används vad?

-Vad bör man främst titta på om man vill uppnå bra:

Läsbarhet, Bildåtergivning, Bigning och vikning, Sprickfria hörn, Prägling, Styvhet i materialet, Vithet, Lång livstid, Tryckegenskaper (runnability).

-Hur skiljer sig detta mellan grafiskt papper och grafisk kartong?

Hur går ni tillväga (i korta drag) när ni tar fram en ny grafisk papper- eller kartongprodukt?

-Vilka aktörer ingår/tvärfunktionella team? *(Kunden, Förpackningsutvecklare, AD, CW etc.)*

-Har kunden önskemål om material (återkommande önskemål)?

-Saknar kunden någon kunskap om material (återkommande frågor)?

-Finns det några svårigheter vid val av material för en grafiska papper- eller kartongprodukter *(kunden vill ha billigt/ ej betala extra för idéer /förstår inte vikten av materialval)*?

-Vad är viktigt att tänka på vid utvecklingen av en ny grafisk papper- eller kartongprodukt? *(svårt att förutsäga pris, miljöpåverkan..?)*

Hur arbetar ni med upplevelsen/känslan vid utvecklingen av era produkter? Är det en viktig del?

-Är det ni som bestämmer vilken "känsla" produkten skall kommunicera?

-Hur viktig är visuell design i förhållande till materialval?

När i utvecklingsarbetet av grafiska papper- och kartongprodukter sker materialvalet? Varför?

-Finns det några för- eller nackdelar med detta?

-Vad frågar era kunder er när det gäller materialval?

-Upplever ni att era kunder har kunskap kring materialval? (sätter de krav/önskemål om material?)

Känner du att det är något som kunden borde veta kring materialval som de inte vet?

(Får ni ofta samma typ av frågor?)

Hur går ni tillväga när ni väljer material?

-Vem väljer material? Är det rätt person? *(Hur mycket påverkar du el. kunden materialvalet?)*

-Skapas en kravspec., för produkten som skall utvecklas, utifrån vilken man väljer material?

-Känner du att du har kunskap att välja material, och hur det påverkar slutresultatet?

- Brukar ni använda efterbearbetningar så som ex prägling, bigning o.s.v.?
  - Anpassar ni då materialvalet till detta?
- Uppfattar du att **kunden** anser att pris eller kvalité är viktigast?
  - Vad anser du vara kvalité hos ett material, slutresultatet?
- Anser **ni** att pris eller kvalité är viktigast?
- Anpassar kunden sig efter pris?
- Anpassar kunden sig efter tid?

-Hur lång tid spenderas i dagsläget på materialvalet?

-Vad styr tidsramen för materialvalet?

-Skulle du vilja förändra mängden tid som spenderas på materialvalet?

-Var har ni fått er kunskap ifrån/vem frågar ni när ni behöver mer kunskap? (utbildningar, grossister..?) Är du nöjd med din informationskälla?

-Vart vänder ni er om ni vill ha information om nya material? (mässor, papperstillverkare, grossister, internet..?) Är du nöjd med din informationskälla?

-Samarbetar ni med ett specifikt tryckeri?

-Brukar det önskade material finnas inne i lager hos tryckeriet?

-Händer det att ni väljer ett annat material än det ni önskar på grund av långa leveranstider? Blir det onödigt dyrt (för kunden) ibland p.g.a. ex. tidspress (kort deadline) el. dyrare material?

-Hur lång tid brukar tryckprocessen ta i genomsnitt?

-Hur stora upplagor brukar ni oftast trycka?

-Varierar ni tryckmetod efter storlek på upplaga?

-Varierar ni material efter storlek på upplaga?

-Vilka parametrar påverkar främst priset på slutprodukten?

-Varierar torktiden mycket beroende på materialval (el. tryckteknik)? Tar ni betalt för längre torktid?

-Vet ni vad tryckeriet baserar sitt pris på? *(Material, Tryckmetod, Torktid o.s.v.)*

Vilka material (papper/kartong) är de typiska för specifika trycksaker, ex. vilket material är vanligast för reklamblad, affischer, förpackningar, broschyrer

Använder du några verktyg/metoder som kan assistera vid val av material?

-Använder du någon specifik informationsbok, materalprovsamling, hemsida..?

-Vad innehåller dessa, saknas något?

-Är det något som är extra bra?

Är miljöaspekter viktiga för er, vid valet av material?

-Vad anser du vara ett korrekt miljöval gällande material (grafisk kartong / grafiskt papper)?

-Vet du om olika tryckprocesser skiljer sig ur miljösynpunkt?

Hur viktig är produktens miljöpåverkan för er/kunden?

-Brukar detta efterfrågas?

