MASTER

Creating and appropriating value with complementary partners in a declining book publishing industry

Hardenbol, K.M.

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Creating and Appropriating Value
with Complementary Partners in
a Declining Book Publishing Industry

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Author:
BSc K.M. (Kasper) Hardenbol

Student ID:
0670294

Email address:
kasperhardenbol@gmail.com

First TU/e Supervisor:
dr M.M.A.H. Cloodt   TU/e, ITEM

Second TU/e Supervisor:
dr ir I.M.M.J. Reymen   TU/e, ITEM

Third TU/e Supervisor:
dr ir B. Walrave   TU/e, ITEM

Company Supervisor:
dr H. Jongen   Océ Technologies

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"Whenever a theory appears to you as the only possible one, take this as a sign that you have neither understood the theory nor the problem which it has intended to solve."

Karl Popper

Preface

Behold! Before you lies my Master Thesis; the final element separating me from a Master of Science degree in Innovation Management. I invite you to immerge yourself in one of the most interesting theses you have ever read! Do you now immediately question whether this claim is factual or, more likely, a gratuitous exaggeration? Just remember Friedrich Nietzsche's statement that "*there are no facts, only interpretations*". I will gladly leave you to form your own interpretation with regard to my work, but I hope that it may inspire a thought, trigger a discussion, or perhaps even incite someone or something to action.

During the course of this Master Thesis study many obstacles had to be overcome, which I could never have achieved without the help and support of others. The list of people I would like to and should thank is too long and the amount of available space too short. However, I would like to use this opportunity to personally thank some people.

First and foremost I would like to thank Huibert for his ongoing support, great advice, and encouragement. I could not have wished for a more dedicated, enthusiastic, and motivating company supervisor. Special thanks go out to Guido and Corinna, who helped me out when I was in doubt, encouraging me to consider alternative solutions, thereby providing a continued source of inspiration. Furthermore, it has been an honour and a privilege to work together with all my esteemed colleagues at Océ. Never before have I encountered such a great working atmosphere filled with professionals who go above and beyond, and I honestly hope that in the future I will regard many of you not as my colleagues, but as my friends. It goes without saying that your contribution was invaluable and vital to the successful completion of my study.

I also would like to express my gratitude and appreciation for my TU/e supervisors; Myriam and Isabelle. I wanted to conduct my Master Thesis study in an unusual way, using a novel research method, because of a personal conviction that the commonly used scientific paradigms are not (always) appropriate for studying organizations and organizational science. Without the unwavering support of Myriam for my choice, coupled with her professional, experienced counsel, always keeping me and the study on track, I would never have been able to conduct the study in this way. Likewise, my thanks go out to Isabelle who challenged me to raise the bar, and find a way to structure this Master Thesis so that it complements my adopted research method, instead of trying to make it fit in with the traditional scientific paradigms.

Next, I would like to thank everybody who has allocated time to help me gather information with regard to the current state of the book publishing industry, the developments within the industry, and the future. Whether I have had the opportunity of interviewing you, or whether you replied to my email(s), know that all help and input is greatly appreciated, and this study could never have been realized without your valuable insights. In addition, I thoroughly enjoyed talking to you and getting to know your vision on the world of book publishing and/or printing. Perhaps we will meet again once I start my professional career.

Last but not least, I would like to thank all of my friends and family members whom I have spoken to about the study for their support, advice, tips, and above all, for their patience. My thanks especially go out to Bob, whose design skills and feedback proved invaluable.

All in all, conducting a Master Thesis study is one of the hardest things I have ever done, and you kept me motivated and sane during the process. I feel blessed with your love and support! This study has been an exciting journey; a life-changing learning experience, full of ups and downs. However, let it be concluded by an up and by me saying that I hope you will thoroughly enjoy reading the rest!

Kasper Hardenbol
Eindhoven, December 11th 2016

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Management Summary

The printed book, the original Information Technology (IT), has been the preferred medium for packaging and disseminating information for centuries. Now almost 600 years after the invention of the print press, the preferred medium is increasingly a digital one (Van der Weel, 2016). Due to the rise of eBooks, e-learning, and e-publishing a substantial share of the book market has digitized. These developments indicate that the book publishing industry is in the middle of a fundamental transition; a digital transformation. The digital transformation appears an irreversible trend, contributing to the significant reduction in printed book sales in recent years. However, contradictory to the slow demise of book printing, digital book printing is on the rise. It is growing mainly by capturing book print volume from offset printing (IT Strategies, 2014), driven by shorter print run lengths, more printing on demand, more distribute-and-print, and more book customization and –personalization (Interquest, 2016b). Though digital printing also enables new applications, like self-publishing. Océ Technologies, a global leader in digital printing, found itself in the middle of the digital transformation of the industry, unsure how to assess the consequences of this transformation for digital book printing. This doubtful situation that arose in practice was the precursor to this study's inquiry.

The initial aim of this study was to determinate the doubtful situation, and to design a solution that when implemented can create and capture value for Océ in the digital book print market. This urged this study to adopt a pragmatist research method that facilitates conducting design-based research. The Deweyan Inquiry was adopted as it allows for simultaneous theory building, observing practice, and solution design together with practitioners (Stompff, 2012). As such, in this study the doubtful situation was not neutrally observed, but actively enacted in a real-life setting in order to change it.

The next step was instituting whether the doubtful situation is problematic, and framing the problem as precise as possible. Therefore, data was obtained from multiple sources using various procedures, such as industry sales figures, market reports, company documents, and a semi-structured interview round with 22 industry actors. A model was formulated that can be used to predict the likely future appearance form of a book category. It asserts that book categories more aimed at transferring content benefit to a larger extent from the capabilities of digital IT media, as opposed to books more aimed at providing an experience, which benefit to a larger extent from the printed book medium. As such, it predicts that digitization will be rapid for books aimed at transferring content, such as technical-, scientific-, professional-, and educational books, while books aimed at providing an experience, such as literary, fictional-, and children books, will remain longer in print. Over time all book categories will transition towards a more hybrid mix of paper- and digital books, leading to a further decline in book print volumes.

Strikingly, the market share of digital book printing is high in categories that are expected to digitize rapidly, and low in book categories expected to remain longer in print. This means that the remaining book print volume will be dominated by book categories that are mostly offset printed, with which digital book printing is less familiar, and which have different print quality-, paper substrates-, and finishing requirements. For instance, book categories aimed at providing an experience are mostly bought in brick-and-mortar bookstores, often as a present, and/or on an impulse. For these books the look and feel of a book is the most important purchase decision criterion. These aspects are determined more by the quality of book finishing, especially (hardcover) bookbinding, than by the quality of book printing. Therefore, in the future the market success of a printed book will increasingly be determined by the quality of book finishing.

Thus, the problem is that the digital transformation alters the mix of remaining book print volume, the division of volume over printing technologies, and the requirements that digital print presses will have to meet. In coming years book printing will decline further, accelerated by developments in digital publishing technology. However, in the meantime there are valuable opportunities for digital book printing. Provided

it can ensure victory in the technology substitution battle with offset printing technology before the eventual demise of book printing. As such, this study embarked to show that, as long as not all methods to halt industry decline are exhausted, value-creating growth strategies should be implemented in a declining industry itself. This led to the formulation of the main research question:

How can Océ create and appropriate value, and attain a competitive advantage in the declining book publishing industry where competing printing technologies vie for market dominance?

Subsequently, this study established how the industry actors, factors, and their relationships affect the problem, and influence which solution designs can be implemented. Thereby defining the design space. Within this design space four concept solution designs are defined, after which the most promising one was selected together with Océ practitioners. It entails a strategic alliance with finishing equipment manufacturers, aimed at increasing the combined potential of Océ's print presses with finishing equipment.

Next, the selected solution design was improved using findings from a literature study, and from a second round of structured interviews with actors directly affected by solution design implementation (i.e. digital print providers and finishing equipment manufacturers). Thereby evolving the concept solution design in a more detailed, appropriate, and actionable solution design. Figure 0.1 displays the final solution design, distinguishing its goals (the why), methods (the how), and activities (the what).

WHY
- To Create and Capture Value in the Declining Book Publishing Industry
- To Ensure Victory in the Technology Substitution Battle with Offset Book Printing Technology
- To Attain a Competitive Advantage in the Market for Digital Book Printing Presses

HOW
- Develop a Strategy for Capturing Opportunities in the Current Market
  - Tailored to Industry Characteristics and Industry Dynamics
- Resolve Part of the Technology Ecosystem Emergence Challenge for Digital Book Printing
  - Manage & Increase Complementarity Digital Book Printing Presses and Hardcover Bookbinding Equipment
    –> Increase Quality & Number of Bookbinding Options
  - Minimize Behaviour Changes for (Former) Offset Print Providers
- Innovate the Business Model with Strategic Alliance Partner(s)
  - Improve the Value Proposition Combining Internal and External Resources
    –> Hardcover Bookbinding Equipment Manufacturer Experienced with Offset Technology
    –> Rare, Valuable, Imperfectly imitable, Non-substitutable Resource Combination

WHAT
- Mapping Bookbinding Equipment Manufacturer Landscape
- Sales Collaboration with Bookbinding Equipment Manufacturer(s)
  - Enable Solution Selling
    –> Create Options and Coordinate Offers for Customers Together
- R&D Collaboration with Hardcover Bookbinding Equipment Manufacturer
  - Develop Near-Line Finishing Solution
    --> Co-specialized Asset Interface
    --> Software that Improves Print Process Management, Sequencing, and Monitoring
  - Involve Customer(s) in the R&D Process and Experimentation Phase

Figure 0.1: Final Solution Design: Goals, Methods & Activities

The goals of the final solution design are threefold: 1) to create and capture value in the declining book publishing industry, 2) to ensure victory in the technology substitution battle with offset book printing

technology, and 3) to attain a competitive advantage in the market for digital book print presses. As such, it answers every aspect of the main research question.

To realize these goals it incorporates several methods. Firstly, it entails a growth strategy aimed at creating and capturing value in the current, declining industry, tailored to industry characteristics and –dynamics. Secondly, it incorporates increasing the complementarity between digital book print presses and hardcover bookbinding equipment. This resolves part of the technology ecosystem emergence challenge for digital book printing by removing one of its leading barriers; the low quality of finishing/binding (Interquest, 2016b), and the failure to realize hardcover books on demand. Thirdly, it incorporates innovating Océ's business models with a strategic partner. Hereby improving the value propositions of its digital book print presses by combining internal- with the external resources of a hardcover bookbinding partner.

To attain the goals through these methods three activities are essential. Firstly, mapping the landscape of bookbinding equipment manufacturers to find suitable collaboration candidates. Secondly, conducting a sales collaboration with one or preferably multiple bookbinding equipment manufacturers. This enables solution selling; the joint creation of options, and coordination of customer offers, through regularly exchanging info with regard to customers' needs, preferences, and leads. Thirdly, conducting an R&D collaboration with a hardcover bookbinding equipment manufacturer, while involving digital print providers, to develop a near-line finishing solution. Preferably a co-specialized asset interface; a software linkage allowing the two production factors to connect, communicate, and control each other. Herewith digital print providers can monitor book production at any stage, efficiently sequence print jobs, and match the right printed book block to the right book cover at the right time, even for books printed on demand. The increased complementarity reduces production- and set-up times, waste, and the amount of manual inputs. Simultaneously, it reduces the required behaviour change for offset print providers who want to switch to digital book printing, but who want to keep using their existing finishing equipment.

A limitation of this study is that the final solution design has not yet been implemented. Without implementation and testing the final solution design in practice there is no proof for its validity, according to pragmatists. Therefore, the implementation plan describes the sequence of steps that are still to be taken to verify the validity of the final solution design.

Besides recommending Océ to implement the final solution design according to the implementation plan, this study makes additional recommendations. Firstly, it recommends conducting the R&D collaboration with a hardcover bookbinding equipment manufacturer that has experience and legitimacy in the offset finishing market. Secondly, it recommends to initially develop a near-line finishing solution only for sheet-fed digital inkjet print presses. Thirdly, it recommends the salesforce to focus on an additional aspect in the selling process; the as-used performance of a print press, which depends on how well it can be integrated with pre- and post-finishing equipment in a book production line. Lastly, it recommends Océ to search for other markets to address with its product portfolio. Though currently it is beneficial to pursue this growth strategy in the declining industry, in the long-term future inevitably a digital book or a multi-media platform will be developed that even surpasses the capabilities of a printed book in providing an experience. This would result in rapid digitization of most book categories, and signal the end of the paper book era.

In conclusion, through the adoption of a novel pragmatist research method, this study proposes a design that constitutes a novel decline stage growth strategy, tailored to the Dutch book publishing industry, and aimed at deciding the technology substitution battle in favour of digital printing technology. As such, it makes a theoretical contribution to decline stage literature, and to research method literature. However, future research is required to find out whether the final solution design is generalizable to other book publishing industries, and whether elements of its decline stage growth strategy are generalizable to firms operating in other declining industries. Furthermore, future research is required to assess the applicability of the Deweyan Inquiry as a method for conducting design-based research.

List of Figures and Tables

Part 1

This part introduces the doubtful situation that arose in practice, which was the precursor to this study's inquiry. Thereby providing a description of the firm and the industry in which the inquiry has been conducted. Subsequently, it elaborates upon the adopted research approach and -methodology, which are tailored to the characteristics of the doubtful situation, and to attaining this study's desired outcomes.

1. Introduction

Printed book sales around the world, but especially in North America (NA) and Western Europe (WE), are declining at a significant rate both in terms of revenue and volume (Caslon, 2015; Interquest, 2016b). This is not a recent finding or a temporary fad, but has been occurring for several years now, and is expected to continue to transpire. Where the printed book, the original Information Technology (IT), has been the preferred form and medium for packaging and disseminating information for centuries, now almost 600 years after the invention of the print press, the preferred medium is increasingly a digital one (Van der Weel, 2016). Due to the rapid rise of eBooks, e-learning, e-publishing, and the internet, a substantial share of the book market is now digitized. All these developments indicate that the book publishing industry is currently in the middle of a fundamental transition; a digital transformation. The ramifications of the digital transformation of the book publishing industry are immense, causing a shift in both the traditional value- and supply chain, and in the industry power balance, as well as initiating a redefinition of what a book entails. Many firms active in the industry are trying to innovate their business models, streamline their supply chains, and cut their costs. As a reaction an industry consolidation is taking place, in which through a series of mergers and acquisitions (M&As) remaining firms try to benefit from economies of scale.

The content of books can be printed using several printing technologies. The most often utilized printing techniques are digital printing technology and offset printing technology. Currently the traditional printing technology; offset printing, is losing market share rapidly, and digital book printing is on the rise. Although currently only a small portion of the book print market is printed digitally; 20% in the Netherlands (NL) (Interquest, 2016b), ≈ 8% in WE (Interquest, 2015), and ≈ 9% in NA (Interquest, 2016a), the value of this portion of the book print market as percentage of the total is significantly larger (Caslon, 2015). Furthermore, the market share of digital book printing is expected to steadily increase in the years to come.

Océ Technologies is a firm which manufactures digital print presses for, amongst others, the book print market. It finds itself in the middle of the digital transformation of the publishing industry stuck with several questions. Feeling it is the right time to reflect on what is occurring within the book publishing industry, they posed the following question, which was the starting point of this study: *How does the digital transformation of the book publishing industry impact the book print market, digital print press manufacturers, such as Océ, and the future of (digital) book printing?*

Subsequently, Océ wanted to define opportunities, and to design a solution that when implemented can create and capture value in the digital book print market. The solution design was to be based on the industry developments and the likely future, while (initially) emphasizing the translation of opportunities to product development initiatives. Put differently; Océ wanted to know which innovative products or product features are and will be required to remain an important market player within the (digital) book print market. As such, this study did not start with a problem, but with a doubtful situation, which arose from practice, encountered by Océ practitioners. Unable to fully explain the occurrence and the consequences of the current situation and its developments, Océ deemed it required further inquiry. This type of inquiry urged this study towards adopting a pragmatic research method. However, before the adopted research approach is introduced is Chapter 2, first, section 1.1 provides a brief description of the firm at which the study was conducted. Subsequently, section 1.2 delineates the book publishing industry and its constituents to clarify Océ's role within the book publishing industry.

1.1 Océ Technologies: a Canon Company
This study was conducted at the Océ Technologies Headquarters in Venlo, NL. Océ, established in 1877, is a global leader in digital imaging, industrial printing, and collaborative business services. In 2015 Océ realized €1.9 billion in revenues with roughly 3,600 employees worldwide, and it is currently one of the top ten R&D investors in the NL (Canon, 2016). In 2009 Océ merged with Canon, a Fortune 500 firm that

realized €29 billion in revenues in 2015, employing 190,000 employees worldwide (Canon, 2016). Together they are one of the global leaders in digital printing and imaging.

Océ manufactures products that can be divided into three product categories; large format printers, office printers, and production printers. Large format printers are used for large format, high-quality, technical- and graphic arts applications, but not for book publishing. Office printers are also not targeted at publishing applications, but at low-volume, office applications. For the high-speed, high-volume, medium-quality, production printers the applications are typically found in graphic arts, transaction printing, direct mail, corporate reprographic departments, packaging, and publishing applications. Examples of products printed on production printers are: books, booklets, catalogues, collaterals, magazines, manuals, and newsletters.

Océ manufactures both web-fed print presses and sheet-fed print presses. However, at the Venlo location only sheet-fed printers are manufactured. The difference between the two types of printers is that sheet-fed print presses feed individual sheets of paper into a print press, while web-fed presses feed a continuous roll of paper through a print press. Web-fed presses are generally faster and capable of reaching higher monthly volumes. They offer production efficiency, whereas sheet-fed presses offer application flexibility. Although sheet-fed print presses cannot compete on monthly volume or speed, they are able to handle a more diverse set of media, and offer more media flexibility within a job. Also, they are on average more (cost-)efficient for printing shorter print runs, enabled by relatively short set-up times between print jobs.

Océ's print presses used to employ digital electro-photographic (EPG) print technology (also referred to as digital toner printing). Nowadays most of Océ's print presses targeted at the book publishing industry use digital inkjet print technology. Although digital inkjet still provides slightly inferior quality, it does so at a much higher speed and often at lower running costs. The growth in digital book print volume, despite an overall decline in book print volume, is partly driven by a migration of book print providers to digital inkjet technology. Table 1.1 lists some of Océ's print presses currently targeted at the book publishing industry.

Table 1.1: Océ Digital Book Print Presses

Printer Name	Paper Feed Type	Technology	Colour
Océ ColorStream 6000 series	Web-fed	Inkjet	Yes
Océ VarioPrint 6000 series	Sheet-fed	Electro-photographic	Black & White
Océ ImageStream 2000 series	Web-fed	Inkjet	Black & White
Océ VarioPrint i300	Sheet-fed	Inkjet	Yes

1.2 The Book Publishing Industry & Océ's Role

In order to fathom which opportunities might emerge for Océ from the digital transformation of the book publishing industry, the book publishing industry must be characterized. Therefore, the following paragraphs define it in terms of its structure, supply- and value chain, and its constituents (actors). Furthermore, Océ's (current) role within the book publishing industry is described.

1.2.1 The Book Publishing Industry

Traditionally, an author would write a manuscript, which would then, if deemed worthy, be published by the industry quality guarantor: the publisher. After selection of, investment in, and improvement of the original manuscript, it would be sent to a print provider who would apply his craftsmanship and print the book in large volumes using an offset print press. Afterwards, the print provider would conduct book finishing activities, such as cutting, gluing, bookbinding, etc. Then the book would be sent to either a book distributor or to a wholesaler, who would supply it to the book channels, such as the bookstores, libraries, and book chains. Finally, the channels would sell or lend the book to the end customer; the book buyer.

The book publishing industry has been around for centuries, and following the introduction of the first offset print press in 1875, the traditional book publishing supply chain has looked like shown in Figure 1.1.
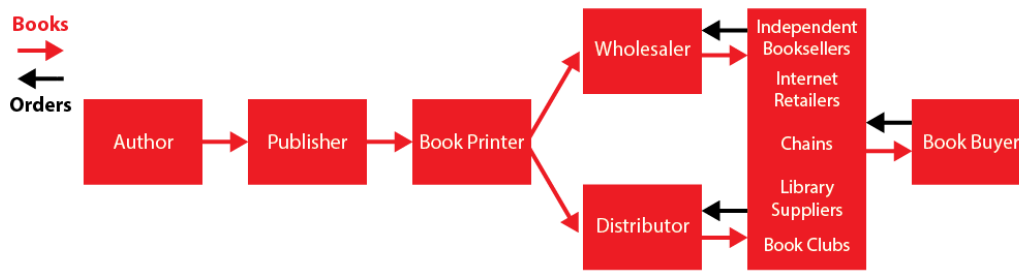
Figure 1.1: The Traditional Book Publishing Industry Supply Chain (Canon UK, 2015)

Nowadays, due to advances in technology, the industry's supply- and value chain look rather differently, as shown in Figure A.1 in Appendix A. No longer does the publisher fulfil its traditional role of industry gatekeeper; that of selecting and packaging information in a form so that it is worth disseminating (Van der Weel, 2016). Digital printing and online publishing has enabled authors and firms to publish their books themselves or with the aid of self-publishing firms. Self-publishing firms are more like production houses than traditional publishers in the sense that they do not offer all services a traditional publisher would offer.

Offset printing requires a minimum print run length of several hundred books before a print run can be printed cost-efficiently. This is due to the high fixed costs of manufacturing offset printing plates. Nowadays books can be printed cost-efficiently in small quantities or even in single copies using digital printing technology, which involves nearly no fixed costs coupled with higher variable costs. As a result, digital printing technology is used to print books that sell in low volumes, and offset printing technology is used to print books that are manufactured and sold in high volumes.

Books are no longer exclusively published as paper books. Its appearance is increasingly a digital one; be it an e-book, a PDF-file, a mobile file, or an audio-file. Digitization is driving the slow decline of the book publishing industry, despite that the market for information is not in decline. Illustrated by the quote of the CEO of Mybestseller & Sweek: *"The market for reading will not necessarily become smaller, but we will see a shift in the market for reading from printed media to digital media. Writing and reading will become social, and mobile will be leading".*

These developments have led to an industry disintermediation; several actors have given up their place in the value chain (Van der Weel, 2016). Now there are many ways for an author's manuscript to reach a book buyer. For example, it can go through the traditional steps as specified in the traditional supply chain. It can be published as an e-book by a traditional publisher, or it can be self-published as a paper book with the aid of a self-publishing firm. But it can also be published on an author's personal website without help. As such, the publishing industry can increasingly be classified as having a value network in which its constituents create value together, rather than a value chain (Tian & Martin, 2010). In the traditional book publishing value chain the publisher and the book channels were able to appropriate most value; respectively 25-30% and 40-50% (Canon UK, 2015). However, in today's book publishing value network the created value is increasingly being appropriated by other actors, which presents opportunities for other firms active in the book publishing industry.

1.2.2 Océ Role within the Book Publishing Industry

Océ's role within the book publishing industry is that of manufacturer of digital book print presses. Originally not part of the traditional publishing industry supply chain, but since the rise of digital printing Océ has positioned itself in the industry's value network as a technology supplier. Océ's customers are digital print providers who have always printed digitally, offset print providers who are transitioning to digital printing technology, or offset print providers looking to complement their offset print presses with digital print presses.

2. Research Approach

To arrive at a solution design that, when implemented, can create and capture value in the book publishing industry a suitable research approach must be selected first. This approach defines which scientific paradigm, and which research method is adopted. Therefore, section 2.1 describes the characteristics of three scientific paradigms, their assumptions, and a rationale for adopting one. Section 2.2 introduces a research method that fits the subject matter of this study, and the selected scientific paradigm. Lastly, section 2.3 describes the implications of selecting the research method for the structure of this study.

2.1 Scientific Paradigms

A scientific paradigm refers to the collection of beliefs, values, and techniques shared by the members of a specific scientific community (Kuhn, 1970). Researchers studying organizational science can choose to adopt one of three prevalent scientific paradigms. Those three scientific paradigms are the positivist-, the constructivist-, and the pragmatist paradigm.

The selection of a scientific paradigm determines both which research methods can be utilized, and how the study is structured. Its choice should not be made uninformed. Especially since a scientific paradigm should facilitate and be tailored to attaining the goal of a study, which in this case is the creation of a solution design that can change the situation. Simon (1996) stated: *"Engineers are not the only professional designers. Everyone designs who devises courses of action aimed at changing existing situations into preferred ones."* (Simon, 1996, p. 111). Therefore, this study requires a design researcher and a scientific paradigm that fits the to-be conducted design activities. Or as Dorst (1997, p. 206) put it: *"The design researcher has a choice of which paradigm to use, and when making this choice the researcher must adapt to the kind of design activity that is being studied."*

2.1.1 Positivism

The most commonly adopted scientific paradigm, the positivist paradigm, originates from studying natural sciences. It assumes that there is an objective reality, which can be deduced by a neutral, detached researcher by conducting controlled experiments with the aim to empirically falsify reality (Popper, 1959). The objective reality in positivism is regarded as independent of how it is perceived by people, organizations, or by a researcher. As such, it assumes that a researcher should not change or influence the objective reality (Creswell, 2002). A positivist researcher should be a 'fly on the wall'. (Holstein, & Gubrium, 2004, p. 151).

Adopting the positivist paradigm would entail starting with the definition of a research topic, followed by a thorough literature study and the definition of a research gap. Subsequently, hypotheses and research questions would be drafted. Only then would one commence with the collection and subsequent analysis of (quantitative) data in order to try to falsify the formulated hypotheses.

2.1.2 Constructivism

The second most common scientific paradigm is the constructivist paradigm, which finds its origin in sociology and anthropology. Constructivists reject the notion that there is an objective reality, instead they regard reality as constructed in a process that is historically and culturally specific (Blumer, 1969). Multiple opinions could co-exist with regard to what reality is. Therefore, constructivists do not aim to portray an objective reality, but instead aim to identify the socially constructed perception of reality (Berger & Luckmann, 1966). This socially constructed perception is shaped through the language, relations, and interaction between people, and in order to understand the meaning system the researcher has to remain neutral, but observe and participate in the studied situation (Blumer, 1969).

The constructivist paradigm entails that one starts with observation and gathering qualitative data from practice. After sufficient data has been gathered one can commence to identify repeated ideas, concepts, and elements, code and group those into categories, and then theorize about relationships among sections

of data. In this way a theory, grounded in data, emerges that provides a detailed picture of the studied phenomenon (Martin & Turner, 1986). Therefore, a comprehensive literature study would not be conducted before, but after the formulation of a grounded theory. Its goal would be to find out whether and to what extent the grounded theory provides valuable new insights for one or multiple research fields.

2.1.3 Pragmatism

The pragmatist paradigm, based on works of researchers like Dewey (1934, 1938), James (1890), Mead (1934), and Peirce (1877, 1878), is the least used paradigm within organizational sciences. Pragmatism assumes that there is an objective reality, which can be abducted by a researcher who intentionally interacts with the subject matter, by conducting real-life experiments in order to find proof for hypotheses (Dewey, 1938). In pragmatism one employs abductive inferencing, referring to the process through which a researcher moves from an observation to a theory accounting for the most likely explanation for the observation (Hobbs et al., 1988). Abductive inferencing differs from inductive inferencing in constructivism, as one does not try to generalize a theory based on the fact that it is true in one instance.