-Handlar det då om tillverkningen (företagets miljöarbete) eller att pappret i sig är ett bra miljöval? Eller tryckprocesser?

Tryckeri

Vad är din jobbtitel?

Vad har du för bakgrund inom branschen?

Har du någon utbildning om grafiskt papper och grafisk kartong?

Vad går er versamhet ut på? Vilken typ av produkter gör ni där ni använder grafiskt papper eller grafisk kartong?

Vilken typ av kunder har ni?

------SEPARAT FORMULÄR TILL INTERVJUOBJEKTET----------

5. Vilka egenskaper tittar ni främst på vid val av material till dessa produkter?

	(Inte alls)					**(**Mycket viktigt)
Läsbarhet	1	2	3	4	5	6
Bildåtergivning	1	2	3	4	5	6
Ytegenskaper	1	2	3	4	5	6
Vithet & Ljusstabilitet	1	2	3	4	5	6
Formbarhet (komplexa former)	1	2	3	4	5	6
Styvhet	1	2	3	4	5	6
Rivstyrka	1	2	3	4	5	6
Gramvikt	1	2	3	4	5	6
Tjocklek		1	2	3	4	5 6
Lämpligt för efterbearbetning	1	2	3	4	5	6
Åldersbeständighet	1	2	3	4	5	6
Körbarhet	1	2	3	4	5	6

Annat/Kommentera

_____

6. Rangordna faktorerna nedan utefter deras prioritet vid val av material!

	(Inte alls viktigt)					(Mycket viktigt)
Pris	1	2	3	4	5	6
Tillgänglighet	1	2	3	4	5	6
Miljövänligt	1	2	3	4	5	6
Materialegenskaper	1	2	3	4	5	6
Kvalité	1	2	3	4	5	6
Kundens begäran	1	2	3	4	5	6

Annat/ Kommentera

_____

Kan du kortfattat beskriva skillnaden mellan grafiskt papper och grafisk kartong som du känner till?
När används vad?

-Vad bör man främst titta på om man vill uppnå bra:
Läsbarhet, Bildåtergivning, Bigning och vikning, Sprickfria hörn, Prägling, Styvhet i materialet, Vithet, Lång livstid, Tryckegenskaper (runnability).

-Hur skiljer sig detta mellan grafiskt papper och grafisk kartong?

lär sker materialvalet?

-När kommer era kunder med förfrågningar om material?
-Finns det några för- eller nackdelar med detta?
-Vad frågar era kunder om?
- Upplever ni att era kunder har kunskap kring materialval? (sätter de krav/önskemål om material?)

Känner du att det är något som kunden borde veta kring materialval som de inte vet? (Får ni ofta samma typ av frågor?)

lur går ni tillväga när ni väljer material?

-Vem väljer material? Är det rätt person? *(Hur mycket påverkar du, respektive kunden, materialvalet?)*

-Känner du att du har kunskap att välja material, och hur det påverkar slutresultatet?

- Brukar ni använda efterbearbetningar så som ex prägling, bigning o.s.v.?
  - Anpassar ni då materialvalet till detta?
- Uppfattar du att **kunden** anser att pris eller kvalité är viktigast?
  - Vad anser du vara kvalité hos ett material, slutresultatet?
- Anser **ni** att pris eller kvalité är viktigast?
- Anpassar kunden sig efter pris?
- Anpassar kunden sig efter tid?

-Hur lång tid spenderas i dagsläget på materialval?

-Vad styr tidsramen för materialval?

-Skulle du vilja förändra mängden tid som spenderas på materialval?

-Var har ni fått er kunskap ifrån/vem frågar ni när ni behöver mer kunskap? (utbildningar, grossister..?) Är du nöjd med din informationskälla?

-Vart vänder ni er om ni vill ha information om nyheter? (mässor, papperstillverkare, grossister, internet..?) Är du nöjd med din informationskälla?

-Köper ni in stora lager med material eller beställer ni vid efterfrågan?

-Får ni specialpris när ni köper mkt på en gång?

-Händer det att ni väljer ett annat material än det ni önskar på grund av långa leveranstider? Blir det onödigt dyrt (för kunden) ibland p.g.a. ex. tidspress el. dyrare material?

-Riktar ni materialvalet mot det som finns på lager?

-Vilka köper ni främst ifrån?

-Hur lång tid (tryckprocessen) brukar ni i genomsnitt ha på er?

-Hur stora upplagor brukar ni oftast trycka?

-Varierar ni tryckmetod efter storlek på upplaga?

-Varierar ni material efter storlek på upplaga?

-Vilka parametrar påverkar främst priset på slutprodukten?

-Varierar torktiden mycket beroende på materialval (el. tryckteknik)? Tar ni betalt för längre torktid?

Vilka material (papper/kartong) är de typiska för specifika trycksaker, ex. vilket material är vanligast för reklamblad, affischer, förpackningar, broschyrer

Använder du några verktyg/metoder som kan assistera vid val av material?

-Använder du någon specifik informationsbok, materalprovsamling..?

-Vad innehåller dessa, saknas något?

-Är det något som är extra bra?

Anpassar ni tryckfärg och tryckmetod efter materialet? hur? (universalfärg, högglansfärg, kartongfärg,Ytoxiderande färg..)
(Hur tänker ni kring bläcket som används vid tryck? Hur påverkar bläcket kvalitén på slutprodukten?)

Är miljöaspekter viktiga för er, vid valet av material?

Vad anser du vara ett korrekt miljöval gällande material (grafisk kartong / grafiskt papper)?
Skiljer sig olika tryckprocesser ur miljösynpunkt?

Hur viktig är produktens miljöpåverkan för er/kunden?

Brukar detta efterfrågas?
Handlar det då om tillverkningen (företagets miljöarbete) eller att pappret i sig är ett bra miljöval?
Eller tryckprocesser?

Förlag

Vad har du för jobbtitel?

Vad har du för bakgrund inom branschen (grafiska/förpackningsbranschen)?

Har du någon utbildning om grafiskt papper och grafisk kartong?

Vad går er versamhet ut på? Vilken typ av produkter gör ni där ni använder grafiskt papper eller grafisk kartong?

- Böcker (inbunden/pocket)
- Tidningar
- Kalendrar
- Affischer

5. Vilka egenskaper tittar ni främst på vid val av material till dessa produkter?

	(Inte alls)					(Mycket viktigt)
Läsbarhet	1	2	3	4	5	6
Bildåtergivning	1	2	3	4	5	6
Ytegenskaper	1	2	3	4	5	6
Vithet & Ljusstabilitet	1	2	3	4	5	6
Formbarhet (komplexa former)	1	2	3	4	5	6
Styvhet	1	2	3	4	5	6
Rivstyrka	1	2	3	4	5	6
Gramvikt	1	2	3	4	5	6
Tjocklek			1	2	3	4	5	6
Lämpligt för efterbearbetning	1	2	3	4	5	6
Åldersbeständighet	1	2	3	4	5	6
Körbarhet	1	2	3	4	5	6

6. Rangordna faktorerna nedan utefter deras prioritet vid val av material!

	(Inte alls viktigt)					(Mycket viktigt)
Pris	1	2	3	4	5	6
Tillgänglighet	1	2	3	4	5	6
Miljövänligt	1	2	3	4	5	6
Materialegenskaper	1	2	3	4	5	6
Kvalité	1	2	3	4	5	6
Kundens begäran	1	2	3	4	5	6

Vilken typ av kunder har ni?

Privatpersoner, företag etc. - Hur skiljer sig kunskapen om material/hur mycket ni får bestämma?

Kan du kortfattat beskriva skillnaden mellan grafiskt papper och grafisk kartong som du känner till?

När används vad?

-Vad bör man främst titta på om man vill uppnå bra:

Läsbarhet, Bildåtergivning, Bigning och vikning, Sprickfria hörn, Prägling, Styvhet i materialet, Vithet, Lång livstid, Tryckegenskaper (printability), Runnability.

-Hur skiljer sig detta mellan grafiskt papper och grafisk kartong?

När sker materialvalet?

-Kommer era kunder med förfrågningar om material? Isf när?

-Finns det några för- eller nackdelar med detta?

-Vad frågar era kunder om?

- Upplever ni att era kunder har kunskap kring materialval? (sätter de krav/önskemål om material?)

Känner du att det är något som kunden borde veta kring materialval som de inte vet? (Får ni ofta samma typ av frågor?)

Hur går ni tillväga när ni väljer material?

-Vem väljer material? Är det rätt person? *(Hur mycket påverkar du, respektive kunden, materialvalet?)*

-Känner du att du har kunskap att välja material, och hur det påverkar slutresultatet?

- Brukar ni använda efterbearbetningar så som ex prägling, bigning o.s.v.?
- Vilken typ av bindning använder ni?
  - Anpassar ni då materialvalet till detta?
- Uppfattar du att **kunden** anser att pris eller kvalité är viktigast?
  - Vad anser du vara kvalité hos ett material, slutresultatet?
- Om ni vill göra en produkt som känns "lyxig", vad använder ni för material då?
- Anser **ni** att pris eller kvalité är viktigast?
- Anpassar kunden sig efter pris?
- Anpassar kunden sig efter tid?

-Hur lång tid spenderas i dagsläget på materialval?

-Vad styr tidsramen för materialval?

-Skulle du vilja förändra mängden tid som spenderas på materialval?