The pragmatist maxim is that the objective reality is regarded as an emergent property of the verification of ideas or theories in practice (Peirce, 1878). Only if a theory or design is tested in practice, then one can make assertions to whether it is likely to work in other situations as well. In that sense, pragmatism prioritizes identifying practical consequences to theoretical consequences, which have no practical implications. Through experience and continuous interaction with the subject matter, new theories and knowledge are produced. However, pragmatism does not regard experiences as facts, since they can also be artefacts that are derived from a researcher's direct engagement in the studied situation (Romme, 2016).

2.1.4 Selecting a Scientific Paradigm: Pragmatism

Now the elements of the three scientific paradigms have been briefly described, a deliberate choice can be made to adopt one. For this study the pragmatist paradigm is the most appropriate paradigm, because of the following reasons. Firstly, while conducting this study the researcher wanted to actively interact with the doubtful situation and its constituents in order to enact and change it, rather than being a fly on the wall. Thereby losing the neutrality of a researcher, which is obligatory in the positivist- and the constructivist paradigm. The pragmatist paradigm enables the researcher to interact with and enact the subject matter in a real-life setting.

Secondly, the pragmatist paradigm allows for a Darwinian approach on the formulation of theories (Talisse, 2002). Referring to the gradual, concurrent generation of multiple theories with regard to how a doubtful situation can be unified and changed, and the subsequent survival and selection of the fittest theory, which holds most value for practice (Talisse, 2002). True to Darwinism, this fittest theory is not regarded as truth; a completely accurate description of the objective reality. Instead it is regarded as the currently best available theory until a new situation is encountered that requires an enhancement of the theory. Dewey (1938) referred to the best available theory as a warranted assertion, which is a justified, defensible statement, reframing from ever using the term truth. According to Romme et al. (2015), this pluralism in theorizing is essential in achieving a shared sense of purpose and responsibility between management practitioners and scholarly researchers. Thus, the pragmatist paradigm suits this study well as in making sense of a doubtful situation and designing a tool that can enact and change this situation there is no truth, or optimal theory. Instead the consideration of multiple competing theories and the subsequent elimination of less suitable theories in favour of the fittest theory, so that one can make the warranted assertion that this is currently the best way forward, is believed to be the most accurate depiction of real-life corporate problem solving.

Thirdly, the pragmatist paradigm allows for the selection of those research methods that are best suited to researching the subject matter, without explicitly favouring either quantitative methods, such as the positivist paradigm, or qualitative methods, such as the constructivist paradigm. Pragmatism recognizes that

all methods have their flaws, but can be complementary to one another. As such, it allows for the utilization of mixed methods research (Johnson & Onwuegbuzie, 2004). For studying the book publishing industry and creating a solution design a mixture of research methods is regarded as most suitable by the researcher.

Lastly, the pragmatist paradigm does not prioritize developing new theory over practical tools, such as in the positivist paradigm, and it does not prioritize developing practical tools over new theory, such as the constructivist paradigm (Glaser, 2003; Martin & Turner, 1986). It does not regard theory and practice as conflicting, but rather as two sides of the same coin: as intelligent versus uninformed practice (Dewey, 1930). Therefore, a pragmatist study does not start with a literature study, followed by the definition of a research gap, and the formulation of hypotheses and research questions, like a positivist study. It also does not start with observation and data gathering from practice, followed by coding and grouping these into categories, and subsequently theorizing about relationships, such as in the constructivist paradigm. A pragmatist study starts with an issue or a doubtful situation followed by the gradual formulation of competing theories, concurrently with data gathering from practice and data analysis. As such, theory building, solution design, and practicing are concurrent human activities that engage with and manipulate the situation in a practical manner (Zundel & Kokkalis, 2010). Furthermore, pragmatism allows a researcher and practitioners to learn to see from different perspectives through dialogical encounters with each other, and foster a shared interest in outcomes and implications (Romme et al., 2015). In conclusion, the pragmatist approach closely resembles how real-life problems are tackled by practitioners, and as this study was conducted while actively collaborating with practitioners, the pragmatist paradigm fits this study best.

Now the argument is presented for why adopting the pragmatist paradigm is best for this study, a specific pragmatist research method must be adopted that is the closest fit to the subject matter of this study. The next section introduces the adopted pragmatist research method: a Deweyan Inquiry.

2.2 Research Method: Deweyan Inquiry
The Deweyan Inquiry is a research method introduced by Dewey (1938), but more recently posited as a method through which practitioners can engage in research (Stompff, 2012). Its name is derived from Dewey's definition of an inquiry into situations arising in practice: *"Inquiry is the controlled or directed transformation of an indeterminate situation into one that is as determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole."* (Dewey, 1938, p.104). In such an inquiry theory building, observing practice, and (re)design are important elements. Together these elements help the researcher/practitioner achieve understanding, and to enact and change the situation from an indeterminate, doubtful situation, into a unified whole in which the situation is fully comprehended.

The Deweyan Inquiry constitutes of six steps: 1) doubtful situation, 2) institution of the problem, 3) determination of a problem–solution, 4) reasoning, 5) experimentation, and 6) warranted assertion (Dewey, 1938). During a Deweyan inquiry one meanders between theory building and observing practice. In Stompff's (2012) visualization of the research method this meandering is indicated by arrows (Figure 2.1), which represent the evolution of the solution design(s) during the inquiry. The Deweyan Inquiry sticks close to the pragmatist paradigm, providing a solid, comprehensive guideline; the full pragmatist cycle, in the sense it is not just based on taking action, but it also on the development of doubts with regard to both practice and theory (Stompff, 2012).

2.2.1 Step 1: Doubtful Situation
The generating power of real doubt is central to any pragmatist method (Warfield, 1994). The first step in a Deweyan Inquiry is referred to as a doubtful situation, which is the precursor of an inquiry (Dewey 1938). A doubtful situation, which arises in practice, is usually first encountered and acknowledged by practitioners, sensing that something strange, uncertain, or unexpected is occurring that cannot be explained easily. This inability to explain why a situation is occurring is often due to practical situations being complex,

laden with culture-, relation-, and context-specific elements, making it impossible to immediately unify the elements within the situation without an inquiry (Dewey, 1938). The decision that an indeterminate situation actually requires further inquiry completes the first step of a Deweyan Inquiry (Dewey, 1938).
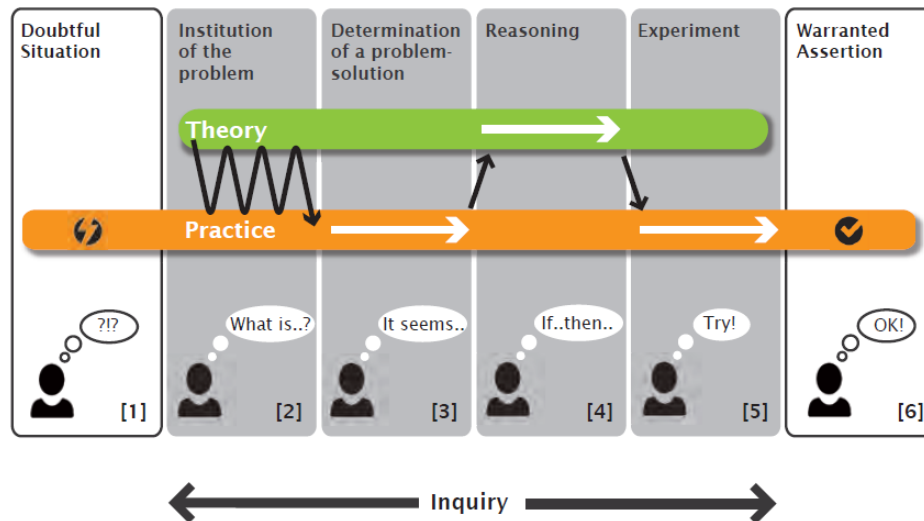
Figure 2.1: The Steps in a Deweyan Inquiry (Stompff, 2012, p. 51)

2.2.2 Step 2: Institution of the Problem

During the second step of the Deweyan Inquiry one institutes whether the doubtful situation is problematic. Subsequently, one tries to identify and frame the problem as precise as possible. Framing of the problem is of utmost importance as it determines what will be attended to in an inquiry (Schön, 1983). For instance, organizations or people (actors), relations between actors, or other factors that are present and influence the situation. Institution and framing the situation involves both practice and theory; observations of the situation in practice, as well as the development of theories needed to guide these observations (Dewey, 1938). Institution of a problem solely based on theories, without making observations in practice, would entail pure deduction. This is more in line with positivism, and fails to account for the specificity and uniqueness of the context in which something occurs (Dewey, 1938). On the other hand, institution and framing of a problem on the basis of observations, without consulting theories as to what occurrences and aspects of a situation might be relevant, would entail pure induction (Dewey, 1938). This is more in line with constructivism, and would lead to an unnecessary large amount of data gathering and analysis work as anything could be considered potentially relevant data. Acknowledging this, in this step one meanders a lot between theory and practice as they complement each other in defining and framing the problem.

To institute the problem a round of interviews is conducted with actors in the Dutch book publishing industry. This step also includes an analysis of industry sales figures, market reports from independent agencies, and company documents. Thereby combining both qualitative and quantitative data.

2.2.3 Step 3: Determination of a Problem-Solution

To establish which and how the actors and factors that were included in the framing of step two are relevant to the problem (Dewey, 1938), in the third step of the Deweyan Inquiry one observes these in practice. This includes defining and describing the factors and actors, and the nature and reasons for the relationships between actors. Next, initial hypotheses are formulated, which try to connect the problem to possible solutions. This is true to the pragmatist paradigm, which specifies that the determination of a problem without reference to potential solutions is meaningless (Dewey, 1938). As such, the focus during problem determination is on finding solutions that can be implemented in practice. During this step solutions concurrently emerge, in the form of ideas that point to potential opportunities worthy of pursuit. This process is called abduction, referring to the formulation of 'simple' but likely theories that can potentially

solve the problem (i.e. 'educated guesses') (Peirce, 1877). As competing theories develop and evolve, the definition of the problem also evolves. Therefore, the Deweyan Inquiry is a progressive and cumulative inquiry (Dewey, 1938), which leads to theories that are relevant, flexible, and usable (Van Bruinessen, 2016).

Findings from the first round of interviews, conducted in step two of this inquiry, are used to complete the first part of the problem-solution step. Here it is defined which solutions are implementable, and what can be changed in the doubtful situation. The second part, formulating concept solution designs, is conducted using an opportunity oriented design cycle procedure in which concept solutions are designed, and subsequently presented using concept sketches at feedback meetings with Océ practitioners. There the concept solution designs are reviewed based on solution decision criteria, resulting in the selection of the most appropriate concept solution design to be developed further.

2.2.4 Step 4: Reasoning

The fourth step in the Deweyan Inquiry involves reasoning how the selected solution design can be improved. This entails comparing and improving the selected solution design with academic concepts and theories (Dewey, 1938), as well as improving it together with practitioners. As such, in step four the potential consequences of the implementation of the solution design on the doubtful situation are evaluated (Van Bruinessen, 2016), which helps to plan and initiate the verification of the theories in the experimentation step. In this way, solution designs created within a Deweyan Inquiry are the outcome of observations in practice, enhanced by academic theories, which are highly actionable (Dewey, 1938).

To improve the reasoning a second round of interviews was conducted with actors that are directly affected by the creation and implementation of the solution design. Furthermore, a literature study was conducted to incorporate academic findings that can improve the solution design.

2.2.5 Step 5: Experimentation

During the fifth step in the Deweyan Inquiry, the experimentation step, experiments are conducted in order to test and verify whether the final solution design holds up in the practice of the doubtful situation (Dewey, 1938). In the pragmatist paradigm one assumes that only through intervention and testing the hypotheses of a solution design in real-life one can gather proof for the validity of the hypotheses of a solution design (Peirce, 1878). This is achieved by enacting and changing the doubtful situation according to the final solution design. However, this is not a one-time fix. Progressive inquiry is required as soon as the situation is sufficiently altered by something or someone. Progressive inquiry can transition the new doubtful situation into a unified situation again, which is achieved through observation, reflection, and subsequent mitigation of problems that arise following solution design implementation (Dewey, 1938).

Although there is not enough time to implement the final solution design while conducting this study, several actors that are directly affected by the implementation of the solution design are approached to find out whether they would be willing to support Océ in its implementation, and how they would envision this.

2.2.6 Step 6: Warranted Assertion

Once progressive inquiry has led to the verification of the solution design in the doubtful situation, one can conclude that it is valid. However, the validity of the solution and its reasoning are very much dependent on the context- and situation-specific factors of the doubtful situation (Dewey, 1938). In a similar situation, where the factors and their relations are slightly different, one would have to check again whether the hypotheses of the solution design can be validated through experimentation, and unification of the situation can be achieved. In this sense the Deweyan Inquiry is a cumulative and progressive method, which never claims to know for a fact how certain actions mediate and unify an indeterminate situation (Dewey, 1938). Therefore, instead of claiming that the solution design and its theory, which can potentially advance

academic theory, are truths, the Deweyan Inquiry refers to warranted assertions, which implies that progressive inquiry in the future might further enhance the solution or theory (Dewey, 1938).

2.3 Report Outline: an Overview of the Inquiry

Adopting the Deweyan Inquiry for this study effects the structure of this inquiry. These implications are shown in Figure 2.2, providing an overview of the inquiry. This document is divided into six parts, where each parts corresponds to a specific step in the Deweyan Inquiry.
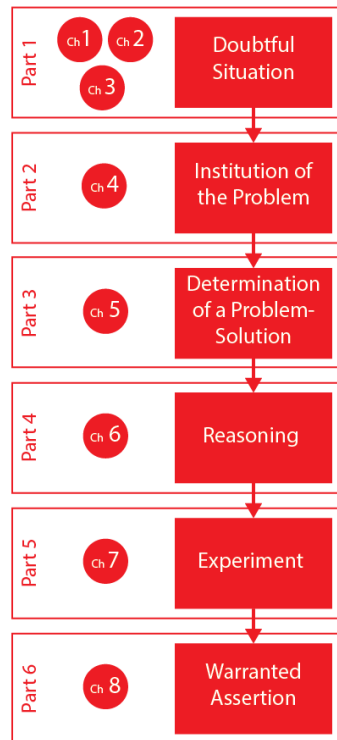
Figure 2.2: Overview of this Study's Inquiry

Part 1 represents step one in the Deweyan Inquiry: the doubtful situation. This includes an introduction outlining the initial doubtful situation, Océ, and the book publishing industry (Chapter 1), a description of the adopted research approach (Chapter 2), and a description of the research tools and procedures that were used to find answers to the research questions, and to create a solution design (Chapter 3).

Part 2 corresponds to step two: the institution of the problem. Chapter 4 defines books, introduces a model for the future of books, and covers the current and future state of the book print markets. It ends with the definition of the problem and the formulation of research questions.

Part 3 describes the determination of a problem-solution. In its single chapter, Chapter 5, the design space is defined, four concept solution designs are introduced, and one solution design is selected.

Part 4 corresponds to the fourth step: reasoning. In this part the selected solution design is improved and refined using both findings from theoretical research, as well as from research into practice (Chapter 6).

Part 5 of this report describes the experimentation step. Its sole chapter, Chapter 7, describes the final solution design, and the steps that are to be taken to implement and test the final solution design in practice.

Part 6 corresponds to the final step in the Deweyan Inquiry: warranted assertion. Chapter 8 provides this study's conclusion and its practical recommendations, as well as the discussion of its theoretical implications. Furthermore, it lists this study's limitations, and provides suggestions for future research.

3. Research Methodology

This chapter describes the research methodology; the tools and procedures that were used for the empirical- and the theoretical research. Thereby outlining how data and information was searched, collected, integrated, and analysed. Describing the employed empirical- and theoretical research tools and procedures allows for a critical evaluation of this study's validity (Kallet, 2004).

3.1 Empirical Research Tools and Procedures

The goal of the empirical research was to gather and analyse data in order to interpret the factors, actors, and their relationships in the specific, operational context of the doubtful situation. Also, to design a solution that when implemented in practice can unify the situation and solve the problem. The following paragraphs describes which and when empirical research tools and procedures were used.

Industry Sales Figures, Market Reports, and Company Documents

To institute the problem in step two of this inquiry, an integral procedure was analysing industry sales figures, market reports from independent agencies (e.g. Interquest, Caslon, IT Strategies, Smithers Pira), and consulting company documents and knowledge. This procedure combined both qualitative and quantitative data. Comparing findings such as sales figures, reports, and documents published by multiple (independent) sources is referred to as data triangulation. Triangulation: the cross-verification of data obtained from multiple sources or using different procedures, is an effective strategy to promote qualitative research validity (Johnson, 1997). The findings of this analysis are stated in Chapter 4.

Semi-structured Interviews

Two rounds of interviews were conducted in this inquiry. The first round of interviews was conducted partly for orientation, partly it was aimed at identifying ways to create and capture value within the book publishing industry. It was conducted partly in step two and partly in step three of this inquiry. Qualitative data was gathered in this round of semi-structured interviews with various actors operating at different levels within the doubtful situation, integrating multiple respondent perspectives (Yin, 2003).

A total of 22 actors were interviewed, where each interview took approximately 30-90 minutes, depending on the time that could be allotted. Appendix F describes which people were interviewed in this interview round and how and why these interviewees were selected. It also specifies the questions that were asked in an interview protocol. A non-exhaustive list of interviewed actors operating in the book publishing industry includes: book buyers, brick-and-mortar bookstores, online bookstores, libraries, traditional publishers, self-publishers, book distributors, digital book print providers, and offset book print providers.

The semi-structured interview technique for this first interview round was chosen since it allows for exploration of a predetermined set of questions over the duration of an interview, while still allowing the interviewer to freely pursue a certain topic more in depth if that is warranted (Patton, 1990). Semi-structured interviews are suitable when learning the perspective of multiple interviewees is the goal (Patton, 1990). Since the Deweyan Inquiry assumes that through interaction with actors operating in the doubtful situation a situation can be changed, the potentially conflicting perspectives and reasoning of these actors must be learned to understand the doubtful situation, and to attain momentum and support for change.

Structured Interviews

The second interview round was conducted in step four of the inquiry after the selection of a solution design. Its primary goal was to gather information that can make the selected solution design more appropriate and actionable, so that it can be implemented and experimented with in practice. Its secondary goal was to find out whether actors were willing to support Océ in implementing the solution design. For this interview round only digital print providers and finishing equipment manufacturers were interviewed. A total of four actors were interviewed, where each interviewee was asked ten questions. Appendix F

describes who were interviewed, why these actors were selected, and it provides the interview protocol for the second interview round.

The qualitative structured interview technique was selected for this interview round since it allows for optimal comparison of qualitative data. Through a predefinition of questions and topics, and formulating the questions in exactly the same way, the answers of respondents can easily be compared (Patton, 1990). This was useful as one of the goals was to find out which of the respondents would be more open to supporting Océ in solution design implementation.

Open Coding

All interviews in both interview rounds were recorded, transcribed, and analysed. The analysis of the transcripts of the first round of interviews was conducted in the second step of the inquiry. Its findings are incorporated in Chapter 4 & 5. The transcripts of the second round of interviews were analysed in the fourth step of the inquiry, and its findings are discussed in section 6.2. The data analysis technique that was used is referred to as the open coding technique. Open coding refers to labelling and categorizing the qualitative data of interviews (Pandit, 1996). In this way all qualitative data related to one phenomenon, but mentioned in different interviews, is grouped together into one distinctive high-level category. A category was then divided into several sub-categories, where each sub-category consists of several concepts: *"the basic building blocks for the analysis and for theory building"* (Strauss & Corbin, 1990, p. 13). Each category is highlighted in a distinctive colour, and sub-categories are represented in slightly different colour shades similar to their corresponding category colour. All open coding was conducted in Microsoft Excel.

1:10:100 Design Cycle Approach

To facilitate the evolution of multiple solution designs during the inquiry, while meandering between observing and theory building, the 1:10:100 approach was used. The 1:10:100 approach refers to an opportunity oriented design cycle procedure in which one goes through several iteration- and reflection cycles with different time spans (Van Turnhout et al., 2013). A range of concept solution designs are developed before and presented at feedback meetings, where the solution designs have gone through all phases of a traditional design project, only very swiftly. At these feedback meetings Océ practitioners were given an impression of the concept solution designs, so that they could provide feedback. Concept solution designs were presented using small-scale, low-fidelity test methods, such as visual aids (e.g. concept sketches), in order to facilitate a reflective design conversation with the stakeholders who are tasked to unify the indeterminate situation (Van Turnhout et al., 2013). Their feedback then triggered an iterative cycle in which the requirements and parameters of the theory are evaluated and, if necessary, changed (Van Turnhout et al., 2013). At subsequent feedback meetings this process repeated itself. As such, theories and solution designs co-evolved, while others were eliminated, until the most appropriate, actionable solution design remained. Section 5.2 introduces the four concept solution designs that were developed for this study, as well as the corresponding concept sketches. Section 5.3 describes how and why one of those solution design was selected, while the others were eliminated.

The 1:10:100 design cycle approach was applied throughout the first three steps of this study's inquiry. The presentation of concept solution designs and the selection of a solution design took place at the end of the third step.

The 1:10:100 approach allows for early occurrence and detection of mistakes and unfavourable solution directions, reduces the amount of required rework, makes the final solution design more focused, and increases the chances of successful implementation. Furthermore, it creates a common understanding of the theory with stakeholders, it gradually and jointly brings focus to the project with company stakeholders, and it continuously uncovers, validates, and balances a wide range of requirements (Van Turnhout et al., 2013). Since the 1:10:100 approach aligns research and design activities in a project, it is an excellent complement to the Deweyan Inquiry, where theory, practice, and design are intertwined.

3.2 Theoretical Research Tools and Procedures

A literature study was conducted in the fourth step of the inquiry and published in a separate document. Its goal was to improve the reasoning of the solution design by incorporating academic findings and theories. The search strategy for academic articles consisted of the keyword search strategy and snowballing (Van Aken et al., 2007). The keyword search strategy refers to using combinations of keywords to search for articles in scholarly databases, such as Google Scholar, Web of Science, and ProQuest–ABI/INFORM, to which the TU/e offers access. Snowballing refers to searching in the references of selected articles to find other relevant articles (Van Aken et al., 2007). The quality of an article, as indicated by the number of citations it has received and the journal impact index of the journal in which it has appeared, was together with the relevance of an article, the most important selection criteria.

Now the doubtful situation has been introduced, and the research approach and research methodology are elaborated upon, the next section of this document; Chapter 4, institutes which elements of the doubtful situation are problematic and in what way. As such, the chapter institutes and frame the problem to indicate what and whom is attended to in this study.

Part 2

This part institutes whether the doubtful situation is problematic, and subsequently identifies and frames the problem as precise as possible. Thereby defining what and whom is attended to in this inquiry, while meandering between observing practice and building theories in order to guide these observations.

4. The Institution of the Problem

The doubtful situation in which the ramifications of the digital transformation of the book publishing industry are difficult to accurately predict, led to the formulation of a question that guided the initial analysis: *How does the digital transformation of the book publishing industry impact the book print market, digital print press manufacturers, such as Océ, and the future of (digital) book printing?*

Although this question provided a starting point, it was not adopted as research question. The initial question was not shaped by the purpose of this study (i.e. creating a solution design that can unify the doubtful situation), and as such, it lacks focus and direction. Furthermore, a study's research questions should clearly delimit what will and what will not be attended to in the study (Leedy, 1993). Before formulating research questions, first, it had to be instituted whether and what aspects of the doubtful situation can be classified as problematic. It had to be framed as precise as possible in order to define which actors and factors are attended to in this inquiry. Therefore, observations in practice were complemented by the development of theories to guide these observations. As such, this chapter meanders between reporting findings from observing practice, and building theories that guide these observations.

This chapter describes the findings from the market analysis that was conducted following the introduction of the doubtful situation. However, before its findings are discussed, some basic concepts and definitions must be introduced. Therefore, this chapter is structured as follows. Firstly, section 4.1 explains what is meant by a 'book', in which forms books appear, and the importance of the purpose of a book. Secondly, section 4.2 introduces a model with which the future of books can be framed. Thirdly, section 4.3 describes the current state and developments within the global book print market and the digital book print market, the growth drivers of digital book printing, the distribution of book print volume over various book printing technologies and book categories, and the consequences of the digital transformation of the publishing industry for the future of the digital book print market. Lastly, section 4.4 defines, based on the findings in previous sections, which aspects of the doubtful situation are classified as problematic, translates this into a problem statement, and formulates research questions that delimit what is attended to in this inquiry.

Thus, this chapter builds a theory with regard to the future of books, through the definition of the what, the how, and the why of books, and by describing why and how the digital transformation is likely to unfold. Subsequently, it defines the relevant trends and drivers, and then relates these findings to the theory regarding the future of books. Thereby answering the initial question and forming the basis for the formulation of a proper problem statement and research questions.

4.1 Books: the What, How, and Why

The question: 'What constitutes a book?' can be answered on multiple abstraction levels. At the most basic level of abstraction a book is defined as its physical manifestation: *"A book is a set of written, printed, illustrated, or blank sheets, made of ink, paper, parchment, or other materials, usually fastened together to hinge at one side... A set of text-filled or illustrated pages produced in electronic format is known as an electronic book, or eBook."* (Book, 2016)

Within this definition there are a multitude of appearance forms that are considered books. A non-exhaustive list of different kinds of books is given by: almanacs, atlases, children books, coffee table books, comic books, cooking books, dictionaries, graphic novels, higher educational books, novels, religious books, schoolbooks, and scientific books. Moreover, these books appear in different forms, or on different media, for instance, as: eBooks, PDF-files, audiobooks, or paper books, which in turn can be paperback, hardbound, coverless, foldable, etc. Needless to say that due to this enormous variety of appearance forms, it is impossible to forecast the future of the books as if it was one uniformity. Books are subject to dynamics that differ per book category, manufacturing technique, and geographic region.

It is possible to forecast the future of specific book types by answering the question of what a book constitutes on a higher abstraction level. There the physical manifestation of a book (the what) is a mere description of the thing trying to achieve a certain goal (the why) in a certain way or form (the how). To truly come to the essence of a book, one must look at it what it tries to achieve; its purpose.

This study proposes that the ultimate purpose of any book can be classified somewhere on a spectrum ranging from purely transferring content on one end of the spectrum, to purely providing an experience on the other end. Where books aimed at transferring content are meant to inform the reader; transferring content into knowledge, and where books aimed at providing an experience are meant to provide an experience through storytelling, while evoking emotions. All books facilitate, to some extent, the transfer of content or information from the book medium to a reader, and the transformation of this content into personal knowledge. However, the extent to which content transfer, as opposed to providing an experience, is its main purpose, determines a book's position on the book purpose spectrum. In general, examples of books more aimed at providing an experience and evoking an emotional connection are: children books, fictional novels, coffee table books, comic books, graphic novels, etc., while examples of books more aimed at transferring content are: almanacs, atlases, dictionaries, scientific books, school books, etc. Figure 4.1 displays the book purpose spectrum and classifies different types of books on this spectrum.

Figure 4.1: Book Purpose Spectrum

4.2 The Future of Books

It is relevant where a certain book type can be classified on the book purpose spectrum, because it can be used to predict the likely appearance form of a book category in the future. Depending on its position on the book purpose spectrum, the printed book form might not be the most suitable medium for achieving its intended purpose. Generally, book categories more aimed at providing an experience and evoking emotions (currently) benefit to a larger extent by the printed book medium, as opposed to books aimed at transferring content and informing, which benefit to a larger extent from the capabilities of digital IT media.