-Var har ni fått er kunskap ifrån/vem frågar ni när ni behöver mer kunskap? (utbildningar, grossister..?) Är du nöjd med din informationskälla?

-Vart vänder ni er om ni vill ha information om nyheter? (mässor, papperstillverkare, grossister, internet..?) Är du nöjd med din informationskälla?

- Köper ni in materialet själva eller är det ex tryckeriet som köper in pappret/kartongen?

-Köper ni in stora lager med material eller beställer ni vid efterfrågan?

-Får ni specialpris när ni köper mkt på en gång?

-Händer det att ni väljer ett annat material än det ni önskar på grund av långa leveranstider? Blir det onödigt dyrt (för kunden) ibland p.g.a. ex. tidspress el. dyrare material?

-Riktar ni materialvalet mot det som finns på lager?

-Vilka köper ni främst ifrån?

-Hur lång tid (tryckprocessen) brukar ni i genomsnitt ha på er?

-Anpassar ni materialval efter körbarhet?

-Hur stora upplagor brukar ni oftast trycka?

-Varierar ni tryckmetod efter storlek på upplaga?

-Varierar ni material efter storlek på upplaga?

-Vilka parametrar påverkar främst priset på slutprodukten?

-Varierar torktiden mycket beroende på materialval (el. tryckteknik)? Tar ni betalt för längre torktid?

Använder du några verktyg/metoder som kan assistera vid val av material?

-Använder du någon specifik informationsbok, materalprovsamling..?

-Vad innehåller dessa, saknas något?

-Är det något som är extra bra?

Anpassar ni tryckfärg och tryckmetod efter materialet? hur? (universalfärg, högglansfärg, kartongfärg,Ytoxiderande färg..)
(Hur tänker ni kring bläcket som används vid tryck? Hur påverkar bläcket kvalitén på slutprodukten?)

Är miljöaspekter viktiga för er, vid valet av material?

Vad anser du vara ett korrekt miljöval gällande material (grafisk kartong / grafiskt papper)?
Skiljer sig olika tryckprocesser ur miljösynpunkt?

Hur viktig är produktens miljöpåverkan för er/kunden?

Brukar detta efterfrågas?
Handlar det då om tillverkningen (företagets miljöarbete) eller att pappret i sig är ett bra miljöval?
Eller tryckprocesser?

Appendix 3 - Questionnaire

This appendix presents the information and questions in the distributes questionnaire, both a Swedish and an English version was constructed.

[Swedish version]
Hej,

Vi heter Malin Almers och Sara Arvidson och är studenter på utbildningen Teknisk Design vid Chalmers Tekniska Högskola.

För närvarande arbetar vi med vårt examensarbete som syftar till att utveckla en produkt eller tjänst som underlättar vid valet av material för aktörer inom papper- och kartongbranschen (ex. grafiska formgivare, förpackningsdesigners, tryckerier, reklambyråer, återförsäljare av papper och kartong). Den produkt eller tjänst som skall utvecklas ämnar att spara resurser i form av exempelvis tid, pengar och skog, samt främja papper- och kartongprodukters syfte såsom att optimera kundupplevelse, tryckegenskaper och kvalité genom att assistera beslutsfattaren vid val av optimalt material.

Vi har här med satt ihop en enkät vilken behandlar frågor kring materialval, och skulle vara mycket tacksamma om du vill hjälpa oss genom att svara på enkäten! Den estimerade tiden för att genomföra enkäten är 10-15 min.

Vänliga hälsningar,
Malin Almers
Sara Arvidson

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Sara Arvidson, +46702674794
Malin Almers, +46709966009

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1. Vilket land bor du i?
2. Vilken jobbtitel har du?
3. Hur länge har du jobbat i papper- och kartongbranschen?

<1 1-5 5-10 15-20 20<

4. Vilka typ av produkter gör du främst?

Förpackningar
- ❑ Kosmetik
- ❑ Mat
- ❑ Medicin
- ❑ Alkohol
- ❑ Tobak
- ❑ Annan____

Trycksaker
- ❑ Flyers
- ❑ Broschyrer
- ❑ Kataloger

- ❑ Visitkort
- ❑ Annan____

❑ Other_____

5. Vilka egenskaper tittar ni främst på vid val av material till dessa produkter?

	(Inte alls)					(Mycket viktigt)
Läsbarhet	1	2	3	4	5	6
Bildåtergivning	1	2	3	4	5	6
Ytegenskaper	1	2	3	4	5	6
Vithet & Ljusstabilitet	1	2	3	4	5	6
Formbarhet (komplexa former)	1	2	3	4	5	6
Styvhet	1	2	3	4	5	6
Rivstyrka	1	2	3	4	5	6
Gramvikt	1	2	3	4	5	6
Tjocklek	1	2	3	4	5	6
Lämpligt för efterbearbetning	1	2	3	4	5	6
Åldersbeständighet	1	2	3	4	5	6
Körbarhet	1	2	3	4	5	6

Annat/Kommentera

_____

6. Rangordna faktorerna nedan utefter deras prioritet vid val av material!

	(Inte alls viktigt)					(Mycket viktigt)
Pris	1	2	3	4	5	6
Tillgänglighet	1	2	3	4	5	6
Miljövänligt	1	2	3	4	5	6
Materialegenskaper	1	2	3	4	5	6
Kvalité	1	2	3	4	5	6
Kundens begäran	1	2	3	4	5	6

Annat/ Kommentera

_____

7. Känner du till skillnaden mellan grafisk kartong och fint papper?

(Inte alls) 1 2 3 4 (Fullständigt)

8. Kan du kortfattat beskriva skillnaden mellan grafisk kartong och fint papper som du känner till?

9. Till mina produkter använder jag oftast

- ❑ Grafiskt papper
- ❑ Grafisk kartong
- ❑ Båda

Till vilka produkter använder du vardera material, och varför?

10. När i utvecklingsarbetet av era produkter sker materialvalet?

- ❑ Början av projektet

- ❑ Mitten av projektet
- ❑ Slutet av projektet
- ❑ Vet inte

Annat/Kommentera

_____

11. Finns det några för- eller nackdelar med detta?

12. När anser du att det är optimalt att materialval sker?

- ❑ Början av projektet
- ❑ Mitten av projektet
- ❑ Slutet av projektet
- ❑ Vet inte

Annat/Kommentera

_____

Varför?

13. Hur sker beslut om material (fint papper eller grafisk kartong)?

14. Hur påverkar storleken på upplagan valet av material?

15. Vem/vilka tar beslut om materialval?

Är detta rätt person(er)?

- ❑ Ja
- ❑ Nej

Varför?

Om nej, vem skulle lämpa sig bättre? Varför?

16. Känner du att du har möjlighet att kunna påverka materialvalet?
(Inte alls)1 2 3 4 (Fullständigt)

17. Skulle du vilja ha mer möjlighet att påverka materialvalet?

- ❑ Ja
- ❑ Nej

18. Känner du att du har kunskap att välja material?
(Inte alls) 1 2 3 4 (Fullständigt)

19. Känner du att du saknar någon kunskap för att ta ett aktivt materialval? Isåfall vad?

20. Vart vänder du dig för att få mer information om material?

- ❑ Mässor/Utställningar
- ❑ Butiker
- ❑ Återförsäljare av papper/kartong
- ❑ Internet
- ❑ Tryckerier
- ❑ Tillverkare av papper/kartong

Annat/Kommentera

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21. Är du nöjd med din informationskälla?

- ❑ Ja
- ❑ Nej

Varför?

22. Hur lång tid spenderas i dagsläget på materialval?

Vad styr tidsramen för materialval?

23. Skulle du vilja förändra mängden tid som spenderas på materialval?

- ❑ Nej
- ❑ Mindre tid
- ❑ Mer tid

Kommentera

_____

24. Hur långa är era projekt i genomsnitt?

25. Använder du något hjälpmedel, i form av en produkt eller tjänst, för att välja material?

- ❑ Ja

  Vad och varför?

  Vad skulle kunna göra verktyget bättre?

- ❑ Nej

  Varför?

  Skulle du vilja använda ett verktyg och isf vad skulle du vilja att det innehöll?

26. Vad anser du vara ett bra miljöval gällande material (grafisk kartong / grafiskt papper)?

27. Har era kunder några önskemål eller krav gällande miljöaspekter?

- ❑ Ja
- ❑ Nej

[English version]
Hi,

We are Sara Arvidson and Malin Almers, students at Chalmers University of Technology in Gothenburg, Sweden, with major in industrial design engineering.

This is a set of questions that treats the subject of **how the choice between fine paper and paperboard is performed, and which factors that are considered during the choice**. We want to figure out the amount (and possible lack of knowledge) concerning fine paper and paperboard, in the graphical and packaging industry. The purpose of this research is to gain knowledge about the material decision during the development of fine paper or paperboard products. The aim is to develop a product that will assist during the material choice, and thereby improve the packaging and graphical products in terms of, for instance, strived properties, effort, time and money spent.

This research and the development of a product that will assist you during the material choice is a part of our master thesis. We are very grateful and appreciate that you are taking the time to answer these questions. The time required to answer this form is estimated to approximately 15 minutes.

If you have any questions, please don't hesitate to contact us!