If one accepts that transferring content is on one end of the book purpose spectrum, and digital IT media are more effective and efficient in achieving this purpose, while the purpose on the other end of the book purpose spectrum; providing an experience, is currently best accomplished by the paper book medium, then the digital transformation of the book industry is expected to start with the digitization of books that can be categorized as more aimed at transferring content. For the supporting rationale see Appendix B.

However, interviews with book buyers indicated that besides a book's purpose there is an additional factor that is influential in the decision of whether someone prefers a paper book or a digital book; i.e. personal

affinity. When somebody experiences a strong personal affinity with a book or a book's subject, then that person would generally prefer a paper book to a digital version of that book.

4.2.1 Individual Book Sensation Matrix

Combining these two factors in one model results in the Individual Book Sensation Matrix as shown in Figure 4.2. Based on a book's purpose and on whether a person has a personal affinity with a book or its subject, a book can be categorized in either of four quadrants: the 1) affective-emotional connection quadrant, 2) affective-emotional disinterest quadrant, 3) cognitive-intellectual disinterest quadrant, and the 4) cognitive-intellectual connection quadrant.

Figure 4.2: Individual Book Sensation Matrix

Books within Quadrant 1 are aimed at providing an experience and the individual has a personal affinity with the book. Therefore, it is expected that this person establishes an affective-emotional connection with it and prefer to own a paper book, rather than a digital book. Books in Quadrant 3 aim to transfer content, but the individual does not have a personal affinity with it. That person has a cognitive-intellectual disinterest in the book. As such, books in this quadrant are preferred in a digital form. Books in Quadrant 2 are aimed at providing an experience. However, the individual has a low affinity with the book, so the person has an affective-emotional disinterest in the book. Although typically somebody would prefer a paper book for a book that provides an experience, due to an affective-emotional disinterest sometimes owning a digital version is preferred. Books in Quadrant 4 are aimed at transferring content, coupled with a high personal affinity. Somebody would likely establish a cognitive-intellectual connection with that book. Although typically somebody would prefer a digital book for a book aimed at content transfer, due to the cognitive-intellectual connection that person sometimes prefers to have a paper version. Books in Quadrant 2 and 4 are not definitely preferred in a paper or digital form, but books in Quadrant 2 are expected to be preferred in paper form more, while books in Quadrant 4 are expected to be preferred in digital form more.

4.2.2 Forecasting Book Digitization Trajectories

By classifying a book in a quadrant of the Individual Book Sensation Matrix, and subsequently aggregating all individual preferences on the level of the total population, one would be able to forecast the future of a book category's appearance form. Figure 4.3 on the next page shows the expected book digitization trajectories per Individual Book Sensation Quadrant as S-curves. This serves as a way to frame the likely future. The percentages over the timeframe of the model are to be regarded as propositions, which are based on a careful analysis of the current technological trends and changing behaviour patterns. However, this model is not empirically verified. As such, the actual percentages of digitization for each book quadrant in 2040 are to be regarded as best estimates.
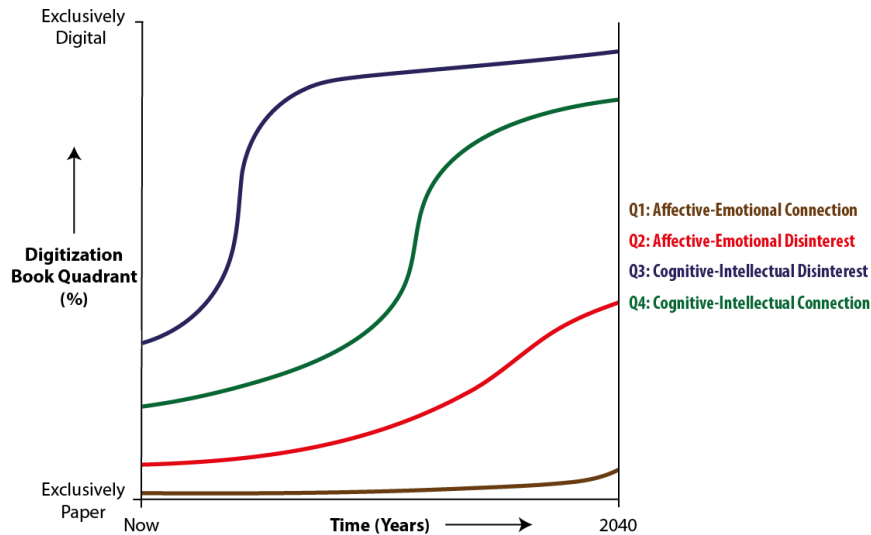
Figure 4.3: Expected Book Digitization Trajectories

As shown in Figure 4.3 in the near future the appearance form of book categories in all quadrants will transition towards a more hybrid mix where paper- and digital books will coexist. Depending on which quadrant a book category can be allocated to, the hybrid mix will at a certain point in time be dominated by either the paper version or the digital version of a book. Furthermore, it indicates the speeds at which the digitization trajectory is likely to transpire for each quadrant.

To determine to which quadrant each book category can be allocated one should conduct surveys on a representative subset of book readers. However, since this model was proposed as a way to frame the future, rather than empirically verify it, coupled with a lack of time and resources, this has not been incorporated in this study. Although based on findings from the first interview round, a classification attempt was made, as shown in Table 4.1. Book categories allocated to Quadrant 1 & 3 are self-explanatory, but the allocation of book categories to Quadrant 2 & 4 is up for debate as individual preferences vary.

Table 4.1: Classification of Book Categories to individual Book Sensation Matrix Quadrants

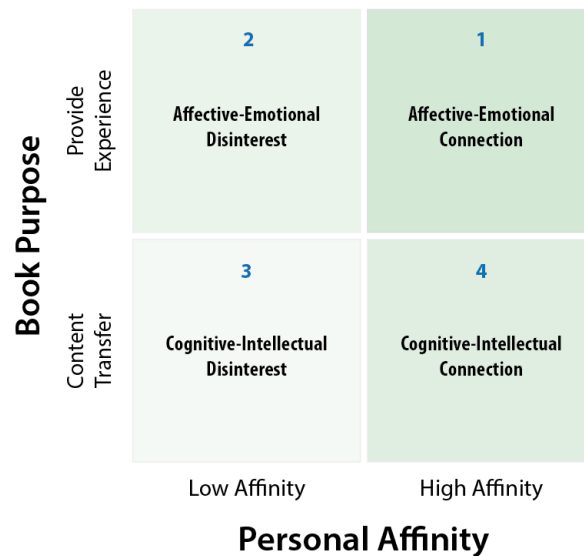| Quadrant 1: Affective-Emotional Connection	Quadrant 2: Affective-Emotional Disinterest	Quadrant 3: Cognitive-Intellectual Disinterest	Quadrant 4: Cognitive-Intellectual Connection
Children books	Cooking books	Encyclopaedias	Scientific books
Young adult books	Classical books	Dictionaries	Non-fiction books
Graphic novels		Telephone books	Professional books
Collectible books		Catalogues	Academic dissertations
Colouring books		Educational books	Management books
Coffee table books		Technical books	
Fictional books			
Religious books			
Art books			

4.2.3 Digitization of Book Categories in Practice

Evidence for the rapid digitization of book categories in Quadrant 3 & 4, which are mainly aimed at transferring content, is witnessed in practice as the share of encyclopaedias, dictionaries, and telephone books that are published in paper form has plummeted in recent decades. Additionally, professional, scientific, and educational books are also declining in paper format. For instance, nowadays John Wiley and Sons, a firm in the knowledge and learning business, makes roughly 60% of its revenues from digital books (Stobaugh, 2016). Also, the development and rise of e-learning, and of Massive Open Online Courses (MOOCs) in school and universities around the world, are driving forces for the digitization of higher educational and scientific books. The CEO of Scanlaser, a digital print provider, affirmed this trend by stating: *"It is moving fast towards a hybrid mix of digital and printed books, where paper books will assume a supporting role to digital. Especially in the scientific and educational market; these markets will not just stagnate, but decline."* The

CEO of Wilco, an offset print provider, agreed by stating: *"Digitally published books are a bigger threat to book printing in the professional, scientific, and educational market, than eBooks are in the literary market"*. Furthermore, Interquest (2015) predicts -5.5% CAGR (Compound Annual Growth Rate) in book print volume for professional-, scientific-, and technical books, and -3.0% for education books in WE between 2015–20.

In contrast, for book categories in Quadrant 1 & 2, the book digitization process is transpiring much slower, as the paper book is still an excellent medium for providing an experience. Evidence for this is that Interquest (2015) predicts only a -2.0% growth in book print volume for trade books in WE in the period 2015–20. Furthermore, in WE and NA printed book sales actually went up for the book categories: children books, graphic novels, collectible books, and colouring books (Interquest, 2016b), while the rise of eBooks has stagnated in the fictional trade book market. For years the publishing industry, and especially literary publishers, viewed the rise of the eReader and eBooks with fearful eyes, for eBooks were deemed capable of completely replacing printed books. But even though a substantial market share has been captured by eBooks, its growth has stagnated, and the market share of eBooks is not expected to start growing again. For an elaboration on the stagnation and future of eBooks see Appendix C.

Book digitization currently is less apparent for book categories in Quadrant 1 & 2. However, over time book digitization will also become visible in those book categories that are more aimed at providing an experience. Thus, although the book print market is not expected to disappear in coming years, it is expected to be reduced in size due to certain book categories going out of print. In the long term inevitably a digital version of a book or a new-to-be-developed multi-media platform will be developed that surpasses the capabilities of a paper book in providing a fulfilling experience as well. This would result in the digitization of most book categories, and signal the true demise of the paper book era. The time frame in which this will transpire is hard to establish as estimates range apart, varying from two decades to a century.

4.3 The Book Print Markets

As book categories in all quadrants transition towards a hybrid mix of paper- and digital books, the total book print volume declines. The process in which traditional printing technology is replaced by digital publishing technology is fastest for book categories that are more aimed at transferring content, as opposed to books that provide an experience. Due to the slow pace of technology substitution in the latter the consequences of the digital transformation of the publishing industry are not immediately disastrous for book printing. There will remain a substantial book volume to be printed in the decades to come.

This raises the question whether that remaining book print volume will be printed using offset printing technology, or digital printing technology. For an introduction of and elaboration on the concepts of offset- and digital printing technology, their differences, and (dis)advantages, see Appendix D. Here it is explained when and why one would choose to use either technology to print a certain book or series of books.

To more precisely forecast the consequences of the digital transformation on the future of book printing and the size of the book print markets, one must start by defining the current market sizes, the trends, and drivers within these markets. The following paragraphs provide an in-depth analysis.

4.3.1 The Global Book Print Market

In 2014 the global book print volume, which includes all offset- and digital book print volume, amounted to 3,400 bn A4 pages (Caslon, 2015). This global book print volume will decline in the years to come. For 2018 it is expected that the global book print volume will reduce to 3,050 bn A4 pages (Caslon, 2015), corresponding to a decline of 10.3%. It is important to note that this decline has not started recently, but that it has been unfolding since 2008 in WE and NA. Additionally, not just the global book print volumes are declining, but the global book printing revenues as well. These are expected to continue to decline by 0.9% CAGR between 2015–20 (Smithers Pira, 2015). Although 2015 formed an exception to the general trend as global book print volumes and -revenues slightly increased, this is to be regarded as an anomaly,

and for subsequent years it is expected that the negative trend will continue. As evidenced for the NL, where the cumulative revenue trend for trade books, published by www.boekblad.nl, showed that in the first 22 weeks of 2016 7% fewer revenues were made from the sales of trade books, than in 2015.

Appendix E shows that this negative global trend is led by declines in printing volumes and revenues in WE, NA, and to a lesser extent by declines in Eastern Europe, the Middle East, and Australasia. Although some regions, such as Asia, Africa, and Latin America, go against the trend as book print volumes and revenues are expected to increase for these regions (Smithers Pira, 2015). Figure 4.4 displays the fluctuation of the global book print volume in billions of A4 over the period 2012–29.
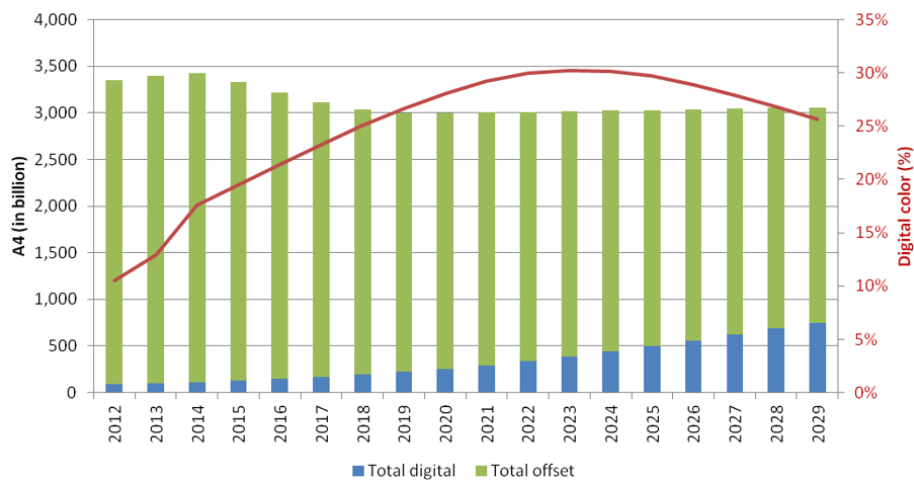
Figure 4.4: Size and fluctuation of the Global Book Print Volume (Caslon, 2015)

Caslon forecasts that the negative trend will not persist, but that the global book print volume will stabilize after 2019, and even display some minor growth after 2020 (Caslon, 2015). Arguing that the stabilization will be driven by a substantial increase in book print volumes in regions such as China and Latin America. However, they also forecast that even the decline in book print volumes in WE and NA will come to a halt. However, in light of the model of the future of books in section 4.2, Caslon's estimates are likely overly optimistic. Very few potential drivers exist that could possibly explain a stabilization in book print volumes in WE and in NA in the near future. Traditional drivers of growth in book print volumes in the period following the end of World War II were the rapid population growth and increased interest in and access to books of the middle class. Nowadays, these drivers are unlikely candidates for future growth in WE and NA. Furthermore, there are also many negative trends, such as a general decline in readership, average readers devoting less time to printed media due to the presence of an abundance of other time-consuming IT media, and a demographic shift in which the younger generation prefers to rent rather than own physical things. Thus, all points to the global book print market being a market in demise, which may never recover.

4.3.2 The Digital Book Print Market
Despite the global book print market's demise, throughout the period 2012–29 both the global digital book print volume, as well as its market share has been on the rise, and is expected to continue to rise in the years to come (see Figure 4.4). Currently, only a small percentage of the global book print volume is printed digitally. In 2015 roughly 8% of the book print volume in WE, and 9% of the book print volume in NA was produced on digital print presses. These percentages are expected to grow to about 15% for both WE and NA by 2020 (Interquest, 2015, 2016a). Caslon (2015) is more conservative in estimating the market share of digital printing by stating that in 2014 the global digital book print volume amounted to 115 bn A4 (3.4% market share). They expect it to grow to 210 bn A4 in 2018 (6.9% market share).

Regardless of differences in magnitude, all independent research agencies agree that digital book printing is on the rise and that the market will continue to experience double-digit growth in subsequent years. But where is this growth in digital book print volume coming from?

4.3.3 Growth Drivers of Digital Book Printing

The digital book print market is mainly growing by capturing book print volume that is migrating from offset- to digital printing (IT Strategies, 2014). Although digital book printing enables the creation of some new book applications that would otherwise never have been printed, replacing offset is where the bulk of the new digital book print volume originates from. Subsequent paragraphs discuss the most important growth drivers of digital book printing. These drivers are derived from research by Interquest (2016b).

Shorter Print Run Lengths

A driver for the migration of offset book print volume to digital printing is the reduction in average book print run lengths in nearly all geographic regions and book categories. Run length refers to the number of books that are printed within a single production run. Appendix D describes that as average print run lengths go down, then more books become eligible to be cost-efficiently short-run printed on digital print presses (i.e. run length 50–700). Publishers and book print providers in both NA and WE quote the average print run length reduction as a leading trend within the industry (Interquest, 2015, 2016a). The reasons for the decline are found in: 1) online retailers (e.g. Amazon, Bol, etc.) offering a wider range of book titles in low volumes, than traditional brick-and-mortar bookstores, 2) a decrease in demand for newly published printed books due to e-substitution, 3) publishers reducing their inventory costs by printing more books on demand, at the expense of printing to stock, and 4) the fast-growing number of self-publishers and self-published book titles, which rarely sell more than 300 copies. Anderson's (2006) maxim holds true for the publishing industry: 'the future of business is selling less of more', enabled by digital printing technology.

More Printing on Demand

A second driver for the migration of offset book print volume is the increase in popularity of Printing on Demand (POD). Where POD refers to very short-run printing (i.e. run length: 1–50), up to single-copy printing. POD is mostly conducted on digital sheet-fed print presses as these are more efficient and faster in switching between different book sizes and paper substrates, than digital web-fed print presses. In POD book titles are not printed by forecast, but printed when paid for by a customer. After the books are printed, they are delivered straight to the book buyer within hours after receiving an order, thereby saving inventory costs. POD enables online retail channels to retain books in their product portfolio that do not sell in volumes that warrant keeping stocks. For example, older books in the latter phases of their Product Life Cycle (PLC); backlist books. Another example is self-published books that rarely sell in large enough quantities to make offset printing cost-efficient. Interestingly, most books printed on demand fall under the trade book category (e.g. backlist or POD literary books, thrillers, science-fiction books, etc.)

POD made up 8% of the European digital book print market in 2015, and this is expected to increase by 25.4% CAGR to 15% in 2020 (Interquest, 2015). Meanwhile in NA POD's market share of the digital book print market amounted to 17% in 2015, and is expected to increase to 21% in 2020 (Interquest, 2016a). This difference in market shares is to a large extent due to Amazon's dominant market position as online book retailer in NA, whereas in WE its presence is fragmented and less dominant. Amazon prints many of its books on demand, whereas most competitors keep stocks of offset printed books.

More Distribute-and-Print

A third driver for the migration of offset book print volume to digital printing is the usage increase of distribute-and-print models. Traditionally books were printed at a central location and then distributed to warehouses and sales channels around the country/region/world. In a distribute-and-print model books are printed directly in the region or country of end consumption, as close as possible to the final customer. This can result in significant shipping cost savings, reduce delivery lead time, and is more environmentally friendly. However, despite the advantages it offers publishers and print providers whose customers are spread over a large geographic area, such as those in NA or Britain, for those in smaller language regions, such as the NL, the advantages of distribute-and-print models are a lot less significant. In 2015 the market

share of distribute-and-print book print volume in both NA and WE was still modest; 4% and 3% respectively. However, that is more than twice what it was in 2012 (Interquest, 2015, 2016a).

More Book Customization and –Personalization

Book customization and –personalization is a fourth driver of the migration of offset book print volume to digital printing. Customization refers to the versioning of books in which content is customized for different target groups. Personalization refers to the personalization of the cover and/or a few pages, but also to books that are highly personalized throughout. These books, which make use of variable data printing, cannot be produced using offset printing technology, as then for every version a new, expensive printing plate has to be manufactured, raising the unit costs exponentially. Although book customization and –personalization is becoming more prevalent, it is occurring slowly. Just 1.5% of the digital book print volume in WE was either customized or versioned in 2015, but book publishers expect this to increase to 10.0% in 2018 (Interquest, 2015). For NA it is a different story as in 2015 already 21% of the digital book print volume incorporated some customization or personalization, and book publishers expect this to increase to 26% in 2018 (Interquest, 2016a). The most common applications of customized- or personalized books are: personalized children books, customized educational books, and customized professional books.

More Self-publishing

A new book application enabled by digital printing is self-publishing, referring to the publication of a book by an author himself or with the help of a self-publishing platform or -firm, but without involvement of a publisher. Books that are self-published are usually deemed unfit for publishing by traditional publishers due to their expectation that they will not sell enough copies to warrant publishing. As such, self-published book rarely sell many copies. A typical self-published book will sell between 30-300 copies. Therefore, self-publishers almost exclusively make use of POD. Despite the low average sales, the total volume of self-published books is quite substantial and growing swiftly. For instance, the self-publishing market in the United States (US) nearly quintupled in the period 2008–13 (Interquest, 2016a) to 302.622 printed self-published book titles (Interquest, 2015). In 2015 in WE self-published books accounted for 5% of the total European digital book print volume, and this is expected to increase to 9% in 2018 (Interquest, 2015). Meanwhile in NA self-published books account for 11% of the total digital book print volume, and this is expected to increase to 13% in 2018 (Interquest, 2016a). Curiously, despite these developments just a small percentage of publishers in WE and NA see self-publishing as a key market trend (Interquest, 2015, 2016a).

4.3.4 Distribution of Digital Book Print Market Volume

Due to the growth drivers: shorter average print run lengths, more POD, more distribute-and-print, more book customization and –personalization, and more self-publishing, digital book printing will continue to grow at the expense of offset printing. As the amount of digital book print volume increases, this effects its distribution. Namely, it changes the way book print volume is distributed over printing technology types, the ratio of output that is printed in black & white (monochrome), as well as the distribution over paper-feeding technologies. This section discusses how book print volume is and will be distributed.

Inkjet vs. EPG vs. Offset

Figure 4.5 shows how in WE and NA the book print volume was divided over book printing technologies in 2015, and how it will be in 2020. Book print volume will grow marginally for EPG print presses. This is due to the variable cost prize for printing in monochrome on EPG print presses being almost equal to the price for printing in monochrome on a digital inkjet print press. Also, many digital print providers already own multiple digital EPG print presses, which must be allocated print volume. Regardless, most offset book print volume that migrates to digital printing will be printed on digital inkjet presses as technology advances in digital inkjet offer improved print quality at lower running costs than EPG print presses. Though print providers indicate that the quality of colour inkjet must improve, and price and Total Cost of Ownership (TCO) must come down for digital inkjet printing to realize its potential (Interquest, 2015).
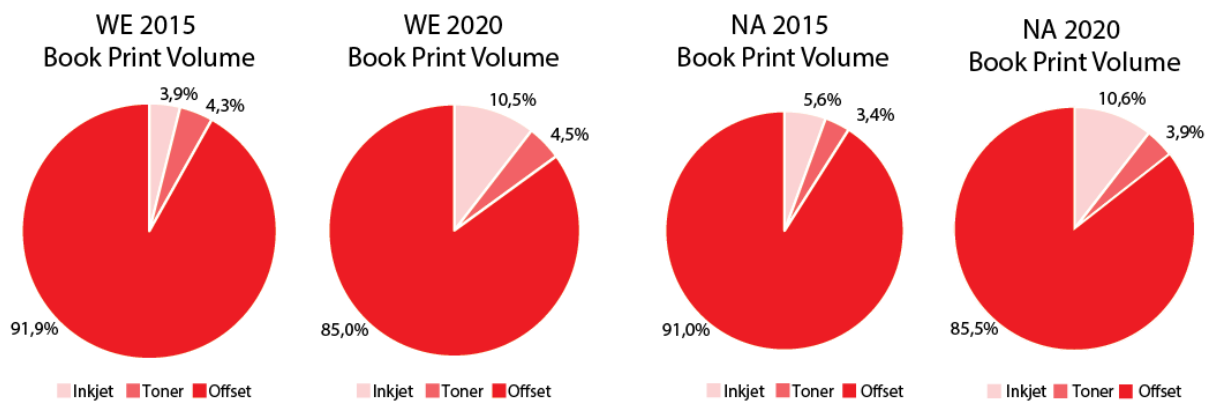
Figure 4.5: Market Shares Printing Technologies of Total Book Print Volume for WE and NA (Interquest, 2015, 2016a)

Monochrome vs. Colour

The ratio that is printed in monochrome and in colour is shifting. The digital book print market is traditionally dominated by monochrome printing, but in recent years colour printing has gained market share. This is driven by improvements in digital inkjet colour quality. In 2014 15 bn A4 were printed in colour, which is 13.0% of the digital book print volume (Caslon, 2015). For 2018 Caslon (2015) forecasts this to grow to 40 bn A4, corresponding to 19.0% of the digital book print volume. So, even though the monochrome book print volume is increasing rapidly, colour book print volume growth is expected to outpace it in subsequent years. The red line in Figure 4.4 tracks the percentage of digital book print volume printed in colour (Caslon, 2015). It indicates that it will grow faster than digital monochrome book print volume, until around 2023 when its market share will plateau around 30% (Caslon, 2015). After 2023, the market share of digital monochrome printing will become larger again, because of offset migration of book print volume that is chiefly monochrome, such as literary book print volume. Currently, the main colour applications for digitally printed books are: educational books, of which around 67% of the books are printed in colour, and TSP books, of which 33% of books are printed in colour (Interquest, 2016a).

Sheet-fed vs. Web-fed

The distribution of digital book print volume over sheet-fed and web-fed print presses is also changing. The digital book print market is mainly growing due to the migration of offset book print volume, partly driven by a reduction in average run lengths. Therefore, to a large extent this new book print volume will be printed in short- or medium-run lengths (run lengths < 300 books) that before could not be cost-efficiently printed on digital print presses. Generally, books printed in larger run lengths on similar paper substrates can be printed faster and more efficiently on web-fed print presses. Sheet-fed print presses offer more advantages for print jobs requiring more media- and substrate flexibility (i.e. very short-run printing).

Average print run length is not the only factor for print providers in deciding between using sheet-fed or web-fed print presses. A major factor is monthly volume (Interquest, 2016a). A typical dedicated book print provider prints books in monthly volumes of several million A4 pages. Sheet-fed print presses are not capable of reaching such high monthly volumes. For instance, an Océ VarioPrint i300 prints on average 3 million A4 pages per month, and an Océ VarioPrint 6000 series roughly 1.5 million. While web-fed print presses such as the ColorStream 3000 Twin, and the JetStream Dual print on average in excess of 10 million A4 pages per month. So, for digital print providers who print in larger volumes and do not focus on POD, utilizing web-fed print presses is the preferred printing set-up. Especially as web-fed print presses with 'Book of One' software now print short runs more effectively than before. Of course, there are also other factors that come into play when making the decision between web-fed and sheet-fed, such as quality, price, reliability, etc. Regardless, Caslon (2015) predicts that web-fed print presses will capture more market share in the future. Despite a loss in market share, the absolute print volume for both monochrome- and colour sheet-fed book printing will increase substantially (Caslon, 2015). To illustrate the current and expected distribution of volume over paper-feeding technologies and colour/monochrome see Figure 4.6.

Digital Book Print Volume 2015
- 10,5%
- 8,9%
- 18,2%
- 62,4%
- Color web-fed ■ Mono web-fed
- Color sheet-fed ■ Mono sheet-fed

Digital Book Print Volume 2020
- 18,5%
- 9,6%
- 26,8%
- 45,1%
- Color web-fed ■ Mono web-fed
- Color sheet-fed ■ Mono sheet-fed

Digital Book Print Volume 2029
- 26,4%
- 17,8%
- 7,9%
- 47,9%
- Color web-fed ■ Mono web-fed
- Color sheet-fed ■ Mono sheet-fed
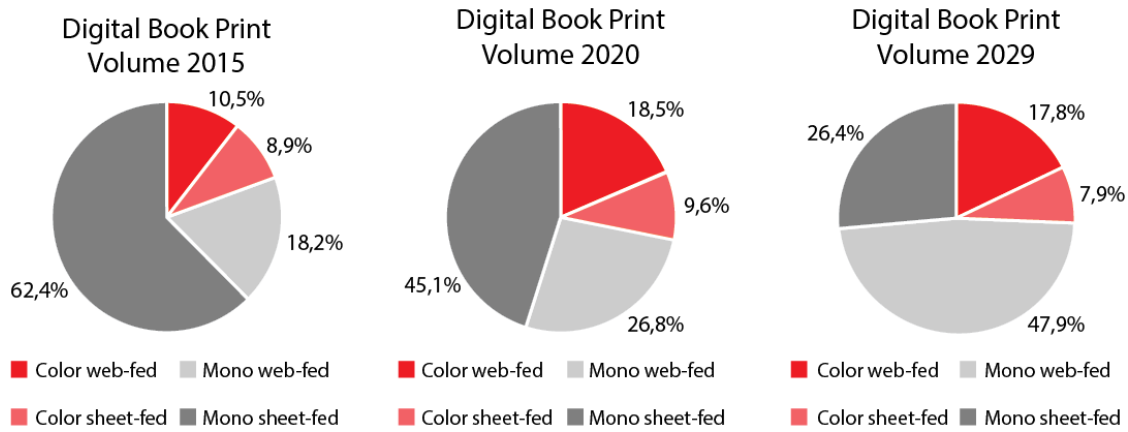
Figure 4.6: Market Shares Digital Printing Applications of the Total Digital Book Print Volume (Caslon, 2015)

4.3.5 Book Print Categories

The digital transformation does not just change the distribution of book print volume over printing technologies, but also the distribution over book categories. To understand the ramifications one must look at the book categories that are currently printed. This section covers the changing market shares of book categories in the relevant book print markets. For definitions of the book categories see Appendix E.

Combined Offset- and Digital Book Print Market Book Categories
As shown in Figure 4.7, the three largest book print categories in 2015 were: trade books, TSP books, and education books. Trade books include, among others, children-, fiction-, and non-fiction books, TSP books include technical-, scientific-, and professional books, and education books include higher- and lower education books. The remaining category; 'other', incorporates all remaining book categories (e.g. religious books and coffee table books, etc.) and only accounts for a small percentage of the total book print volume.

NA Book Print Volume 2015
- 6,5%
- 19,6%
- 7,9%
- 66,0%
- ■ Trade ■ TSP
- ■ Education ■ Other

WE Book Print Volume 2015
- 7,9%
- 16,7%
- 9,9%
- 65,5%
- ■ Trade ■ TSP
- ■ Education ■ Other
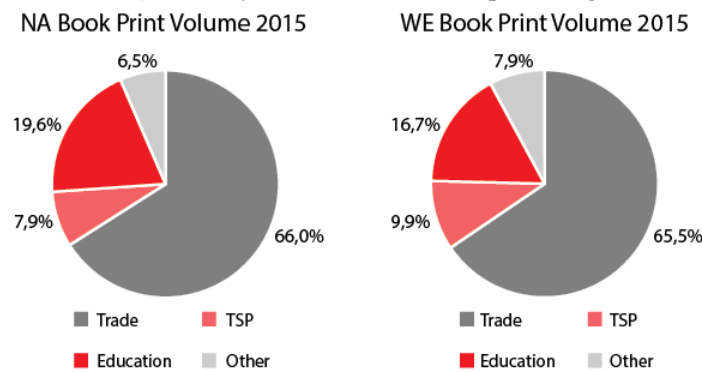
Figure 4.7: Book Categories' Market Shares in WE and NA in 2015 (Interquest, 2015, 2016a)

Digital Book Print Market Book Categories
As shown in Figure 4.8 on the next page, in 2015 the three largest digital book print categories were trade books, TSP books, and education books. The market share for the education book category is larger in NA, than in WE. This is remarkable, but probably related to the origin and presence of several of the largest educational publishing firms in the world, which are American and sell their English education books around the world, including in WE.

When comparing Figure 4.7 & 4.8 one notices significant differences in the market shares of certain book categories. Digital book printing is percentagewise more used for printing education- and TSP books, while offset printing is used more for printing trade books. Overall, it seems that the trade book category is not printed digitally much. One finds its reason when one looks at the trade book volume that is printed

digitally. Most of this consists of backlist- and self-published books, both of which are printed on demand. Recently published book titles (i.e. frontlist books), and children books are hardly ever printed digitally.

Figure 4.8: Digitally Printed Book Categories' Market Shares in WE, NA, and the NL in 2015 (Interquest, 2015, 2016a, 2016b)

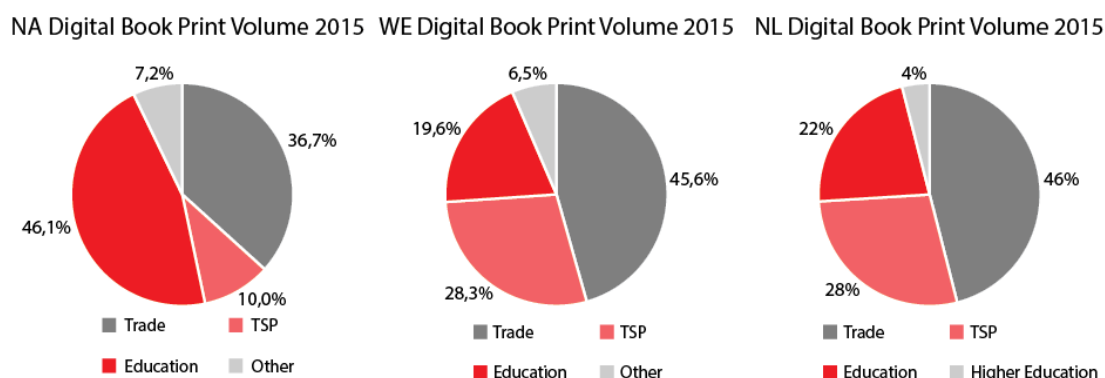The broad definition of the trade book category still makes it the largest digital book print category in the NL and in WE, and the second largest in NA. However, this provides a distorted image of reality as book categories that are usually associated with the trade book category; (frontlist) literary books, fictional novels, children books, etc., are hardly ever printed digitally. This is affirmed by a Business Developer at Printforce; a digital print provider: *"We are mainly active in the scientific market, those are our biggest customers. Furthermore, we print a lot for self-publishers. And slowly some growth is visible in the trade segment."* And by the Technical Director of Digiforce, another digital print provider: *"Our client portfolio consists for 95% of schools, higher education institutions, educational publishers, professional training companies, and self-publishers."* To illustrate that frontlist trade books are being printed in the NL, and not outsourced entirely to other countries, the CEO of Wilco; the largest Dutch offset print provider stated: *"For us the professional/ scientific market is 30% of our revenues, the literary (trade) market is 30%, the educational market is 30%, and 10% is print work such as annual reports etc."*

4.3.6 Consequences for the Future of the Digital Book Print Market

Defining which book categories are printed digitally is relevant in light of the future. To recap, the digital transformation will start with the digitization of books aimed at transferring content (i.e. technical-, scientific-, professional-, and educational books), while books aimed at providing an experience (i.e. literary, fictional-, and children books) will remain longer in print. Therefore, book categories in which digital printing is established (i.e. education, TSP), apart from backlist trade books and self-published books, are expected to rapidly transition to a hybrid mix of digitally published- and paper books. While book categories in which digital book printing is marginal (i.e. frontlist trade, children) are likely to stay in print the longest.

Thus, the ramifications of the digital transformation of the book publishing industry are that the near future looks bright for digital book printing as print volumes will grow, but the long term future is not necessarily so bright. Some firms recognize this, for instance, the Technical Director of Digiforce stated: *"The owners of Digiforce participate in several small companies which focus on publishing in an e-learning environment, e-publishing, hybrid publishing, because they still want to make a living in five years. Book printing is now a growing market, however whether it will be in five years is the question."* This sentiment is shared by a Business Developer at Printforce: *"Innovations in digital inkjet printing are all incremental innovations. After some time digital print will take some market share from offset print. This will come from more scientific books, self-publishing, and international volume. The trade segment a little, this will come slowly, but that will take longer. Perhaps in full colour. In the meantime a disruptive innovation might crush inkjet."* The CEO of Mybestseller & Sweek was even clearer: *"In time digital print press manufacturers will go bankrupt, because the market is going digital. That is in the long term; I think it might take longer than 40 years still. However, Océ should start thinking about other applications, because there is little perspective in book printing in the long term."*

Nevertheless, in the meantime there are valuable opportunities to be captured. The digital transformation leads to a different mix of remaining print volume, some of which is rarely printed digitally. Thereby, each

book category has different requirements with regard to quality, paper substrates, finishing, and sometimes even requiring a unique supply chain. As such, the valuable opportunity is that of becoming the first digital print press manufacturer to develop a digital print press with features and capabilities that are tailored to printing the remaining book categories. In that way Océ, can, through product development initiatives, create and capture value, and remain an important market player within the digital book print market.

4.4 Problem Statement & Research Questions

The goal of this step was to institute whether the doubtful situation is problematic, and to identify and frame the problem to define what is attended to in the inquiry. This required meandering between observing the doubtful situation in practice, and building theories needed to guide the observations. The question guiding the initial analysis was: *How does the digital transformation of the book publishing industry impact the book print market, digital print press manufacturers, such as Océ, and the future of (digital) book printing?*

The digital book print market and Océ are indeed impacted by the digital transformation of the book publishing industry. This presents several opportunities for value creation and appropriation. However, some aspects of the doubtful situation can also be classified as problematic. As such, the problem can now be instituted and framed in a meaningful, focused way, culminating in the following problem statement:

In the short term the digital transformation of the book publishing industry alters the mix of book categories that will be printed, how book print volume will be divided over printing technologies, and the requirements that digital print presses have to meet, while in the long term it threatens the existence of the (digital) book print market.

To capture the opportunities and solve the problem, research questions were formulated that clearly delimit what will and what will not be attended to in this inquiry. The main research question of this study is:

How can Océ create and appropriate value, and attain a competitive advantage in the declining book publishing industry where competing printing technologies vie for market dominance?

The main research question guides this study's inquiry, along with the following sub-questions:
- *How can firms create and appropriate value, and attain a competitive advantage?*
- *How does the declining book publishing industry, and the challenges related to achieving technology substitution and –adoption, influence ways in which value can be created and appropriated?*
- *In what way will the requirements that digital book print presses will have to meet change in the future as a result of the digital transformation of the book publishing industry?*
- *How are factors and actors in the doubtful situation related, and how do these influence the (re)design of the situation?*

The problem and research questions focus on the book publishing industry. Therefore, this inquiry is delimited to include actors operating in that industry. However, since it was easier to approach and gather data from Dutch firms, and since the NL is one of the leaders in digital book printing in terms of quality and quantity, this study focuses on the Dutch book publishing industry, its unique factors, and actors.

Answering the main research question involves designing competing solution designs for either a novel product or business model for Océ that, when implemented in practice, can potentially enact and change the doubtful situation into a unified situation. In a unified situation the problem is solved, or the factors in the situation altered to such an extent that the situation can no longer be classified as problematic. After reviewing the feasibility of the concept solution designs, one solution design is selected to be elaborated further using findings from practice and academic literature. Thereby, ending up with the most appropriate, actionable solution design, which can then be implemented and experimented with in practice.

Part 3

This part defines the design space by establishing how the factors, actors, and their relationships in the doubtful situation affect the problem, and how these influence what solutions can feasibly be implemented. Four competing solution design concepts are introduced, after which the most promising solution design is selected to be developed and improved.

5. Determination of a Problem-Solution

After having defined what and whom will be attended to in this inquiry, section 5.1 establishes how these actors and factors are relevant to the problem, and how they influence or determine the 'design space'. The design space refers to the set of possible future states of the product, process, or solution that is the design goal (Reymen et al., 2006). Thus, the design space specifies which solution designs are allowed or feasible. Then, section 5.2 connects the problem, through abduction, to possible solutions that can be implemented in practice, answer the research question, and potentially solve the problem. These solution designs are based on initial hypotheses or ideas that point to 'simple' but likely theories ahead of formulating a more detailed, comprehensive theory later. All four concept solution designs are presented in the form of a concept sketch, accompanied by a brief explanation elaborating on their reasoning. Finally, section 5.3 describes the selection process that resulted in the selection of one solution design to be developed and improved in consecutive steps of this inquiry.

5.1 The Design Space

The Dutch book publishing industry serves a small language region. In this region the average book print run length for new books is low; just 1,648 copies for frontlist books (Interquest, 2016b). Consequently, there is a high digital book print prevalence; 20% of the book print volume is printed digitally with an average run length of 213 copies (Interquest, 2016b). This makes the Dutch book publishing industry exceptional. As a result, some actors and factors are unique to the Dutch book publishing industry. Though it also shares some actors and factors with the global book publishing industry. For instance, the presence of generic actors, like those introduced in section 1.2, and the factors described in Chapter 4 related to the digitization of books, the available book printing technologies, and the book categories' dynamics.

This section describes all other factors and actors in the Dutch book publishing industry relevant to the problem and to the design space. In addition, the nature of the relationships that exist between actors is specified. For together the combination of factors, actors, and relationships between actors determine what can be designed, implemented, and changed in the initial doubtful situation. Since this study aims to create an implementable solution design that Océ can use to create and appropriate value through product development initiatives, only actors involved in the product interrelationships (i.e. book selection, creation, access, and aggregation) of the book publishing value network are considered. The part of Figure A.1 indicating these product interrelationships is shown in Figure 5.1.

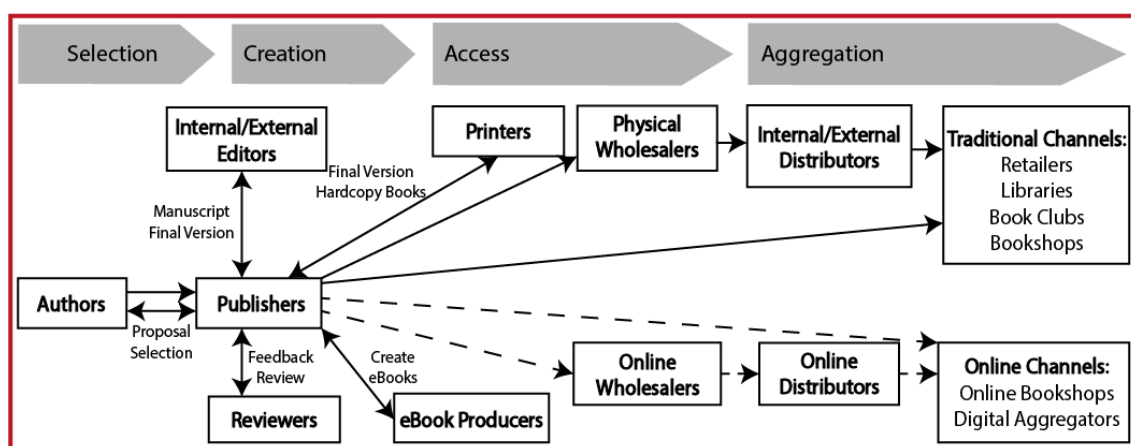*Figure 5.1: The Product Interrelationships of the Book Publishing Value Network (Tian & Martin, 2010).*

Not all actors shown in Figure 5.1 are relevant to the problem or to the design space, while other actors that are not included are extremely relevant to this inquiry. A list of actors active in the Dutch book publishing industry that are relevant to the problem and influence the design space is given by: authors,

(self-)publishers, digital & offset print providers, print press manufacturers, print finishing equipment manufacturers, distributors, online- and brick-and-mortar bookstores, and book buyers. Their roles and relationships, and how various relevant factors affect the actors and their relationships is described next.

5.1.1 Authors

An author's role is writing a manuscript and finding a way to have the manuscript published. An author can publish a manuscript in a variety of ways; as a printed book, an eBook, a PDF-file, a blog, an audio book, a DVD, a mobile file, etc. An author usually has a relationship just with a (self-)publisher. An author forms a partnership with a (self-)publisher to be able to reach a broad audience for the book. An author does not pay for publishing at a traditional publisher, although self-publishers sometimes charge a small fee. After publication the author's role is to be a marketing ambassador for the book.

5.1.2 Publishers and Self-publishers

The role of a publisher is to determine which manuscripts are worthy of publication, to invest in and improve the manuscripts, to select a print provider to manufacture the books, and to market and sell the books to individual book buyers and sales channels. The publisher traditionally performs the most extensive range of activities of all actors within the industry, and therefore, wields most power. However, that power is waning. Due to the advent of online publishing and digital printing it is no longer the unique competency of a publisher to select, manufacture, and find an audience for a book. Manuscripts deemed 'not good enough' by publishers can now find their way to book readers in a multitude of ways, enabled by digital publishing and by cost-efficient production in very small volumes using digital book printing technology.

Many publishers have been slow to adjust to this change in industry dynamics. From the opportunity this presented self-publishers have sprouted; a term which can refer to authors who publish books themselves, or to self-publishing firms that assist authors in book production, and -distribution. The latter definition is referred to in this document. As opposed to publishers, self-publishers do not make judgements with regard to the quality of a manuscript, thereby eliminating the selection process. They are just production houses assisting in book production and distribution. Thus, the range of activities, as well as the extent to which these are performed by publishers, is much more extensive. This explains the focus of traditional publishers on offset printing and self-publishers' focus on digital printing. Publishers try to only publish high-quality books that sell in large volumes. Printing and selling large numbers of books is a necessity to break-even and to start turning a profit. Its manuscript selection-, improvement-, and marketing activities are of utmost importance to realize this. Meanwhile, self-publishers use digital printing to produce as many book titles as possible, conduct no selection activities, and only minimally invest in manuscript improvement. Therefore, they require only few sales to break-even. When a digitally printed book does sell in larger volumes this would result in a lower profit margin for a self-publisher due to the higher average unit costs for books printed digitally in higher volumes. As such, publishers only sell the 'needle in a haystack'-books, whereas self-publishers sell the entire haystack and hope that several books sell in significant volumes.

In conclusion, the role of publishers and self-publishers is to be an author talent scout, to partner with, and assist authors in bringing their ideas, story, or message to a broad audience. This does not necessarily entail the dissemination of those ideas in a printed book form. In order to realize this publishers maintain relationships with authors, digital- and offset print providers, distributors, online- and brick-and-mortar bookstores, and book buyers. In a sense the publishers are the quality guarantor of the book publishing industry, influencing both the supply (i.e. which books are published) and the demand (i.e. which books are incorporated in the collection of the sales channels and libraries).

5.1.3 Offset- and Digital Print Providers

The role of offset- and digital print providers is to print books as ordered by publishers, self-publishers, organizations, or individuals while adhering to the contract-specified format, paper substrate, delivery time, and quality, for an agreed upon price. Usually print providers also conduct finishing activities in a separate

bindery section of the factory floor. However, these activities can also be conducted in-line in a complete end-to-end book production solution, or outsourced to a third-party book bindery.

The differences between offset- and digital book printing are covered extensively in Appendix D. Moreover, offset- and digital print providers also assume different roles. Digital print providers typically assume the enabling role of production house for print volume, employing mostly low-skilled operators, focusing on efficiency and cost reduction. In contrast, offset print providers tend to assume the role of a value-adding specialist print provider, employing skilled craftsmen, focusing on producing high-quality for competitive prices. Generally, an offset print provider would take a more active role in the design and creation of a book, to ensure that it matches the purpose of the manuscript. Another difference is related to their average yearly book print volumes. Four of the largest digital print providers in the NL; Printforce, Scanlaser, Digiforce, and Joint Book Services (i.e. CB Logistics) each print between 500,000 and 3,200,000 books per year. While the largest offset print provider Wilco prints roughly 60,000,000 books per year.

As more offset book print volume migrates towards digital printing the market for offset printing becomes smaller. This creates overcapacity at the offset print providers, who will have to take contracts below cost price, leading to insolvency and bankruptcy. Therefore, in the future more (smaller) offset print providers are expected go out of business and exit the market. Meanwhile, both print provider types maintain relationships with book distributors and book buyers. Additionally, they form relationships with print press manufacturers and finishing equipment manufacturers to acquire, and maintain their production factors.

5.1.4 Offset- and Digital Print Press Manufacturers

Offset- and digital print press manufacturers are not directly involved in the book publishing industry supply chain, but they are in the industry value network in their role of technology suppliers of book print presses. A key difference between the two is that the origins of digital print press manufacturers is found in other industries, and that the (partial) switch to book printing is recent. Offset print press manufacturers have a long history in the industry, and as such, have fostered quite a reputation and a lot more legitimacy in the industry. To some extent this explains the difference in customer bases. The customers of offset print press manufacturers are mostly older, larger print providers who have always used offset printing. While the customers of digital print press manufacturers are mostly newer, smaller print providers who have always printed digitally. Although a trend is becoming apparent indicating that some offset print providers are transitioning to digital printing, while others are looking to complement their offset print presses with digital print presses. As more book print volume migrates towards digital printing the market for offset print presses becomes smaller. Therefore, some offset print press manufacturers started diversifying and developing digital print presses, often in partnership with a digital print press manufacturer.

To supply their technology print press manufacturers maintain close relationships with print providers. These can opt to purchase a print press or lease it for a periodical fee. However, print press manufacturers' main source of income originates from the 'click price' (a price paid by print providers per 1,000 printed sheets), consumables like ink or toner, and maintenance costs. The extent to which digital- and offset print press manufacturers form relationships with finishing equipment manufacturers differs. Generally, offset print press manufacturers maintain closer relationships, than digital print press manufacturers. This can partly be explained by the difference in markets in which the clients of each print press manufacturer are primarily involved. Digital print providers produce books for markets where the finishing requirements are lower, than in the markets where offset print providers focus on. As such, the way finishing equipment can be adapted to the offset print press is a customer decision criterion for offset print providers looking to buy a new offset printing press. For digital print providers this aspect has been less of an issue, although it is becoming increasingly important. Therefore, the relationships between digital print press manufacturers and finishing equipment manufacturers are less extensive. Some relationships are also forming between offset- and digital print press manufacturers to learn from each other and to get access to new markets.

5.1.5 Finishing Equipment Manufacturers

The role of finishing equipment manufacturers is to supply book finishing technology to print providers. There are many finishing activities types, referring to all activities performed after printing a book's content (see Appendix D). However, most firms specialize in machines that conduct just one or two activities, leading to a large array of finishing equipment manufacturers. Finishing is vital as without finishing activities a book would just be a stack of loose, printed papers (i.e. a book block); an unsellable product. Furthermore, the quality of book finishing will become more important in the future (see section 4.2.2). In the future remaining book print volume will be dominated by book categories aimed at providing an experience. For these categories, which are mostly bought in brick-and-mortar bookstores, often as a present, and/or on an impulse, the look and feel of a book is the most important purchase decision criterion. To quote the CEO of the offset print provider Wilco: *"A book is for 70% its cover and for 30% its content."* As such, the quality of finishing activities, especially hardcover bookbinding, will increasingly determine a book's success.

Finishing equipment manufacturers form relationships with both types of print providers. Some finishing equipment manufacturers only develop machines to be used for either offset- or digital book finishing, but most develop machines that can be used in conjunction with both printing technologies. As such, finishing equipment manufacturers form relationships with both offset- and digital print press manufacturers.

5.1.6 Book Distributors

The role of book distributors is transporting books from print providers to sales channels or directly to book buyers. Although in the NL some books are sent directly to the end customer using third party package delivery firms like PostNL, UPS, and GLS, most books (> 90% of book print volume) are handled, stored, and shipped by a single firm: CB Logistics. Whereas the majority of digitally printed books are shipped directly to book buyers, the majority of offset printed books are handled by CB Logistics. CB logistics provides logistical services through its extensive distribution network, operating from a central point in the NL. It collects books at print providers, and then ships them to its warehouse and distribution centre in Culemborg. Here nearly all offset printed books destined for the Dutch book market are stored, with exception of the stock of a few publishers and channels who use their own warehouses. While books are stored they remain owned by the publishers who make all decisions with regard to if and for how long they want to keep stock at CB Logistics. From Culemborg books are shipped daily to most Dutch bookstores. All bookstores can select from the full range of book titles offered by CB Logistics (i.e. 80,000 book titles). Besides warehousing and distribution CB Logistics also facilitates data analytics for publishers and bookstores, ISBN registration for newly published books, and POD at its Joint Book Services print facility (JBS is a joint venture of CB Logistics, Printforce, and Océ) for books with low annual sales. For instance, backlist trade books and self-published books, or books for which there is a sudden demand peak.

CB Logistics is an influential firm due to its monopolist-like role of book distributor for brick-and-mortar bookstores and offset printed books. This makes it difficult to establish digital book printing as a truly competitive alternative to offset printing. For digitally printed books do not necessarily require CB Logistics' distribution network. Furthermore, as these are never produced to stock CB Logistics cannot turn a profit from warehousing. Matters are complicated further by its ownership structure. CB Logistics, formerly known as Centraal Boekhuis, is for 50% owned by all Dutch publishers, and for 50% by all Dutch bookstores. In essence it is a branch organization serving the interests of publishers and bookstores. In that light it is remarkable that the 2012 name change was not just a formality, instead constituting a shift in focus from solely distributing books to also distributing media, fashion, and healthcare. This study regards this strategic shift as indicative of how CB Logistics regards the future of book printing in the NL.

CB Logistics maintains relationships with (self-)publishers, print providers, digital print press manufacturers, finishing equipment manufacturers, and online- and brick-and-mortar stores. The relationships with publishers and bookstores are especially close.

5.1.7 Online- and Brick-and-Mortar Bookstores

The role of online- and brick-and-mortar bookstores is to sell books to book buyers. In the past brick-and-mortar bookstores and libraries were the dominant channels where readers would acquire books. Now online channels are becoming more dominant, although books are still predominantly sold in brick-and-mortar stores. Furthermore, books sold 'offline' are increasingly sold in non-dedicated bookstores, such as supermarkets, department stores, or gas stations. This is referred to as 'branchevervaging'; a Dutch word for the blurring of book selling branch boundaries. As a result many dedicated brick-and-mortar bookstores have gone bankrupt. The reduction of their numbers and market share is expected to remain a trend.

Brick-and-mortar bookstores have started to view their role more as to provide a joyful experience to their customers. Where they used to distinguish themselves from competitors by offering broad book collections, combined with an unparalleled amount of book knowledge, nowadays they find it hard to compete on these aspects. Any online bookstore can pay for a connection with CB Logistics and immediately offer 80,000 book titles, most of which are home-delivered within 24 hours. While a brick-and-mortar store, due to its limited space, can only offer a smaller book collection at any time. Although brick-and-mortar stores can use the same service and have a book home-delivered within 24 hours, often book buyers who are told that a book is out-of-stock forego purchasing the book at the brick-and-mortar store, and instead order it online at one of the larger online bookstores. Additionally, when book buyers search for information on books the go-to medium is increasingly the internet, instead of the salespeople in the brick-and-mortar bookstores. Therefore, many brick-and-mortar bookstores are trying to reinvent themselves by focusing on providing a joyful experience to their customers by offering additional services that complement book selling, such as book readings, pubquizzes, workshops, and in-house coffee corners. A process that the CEO of Managementboek.nl cynically referred to as: *"a sort of last convulsive throe to try to bring people into your bookstore"*.