Best regards,
Sara Arvidson and Malin Almers

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Sara Arvidson, +46702674794
Malin Almers, +46709966009
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1. Which country do you live in?
2. What is your profession?
3. How many years have you been in the paper/paperboard industry?
<1 1-5 5-10 15-20 20<

4. Which products do you primarily produce?
Packaging
- ❑ Cosmetics
- ❑ Food
- ❑ Medicine
- ❑ Liquor
- ❑ Tobacco
- ❑ Other____

Printed products
- ❑ Flyer

- ❑ Folders
- ❑ Catalogue
- ❑ Business cards
- ❑ Other____

❑ Other_____

5. Which properties are important when choosing material (fine paper or paperboard) for these products?

	(Not at all)					(Very important)
Readability	1	2	3	4	5	6
Image quality	1	2	3	4	5	6
Surface	1	2	3	4	5	6
Complex formability	1	2	3	4	5	6
Durability	1	2	3	4	5	6
Finishing options	1	2	3	4	5	6
Price	1	2	3	4	5	6
Availability	1	2	3	4	5	6
Whiteness & light stability	1	2	3	4	5	6
Stiffness	1	2	3	4	5	6
Tearing strength	1	2	3	4	5	6
Runnability	1	2	3	4	5	6

Other/Comment

_____

6. Rank the following options according to their relevance during material choice (fine paper or paperboard)!

	(Not at all)					(Very important)
Money	1	2	3	4	5	6
Availability	1	2	3	4	5	6
Environmental impact	1	2	3	4	5	6
Material properties	1	2	3	4	5	6
Quality	1	2	3	4	5	6
Customers' request	1	2	3	4	5	6

Other/Comment

_____

7. How familiar are you with the difference between fine paper and paperboard?

(Not at all) 1 2 3 4 (Completely)

8. Please define the differences that you are aware of (in short).

9. For my products I use

- ❑ Fine paper
- ❑ Paperboard

For which products are the material(s) used, and for what reasons?

10. When, in the development process of your products, does the material decision take place?

- ❑ Beginning of the project
- ❑ Half-way in the project
- ❑ End of the project
- ❑ I don't know

Other/Comment

_____

11. Are there any advantages or disadvantages with this? What?

12. When in the process do you consider it to be optimal to make the material decision?

- ❑ Beginning of the project
- ❑ Half-way in the project
- ❑ End of the project
- ❑ I don't know

Other/Comment

_____

Why?

13. How is the material (fine paper or paperboard) chosen?

14. How does the size of the edition affect the choice of material (fine paper or paperboard)?

15. Who(m) choose material?

Is this the right person(s)?

- ❑ Yes
- ❑ No

Why?

If no, who would be more appropriate for this task? Why?

16. Do you have the opportunity to influence the material decision?

(Not at all) 1 2 3 4 (Completely)

17. Would you like to have a bigger influence?

- ❑ Yes
- ❑ No

18. Do you have enough knowledge to make a material choice?

(Not at all) 1 2 3 4 (Completely)

19. Do you lack any knowledge concerning this manner? What?

20. Where do you get information about materials (fine paper or paperboard)?

- ❑ Fairs and exhibitions
- ❑ Stores
- ❑ Merchants of paper/paperboard
- ❑ Internet
- ❑ Printing companies
- ❑ Producers of paper/paperboard

Other/Comment

_____

21. Are you satisfied with your source of information?

- ❑ Yes
- ❑ No

Why?

22. How much time do you spend on the material choice?

Which factors regulate the provided time?

23. Would you like to spend less or more time on the material choice?

- ❑ No
- ❑ Less
- ❑ More

Other/Comment

_____

24. What is the average time frame of your projects?

25. Do you use any aids when you choose material (fine paper or paperboard)?

- ❑ Yes
  What and why?

  How could it be improved?

- ❑ No
  Why?

  Would you like to use any aid and what would such an aid contain?

26. Which factors are important to regard when choosing material (fine paper or paperboard) from an environmental point of view?

27. Do your customers have any requests or requirements regarding environmental aspects?

- ❑ Yes
- ❑ No

Appendix 4 - Requirement specification

This section presents the identified requirements listed in a requirement specification.