Meanwhile, the market share of online bookstores grows rapidly. The online market, dominated by a few larger firms, is characterized by firms who maintain an extremely wide range of frontlist and backlist book titles, and who try to distinguish themselves by offering reliable and efficient direct availability. This direct availability, which in the NL refers to (approximately) 24 hour delivery ('Order today, and receive your order the next day'), can be achieved partly because of the existence of CB Logistics, and partly because digital printing enables direct availability at relatively low costs. Online bookstores compete with each other on brand reputation, site functionality, and reliability as they all offer the same book collections using the same distribution channels. Price is neither for brick-and-mortar bookstores nor online bookstores a useful tool to compete for clientele, because of the Dutch fixed book price law that applies to all Dutch printed books. It states that a publisher must set a price for a book, and that no bookstore can sell that book for less. It is intended to promote the availability of a diverse range of books by eliminating price competition.

Virtually all books sold by offline bookstores, and to a lesser extent by online bookstores, are offset printed. Due to a combination of reasons it remains a challenge to integrate digitally printed books in the industry supply chain. Firstly, publishers in the trade book segment, the largest market segment sold by offline bookstores, almost never use digital printing for books that sell more than 300 copies per year, which is nearly all they publish. Secondly, bookstores order most books from CB Logistics, which prefers to handle offset printed books. The necessity for CB Logistics to use digital printing to accommodate sudden peaks in demand is not encountered often, because it aggregates the demand for all books in the NL, and it can forecast this demand accurately using its database of detailed sales trend information. Thirdly, books kept as inventory in offline bookstores do not have to be paid for by bookstores before they are sold. They remain property of a publisher until sold and can even be returned. As such, brick-and-mortar bookstores keep offset printed book stock risk-free without investments. This in contrast to digitally printed book stock, which must be paid for before production and shipment. As a result, digitally printed books are not sold in brick-and-mortar bookstores, except for some backorders delivered on demand by CB Logistics.

Brick-and mortar bookstores form relationships with authors, publishers, book distributors, and book buyers. Online bookstores too, but also deal with self-publishers to be able to offer their books, and with digital print providers to print those books on demand.

5.1.8 Book Buyers

A book buyer's role is simply to buy books. A book buyer can be an individual, but also a club, government, firm, educational institution, etc. A book buyer can get access to a book by buying it in an online- or brick-and-mortar bookstore, directly from a self-publisher, by lending it in a library, etc. Although people of all races, ages, genders, and affiliations read books, the groups that read and buy most books tends to adhere to certain demographics. Pew Research Center (2016) found that in the US the groups that read most books are young adult women (age 18–29), people with higher levels of education and incomes, and Caucasians. The Director of the brick-and-mortar bookstore Van Piere in Eindhoven stated with regard to its typical customers that: *"In principle we serve everybody, however, you do see that a large percentage of our customers tend to come from certain neighbourhoods where more highly-educated people with higher incomes live"*.

Individual book buyers form relationships with online- and brick-and-mortar bookstores, and sometimes with (self-)publishers. Organizational book buyers do too, but occasionally also publish themselves and therefore, form relationships with offset- or digital book print providers to realize book production.

5.2 Concept Solution Designs

The previous section illustrated how the actors, factors, and relationships between actors in the industry affect the design space. The next section presents four competing concept solution designs that can be positioned within that design space. These can, when implemented in practice, potentially solve part of the problem, while allowing Océ to create and appropriate value within the book publishing industry. They were conceived while gathering data, improved and refined using new data, and feedback received from Océ practitioners. In this way the solution designs evolved from simple abstract ideas to concept solution designs. At feedback meetings practitioners were given an impression of the solution designs using concept sketches, and short descriptions of the components and reasoning of each solution design, thereby facilitating a reflective design conversation. The same structure is adhered to in this section.

5.2.1 Concept Solution Design 1: POD Workflow Automation

Concept solution design 1, shown in Figure 5.2, is referred to as a POD workflow automation. The to-be-developed software couples the PRISMA software of an Océ print press with the inventory management software housed within the Enterprise Resource Planning (ERP) system of a sales channel. To realize the software coupling Océ would need to partner with one or several larger ERP systems developers (e.g. Microsoft Dynamics, Oracle, SAP, etc.). This solution would enable that as soon as an out-of-stock book is sold in a brick-and-mortar bookstore, an online bookstore, or on a publisher's website, then an order for the book is immediately placed at a preferred digital print provider, and the book's data file automatically added to the digital queue of the print press, without the need for any manual inputs by the sales channel or the digital print provider. Subsequently, the book is printed digitally, finished, and shipped just in time (JIT) via one of the standard distribution channels to either the sales channel or directly to the book buyer.

POD orders arise a lot more frequently and haphazardly, than orders for books printed in longer print runs. As such, sequencing POD jobs on a digital print press requires evaluating all incoming orders, their magnitude and urgency, at least daily, but preferable on a continuous basis as demand accumulates throughout a day. This solution design automates this process by automatically processing orders, and auto-sequencing them on a digital print press. As such, this solution design is tailored to facilitating printing books on demand, which is becoming more popular. One reason for this popularity is that sales channels, and especially online bookstores, are trying to cut their inventory costs to a minimum. Online bookstores do not need inventory if books can be printed on demand and delivered to a book buyer within the industry-imposed delivery times. Brick-and-mortar stores could also benefit from POD, although to a lesser extent.
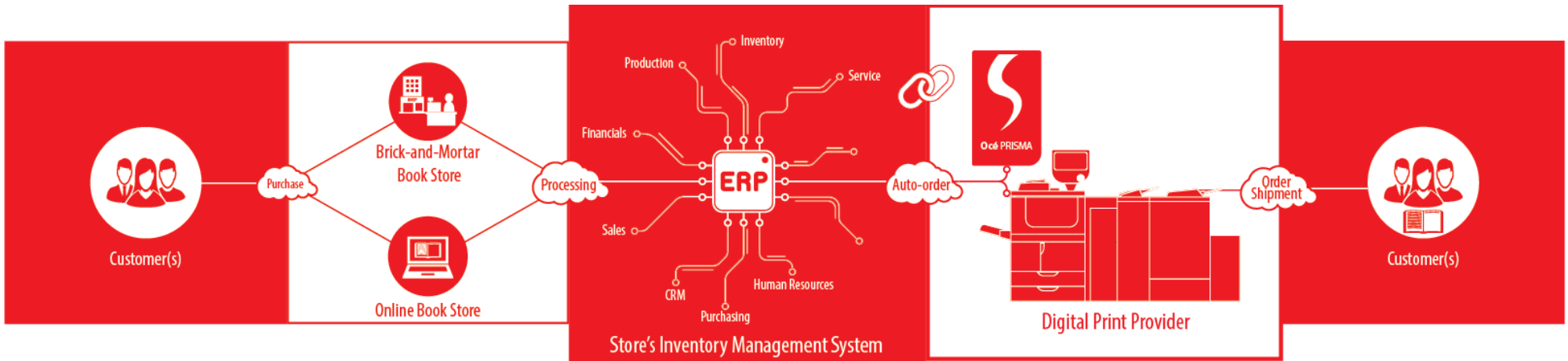
Figure 5.2: Solution Design 1; POD Workflow Automation

Their current reluctance arises from the fear that an out-of-stock situation does not lead to a backorder, but instead to a lost sale. This mechanism will likely become less self-evident in the future, as in other industries one sees that brick-and-mortar stores are slowly transitioning towards places where customers browse and order, but where the order is then home-delivered or picked up at a store/warehouse/pickup-point at a later time. Therefore, where automated book POD is already beneficial to online bookstores, in the future it is likely to become beneficial as well for brick-and-mortar bookstores.

Implementing this solution design reduces the sales channels' inventory costs, accommodates JIT inventory management, and reduces time and resources that digital print providers spend on sequencing POD book print jobs on their digital print presses. As the first print press manufacturer to develop and implement this software innovation Océ would create value for its customers (i.e. digital print providers), and for the customers of its customers (i.e. sales channels) in a way that is currently unmatched by any competing print press manufacturer. It would make the software coupling a Unique Selling Proposition, and Océ a driver in streamlining the digital book print industry supply chain. The improved value proposition will lead to more value appropriation through the expected increase in Océ print press sales.

5.2.2 Concept Solution Design 2: Extensive Printing- and Distribution Network

Concept solution design 2, shown in Figure 5.3, entails the creation of an extensive printing- and distribution network. This includes opening several digital printing facilities and distribution centres in a geographically dispersed area, encompassing either the entire world, or regions that use digital book printing technology to a larger extent (e.g. WE, NA, and South-East Asia). As a print press manufacturer Océ prefers to avoid direct competition with its customers. Therefore, to implement this solution Océ would need to implement this solution in a joint venture with a large, established digital print provider, who already has built quite a (preferably global) reputation. The tasks could then be divided as follows: a large(r) digital print provider, for instance, Printforce or Scanlaser, would conduct the marketing and sales activities, and manage the printing facilities, while Océ would supply the technology for the printing facilities. The marketing and sales activities would be (mainly) managed from one central place in the world (indicated in Figure 5.3 by the high-rise office building), attaining orders from customers around the world (indicated by a person). These book print jobs would then be distributed to a printing facility (indicated by a house with a printer) located geographically closest to the end customer (indicated by the dotted grey line). There the book is digitally printed locally, finished, and then distributed to the end customer (indicated by a white arrow).
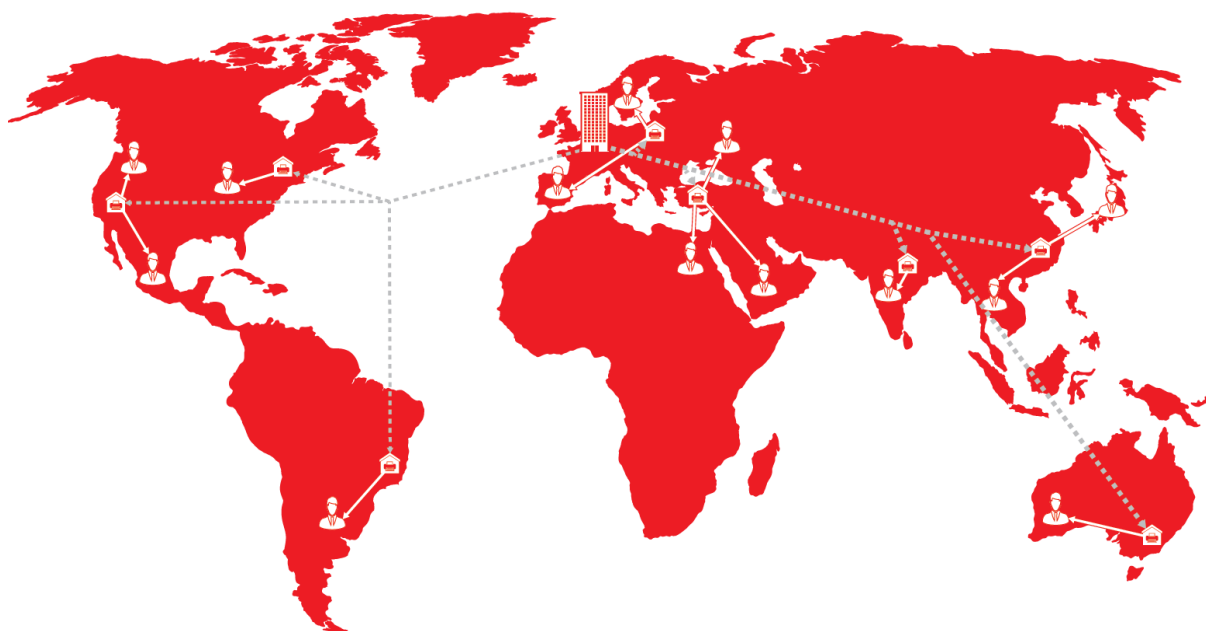

Figure 5.3: Solution Design 2; Extensive Printing- and Distribution Network

Essentially, this is a distribute-and-print model (see section 4.3.3), which is becoming more prevalent in the global book publishing industry. It potentially saves shipping costs, as books are no longer printed in one place and then distributed around the world via plane. Although for some regions international distribution via plane is still cheaper than local delivery overland. For instance, Scanlaser's CEO stated: *"It is not a lot more expensive to fly one book from Amsterdam to New York, than to send one book in an envelope overland from Houston to New York."* Books produced in a distribute-and-print model are also delivered in shorter lead times in regions where local shipping is faster than international shipping. So, an extensive printing- and distribution network potentially saves costs and time, but its advantages might be marginal. A decisive factor is the quality of the books. Since Dutch print providers are global frontrunners in producing high-quality digitally printed books, they are excellent candidates for the joint implementation of this solution. Their expertise and Océ's technology is required to consistently produce high-quality books in facilities around the world.

Thus, the goal of the global printing- and distribution network is to provide uniform, high-quality, digitally printed books to customers across the world. Currently there is only one monopolist-like firm that offers a similar book printing- and distribution network: Ingram Lightning Source. Due to its market position currently being unchallenged, it is able to charge high prices for its products and services. An effective competing printing- and distribution network, charging slightly lower prices, may capture significant book print volume and market share from Ingram. In that way the creation of value for global book buyers leads to more book print volume for the digital print provider. Also, to value appropriation for the digital print provider and for Océ; as the more book print volume is printed on Océ print presses, the more Océ earns.

5.2.3 Concept Solution Design 3: Low-end Sheet-fed Inkjet POD Print press

Concept solution design 3, shown in Figure 5.4, entails the development of an innovative product; a low-end sheet-fed digital inkjet POD print press. This print press can cost-effectively be used by sales channels and (self-)publishers to print their own books on demand. Most print presses require high monthly book print volumes to be utilized cost-effectively. Just a few firms are large enough to even be considered a potential customer for Océ. As a result, apart from the largest multinationals, all those firms outsource their print work to digital print providers. They would no longer have to after implementation of this solution.
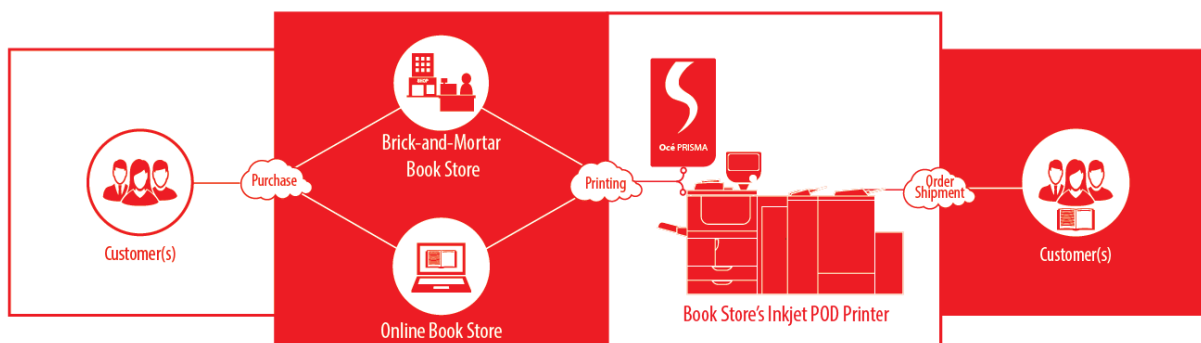
Figure 5.4: Solution Design 3; Low-end Sheet-fed Inkjet POD Print press

Digital printing does not require a highly skilled labour force. A firm new to digital book printing would not encounter high obstacles in acquiring the skills and capabilities to print its own books. The main hurdle is that there are few affordable alternatives to outsourcing book printing for firms with insufficient monthly volume to warrant purchasing a digital print press. There is one start-up firm; On Demand Books (ODB) that produces a print press that is used for low-volume POD, but it has not become a success. Currently only 67 of their Espresso Book Machines (EBMs) are installed globally, mostly at brick-and-mortar stores, libraries, and university bookstores (Interquest, 2016a). The EBM suffers from technical problems, such as leaking inkjets, malfunctioning sensors, operating difficulties in some climates, bad metadata, and glue stench issues. However, its main issue is with its limited content; many publishers do not allow third parties to print their books, banning EBM owners from doing so. Therefore, the EBM remains more a novelty, than a serious competitor to print presses offered by established digital print press manufacturers.

Despite EBM's failure to capture substantial market share, many (self-)publishers and sales channels retain the dream of printing their own books. This is exemplified in the quote from a manager at Boekscout; a POD self-publishing firm: *"The nicest thing would be if a publisher would no longer be an intermediate between the author and the print provider, but that we have our own print press and that we control that aspect as well. That you no longer have to pay a margin to the print provider."* This solution aims to fulfil that wish through the development of a low-priced digital print press with easy-to-use software. For it to be low-priced it will produce books of medium quality, rather than books of high quality. Therefore, it would probably appeal most to firms who predominantly make use of digital printing, and who value fast delivery speed and a higher margin over delivering the highest quality. Thus, it should be aimed at self-publishing firms or at sales channels with a self-publishing label. These firms own all the rights to the content, so then there will be no content issues like with the EBM. Furthermore, the chance that the print press will suffer from technical issues to a similar degree as the EBM is small, because of much more knowhow and expertise at Océ.

Thus, for self-publishers and sales channels this solution creates value as they are able to capture a higher margin from book sales. For Océ it is a valuable opportunity as it can lead to more print press sales, to new customers, and to higher variable earnings as print presses with lower monthly volumes can be charged higher click prices than print presses that run higher average monthly volumes.

5.2.4 Concept Solution Design 4: Strategic Alliance with Finishing Equipment Manufacturers

Concept solution design 4, shown in Figure 5.5, entails a strategic alliance with one or several book finishing equipment manufacturers. In the production of a book a digital print press is used in conjunction with various types of book finishing equipment. The printing- and finishing processes are mostly regarded as individual and separate processes, especially since most print providers use off-line finishing; separating the finishing equipment completely from a print press. However, there is a high complementarity between the two production factors, which means that the two yield superior value in combination (Teece, 1986). Or as a Product Manager at Müller-Martini, a finishing equipment manufacturer, put it: *"The mutually adapted potential of a digital print press and the finishing equipment is higher than the sum of its parts."* Currently the two production factors are often sub-optimized in the sense that the functionalities and limitations of a print press do not match with those of the finishing equipment. This leads to lower benefits, and to unnecessary delays, costs, and waste. According to Interquest (2016b), the quality of finishing/binding is the leading barrier for digital book printing. This solution aims to rectify that by increasing the complementarity and the combined potential of Océ's digital book print presses and finishing equipment.

Figure 5.5 describes four alliance maturity levels at which the strategic alliance can be conducted. As the preferred degree of collaboration was not yet defined, all of these were considered potential alliance maturity levels. At level 0 Océ just maps the landscape of book finishing equipment manufacturers. This means researching what kind of finishing equipment manufacturers exist, which ones are used in conjunction with Océ's print presses, their sales volumes, level of expertise, openness towards collaboration, etc. Regardless of the preferred alliance level, this precedes collaborating on any higher level.

At level 1 Océ conducts a sales collaboration with one or several book finishing equipment manufacturers, preferably with those whose machines are most commonly used in combination with Océ's print presses. This sales collaboration could entail the regular exchange of information with regard to customers' needs, preferences, and leads. It could also entail bundling products in one offering, so that customers are offered the entire book application, instead of just one facet in the book production process.

At level 2 Océ conducts an R&D collaboration with a book finishing equipment manufacturer. The goal of this collaboration is to separately develop machines that match in terms of functionalities and limitations, and which can communicate with each other. Thereby allowing the digital print provider to monitor the book production process at any stage, to efficiently sequence print jobs, and to match the right book block,

to the right book cover, at the right time, even for books printed on demand. If the two production factors are mutually adapted to each other like that, then they create superior value for digital print providers by reducing production and set-up times, reducing waste, and reducing the amount of manual inputs in the production process. As such, it would increase the book production workflow automation.
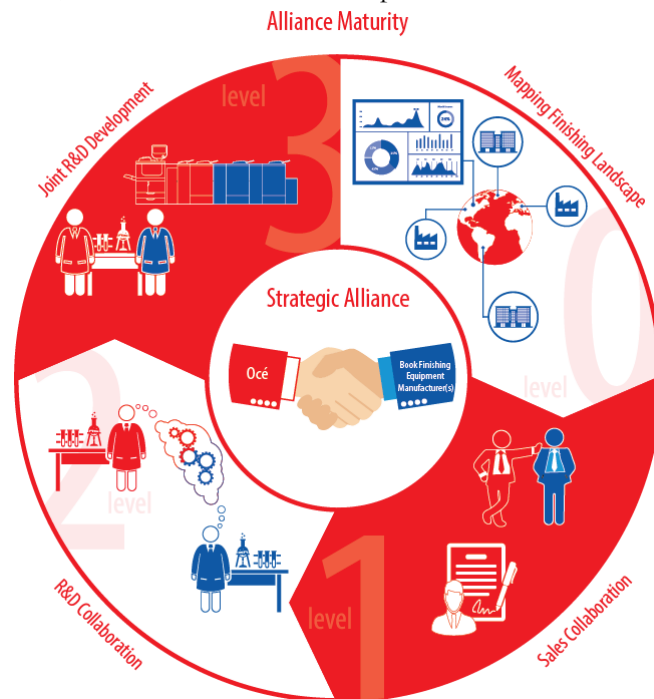
Figure 5.5: Solution Design 4; Strategic Alliance with Book Finishing Equipment Manufacturers

At level 3 Océ conducts a joint R&D development project in which one machine is developed that does both digital printing and finishing in-line. This would require such a high degree of collaboration that a joint venture might be more appropriate, than a strategic alliance. In-line finishing provides advantages, such as less paper handling, required personnel, and waste, and easier job handling. However, it also presents disadvantages, such as a reduction in finishing options, reliability issues, and less flexibility and productivity. Above all, it makes the digital print press much more expensive. Many print providers own existing off-line finishing equipment. As such, they are not likely to prefer a print press with in-line finishing.

Average book print run lengths are decreasing, POD is becoming more prevalent, and time-to-market is shortening, whilst the quality of book finishing is becoming more important due to the rapid digitization of some book categories. Therefore, no longer does just the stand-alone performance of a print press determine its success, but also the extent to which it can be integrated with finishing equipment, and the combined performance of the two production factors. This study ascertains that especially the integration with hardcover bookbinding machines will increasingly determine market success. The reason being that in the Dutch market a high-quality book is almost synonymous with a hardcover book.

This solution creates value for digital print providers as they would be able to purchase book production factors that are tailored to each other, enabling the efficient production of high-quality hardcover books on demand. This would raise the value propositions of Océ and the finishing partner, so that they are likely to sell more machines, handle more book print volume, thereby capturing more value.

5.3 Selecting a Solution Design

Although all four concept solution designs can be implemented by Océ to create and appropriate value in the book publishing industry, not all solve the problem to the same extent. Also, not all of them are equally feasible. In addition, it is impossible to develop and implement all solution designs concurrently. Therefore, a decision had to be made with regard to which concept solution design seemed most promising. This

choice was made after careful deliberation during a feedback meeting with Océ employees, based on how each solution design scored on several solution decision criteria. This section summarizes why concept solution design 4 was selected, and in which aspects the other solution designs fell short.

The solution decision criteria were formulated together with Océ practitioners, based on which criteria were subjectively perceived as most important. The first and most important solution decision criterion was the extent to which a solution design addresses and solves aspects of the problem as defined in section 4.4. A second solution decision criterion was the feasibility of solution implementation. The third and fourth solution decision criteria were respectively the impact of a solution design on profitability, and the required implementation costs. The remaining solution decision criteria were the risks, the degree of change involved, and the required implementation time of each solution design.

Table 5.1 indicates the scores of each concept solution design on the solution decision criteria. Scores are expressed as either a positive score; (++/+), a neutral score; (0), or negative score; (-/--). The sum of these scores multiplied by a criterion's importance determined which solution design was selected. The reasoning for allocating specific scores to solution decision criteria, as well as for assigning weighting factors to the solution decision criteria is elaborated upon in Appendix G.

Table 5.1: Solution Decision Criteria Scores for each Concept Solution Design

Solution Decision Criteria:	Importance	Concept Solution 1	Concept Solution 2	Concept Solution 3	Concept Solution 4
Problem-solving Capabilities	3	+	-	+	++
Impact on Profitability	3	0	++	+	++
Feasibility	2	-	++	0	++
Implementation Costs	2	0	+	--	-
Degree of Change Involved	2	+	++	-	0
Risks	1	-	+	-	0
Implementation Time	1	-	-	--	0
Total		+1	+13	-3	+14

* Importance: 1 = Low Importance, 2 = Medium Importance, 3 = High Importance

As shown in the last row, concept solution design 4: 'Conducting a strategic alliance with book finishing equipment manufacturers', scores highest. It is the only solution design deemed capable of solving parts of the problem, by incorporating elements that address several consequences of the digital transformation of the book publishing industry. Furthermore, it may transform digital book printing into a more attractive alternative to offset printing. Not only does it address the full extent of the problem, it does so in a way that appears quite feasible. Although the implementation will be quite costly requiring some change within the organization, it can be implemented quite fast, while the risks of implementation are shared with another firm. Finally, solution design implementation will have a significant positive impact on profitability.

Now the preferred concept solution design has been selected, the next chapter; Reasoning, discusses how findings from the literature study and from interviews with practitioners were used to make this concept solution design more detailed, complete, and tailored to the practice in which it is to be implemented.

Part 4

This part improves the reasoning of the selected solution design by comparing elements of the solution design to academic concepts and theories in order to make it more detailed and appropriate. Furthermore, it improves the solution design based on the remarks of practitioners to make it more actionable, so that it can be implemented and experimented with.

6. Reasoning

This chapter elaborates the concept solution design to evolve it in a more detailed, appropriate, and actionable solution design, which can be implemented and experimented with in practice. A literature study and a second round of interviews were conducted aimed at improving the reasoning of the solution design using findings from academic literature, and from actors operating in the book publishing industry.

The literature study was conducted concurrently with data gathering and -analysis in step four of the inquiry. Its purpose was to improve the reasoning of the theories and ideas of the solution design by exploring how these are related to, can be altered, and refined by academic theories. Section 6.1 describes its findings, and how these appertain to the unification of the doubtful situation, and to the aspects of the solution design. This chapter only discusses aspects related to the goals and methods of the solution design. Which specific activities must be conducted to attain the goals through the suggested methods is discussed in section 7.1.

The second round of interviews entailed four structured interviews with actors directly affected by solution design implementation (i.e. digital print providers and finishing equipment manufacturers). Its goal was to gather information from practice that can make the selected solution design more actionable, so that it can be implemented and experimented with. A secondary goal was to find out whether other actors are willing to support Océ in solution design implementation. The findings from this round of interviews, and their influence on the selected solution design is described in section 6.2.

6.1 Improving the Solution Design with Academic Theories

The literature study aimed to alter and improve the initially selected solution design, which was mostly based on observations in practice. Thereby ending up with a more detailed and appropriate solution design that is grounded in practice, but enhanced and shaped by academic theories. The next sections cover academic theories that were incorporated because of three reasons. The first set of academic theories in section 6.1.1 cover how theories of the firm view antecedents for, and ways to create and appropriate value, and to attain a competitive advantage. Parts of these theories of the firm are adopted in a 'strategic lens' through which perspective this study views the world. This is imperative as it provides a rationale for how the solution design creates and captures value, according to the adopted strategic lens. As such, it answers the first research sub-question: "*How can firms create and appropriate value, and attain a competitive advantage?*"

Section 6.1.2 discusses academic theories relating to factors that are of influence in the doubtful situation, and which therefore have a strong effect on designing a solution. For example, factors such as the current industry life cycle stage (i.e. decline stage), and the challenges relating to achieving technology substitution and -adoption when multiple printing technologies compete for market share. This section answers the second research sub-question: "*How does the declining book publishing industry and the challenges related to achieving technology substitution and –adoption influence ways in which value can be created and appropriated?*"

The final set of academic theories relate to specific aspects of the selected solution design, such as managing complementarity, business model innovation, and a strategic alliance. Therefore, section 6.1.3 is more directly related to improving individual aspects of the solution design, than the other sections. The other sections focus more on defining which aspects to incorporate in the solution design in the first place. Together the three sections form a bridge between the various academic theories and the solution design, indicating how the concept solution design should be altered and improved based on academic theories.