Requirements	R/DR	Priority	Approach	Solution - The assisting tool	Constraints	Requirement specifier
1. General requirements (R) / Desired requirements (DR)						
1.1 Spread knowledge about the importance of making a conscious material decision	R	5	Create a book including information about the importance of making a conscious material* decision, along with information about materials*. Maximise distribution and use of book. Express savings gained when making an optimised material* decision in terms of: time, cost, quality or emissions.	Introduction: General information about the importance of making a material choice. Main book: Material recommendations for different applications.	Primarily operators within advertising agencies.	Iggesund Paperboard AB Operators in the graphical and packaging industry
1.2 Enable conscious material* decisions	R	5	Provide knowledge about materials* by creating a book including information about materials*.	Introduction: General information about the importance of making a material choice. Main book: Material recommendations for different applications. General information: Technical and mechanical properties of the different materials.	Primarily operators within advertising agencies.	Operators in the graphical and packaging industry
1.2.1 Enhance communication: - Advertising agency to customer - Advertising agency to printer - Advertising agency to packaging engineer - Advertising agency to producer of material* - Advertising agency to merchant of material*	DR	5	Provide knowledge about materials* by creating a book, with emphasis on the book's content in terms of information provided and how it is displayed. Provide a common terminology to minimise misunderstandings during communication. Minimise misunderstandings by "forcing" the user to obtain needed information in terms of e.g. material properties and processes.	Intro: General information about the importance of making a material choice. General information: Technical and mechanical properties of the different materials.	Primarily operators within advertising agencies.	Operators in the graphical and packaging industry
1.2.2 Maximise knowledge transfer	R	5	Optimise the selection of information provided in the book. Maximise the interpretation of the information in terms of usability. "Force" the user to obtain needed information in terms of e.g. material properties and processes, through an optimised book structure and display of information.	The information (what information, display of information, structure of information) in the book in totality.	Time to overview and find info. Nr of pages.	Operators in the graphical and packaging industry

1.3 Minimize material decision time	R	5	Maximise usability of the book: - Efficiency/effectiveness of interpretation of book contents. - Efficiency/effectiveness in finding information.	The information (what information, display of information, structure of information) in the book in totality.		Operators in the graphical and packaging industry
1.3.1 Optimise usability	R	5	Optimise structure of the book's contents. Optimise display of the book's contents.	How the information is displayed, and the structure in the book. Adjust format to printing process, manufacturing, usability including experience.		Operators in the graphical and packaging industry
1.4 Assist during material* decision	R	5	Provide knowledge about materials*, to primarily advertising agencies, by developing a book concept.	The information (what information, display of information, structure of information) in the book in totality. The book provides a mutual terminology which enhances the user to express their material desires. The book includes samples, displays material properties in practise.	Primarily operators within advertising agencies.	Operators in the graphical and packaging industry
1.4.1 Provide information about materials*	R	5	Develop a book, content should include: - Definition of materials* - Construction of materials* - Converting and printing processes - Post-press operations - Material samples - Environmental aspects (throughout product lifetime)	The information in the book in totality.	- Construction of materials*: Pulp, fibres, layers etc. - Converting and printing process: Litho, flexo, gravure, digital, creasing and folding, cutting, runnability, printability - Post-press operations: Laminations, embossing/debossing, creasing & folding, die cutting & laser cutting, binding, (Varnishing) - Material samples: Fine paper and paperboard - Environmental aspects (throughout product lifetime): Products refers to fine paper and paperboard products categorised in books, brochures, printed sheets and packaging	Operators in the graphical and packaging industry
1.5 Attract advertising agencies**	DR	4	Emphasize graphic design, format, selection and amount of information, distribution, and usability.	The book's visual and haptic elements, also structure and display of information and materials.	Subjective	Operators in the graphical and packaging industry

1.6 Display material* properties	R	5	Provide information practical about materials*.	Samples with applied prints, surface treatments and finishing options.	X material* qualities	Operators in the graphical and packaging industry
1.6.1 Display finishing options and surface properties	R	5	Display material* properties in relation to: - Applied finishing options - Applied surface properties - Both applied surface properties and finishing options - Both applied surface properties and printing properties	Samples with applied prints, surface properties and finishing options.	X Finishing options X Surface treatments X Types of prints	Operators in the graphical and packaging industry
1.6.2 Enable testing material* in practise	R	5	Include material* samples in the book concept that can be experimented with by the user.	Include samples in the book.		Operators in the graphical and packaging industry
1.6.3 Product should not depend on available material qualities	R	5	Originate from material properties, not specific materials.	Describe material* properties, recommend materials with respect to desired properties not specific material* qualities.		Operators in the graphical and packaging industry
1.7 Be contained	DR	4	Optimise durability through material* decisions and selection of information. Maximise "timeless" information and design. Enable replacement of samples.	Describe material* properties, recommend materials with respect to desired properties not specific material* qualities. Develop timeless design and information e.g. no current techniques, exact material* qualities, numbers etc.		Project team
1.8 Be made of fine paper and paperboard	R	5		Construct the book by using both fine paper and paperboard.		Iggesund Paperboard AB
1.9 Be adjusted to mechanical manufacturing	R	5	Set emphasis on a simple (mass) production.			Project team
*Material refers to fine paper and paperboard						
**Attraction is subjective, hence this is a desired requirement						

Requirements	Approach	Constraints
2. The assisting tool		
1 INTRODUCTION		
1.1 Basic info: Why the information is directed towards paperboard and advertising agencies	Explain: - A comprehensive study about the actors behaviour in the graphical and packaging industry has been performed. - It is concluded that there is a lack of knowledge regarding paperboard, more knowledge about fine paper is found in the industry. - This assisting tool aims to promote a proper use of paperboard when it is optimal to apply, and thereby obtain higher quality of the fine paper and paperboard applications. - The tool is primarily developed for operators within advertising agencies.	
1.2 The differences between fine paper and paperboard	Explain: - The differences between fine paper and paperboard: grammage and construction (layers). - Material properties gained by applying the different materials. - Features gained by applying the different materials (durability, creasability, longer life expectancy etc.)	
1.3 The importance of making a conscious material decision for fine paper and paperboard applications	- Explain what a conscious material decision implies. - Relate a conscious material decision to savings of resources in terms of time and cost, and the obtained higher quality (end-result, product life time etc.), and environmental impact. Define quality, and relate to the material decision. - Explain the importance of a proper communication, that in turn, is obtained through a mutual terminology which is gained from the assisting tool. - The importance of planning, and initialting collaborations and discussions about materials early in the development process. Illuminate the importance of when to regard materials in the fine paper and paperboard application development. - The consequences of when the material decision procedure is performed i.e. early or late in the development process. - Discuss the described "inner feeling" of a fine paper and paperboard application. Describe how, for instance, a perception of "environmental friendly" can also infact have low environmental impact. Change the association of "environmental friendly".	
1.4 How the assisting tool is used	Explain how the assisting tool is used.	

2 MAIN INFORMATION		
2.1 Important factors	**FEELING** Coated/Uncoated Whiteness Opacity Thickness Stiffness Printability (feeling) **NUMBER OF COPIES** Printing process depending on nr of copies Material cost Creasing and folding Tensile strength? Multi-layer construction Fibre length and construction **ENVIRONMENTAL IMPACT** Eco-labels (discuss with printer) **FINISHING OPTIONS** Laminations Embossing/Debossing Creasing & Folding Die cutting & Laser cutting Binding Varnishing? **PRINTING PROCESSES** Runnability Printability (facts) Adjust size according to sheets Format **DISTRIBUTION** Grammage Format	
2.2. Categories of application's purposes	Identify different application's purposes and categorise the applications.	

3 GENERAL INFORMATION		
3.1 Durability	Explain what durability of a material implies.	
3.2 Paperboard: FBB, SBB, SUB, WLC	Explain the paperboard qualities in general.	
3.3 Material properties	Explain and relate material properties to surface properties, printing and converting processes, finishing operations, printability, runnability and quality aspects.	
- Grain direction - Layer construction - Fibres (Long fibres, Short fibres, Recycled fibres) - Pulp (Chemical pulp, Mechanical pulp) - Grammage, Bulk, Thickness - Tearing resistance - Complex shapability - Toughness, Stiffness, Strength (Tensile strength, Surface strength) - Dimension stability - Creasability, Foldability - Opacity - Taint & odour		
3.4 Surface properties	Explain the properties and relate surface properties to material properties, printing and converting processes, finishing operations, printability, runnability and quality aspects.	
- Whiteness, brightness - Structure, Smoothness, Roughness - Coated (Silk, Matte, Gloss) or Uncoated		
3.5 Barriers	Explain and relate barriers to material properties, printing and converting processes, finishing operations, taint & odour, printability, runnability and quality aspects.	
- Plastic film lamination - Foil lamination		

3.6 Printing process	Explain the printing processes.	
3.6.1 Printing techniques: - Litographic printing (offset) - Flexographic printing - Gravure printing - Digital printing		
3.6.2 Runnability	Explain runnability and relate to printing techniques, material properties, surface properties and quality aspects.	
3.6.3 Printability	Which factors affects image quality and readability: - Surface properties, coated, uncoated	Readability Image quality
3.6.4 Format & Sheet	- Explain how to adjust format to sheet. - Explain sheet, rull-offset etc.	
3.7 Finishing options & Varnishing:	Explain and relate to material properties, printing and converting processes, taint & odour, printability, runnability and quality aspects.	
- Laminations - Embossing/Debossing - Creasing & Folding - Die cutting & Laser cutting - Binding		Laminations: - Foil - Plastic film Binding: - Saddle Stitching - Wire-O binding - Glue Binding - Thread stitching - Thread sealing
3.8 Samples	Include fine paper and paperboard samples with applied finishing options, coatings (uncoated) and prints.	Finishing options & Varnishing - Embossing/Debossing - Creasing/Folding - Printability - Die cutting and Laser cutting - Laminations - Varnishing Coatings - Silk - Matt (display difference in relation to uncoated) - Gloss Prints - Colour reproduction/Image quality - Readability