6.1.1 Strategic Lens

All theories of the firm hold merit as essentially these are complementing, rather than conflicting theories, advocating and stressing the importance of different elements of business strategy in pursuit of a competitive advantage. Depending on the context, any theory can be more applicable, and just using one would result in the understatement of one or several vital aspects of value creation and -appropriation (Amit & Zott, 2001).

In the context of this study: the solution design entails a strategic alliance with a complementary finishing equipment manufacturer. The goal of this strategic alliance is to implement a value-creating strategy through a combination of resources, that allows for value capturing, and which creates a competitive advantage that cannot be easily copied by rival print press manufacturers. In this context the theories of the firm that are most appropriate are the Resource Based View (RBV) (Barney, 1986, 1991; Wernerfelt, 1984), and the relational view (Dyer & Singh, 1998). As such, these theories of the firm are combined and adopted in this study's strategic lens.

The Resource Based View and the Relational View

The RBV and the relational view are quite similar in the way they regard a firm's ability to attain a (sustainable) competitive advantage. Both theories of the firm assume that a competitive advantage can be attained through the implementation of economic value-creating strategies that are not concurrently implemented by any current or potential competitor, thereby allowing for full value appropriation (Barney, 1991). Furthermore, they consider firms capable of attaining a sustainable competitive advantage provided that competing firms are unable to imitate or duplicate the benefits of a value-creating strategy (Barney, 1991).

The core of the value creation and –appropriation logic of the two theories is also similar. Both assume that a value-creating strategy, which can entail the introduction of an innovative task, product, or service; a new resource combination (Schumpeter, 1942), provides a sustainable competitive advantage as long as it is based on a resource or an endowment of resources that is valuable, rare, imperfectly imitable, and non-substitutable (Barney, 1991). Although the adopted strategic lens does assume that often in practice, like in the book publishing industry, due the dynamics of competitive markets, unforeseen industry structure changes (Barney, 1991), and the finite life of effective isolating mechanisms, a competitive advantage provides only a temporal advantage, instead of a sustainable advantage (Lepak et al., 2007).

A key difference between the two theories of the firm is that the RBV only considers in-house controlled resources that enable a firm to implement value-creating strategies as potential sources of competitive advantage (Wernerfelt, 1984). As such, the RBV neglects resources not controlled directly by a firm, as well as the possibility of attaining a competitive advantage through combining internal- and external resources in such a way that competitors are unable to copy the value-creating strategy (Dyer & Singh, 1998). The adopted strategic lens takes the perspective of the relational view. Merely maintaining a focus on a firm's endowment of internal resources overlooks the influence of the network of relationships in which a firm is embedded. The formation of a strategic network of firms can be an important source of value creation, value appropriation, and interorganizational competitive advantage (Dyer & Singh, 1998). Furthermore, it can form a dyadic- or network barrier to imitation, originating from the joint idiosyncratic inputs, interfirm linkages, processes, and routines of the participating firms (Dyer & Singh, 1998).

Another difference is related to whether a firm should protect or share its value-creating knowledge. Here the perspective of the relational view is adopted. The relational view states that through knowledge-sharing with partners, a firm can enhance its organizational learning ability, and access valuable knowledge residing at partner firms (Dyer & Singh, 1998). This enables a firm to improve the quality and efficiency of its routines and skills, thereby creating superior value and outperforming less effective competitors.

Value Creation and –Appropriation Logic of this Study

Adopting elements of the RBV and the relational view in the strategic lens affects how this study regards the solution design's ability to create and capture value. Namely, it views the strategic alliance as an organizational vehicle facilitating the combination of internal Océ resources with external resources of partner firms. If this resource combination is valuable, rare, and impossible to perfectly imitate or substitute, it can be a source of sustainable competitive advantage. Furthermore, the strategic alliance itself is regarded as a key resource, a potential source of competitive advantage, and a barrier to imitation. Also, sharing value-creating knowledge with finishing equipment partners is not seen as a weakness, but as a strength. It enables Océ to improve the quality and efficiency of its routines and skills, and to create superior value.

6.1.2 Doubtful Situation

The final solution design should be tailored to factors that are of influence in the doubtful situation. As such, this section covers how academic theories relating to decline stage strategy, and achieving technology substitution and -adoption when technologies compete for market share, influence the final solution design.

Decline Stage Strategy

The book publishing industry is experiencing a decline in volumes and profits, overcapacity issues, and customer migration towards substitute products and technologies. Elements typical of products and industries in the decline stage (Porter, 1980). According to Martin & Eisenhardt (2004), industries typically decline for two reasons. Either due to the natural evolution of industry life cycles, or due to a disruption or sudden structural change disturbing the industry life cycle ahead of its natural end. In the book publishing industry decline is mostly due to the latter, following the digital transformation of the industry.

The current life cycle stage is essential in the determination of an appropriate value-creating strategy (Hofer, 1975; Anderson & Zeithaml 1984), influencing which activities are vital in attaining a competitive advantage (Stabell & Fjeldstad, 1998). Most researchers, assuming that a declining industry is doomed to perish (Martin & Eisenhardt, 2004), have suggested endgame strategies, such as pursuing a leadership position in market share, building an industry niche position, harvesting revenues while investing less resources, and rapid divestiture through asset liquidation (Anand & Singh, 1997; Porter, 1980). In general, most firms in declining industries try to escape intense competition by pursuing business opportunities in nascent markets (Lindgardt et al., 2009). However, proponents of endgame strategies make the dangerous presumption that an industry decline trajectory is predictable, and that strategies for resource (re)combination can be planned and implemented efficiently. However, firms are limited in their ability to discover novel, valuable resource combinations and apply those in new markets (Ahuja & Lampert, 2001).

In the book publishing industry there are still valuable growth opportunities, and ways to extend its life cycle. Therefore, this study does not resign itself to looking for value creation opportunities in nascent markets. Instead it proposes the implementation of a value-creating strategy in the current market together with complementary finishing partners in order to grow within the declining book publishing industry. To increase its chance of success, this decline stage strategy is adapted to industry characteristics (Barbero et al, 2011) and its implementation well-timed (Harrigan, 1980; Harrigan & Porter, 1983).

Decline stage strategy is somewhat neglected as the challenges and opportunities that product- and industry revitalization strategies present to remaining firms are not sufficiently addressed (Birou et al., 1998). Determining which strategies are most effective in the decline stage requires more work (Anderson & Zeithaml, 1984). In this sense this study embarks on semi-uncharted territory. Although Bamiatzi & Kirchmaier (2014) found that small- and medium-sized firms occasionally successfully pursue strategies aimed at growth and overcoming industry decline, they fail to define specific decline stage growth strategies. This study aims to fill this gap by designing an effective decline stage growth strategy aimed at capturing opportunities in a declining industry where printing technologies try to achieve technology substitution.

Technology Substitution

In the book publishing industry multiple technologies battle for market share. Offset printing technology battles with digital printing technology, while both printing technologies simultaneously compete with digital publishing technology, which is used to publish a book digitally, rather than as a paper book. Digital printing- and digital publishing technology are disruptive technologies, since these do not sustain the industry's traditional performance trajectory, but disrupt and redefine it instead (Christensen, 1997).

There is a difference between the two disruptive technologies. Digital printing is a process discontinuity, whereas digital publishing is a product discontinuity. A process discontinuity refers to a process substitution or –innovation that reconceptualises and improves the industry definition of created value, whereas a

product discontinuity refers to the introduction of a new class of products or major product improvements (Tushman & Anderson, 1986). Digital printing changes the production process and the industry definition of created value, but not the final product; the printed book. It strives to deliver the same quality as offset printing technology, and its advantages are found in process improvements, such as enabling direct availability, and smaller production volumes. In contrast, digital publishing fundamentally changes the production process and the final product. Since its technology trajectory is expected to be much steeper than those of offset- and digital printing, it poses a great threat to those book printing technologies.

The goal of any disruptive technology is achieving technology substitution. Technology substitution transpires as soon as the performance trajectory of a disruptive technology exceeds the performance trajectory of a traditional technology (Adner & Kapoor, 2010). This can unfold in months, years, decades, or may fall short and recede. Adner & Kapoor (2010) attribute differences in the pace of technology substitution to the relative technology performance evolution of competing technologies, which refers to both the performance evolution of the focal technology and that of the surrounding technology ecosystem. The technology ecosystem performance is also referred to as the as-used performance of a technology, and depends on the availability, development, and interaction of complementing technologies and products that customers integrate with the focal technology (Adner & Kapoor, 2010). The as-used performance of a technology is found to be an even more important customer decision criteria, than the performance of a focal technology (Adner & Kapoor, 2010). Therefore, the battle between book printing technologies must be regarded as a battle between technology ecosystems, not just as a battle between competing technologies.

Digital book printing was initially aimed at a niche market, but expected to have disastrous consequences for offset book printing in the long term. However, despite winning substantial market share, scaling up the initial niche market into a mass market proved difficult. To understand why it still has not replaced offset book printing, one must look at the technology ecosystem emergence challenge of digital book printing, and at the technology ecosystem extension opportunity of offset book printing. Although the extension opportunity of the offset print technology ecosystem is low, the emergence challenge of the digital print technology ecosystem is high. This high emergence challenge manifests in, for instance, difficulties integrating digitally printed books within the traditional book supply chain, in limited paper substrate options, and in lower bookbinding quality and options. In such industries technology substitution will not transpire, and the traditional technology will retain a leadership position, until the disruptive technology resolves the ecosystem emergence challenge (Adner & Kapoor, 2010). Since this has not yet happened, the solution design should resolve part of the ecosystem emergence challenge. Therefore, it aims to increase the quality of bookbinding and the number of binding options for digitally printed books.

The second substitution battle is quite different. Although digital publishing still faces many challenges, its ecosystem emergence challenge is low. This means that technology substitution is expected to occur rapidly (Adner & Kapoor, 2010), like in the traditional view of creative destruction (Schumpeter, 1942). Thus, it is expected that in coming years book printing will decline further, accelerated by developments in digital publishing technology. However, in the meantime there are valuable opportunities for digital book printing. Provided it can overcome its ecosystem emergence challenge, and ensure victory in the technology substitution battle with offset printing technology before the eventual demise of book printing technology.

Technology Adoption
To win market share from offset printing more book print providers must adopt digital print presses. Five elements that determine the adoption rate of a technology are its: relative advantage, compatibility, complexity, triability, and observability (Rogers, 2003). Based on these elements customers or decision-making units form opinions with regard to a technology, and consider adoption or rejection (Rogers, 2003).

Digital print press manufacturers tend to focus on communicating the relative advantage of digital printing technology, which is in line with Rogers' (2003) finding that the relative advantage is the most important

driver in technology adoption. However, Gourville (2006) disagrees by stating that when potential customers consider adoption, they do not do this based on its objective value, but rather on its subjectively perceived value. They make this evaluation relative to a reference product, typically a currently owned product, and regard any improvements relative to their reference product as gains, and any deficiencies as losses, where losses far outweigh gains of the same magnitude (Gourville, 2006). This loss aversion leads potential customers to value owned products much higher, than the products which they could obtain, due to the fear of losing value that is generated by their current products (Kahneman et al., 1991).

In the past Océ's customers were mainly digital print providers that only print digitally. This customer group is mostly interested in the relative advantage of a digital print press over its predecessor. However, for the new group of customers; offset print providers who are transitioning to digital printing, digital printing is new and they compare it to their reference product(s): offset print presses. Offset print providers will emphasize what they stand to lose, as opposed to what they stand to gain. Furthermore, adopting digital printing technology requires a behaviour change from offset print providers. Firms often fail to account for the effects of the psychological costs associated with behaviour change (Gourville, 2006).

Océ should define the extent of behaviour change that its products demand, and then aim to minimize customer resistance to these behaviour changes by making behaviourally compatible products, by seeking out unendowed customers, or by targeting believers (Gourville, 2006). Offset print providers are not unendowed, neither can they be classified as believers. As such, to drive digital printing technology adoption in this customer group requires behaviourally compatible products. Therefore, the solution design should increase the compatibility of digital print presses with the workflow and finishing equipment of offset print providers. This makes Océ products behaviourally compatible for them, and will drive technology adoption.

6.1.3 Aspects of the Solution Design

The previous sections indicate what the solution design should entail to be considered an effective decline stage strategy for Océ capable of realizing technology adoption and -substitution in the book publishing industry. It provides a direction for how Océ can capture opportunities, and attain a competitive advantage. Namely, by jointly creating and implementing a resource combination with finishing equipment manufacturers that is valuable, rare, and impossible to perfectly imitate or substitute. This resource combination should resolve part of the ecosystem emergence challenge for digital printing by increasing the quality and number of its bookbinding options. Furthermore, it should increase the compatibility of Océ's digital print presses with the existing workflow and finishing equipment of offset print providers. This section relates and compares the specific aspects of the solution design to academic theories and findings. Thereby further refining and improving the individual aspects of the solution design.

Managing Complementarity

There is a high complementarity between digital print presses and hardcover bookbinding equipment, which means that the two production factors yield superior value in combination (Teece, 1986). Currently the production factors are sub-optimized as the functionalities and limitations of a print press do not match those of a hardcover bookbinding machine, leading to delays, costs, and waste. When complementarity is managed effectively, then more value can be created and appropriated by Océ. Provided that there is a high complementarity between vertically adjacent production factors in the value chain coupled with a high factor mobility (Jacobides et al., 2006). A high factor mobility refers to when there are many complementary factor combinations to choose from, and no single firm possesses a disproportionately powerful bargaining position (Teece, 1986). Since there are many possible production factor combinations, and there is no single powerful bookbinding equipment manufacturer, this condition is fulfilled.

Managing complementarity is achieved through enhancing both the complementarity and the mobility of the complementary assets that are owned by other firms, and simultaneously restricting entry, mobility, and competition in your own asset market (Jacobides et al., 2006). By creating an asset interface through which

a digital print press can be connected to, communicate with, (be) control(led) any hardcover bookbinding machine both the factor mobility and the complementarity is enhanced. The way in which complementary factor combinations are co-specialized to each other determines who benefits most financially from the co-specialized innovations (Teece, 1986). Currently these factors are only minimally co-specialized, which presents the opportunity for Océ to be the first print press manufacturer to do so and appropriate the newly created value. This is referred to as reshaping the industry architecture; the structure and relationships between firms, other economic agents, and their (co-specialized) asset interfaces (Jacobides et al., 2006).

Thus, the solution design should entail managing the complementarity and mobility of a digital print press with hardcover bookbinding machines through the creation of a (co-specialized) asset interface that improves the effectiveness and efficiency of a book production line. This creates a more competitive downstream bookbinding equipment market, and increases the value proposition of Océ's book print press.

Business Model Innovation

As the industry faces the rise of digital publishing technology, the efficacy of business models of print providers and print press manufacturers is challenged. A business model refers to "*the heuristic logic that connects technical potential with the realization of economic value*" (Chesbrough & Rosenbloom, 2002, p. 529). It describes how value is created and appropriated by a network of firms as a business model spans outside a firm's boundaries, describing how the entire network of participating firms' resources and capabilities are deployed to create and appropriate value over all transactions that a business model enables (Amit & Zott, 2001).

To create and appropriate value firms introduce different types of innovation. However, when the current business model is challenged, the options are limited. According to Markides (2006), a situation like in the book publishing industry, where the efficacy of the traditional business model is challenged, while digital print press manufacturers try to scale up a niche market into a mass market, requires the introduction of an innovative business model, which encourages current customers to increase their consumption and new customers to enter the market. Through business model innovation new markets can be entered, and existing markets transformed. Business model innovation and experimentation is also a vital way for Océ to lean ahead of its competitors, and to gather momentum for organizational change (Chesbrough, 2010).

The solution design constitutes the alteration of three building blocks of Océ's business model: the value proposition, the key partners, and the key resources (Osterwalder & Pigneur, 2010). Through co-creation of the value proposition with a complementary partner, using both internal- and external resources, a rare, valuable, imperfectly imitable, non-substitutable resource endowment is created that creates and delivers value in a novel way. The business model innovation aims to increase consumption of current customers, but primarily to convince new customers (i.e. former offset print providers) to enter the market for digital print presses. Figure H.1 in appendix H indicates the generic building blocks of Océ's business model for digital book print presses, showing which and how these are altered by solution design implementation.

Strategic Alliance

Growth in a declining industry is realized through either: organic growth, M&As, strategic alliances, or hybrid growth methods (Faulconbridge et al., 2008). Regardless, to successfully implement and manage a business model innovation a change organization must be set up. A change organization refers to a temporary structure in which employees from one or multiple organizations work while implementing the changes (Van Aken et al., 2007). Since the solution design requires a combination of firm resources, knowledge, and expertise, implementation of the solution design by Océ single-handedly through organic growth is not an option. Joint membership of the change organization would enable employees from both firms to easily combine their firm-specific knowledge and expertise on a daily basis.

Solution design implementation in the book publishing industry through an M&A implies vertical integration. This is not an attractive option when there is an unutilized potential for high mobility in the

complementary, vertical asset market (Jacobides et al., 2006), which is the case. The number of production factor combinations can be increased without vertical integration, thereby lowering the possibilities for value appropriation arising from ownership of those complementary assets (Jacobides et al., 2006). Combined with that M&As often require costly, time-consuming, and problematic integration activities (Duysters, 2001), suggests that it is not an appropriate organizational vehicle for the solution design.

A strategic alliance is a voluntary, flexible, and evolving organizational form (Osborn & Hagendoorn, 1997) between two of more firms (Duysters, 2001), who exchange, share, and develop ideas, resources, products, services, and technologies (Varadarajan & Cunningham, 1995), with the aim to accomplish both shared and individual goals (Gulati, 1998) and to improve each other's competitive position (Spekman et al., 1998), while maintaining corporate identities and sovereignty (Duysters, 2001). Firms in fast-changing business environments prefer engaging in flexible strategic alliances over more formal methods of control and complete ownership. The best results are achieved when these are conducted with complementary firms (Duysters, 2001). Thus, a strategic alliance appears a suitable organizational vehicle.

Hybrid methods of growth are suboptimal in this instance as combinations of unsuitable methods with the most appropriate one (i.e. a strategic alliance) will likely not be more effective, than just engaging in a strategic alliance. Therefore, the solution design entails a strategic alliance with a firm that manufactures hardcover bookbinding equipment, aimed at enhancing the complementarity of their production factors.

A strategic alliance may lead to higher coordination costs, increased competitive intensity, and loss of bargaining power (Gulati, 2001). Yet its advantages can outweigh the costs and risks. A strategic alliance can provide flexibility (Duysters, 2001), transformative ability (Doz & Hamel, 1998), market entry barriers (Vaidya, 1999), organizational learning (Doz & Hamel, 1998; Dyer & Singh, 1998), cost reductions (Doz & Hamel, 1998; Gulati, 2001), faster market access (Doz & Hamel, 1998), a way to vet M&A candidates (Duysters, 2001), and a way to attain info with regard to upcoming market changes, so that a firm can reconfigure its own and complementary innovations in response to new opportunities (Teece, 2007).

A strategic alliance increases Océ's transformative ability in response to upcoming market changes, such as changing customer preferences following the digital transformation. Furthermore, it allows for organizational learning as Océ can learn a lot from manufacturers of complementary products. Finally, the strategic alliance may provide Océ with easier market access to a certain group of customers; (former) offset print providers, which are often existing customers of hardcover bookbinding equipment manufacturers. Thus, the advantages of conducting a strategic alliance seem to outweigh the costs and risks for Océ.

6.2 Improving the Solution Design with Practitioners

In previous sections the solution design was made more detailed and appropriate using academic theories. To also make it more actionable a second interview round was conducted with actors directly affected by solution design implementation; practitioners from digital print providers and finishing equipment manufacturers. Section 6.2.1 discusses how these actors regard the combined potential of the production factors, and section 6.2.2 the finishing-line solutions they prefer to be developed. Section 6.2.3 discusses which bookbinding equipment manufacturers are suitable partners, and whether these would be likely to support Océ in solution design implementation. Section 6.2.4 discusses in what way print providers should be involved in solution design implementation. Lastly, section 6.2.5 presents a glimpse of the future; collaborating with competitors to collectively increase the value proposition of digital book printing.

6.2.1 Combined Potential

The interviewees agree that the printing- and the finishing process are mostly regarded as individual and separate processes. This leads to the two processes not matching in terms of functionalities and limitations. In order to stop losing potential of the digital print press and the finishing equipment, the combined potential of the entire book production line must be increased. Therefore, increasing the complementarity

between the production factors is vital. According to a Product Manager at Müller-Martini, a finishing equipment manufacturer: *"The bigger the overlapping section is (i.e. combined potential), the better the overall system is using the potential of each device, which ultimately should be the goal of a customer and of course of the manufacturers as well."*

For digital printing the combined potential is hard to increase. To increase it the print press and the finishing equipment must exchange info and settings of small or single copy print jobs. Each production factor must know how the others are performing to find out if quality demands are met, to determine the order sequence per machine, and to match the right book block to the right finishing procedure. In offset printing only limited communication between the two processes is necessary. This is due to offset printing technology only producing books in high volumes that do not require as precise monitoring and information exchange procedures. Making a mistake in two books out of an order of a 1,000 would not raise the total production costs much for an offset print provider. While making a mistake in single copy digital book production would cause that order to be a loss. In digital book printing it must be right the first time.

The interviewees agreed that in the future the complementarity of the print- and finishing process will become more important. Driven by factors such as: the shortening of the time-to-market of books (i.e. JIT production), declining average print runs, an increasing variety in print jobs, less waste production, and less make-ready time. They expect a movement towards more integration and coordination between the two production factors to realize faster speeds and more flexibility in book production. Key in realising these goals is achieving a higher degree of automation in the production process using efficient production factors that are tailored to each other. This can be achieved by developing a finishing-line solution.

6.2.2 Finishing-Line Solutions

There are four types of finishing-line solutions: off-line, near-line, on-line, and in-line finishing solutions. Each finishing-line solution has its specific advantages, as mentioned in Appendix D. The solution design may entail an R&D collaboration or a joint R&D development. This corresponds to respectively the development of a near-line or an in-line finishing solution.

A Müller-Martini Product Manager suggested improving the combined potential by creating a system in which books are finished in-line. In-line finishing is most suitable for books that are similar in size, shape, and finishing requirements, and produced in longer print runs, since all the system modules must operate at the same speed to reach maximal efficiency. However, digital print providers are increasingly printing books in shorter print runs that vary a lot in terms of size, shape, and finishing requirements. As such, in-line finishing is not the preferred option for many print providers, especially not for digital print providers that use sheet-fed print presses. Other arguments against in-line integration put forth by interviewees were:

- *High system dependencies*; if the digital print press is down, the finishing machine is down too, and vice versa. The total productivity and reliability of the in-line system will be lower.
- *Costly solution*; if finishing is conducted in-line, then a print press is not able to feed print jobs to other finishers. Therefore, each print press would require its own (costly) in-line finisher.
- *Speed differences*; the speed of printing a book block is faster than the speed of finishing. This leads to a bottleneck within the system, which slows book production down significantly.
- *No personnel reduction*; in theory less operators would be required to operate an in-line finishing system, but in practice the longer the connected production line, the more operators are required.

The interviewees consider in-line finishing only a desirable option if the print press and the finishing equipment is operating at a 1:1 relationship, in terms of speed and output volume. Otherwise near-line solutions are preferred. In near-line finishing there is no direct paper flow between the production factors, but they do communicate through, for instance, barcodes or JDF. Barcodes can be used to match a book block to the right book cover, thereby automatizing part of the book production process. Through two-

way JDF communication individual print jobs can be more effectively managed, sequenced, and monitored. Although many manufacturers claim that their machines can communicate in the same language (e.g. in JDF), interviewees found that in practice many machines still are unable to do so.

Near-line finishing allows print providers to attain these advantages, as compared to off-line finishing, while avoiding several of the drawbacks of in-line finishing. For instance, near-line finishing does not impose high dependencies of the entire system, and it is not a costly solution. Furthermore, in the words of the R&D Manager of Printforce, a digital print provider: *"With a near-line solution you avoid a single point of failure (i.e. a bottleneck)."* Therefore, the solution design should entail the development of a near-line solution. Specific near-line solutions that were suggested by the interviewees are:

- A mini-load system that mechanically buffers the book block and cover after production, and then picks up these semi-finished products from the buffer to use as input for the finishing process.
- A software solution that creates a 'smart production workflow' for single copy book production. An open system allowing for communication between the digital print press and the finishing machines to obtain as much useful information as possible, referring to information that can be used to manage the process (i.e. reports, analyses), or to transmit information (e.g. settings and sequencing) from one production factor to the next.

That second one is similar to the solution design. It also bears a resemblance to what CP Bourg, a finishing equipment manufacturer, refers to as their 'Bourg-box', which is software that connects the instructions that are input into the finishing equipment and the digital print press. This Bourg-box is compatible with print presses of all larger print press manufacturers, and specifically developed and driven by CP Bourg. Although this is already a functional product they feel that collaborating with a print press manufacturer to improve the performance and efficiency of the product is the obvious next step. According to a National Sales Executive for a CP Bourg distributor: *"It's just a case of building those relationships. In the past there has never been a significant investment in the relationship between finishing equipment manufacturers and print press manufacturers"*.

This indicates that some actors required for or affected by the implementation of the solution design look favourable towards its implementation. However, just based on this one cannot say for certain that they would also be willing to support Océ in the implementation. Section 6.2.3 discusses which actors would be most suitable for the joint development and implementation of the solution design from an Océ standpoint.

6.2.3 Selecting a Partner Firm

To jointly implement the solution design it is important that an alliance partner is selected with whom motivations harmonize, there is strategic and operational synergy, and chemistry is good. (Porter Lynch, 2001). The solution design proposes that Océ should ally with a hardcover bookbinding equipment manufacturer. As such, it is important to find out which of the potential partners would be most suitable.

Most interviewees agree that a near-line solution should be developed jointly by a print press manufacturer and a finishing equipment manufacturer. Increasing the complementarity of the production factors is just too complicated to be conducted by one firm on its own. Up till now finishing equipment manufacturers have driven the development of near-line finishing solutions. However, the creation of improved near-line solutions requires the participation of print press manufacturers, because print press manufacturers drive the digital book print market; they have most exposure, market share, and access to customers.

The interviewed finishing equipment manufacturers stated that they are open to collaborating with print press manufacturers, which is evidenced by some existing collaborations. They try to collaborate as much as possible with print press manufacturers, because they regard this an essential tactic to deal with the higher mutual dependency of the production factors in the future. Furthermore, they try to collaborate with as many different print press manufacturers at the same time, because they fear that favouring any particular

print press manufacturer would reduce the willingness of others to collaborate, thereby restricting their customers' options to connect their finishing equipment to print presses of other print press manufacturers.

Océ should preferably ally with a hardcover bookbinding equipment manufacturer that supplies the highest quality equipment, and which has experience and legitimacy within the offset finishing equipment market. Collaborating with such a partner would give Océ access to valuable knowledge on how to make their digital print presses compatible with offset printing environments and workflows. It would also give the alliance (and by extension Océ) legitimacy to firms formerly operating solely within the offset market.

6.2.4 The Role of Print Providers

One interviewee remarked that in the solution design one important actor was left out; the customer. Digital print providers have accumulated years of hands-on experience with both production factors and know like no other actor what the requirements and issues are in book production, and in integrating the printing- and finishing processes. The importance of involving print providers in product development is recognized by all manufacturers, and customers are often involved in the co-creation of new products. For example, recently a machine of bookbinding equipment manufacturer Kolbus was developed in cooperation with Printforce, incorporating their know-how and expertise in the product development process.

One digital print provider said that they, and many others, would be open to developing and co-creating a customizable solution in partnership with a print press manufacturer and a finishing equipment manufacturer. However, another digital print provider did not envision a large role for them within the implementation of the solution design. Instead suggesting that digital print press manufacturers should focus on collaborating with suppliers of logistical installations. Regardless, digital print providers do have a role to play in the implementation of the solution design. Although they do not have to be brought into the strategic alliance, Océ should actively involve them in the technology development process.

6.2.5 Collaborating with Competitors: A Glimpse of the Future

To raise the value proposition of digital printing, relative to offset printing, the solution design should not just involve Océ and a bookbinding equipment manufacturer. Instead it should involve all larger print press manufacturers and finishing equipment manufacturers. This would not result in Océ obtaining a competitive advantage, but it would make digital printing a more appealing alternative to offset printing.

The interviewees do not think this is possible in the short term. The personal opinion of a Müller-Martini Product Manager is: *"I think a real alliance between digital press manufacturers and finishing manufacturers can only occur on individual basis where one digital press manufacturer has a close collaboration with a finishing manufacturer. An alliance across all manufacturers is at the moment not a thing I could envision to happen within the next five years or so."* Currently all manufacturers try to make just their own products compatible with complementary production factors in order to outperform competitors. They are not focussed on making digital printing as a whole a more attractive alternative by coordinating their efforts in optimizing a digital book production line.

In the long term a solution design jointly implemented by all large print press- and finishing equipment manufacturers is preferred. According to the R&D Manager of Printforce in such an undertaking it is crucial to develop a scalable model based on common criteria of print press manufacturers. Thus, it entails the development of a platform innovation, built on a basic scalable architecture. This platform would consist of plug-ins connecting a digital print press to finishing equipment, which can be used to personalize production factors in a print production line to a print provider's preference. At present it is impossible to convince all competitors to collectively participate in such a project, despite its advantages. In the future it might be realizable, perhaps after seeing the effects of the successful implementation of the solution design.

Now the reasoning of the solution design has been improved using findings from academic literature and practitioners, the next chapter; Chapter 7, summarizes the findings in a final solution design. It also expands upon the nature and sequence of activities that are to be undertaken in the solution design implementation.

Part 5

This part describes the final solution design; its goals, methods, and activities. Furthermore, it provides a description of the sequence of steps that are to be taken to implement, test, and experiment with the final solution design in practice.

7. Experimentation

The solution design has evolved in a detailed, appropriate, and actionable solution design, tailored to the industry and doubtful situation. This chapter corresponds with the fifth step in the inquiry; experimentation. Normally in this step experiments are conducted to test the final solution design in the doubtful situation. However, within the scope of this study there was not enough time for its implementation. Therefore, its efficacy is not tested. Instead, section 7.1 introduces the final solution design, distinguishing its goals, methods, and activities. Its goals and methods have all been introduced, defined, and justified in previous chapters, and are not elaborated upon in detail. Only its activities are covered in depth. Section 7.1 also describes and visualizes how the final solution design has evolved from the concept solution design.

Without intervention and testing the final solution design in practice, according to the pragmatist paradigm, there is no proof for its validity. This does not mean that it is not valid. However, it does indicate that there are still steps to be taken to verify its validity. This can only be achieved through the enactment and unification of the doubtful situation. As such, section 7.2 provides an implementation plan; the sequence of steps that still need to be taken to test the final solution design in practice.

7.1 Final Solution Design

The final solution design describes how Océ can create and appropriate value, and attain a competitive advantage in the declining book publishing industry where competing printing technologies fight for market dominance. Hence, it answers the main research question, whilst taking into account that the digital transformation of the book publishing industry alters the mix of book categories that will be printed, how book print volume will be divided over printing technologies, and the requirements that digital print presses have to meet. As such, it solves part of the problem as defined in the problem statement. Furthermore, it incorporates how the factors and actors in the doubtful situation influence its design and implementation. Thus, final solution design implementation has the potential to lead to unification of the doubtful situation.

Simple concept sketches sufficed to display the concept solution designs, because their purpose was just to facilitate a reflective design conversation with practitioners, and to select a general solution direction. The visual representation of the final solution design differs as its purpose is markedly different. Its purpose is to show the entire solution design in all its depth, distinguishing its goals, methods, and activities. Since it is significantly more elaborate than the concept solution designs a lot more text is required to communicate its full extent. As such, the final solution design looks like it does in Figure 7.1 on the next page. It is split up in three parts: 1) the why (i.e. goals), 2) the how (i.e. methods), and 3) the what (i.e. activities).

7.1.1 Goals: the Why

The goals of the final solution design are threefold: 1) to create and capture value in the declining book publishing industry, 2) to ensure victory in the technology substitution battle with offset book printing technology, and 3) to attain a competitive advantage in the market for digital book print presses.

7.1.2 Methods: the How

The methods describe how the goals can be achieved. Firstly, it requires a strategy for capturing opportunities in the current, declining market, tailored to the industry's characteristics and dynamics.

Secondly, to resolve part of the technology ecosystem emergence challenge for digital book printing, the complementarity between digital print presses and hardcover bookbinding equipment must be managed and increased. This entails increasing the quality and number of binding options for digital book printing. It also requires minimizing behaviour changes for offset print providers looking to switch to digital printing.

Thirdly, it requires Océ to innovate its business model together with a strategic alliance partner. This entails improving the value proposition of Océ's book print presses by combining internal resources with external

resources of a key partner to create a resource combination that can be a source of competitive advantage. A hardcover bookbinding equipment manufacturer experienced with offset printing is a preferred partner.

Figure 7.1: Final Solution Design: Goals, Methods & Activities

7.1.3 Activities: the What

The final solution design describes which activities must be performed to attain the goals through the proposed methods. The decision to propose these activities is based on findings from academic theories and practitioners. This section elaborates on those activities, providing a rationale for why each was incorporated. It also discusses how these have evolved from the elements of the concept solution design.

Evolution of the Solution Design

The concept solution design entailed a strategic alliance with a finishing equipment manufacturer. Its goals are similar to those of the final solution design, and some of the methods overlap as well. For instance, increasing the complementarity, developing a tailor-made decline stage strategy, and forming a strategic alliance with finishing equipment manufacturers was also pre-eminent in the concept solution design. Other methods were added later to the final solution design following a literature study and a second interview round. Examples of such methods are: minimizing behaviour changes for offset print providers, conducting a business model innovation, and partnering with a hardcover bookbinding equipment manufacturer.

The biggest difference between the concept- and the final solution design is the preferred degree of collaboration. The concept solution design considers collaborating on any of four different alliance maturity levels, and only describes which activities must be performed on a specific level. Therefore, a first step in defining the activities for the final solution design was selecting a preferred collaboration level. However, more appropriate is: a first step was selecting the preferred maximum level of collaboration. Since collaborating on any level would necessitate collaborating on lower levels as well. For example, conducting

a sales collaboration (lv. 1 collaboration) with a bookbinding equipment manufacturer should always be preceded by mapping the landscape of bookbinding equipment manufacturers (lv. 0 collaboration). Otherwise an unsuitable alliance partner might be selected for lack of proper research. Similarly, if an R&D collaboration is the preferred level (lv. 2 collaboration), then the two firms would benefit from coordinating their sales activities through a sales collaboration. This would increase both firms' value capturing ability after developing technology that increases the complementarity of the production factors.

Selecting the Level of Collaboration
An influential factor in selecting a preferred maximum collaboration level was that one of the goals is to attain a competitive advantage. The literature study indicated that a competitive advantage should be built upon a resource endowment that is rare, valuable, imperfectly imitable, and non-substitutable. Furthermore, it specified that creating such a resource combination jointly with a strategic partner, combining internal and external resources, would make it more difficult for competitors to imitate or duplicate the benefits of the value-creating strategy. Mapping the finishing landscape (lv. 0 collaboration) or conducting a sales collaboration (lv. 1 collaboration) does not create a joint resource endowment. Coupled with that in order to manage and increase the complementarity both firms need to actively combine their technical knowledge, expertise, and resources, then it becomes clear that collaborating on any level lower than level 2 would not result in an increased complementarity, nor in a competitive advantage.

This leaves the choice to either conduct an R&D collaboration (lv. 2 collaboration) or a joint R&D development project (lv. 3 collaboration). An R&D collaboration would lead to the mutual adaptation of production factors in terms of functionalities, communications, and limitations. However, they would remain separate machines with no direct paper flow. Such a solution is referred to as a near-line finishing solution. A joint R&D development project would lead to the development of one production factor that does both book printing and finishing; an in-line finishing solution.

Practitioners indicated that the development of a near-line finishing solution is preferable to an in-line finishing solution. Stating that an in-line finishing solution would be more costly to develop, would reduce the number of finishing options, decrease the system reliability, and reduce flexibility and productivity. Since an effective near-line finishing solution would create value for digital print providers, raise the value proposition of Océ's digital book print presses, and potentially be a source of competitive advantage, the maximum preferred alliance maturity level for the final solution design is conducting an R&D collaboration (lv. 2 collaboration). Thus, the final solution design entails collaborating on an R&D level, and on a sales level. However, both are preceded by mapping the landscape of bookbinding equipment manufacturers.

Mapping the Bookbinding Equipment Manufacturer Landscape
The first main activity of the final solution design is mapping the bookbinding equipment manufacturer landscape. This involves researching which manufacturers exist, which ones are commonly used in conjunction with Océ print presses, and comparing their sales volumes, level of expertise, their openness towards collaboration, etc. Although the final solution design entails an R&D collaboration with a hardcover bookbinding equipment manufacturer, this does not rule out simultaneously collaborating on a sales level with (non-)hardcover bookbinding equipment manufacturers. As such, mapping should include all bookbinding equipment manufacturers, although more depth and detail should go into the analysis of potential R&D collaboration partners. Selection of an unsuitable R&D collaboration partner would have more profound negative consequences, than selection of an unsuitable partner for a sales collaboration.

Sales Collaboration
The second main activity is conducting a sales collaboration with one or multiple bookbinding equipment manufacturers. Preferably with firms whose machines are commonly used with Océ's print presses. The potential benefits of a sales collaboration are significant. For instance, through the regular exchange of customers' needs, preferences, and leads, Océ's salesforce would be able to better tailor its sales pitch and

offering to specific clients. It might also improve customer reach of the salesforce by enabling approaching customers who do not own an Océ product, but who do own a bookbinding machine of an alliance partner.

Another benefit is that it enables creating options and coordinating offers for customers together with bookbinding equipment manufacturers. The salesforces of print press manufacturers tend to focus on just selling print presses. However, for customers it is all about producing the entire application. Rather than convincing customers that its print presses are best compared to competitors', Océ should focus on convincing them that its products are essential in creating the optimal book production line. The two production factors can even be bundled in one offering, so that customers are offered a complete solution; a book production application, instead of just one facet in the process. This would save the customer time investigating various offerings of suppliers of book production factors. According to practitioners, a sales collaboration allowing for solution selling results in benefits customers are increasingly demanding.

A final benefit of a sales collaboration is that relationships are built between Océ and complementary partners. These relationships might come in useful when Océ would like to collaborate on a higher alliance maturity level with those complementary partners in the future. More sales partners also means more potential sources of information with regard to upcoming market changes, so that Océ can timely reconfigure its own and complementary innovations to new opportunities or threats (Teece, 2007).

R&D Collaboration
The third main activity is conducting an R&D collaboration with a hardcover bookbinding equipment manufacturer. Together they should develop a near-line finishing solution that increases the combined potential of the two production factors. The details as to what kind of near-line solution should be developed should not be set in stone at this point. Although, this study recommends developing a co-specialized asset interface; a software linkage allowing the production factors to connect, communicate, and potentially control each other. This enhances both the factor mobility and the complementarity, which could create a more competitive downstream market for bookbinding machines, while at the same time increasing the value propositions of Océ's digital book print presses. Furthermore, it would allow digital print providers to monitor book production at any stage, to efficiently sequence print jobs, and to match the right printed book block to the right book cover at the right time, even for books printed on demand. When the two production factors are mutually adapted to each other like that, then they create superior value for digital print providers by reducing production- and set-up times, waste, and the amount of manual inputs in the production process. It would also increase book production automation.

Digital print providers have accumulated years of hands-on experience with both production factors. As such, they know like no other what the requirements and issues are in book production, and in the integration of the printing process and the finishing process. Therefore, to develop the best possible near-line finishing solution Océ and its partner should actively involve customers at multiple stages in the R&D process. Co-creating the near-line finishing solution together with customers is consistent with the philosophy of Océ and several bookbinding equipment manufacturers. Namely, both have a track record of involving digital print providers in the development, implementation, and experimentation of new products. The feasibility of involving digital print providers in the R&D process is high, because it appears that several digital print providers are interested to keep co-creating new products, even in partnership with both a digital print press manufacturer and a finishing equipment manufacturer.

Visualizing the Evolution of the Final Solution Design
Now all goals, methods, and activities of the final solution design have been covered in detail, one can visualize how the activities of the final solution design relate to the elements of the concept solution design as introduced in section 5.2.4. This is shown in Figure 7.2 on the next page, thereby concluding this study's final design cycle. The next section covers the implementation plan; the sequence of steps in which the activities of the final solution design should be performed.
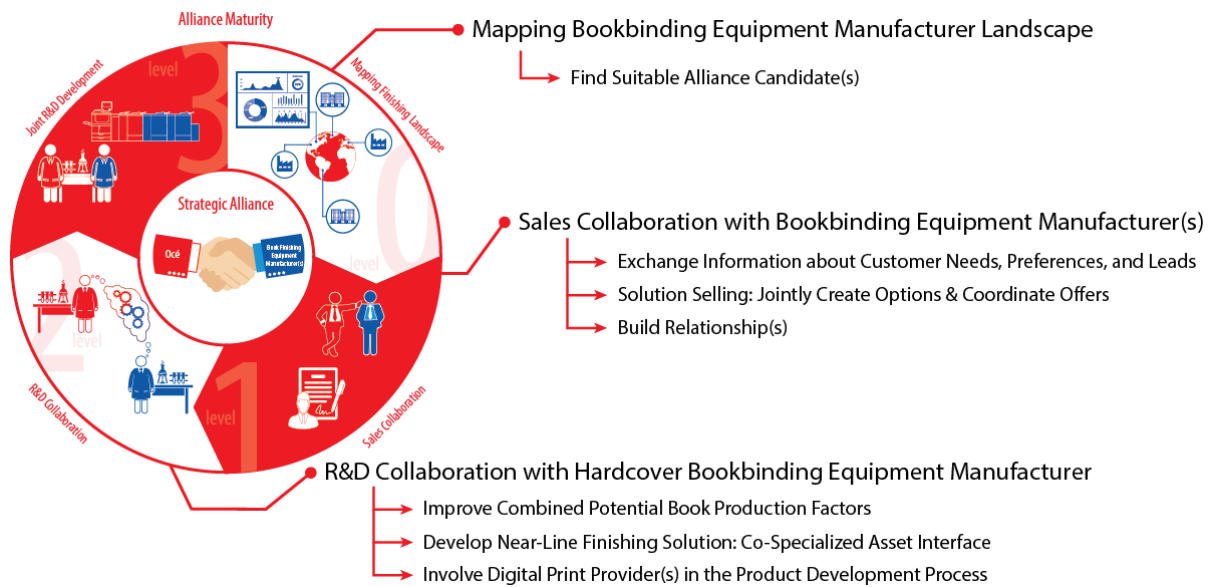
Figure 7.2: Relations between the Elements of the Concept Solution Design and the Activities of the Final Solution Design

7.2 Implementation Plan

To gather evidence for the validity of the final solution design it must be implemented in the practice of the doubtful situation. This section discusses all nine steps of the implementation plan, and supply the reasoning for incorporating specific activities. Most influential in the selection of activities were the 8-Step Change Model (Kotter, 1995), and the Manual for Strategic Alliances (Duysters et al., 2002).

The final solution design describes a change effort; a way through which Océ can transform itself in a better competitor. Kotter (1995) found that few firms are successful in leading change, and that most change efforts fail. To address this shortcoming he formulated the 8-Step Change Model, which lists eight steps that should be incorporated in any change effort. Hence, these have been influential in shaping the implementation plan.

The final solution designs entails conducting a strategic alliance. The Manual for Strategic Alliances describes in detail how firms should undertake a strategic alliance by covering the alliance strategy formulation process, the partner selection process, and the implementation and operationalisation process (Duysters et al., 2002). As such, its recommendations were influential in structuring the implementation of the final solution design.

Step 1

Transformations start when a firm recognizes the need for a major change, and the first step in any change effort is establishing a sense of urgency (Kotter, 1995). To establish a sense of urgency one must begin by conducting an external analysis aimed at identifying the market trends, developments, and the competencies that will become important (Duysters et al., 2002). This study already examined the market and competitive realities, and identified potential problems and opportunities. The next step, and the first step in this implementation plan, is convincing people within the Océ organization that solution design implementation is worthwhile. That it is urgent to conduct the change effort, since Océ does not possess all required competencies. Therefore, the final solution design has been discussed with various Océ employees However, many decision makers have not yet been approached, while others have not yet been convinced about the necessity of solution design implementation. This document accompanied by presentations and meetings is required to convince those that this is a major opportunity that warrants its required investment.

Step 2

The second step is forming a group of people that will guide the implementation. The implementation can be initiated by a small team of people led by one committed manager. However, teams that undertake successful change efforts usually scale up quite fast, as well as their leadership coalitions (Kotter, 1995).

Also, it is paramount that the leadership coalition consists of people with sufficient power. They should encourage the project team to work together as a team, foster a shared view of the problems and opportunities, and create a sufficient level of trust and communication (Kotter, 1995).

Step 3

In the next step the leadership coalition creates a vision to guide the change effort, and a strategy for realising that vision (Duysters et al., 2002; Kotter, 1995). The goals of the final solution design indicate elements of a sound vision for Océ, and the methods and activities describe a strategy through which Océ can realize this vision. However, a vision should be formulated more concise. It should clearly state the desired future role of Océ within the book publishing industry, and indicate which competencies must be developed to fulfil this role. Based on that vision a strategy should then be developed through which the required competencies can be developed, and the formulated vision realized (Duysters et al., 2002).

The vision and strategy should be communicated often using as many intracompany communication methods as possible (Kotter, 1995). Without proper understanding of the vision or the strategy it is impossible to successfully implement the final solution design, and to attain the desired change. Van Aken et al. (2007) even state that in the implementation the key success factor is having a sound communication plan. Through clear and frequent communication Océ can learn from, and reduce resistance to change.

Step 4

The fourth step is mapping the landscape of bookbinding equipment manufacturers. This involves researching what kind of manufacturers exist, which ones are used in conjunction with Océ print presses, and comparing their sales volumes, level of expertise, their openness towards collaboration, etc. This analysis determines whether a firm is a suitable candidate to collaborate with, and on what level. Although it includes mapping all bookbinding equipment manufacturers, more depth and detail should go into the analysis of potential R&D collaboration partners (i.e. hardcover bookbinding equipment manufacturers).

It is essential to develop an overarching alliance strategy, as well as strategies for alliances with individual manufacturers (Duysters et al., 2002). In that way Océ can manage the entire alliance portfolio similarly, while still allowing for differences in individual alliance strategies. These differences should be based on the specific added value of an alliance, and on Océ's motivation to conduct an alliance (Duysters et al., 2002).

Step 5

The fifth step is selecting partners to conduct a strategic alliance with, and coming to an agreement. The previous step should have resulted in a long list of potential partners. Now Océ should draft a profile of its optimal partner, and based on that profile reduce the long list of potential partners to a short list (Duysters et al., 2002). Then the firms on the short list can be approached to find out how these regard conducting a collaborative undertaking. If in these explorative discussions a bookbinding equipment manufacturer indicates that they look favourable towards a collaboration, then Océ should find out at what level they would like to collaborate, and to what extent the two firms are compatible. Strategic and operational motivations of both firms should harmonize, and it should be feasible to formulate joint alliance goals (Porter Lynch, 2001). Before selecting partners Océ should also do a risk- and return analysis to find out whether the expected returns, both strategic and financial, outweigh the risks (Duysters et al., 2002).

Step 6

The sixth step is making the alliance official by signing a Memorandum of Understanding and Principles (MOUP). A MOUP provides an overview of agreed upon aspects, stating the strategic intent, goals, and operational principles of the strategic alliance (Duysters et al., 2002). It marks the start of the collaboration.

Step 7

In the seventh step the strategic alliance is implemented and operationalised (Duysters et al., 2002). In this process trust and relationships should be built and fostered between Océ and its partner(s). This is required

to successfully conduct sales collaboration(s) and an R&D collaboration. Duysters et al. (2002) recommend drafting a cooperation plan stipulating how the participating firms should cooperate during the course of the alliance. Subsequently, a legal agreement should be drawn up to enforce the cooperation plan.

The sales collaboration entails creating options and coordinating offers for (potential) customers together with bookbinding equipment manufacturers. It also entails regularly exchanging and sharing information with regard to customers' needs, preferences, and leads. A sales collaboration allows for solution selling, which would benefit the sale of all Océ's digital book print presses.

The R&D collaboration entails the development of a near-line finishing solution with a hardcover bookbinding equipment manufacturer that increases the combined potential of a digital print press and a bookbinding machine. Through the mutual adaptation of the two production factors, the book production line will be able to create superior value for digital print providers.

In this phase Océ employees, as well as employees of alliance partner(s) must be empowered to act on the formulated vision. This means removing large obstacles to change, changing systems and structures that undermine the vision, and encouraging risk taking and non-traditional ideas, activities, and actions (Kotter, 1995). Only once change inhibitors are removed, then the collaborations can become a success.

In any change effort it is wise to plan for and create short-term wins (Kotter, 1995). Therefore, Océ should define clear performance improvements that it would like to realize, and plan accordingly. In order to keep perceived change urgency levels high Océ should actively create those improvements, rather than passively hope for them to materialize (Kotter, 1995). Furthermore, employees involved in the realization of improvements should be recognized and rewarded.

Step 8

In this step Océ determines to what extent the final solution design has proven capable of attaining its goals. Océ should check whether its implementation resulted in higher customer satisfaction and in more sales. Whether it has led to digital book printing technology winning market share from offset printing, and whether Océ has managed to attain a competitive advantage in the market for digital book print presses. Here it is key to distinguish the contributing effects of the final solution design from effects that would always have occurred due to the gradual development of customer preferences or the market. Additional evaluation criteria to be used are: morale, productivity, innovativeness, and the amount of knowledge and skills internalised (Duysters et al., 2002). When the intended results are not realised, then the alliance should be adjusted, repositioned, or terminated. Otherwise, Océ can continue the alliance in its current form.

Although short-term wins are to be celebrated, it is important that Océ is not too soon with declaring to have won the war. It takes several years for change to be absorbed into the culture of a firm, and new methods and attitudes are easily forgotten (Kotter, 1995). Instead Océ should consolidate the realized improvements by further changing the systems, structures, and policies, as well as continuing to undertake projects and develop employees, in a way that aligns with the formulated vision (Kotter, 1995). In this way the changes in behaviour, approaches, and vision can be institutionalized in Océ's corporate culture.

Step 9

When the implementation of the final solution design has led to the realisation of its goals, Océ can conclude that the doubtful situation is unified, and that its hypotheses were valid. However, the implementation of the final solution design is not a one-time fix, even when successful. In the ninth step Océ should monitor whether the unified situation is sufficiently altered by something or someone. When that happens progressive inquiry is required to transition the new doubtful situation into a unified one again.

The final chapter; Chapter 8, summarizes this study's findings and makes practical recommendations. It discusses its theoretical contributions, its limitations, and provides suggestions for future research.

Part 6

This final part summarizes this study's findings and makes practical recommendations. Furthermore, it provides a discussion of this study's theoretical contribution, it indicates its limitations, and provides suggestions for future research.

8. Warranted Assertion

This chapter provides a summary of this study, as well as a discussion of its implications and limitations. Section 8.1 presents the conclusion, and section 8.2 the practical recommendations. Thereafter, section 8.3 presents the theoretical implications, discussing in what way this study contributes to academic literature. Finally, section 8.4 discusses the limitations of this study, and provides suggestions for future research.

8.1 Conclusion

The printed book, the original Information Technology (IT), has been the preferred medium for packaging and disseminating information for centuries. Now almost 600 years after the invention of the print press, the preferred medium is increasingly a digital one (Van der Weel, 2016). The digital transformation of the book publishing industry appears an irreversible trend, and has already led to the digitization of a substantial share of the book market, and to a reduction in printed book sales. Despite the slow demise of book printing, digital book printing is on the rise. Growing mainly by capturing book print volume from offset printing, although digital book printing also creates some new book applications (IT Strategies, 2014).

The consequences of the digital transformation are not immediately adverse for digital book printing. However, in coming years all book categories will transition towards a more hybrid mix of paper- and digital books, leading to a further decline in the printed book volume. This process will be fastest for books more aimed at transferring content, such as technical-, scientific-, professional-, and educational books. Books more aimed at providing an experience, such as literary-, fictional-, and children books, will remain longer in print. Strikingly, the market share of digital book printing is higher in categories that are expected to digitize rapidly, and lower in book categories expected to remain longer in print. Therefore, the long term future for digital book printing looks considerably less bright. The remaining book print volume will be dominated by book categories with which digital book printing is less familiar, and which have different print quality, paper substrates, and finishing requirements. For instance, for books aimed at providing an experience the look and feel of a book are vital purchase decision criteria. These aspects are determined more by the quality of book finishing, than by the quality of book printing. Therefore, the market success of a printed book will increasingly be determined by the quality of book finishing.

This presents the opportunity to be first to develop a print press with features and capabilities tailored to printing the remaining book category mix. As such, the following main research question was formulated:

How can Océ create and appropriate value, and attain a competitive advantage in the declining book publishing industry where competing printing technologies vie for market dominance?

Utilizing a pragmatist research method; the Deweyan Inquiry, the industry actors, factors, and dynamics were studied, both from a practitioner- and an academic perspective. This led to the development of a final solution design, which provides a detailed, appropriate, and actionable answer to the main research question, while addressing the problem as defined in the problem statement. Thus, it addresses that the digital transformation alters the mix of remaining book print volume, the division of volume over printing technologies, and the requirements that digital print presses will have to meet.

Figure 7.1 displays the final solution design, distinguishing its goals, methods, and activities. The goals of the final solution design are threefold: 1) to create and capture value in the declining book publishing industry, 2) to ensure victory in the technology substitution battle with offset book printing technology, and 3) to attain a competitive advantage in the market for digital book print presses.

To realize these goals it incorporates several methods. Firstly, a strategy for creating and capturing value in the current, declining book publishing industry, tailored to industry characteristics and –dynamics. Secondly, it incorporates managing and increasing the complementarity between digital book print presses

and hardcover bookbinding equipment. This resolves part of the technology ecosystem emergence challenge for digital book printing by removing one of its leading barriers; the low quality of finishing/binding (Interquest, 2016b). Thirdly, it incorporates innovating Océ's business models with a strategic partner. Hereby improving the value proposition of Océ's digital book print presses by combining internal resources with external resources of a hardcover bookbinding equipment manufacturer.

To attain the goals through these methods three activities are essential. Firstly, mapping the landscape of bookbinding equipment manufacturers, and finding suitable collaboration candidates. Secondly, conducting a sales collaboration with one or preferably multiple bookbinding equipment manufacturers. This enables solution selling; the joint creation of options, and coordination of customer offers, through regularly exchanging info with regard to customers' needs, preferences, and leads. Thirdly, conducting an R&D collaboration with a hardcover bookbinding equipment manufacturer, while involving digital print providers, to develop a near-line finishing solution. Preferably a co-specialized asset interface; a software linkage allowing the two production factors to connect, communicate, and control each other. Herewith digital print providers can monitor book production at any stage, efficiently sequence print jobs, and subsequently match a printed book block to the right book cover at the right time, even for books printed on demand. The increased complementarity reduces production- and set-up times, waste, and the amount of manual inputs. Simultaneously, it reduces the required behaviour change for offset print providers who want to switch to digital book printing, but who want to keep using their existing finishing equipment.

Due to the slow pace of digitization in some book categories it currently is beneficial for Océ to pursue this growth strategy in a declining industry. However, in the future inevitably a digital book or a multi-media platform will be developed that surpasses the capabilities of a printed book even in providing an experience. This would result in the digitization of most book categories, and signal the demise of the paper book era.

8.2 Practical Recommendations

Apart from the recommendation to Océ to implement the final solution design according to the proposed implementation plan, this study makes several additional practical recommendations. These help Océ to shape solution design implementation, and to enhance its understanding of the book publishing industry.

Océ should conduct an R&D collaboration with a hardcover bookbinding equipment manufacturer that supplies high-quality equipment, and that has experience and legitimacy in the offset finishing equipment market. Firms meeting those conditions are Kolbus and Müller-Martini. Their products are classified as industrial finishers, meaning that a print provider must have an annual production volume of at least 500,000 books to warrant purchasing their products. Interviews indicated that larger digital print providers in the NL produce about 500,000-3,200,000 books annually. Since this exceeds the minimum required volume, coupled with the expectation that digital book production volumes will continue to rise, leads to the designation of Kolbus and Müller-Martini as suitable candidates. Though this warrants further inquiry, as factors like strategic- and operational synergy, and interfirm chemistry, have not been considered.

A near-line finishing solution for a sheet-fed digital inkjet print press is not likely to work for a web-fed digital inkjet print press, nor for a sheet-fed digital toner print press. To improve the combined potential for all print press types, Océ would have to develop a unique near-line finishing solution for each type. This would significantly increase the risks, costs, and the complexity of the undertaking. Therefore, this study recommends to initially develop a near-line solution that only works for one type for which developing a near-line solution is feasible, and offers high benefits. As such, this study recommends Océ Venlo to start developing a near-line finishing solution for a sheet-fed digital inkjet print press. The reason to start with a sheet-fed print press is that near-line finishing solutions are currently less commonplace for sheet-fed print presses, than for web-fed digital print presses. However, it would offer a lot of advantages for the coordination of books produced in its (very) short print runs. The reason to develop a near-line solution for a digital inkjet print press is that digital inkjet's market share is expected to grow faster than that for

digital toner print presses. Focusing on digital inkjet print presses would address the largest market. As to the feasibility, since this study was conducted at Océ Venlo where only sheet-fed print presses are developed, it is more feasible to convince Océ Venlo executives to develop a near-line solution for a sheet-fed print press, as opposed to for web-fed print presses, which are manufactured abroad.

The salesforce focuses on communicating the relative advantages of Océ's print presses compared to older models, to competitors' digital print presses, and to offset print presses. Aspects like print quality, cost, and reliability are key. This study does not disregard any of those customer decision criteria. However, it does recommend to focus on an extra aspect in the selling process; the as-used performance of a print press. The as-used performance of any technology depends on the availability, development, and interaction of complementing technologies/products that customers integrate with a focal technology (Adner & Kapoor, 2010). For a book print press this depends on how well it can be integrated with pre- and post-finishing equipment in a book production line. For Océ's customers producing a book is the main goal, not just printing a book block. As such, the ease of incorporating an Océ print press in a book production line is of utmost importance, and potentially a deal-maker or breaker in the selling process. Incorporating this customer decision criterion in the selling process would likely improve the effectiveness of the sales pitch.

The last recommendation to Océ is to search for other markets to address with its product- and service portfolio. Despite that the book print market will not disappear in the next decade, and that there are still valuable opportunities to be realized, the market will reduce to a fraction of its size in the not-so-distant future, due to entire book categories going out of print. It is important not to be blindsided by the current rapid rise of digital book printing; after some years the decline in book print volumes will also become apparent for digital book printing. This might even be accelerated by the introduction of a new disruptive technology or by advances in existing IT media. In the long term there is limited perspective in (digital) book printing, and Océ should actively search for and address other markets to ensure firm survival.

8.3 Discussion & Theoretical Implications

Through the adoption of a novel and promising pragmatist research method; the Deweyan Inquiry, this study resulted in a design that constitutes a novel decline stage growth strategy tailored to the Dutch book publishing industry, aimed at deciding the technology substitution battle in favour of digital printing technology. As such, it makes a theoretical contribution to decline stage strategy literature, and to research method literature. Furthermore, it reaffirms the applicability of two academic theories in technology substitution and –adoption literature. Next, all theoretical implications are discussed individually.

8.3.1 Implications for Decline Stage Strategy Literature

Since declining industries are often assumed doomed to perish (Martin & Eisenhardt, 2004), most researchers suggest endgame strategies, which are only implemented when all methods to halt industry decline are exhausted (Harrigan & Porter, 1983). Examples are: pursuing a market share leadership position, building an industry niche position, harvesting revenues while investing less resources, and rapid divestiture through asset liquidation (Anand & Singh, 1997; Porter, 1980). Meanwhile, most firms in declining industries escape intense competition by pursuing business opportunities in nascent markets (Lindgardt et al., 2009). However, industry decline trajectories are not always simple to predict, and firms are limited in their ability to develop strategies for discovering and realizing novel, valuable resource combinations in new markets (Ahuja & Lampert, 2001). This study embarked to show that, as long as not all methods to halt industry decline are exhausted, value-creating growth strategies should be implemented in a declining industry itself. One study already pursued this, but it is not without its limitations. Namely, Bamiatzi & Kirchmaier (2014) found that small- and medium-sized firms occasionally successfully pursue decline stage growth strategies. However, they do not cover large-sized firms, and fail to define specific growth strategies.

The first theoretical contribution this study makes to decline stage strategy literature is showing that large-sized firms can also pursue decline stage growth strategies. It makes a second contribution by defining a

specific decline stage growth strategy. Namely, raising the performance of a technology ecosystem together with a complementary partner in a strategic alliance. More specifically, this is achieved through a business model innovation in which the combined potential of complementary production factors is increased. This constitutes an effective decline stage growth strategy, and bridges a decline stage strategy literature gap.

8.3.2 Implications for Research Method Literature

Many universities, like the Eindhoven University of Technology, encourage their students to conduct design-based research. Design-based research emphasizes understanding the messiness of real-world practice, where the context of a situation is an integral part of a study, and not an extraneous variable to be trivialized (Barab & Squire, 2004). It regards studied actors not as subjects assigned to treatments, but as co-participants in both design and analysis. As such, the focus of design-based research is on building theory that characterizes a design in practice, as opposed to merely testing hypotheses (Barab & Squire, 2004).

Universities' desire for their students to conduct design-based research that is grounded in both theory and practice likely stems from a desire to reduce the wide gap that exists between organizational research and managerial practice (Rynes et al., 2001). However, most students fail to do so, because they adopt research methods that are suboptimal for conducting design-based research. Firstly, students that adopt a positivist- or constructivist research method remain neutral (Creswell, 2002), and conduct their research like a fly on the wall (Holstein & Gubrium, 2004), rather than actively co-designing with practitioners. Secondly, positivist students focus on testing hypotheses (Popper, 1959), rather than on building theory that characterizes a design in practice. Thirdly, constructivist students tend to underestimate the importance of the context of a situation by generalizing grounded theory in order to develop practical tools (Martin & Turner, 1986). Therefore, a different research method is required for students who want to conduct design-based research. Namely, a pragmatist research method that does not regard theory and practice as conflicting, but as two sides of the same coin: as intelligent versus uninformed practice (Dewey, 1930).

A pragmatist research method that fulfils all the requirements of design-based research is the Deweyan Inquiry. As such, this study builds on Stompff (2012) who positioned the Deweyan Inquiry as a research method through which practitioners can engage in research by simultaneously building theory, observing practice, and redesigning elements of a doubtful situation (Stompff, 2012). This study disagrees with his statement that it is just a method for practitioners doing research, which is not applicable for researchers doing practice (Stompff, 2012, p. 299). When a researcher treats actors in the studied situation as co-participants in design and analysis, while participating in practice during the course of a study, a researcher is able to acquire sufficient insights to jointly with practitioners conduct experiments in practice.

This study makes a theoretical contribution to research method literature by for the first time positioning the Deweyan Inquiry as an effective way to conduct design-based research while studying organizational science. For student researchers it is particularly suitable as it does not just specify a vision for conducting design-based research, it also elaborates on the sequence and contents of steps that have to be completed during the course of a study. As such, the Deweyan Inquiry provides a solid process guideline, which raises the feasibility that (student) researchers successfully complete their design-based research studies.

8.3.3 Implications for Technology Substitution and –Adoption Literature

The last contribution this study makes is a reaffirmation of two existing academic theories. This is enabled by the structure of this pragmatist study. As it did not start with a literature study, but with a doubtful situation and concurrent theory building, data gathering from practice, and data analysis, the initial solution designs were based on findings from practice, rather than on academic findings. Noting the similarities between the two identifies which academic theories are consistent with and reaffirmed by this study.

The first academic theory that this study reaffirms is Adner & Kapoor's (2010) technology substitution theory. Practitioners indicated that for digital book printing technology to win the technology substitution

battle with offset printing technology it is vital to improve the quality of book finishing, and the integration of digital print presses with book pre- and post-finishing equipment in a book production line, rather than improving the quality of digital printing technology itself. Thereby improving the as-used performance of digital book printing technology. This finding is consistent with Adner & Kapoor's (2010) findings, reaffirming that the essential factor in achieving technology substitution is the as-used performance of a technology; the performance of a technology ecosystem, rather than the performance of a technology itself.

The second theory that this study reaffirms is Gourville's (2006) technology adoption theory. Potential customers consider technology adoption by evaluating its subjectively perceived value relative to a reference product, typically a currently owned product. Thereby regarding improvements relative to the reference product as gains, and deficiencies as losses, which far outweigh gains of a similar magnitude (Gourville, 2006). This was evidenced in practice as digital print providers named the relative advantage of a new digital print press over their currently owned products as the key adoption factor. For them a new digital print press does not present significant deficiencies compared to their reference product. Meanwhile an offset print provider named the compatibility of a digital print press with its current workflow and finishing equipment the key adoption factor. This emphasis on what it stands to lose, as opposed to what it stands to gain, because of the fear to lose value generated by its current products, resulted in technology rejection. This reaffirms that in driving technology adoption it is vital to define the extent of behaviour change that a products demands, and then minimizing resistance to these behaviour changes (Gourville, 2006).

8.4 Limitations & Suggestions for Future Research

Despite its contributions, this study is not without limitations. Choices with regard to its research approach and –methodology, and its subject matter and scope, affect the validity, reliability, and generalizability of its findings. This section describes these limitations and also provides suggestions for future research.

The first limitation of this study is that, due to limited time and resources, the final solution design has not yet been implemented. This is a major limitation, because pragmatists assume that only through intervention and testing a final solution design in the practice of a doubtful situation one can gather proof for the validity of its hypotheses (Peirce, 1878). Therefore, this study cannot truly make the warranted assertion that the final solution design is valid, nor that its implementation will unify the doubtful situation. The final solution design should be implemented and experimented with by Océ in the near future to establish this.

Despite a lack of verification, the hypotheses of the final solution design appear sound, as they are grounded in both practice and academic theory. Therefore, for now this study disregards its lack of implementation, and discusses how it scores on three forms of validity, as if it has been successfully implemented already.

Yin (2003) describes three validity forms: construct validity, internal validity, and external validity. Construct validity refers to the accuracy with which a study's measures reflect the concepts being studied (Yin, 2003). Most studied concepts were not quantifiable, but were instead assigned meanings through subjective judgements. This made it tough to obtain a high construct validity. Yet, a sufficiently high overall construct validity was obtained by identifying common subjective judgements of concepts, through the triangulation of qualitative data from multiple sources (i.e. market reports, company documents, actor interviews).

The second limitation of this study, related to construct validity, is that in the second interview round only a few actors agreed to participate. This small sample group size, coupled with a potential selection bias, may have led to that not all subjective judgements of concepts introduced in this interview round have been incorporated in the study. As such, further inquiry is required to validate findings from this interview round.

Internal validity refers to: *"the strength of a cause-effect link made by a study whereby interviews, documentary evidence, and direct observations all are gathered in the real-world setting of the case being studied"* (Yin, 2003, p. 239). Due to the adoption of the Deweyan Inquiry, the final solution design is specifically tailored to the doubtful situation that is the subject matter of this study, which means that all interviews, documents, and observations were

gathered in the studied real-world situation. As such, the strength of the cause-effect link of the final solution design in the studied doubtful situation; the internal validity of the study, is high.

A study's external validity refers to the extent to which its findings can be generalized to other situations (Yin, 2003, p. 238). However, in the Deweyan Inquiry the validity of a final solution design is so dependent on context- and situation-specific factors, actors, and their relations, that it cannot be easily generalized. Consequently, rather than by means of subsequent quantitative research, generalizability to other situations is verified by means of solution design implementation and conducting intelligent experiments in the practice of those situations (Stompff, 2012, p. 300). The failure to generalize the final solution design to other situations without implementing and experimenting it again, is the third limitation of this study.

The reliability of a study refers to *"the consistency and repeatability of the research procedures"* (Yin, 2003, p. 240). This study is sufficiently reliable due to a comprehensive description of its research methodology, techniques, and interview protocols. Other researchers can use the same procedures, and ask the same questions, to arrive at the same conclusions. However, the precise outcome of a design process is never entirely certain. Multiple solution designs can be formulated within the design space that answer the research question. Therefore, it is possible that a second researcher will obtain the exact same final solution design, but it is unlikely. As such, the study is consistent, but not as repeatable as a quantitative study.

A fourth limitation is that the definition of solution decision criteria, and the allocation of weighting factors, was an arbitrary, subjective process. Although these were formulated and assigned collaboratively with practitioners, the definition of other criteria with different weighting factors, may lead to the selection of a different preferred concept solution design. Moreover, the formulation of the concept solution designs itself is also the outcome of a subjective design process. Although the design space is objectively defined, the design and selection of a specific solution design in that design space is subjective.

The fifth limitation of this study is related to the loss of neutrality by the researcher. Since in a pragmatist study the researcher is also a participant who enacts and interacts with the subject matter, the researcher may be hampered in making value-free observations. Stompff (2012) states that the potential consequences of this engagement bias are that the researcher is blindsided by its own or others' views on practice and reality. To reduce the engagement bias multiple data collection techniques were used. As such, through data- and method triangulation the effects of the engagement bias was minimized.

The last limitation of the study is related to its reflexivity, which refers to: "*how the researcher and intersubjective elements impact on and transform research*" (Finlay & Gough, 2003, p.4). A downside of using a pragmatist research method is that while designing a solution design with practitioners, a researcher can influence what is done in practice. As such, the researcher in this study may have unwittingly influenced the construction of meanings, thereby mediating the subject matter, and the outcome of the study. Reflexivity cannot be entirely avoided in a pragmatist study, but it reduces its reliability and external validity (Dewey, 1938).

As the final solution design is tailored to the Dutch book publishing industry, future research should be conducted to find out whether it is generalizable to other book publishing industries. Future research is also required to find out whether and which elements of its decline stage growth strategy are generalizable to firms operating in other declining industries. Furthermore, future research should define additional effective growth strategies for firms in declining industries (Anderson & Zeithaml, 1984). The potential benefits and risks should be uncovered in order to identify when a firm should pursue a growth strategy, and when it should employ an end-game strategy. Another suggestion for future research is identifying the applicability of the Deweyan Inquiry as a research method for conducting design-based research. Hereby, distinguishing in which ways it differs from existing (pragmatist) research methods. A last suggestion for future research would be to empirically verify the model for the future of books as described in section 4.2.

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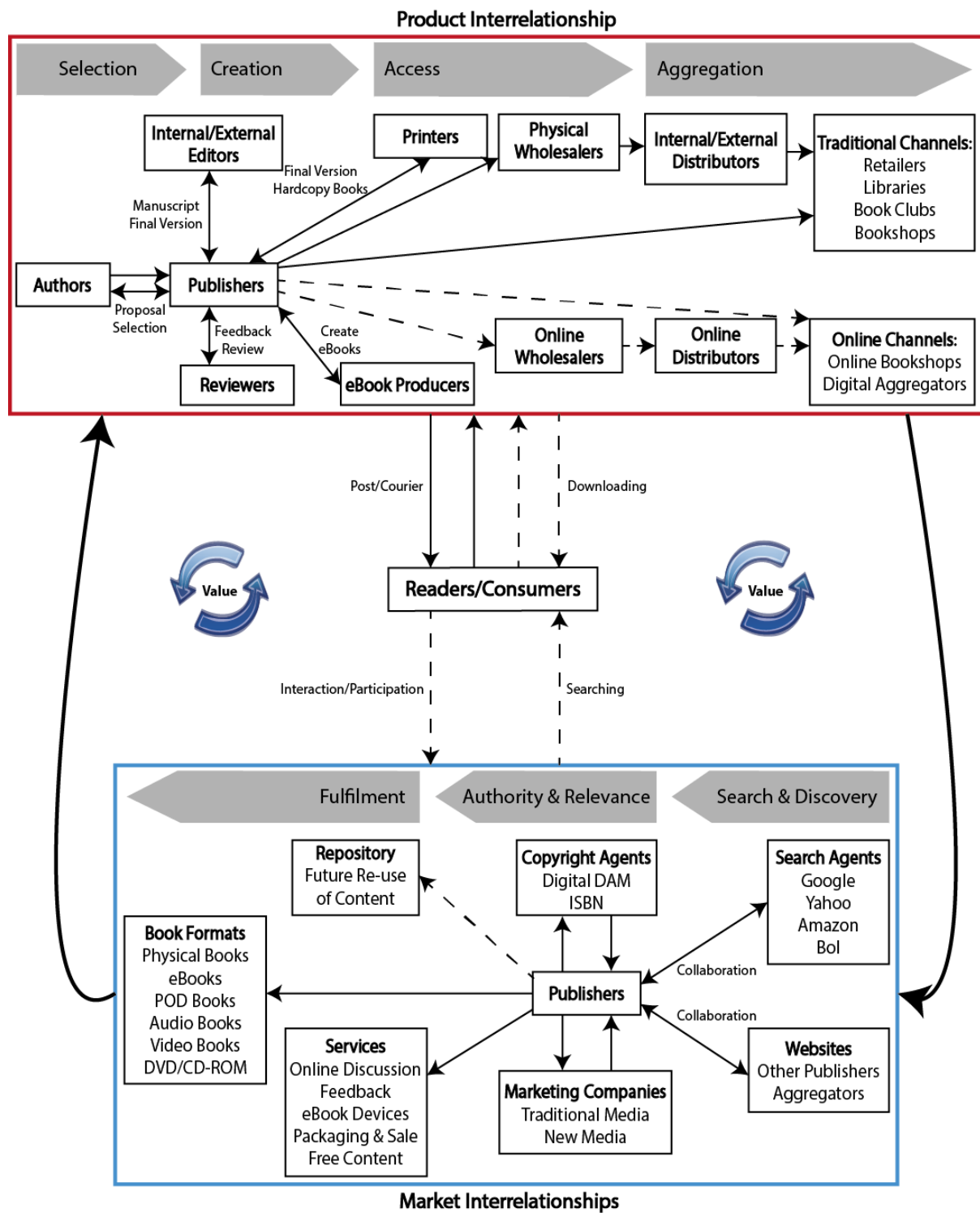# Appendix A: Book Publishing Value Network

Figure A.1: The Book Publishing Value Network (Tian & Martin, 2010)

Appendix B: Relationship Book Purpose & Digitization

Depending on a book's position on the book purpose spectrum it is possible to predict the likely appearance form of that book in the future, as a printed book may not be the most suitable medium for achieving its purpose. Digital IT media are more effective and efficient at transferring content, while providing an experience is currently best accomplished by paper books. As such, the digital transformation of the book industry will start with the digitization of books aimed at transferring content.

Transferring Content

If the purpose of a book is to transfer content; to inform, then the efficiency and effectiveness of an IT medium in achieving that purpose is vital in the choice for a medium. Digital IT media are better equipped to achieve this purpose because of the following reasons.

Firstly, research into active learning, which assumes that the most effective type of learning is experiential, mindful, and engaging, states that taking in and remembering new information, through means of reading a book is a rather ineffective method (Dale, 1969). Visual and verbal information transfer, participatory learning by saying and doing (e.g. feedback, coaching, case studies, etc.), or combinations of methods are a lot more effective in achieving the goal of transferring content into knowledge. A printed book cannot offer these additional methods of information transfer, while nowadays other forms of IT media can. For example, digital versions of higher education text books can provide live links to relevant case studies or provide learning platforms where information between author, professor, and students can be exchanged.

Secondly, if the main purpose of a book is transferring content, then the search function in an eBook or digital book version is much more effective in facilitating swift content search and transfer than paper books. Since it allows the reader to immediately jump to that part of a book that is of most interest to him. For example, an online dictionary or thesaurus is much faster and more efficient than a paper version.

Providing an Experience

Books aimed at providing an experience and evoking emotions benefit to a larger extent by a paper book. A paper book outlines a story, but allows for a person's imagination to fill in the gaps in the story, to visualize, and to experience the story, instead of doing it for a reader, like what happens in video games, films, or other digital media. Also, the visceral feel of a paper book, the pleasure of turning a page, and owning a printed book that can be displayed on a bookshelf, add to the experience of owning and reading a printed book (IT Strategies, 2013). These aspects of paper books, all related to the experience that a book creates, are currently unmatched by any other IT medium. Furthermore, the development of a new medium that is more capable than printed books in providing an experience, is not yet visible on the horizon. Although undoubtedly eventually a digital medium will be developed that surpasses the capabilities of a paper book in providing a fulfilling experience.

The suitability of a paper book for books providing an experience is illustrated in interviews with book readers who, when asked to describe printed books, tend to use words with an emotional, affectional connotation. While when they are asked to describe digital books, words like speed, efficiency, information sharing, and access come to mind. Those words do not possess emotional connotations, and are usually used to describe achieving a different purpose; a quantifiable goal: that of successful content transfer.

If one accepts that transferring content is on one end of the book purpose spectrum, and that digital IT media are more effective at achieving this purpose, while the goal on the other end; providing an experience, is currently best accomplished by printed books, then the digital transformation of the book publishing industry will start with the digitization of books categorized as more aimed at transferring content. Over time the process of book digitization will likely also become more visible in book categories that are more aimed at providing an experience, as advances in digital technology will enable this transition.

Appendix C: The Stagnation and Future of eBooks

EBooks: the What and Why

An eBook is an electronic version of a book read on either a personal computer, smartphone, tablet, or dedicated eReader. There are several advantages of reading eBooks over reading printed books. Firstly, with an eReader one can access many books at the same time, without having to carry a lot of weight around. This is convenient when commuting or travelling. Secondly, via an online library one can instantly access large amounts of eBook titles to be downloaded at any time. Thirdly, eBooks are generally cheaper. Finally, the ability to enlarge text of eBooks on an eReader appeals to many predominantly older readers.

There are also several disadvantages of eBooks. For instance, eBooks are not easily given as a present or borrowed, one cannot browse eBook titles in a brick-and-mortar bookstore, and eReaders have a limited battery life. In addition, reading from a screen for longer periods of time is found irritating to the eyes, and may reduce knowledge retention rates. Most importantly, according to interviews with book buyers, eReaders do not provide the visceral feel of reading a book; the pleasure of turning a page, feeling and smelling the paper, and the ability to put an eBook on a book shelve.

An eBook is in many ways similar to a paper book. It just transfers the content of a paper book into a digital file with the same structure as the original book. Therefore, books that have a linear story, which have to be read from a to z, lend themselves excellently to be transformed into an eBook. While for books that are not necessarily meant to be read in a linear fashion, an eBook offers little advantage. It is one of the reasons why the market share of eBooks is substantial in literary- and fiction book categories, while its market share in book categories like management-, educational-, and cooking books is insignificant.

EBook Market Development

After years of rapid growth eBook sales volume and –revenue growth is stagnating. In 2014 eBook sales revenues in NA grew with 3.8%, and its sales volume with just 0.2%. EBooks now account for 12% of US sales revenues, and 19% of US sales volume (Interquest, 2016a). In WE, after years of slow growth, eBooks only account for a small percentage of sales volume. Depending on the country, its market share in 2014 ranged from 2.9% in France, 4.7% in the NL, to 8.3% in the UK (Interquest, 2015). Furthermore, its growth is slowing down everywhere. The slow eBook market penetration in WE is largely due to the absence of a dominant firm driving the transition to and adoption of eBooks. This role is in NA fulfilled by Amazon, the dominant eBook market leader with roughly 70% market share (Taplin, 2016). Another reason for the slow adoption is more market regulation in WE. Many countries consider eBooks to be services rather than products, and charge a significantly higher VAT for eBooks, than for printed books. In addition, a high level of eBook piracy deflates market share figures. According to the Managing Director of Meulenhoff Boekerij, a Dutch publisher and market leader in eBook sales; *"Some studies, published two years ago, indicate that only one in ten eBooks on eReaders are paid for. The rest is most likely to a large extent obtained from an illegal source."* This makes many publishers reluctant to publish their books as eBooks.

Publishers and print providers in WE and NA confirm that eBooks are not a dominant trend anymore (Interquest, 2016a, 2016b). This reflects in eReader sales and ownership figures. E-Ink revenue declined by 22.9% in 2014 after a 29.0% decline in 2013 (Interquest, 2016a). The percentage of US citizens who owned an eReader declined from 32% to 19% in 2015, whilst the percentage of US citizens owning a tablet increased slightly from 42% to 45% (Pew Research Center, 2016). Worldwide the sales of eReaders declined in the last two years, although sales are expected to grow again in 2016 with 4% CAGR (Interquest, 2016a).

When asked about the impact of eBooks on digital book printing, 57% of British print providers, and 77% of French print providers indicated that they believe eBooks have no impact. (Interquest, 2015).

Respectively 15% and 9% even experienced eBooks as having a positive impact on digital book printing. This study agrees with the latter group that the rise of eBooks, which is now stagnating, in fact partly drives the increase in digital book printing popularity. Although substantial eBook sales volumes reduce the demand for printed books, it also drives the decrease in average book print run lengths. Lower average print run lengths in turn increase the amount of books titles that can be cost-efficiently printed digitally. Therefore, the existence of a market for eBooks has positive externalities for digital book printing.

The Future of eBooks and eReaders

Now the eBook market is stabilizing, the fear that aggressive eBook pricing leads to rapid erosion of printed book sales has waned. Therefore, the expectation is that several publishers and online bookstores will start experimenting with dynamic eBook pricing in order to drive eBook market growth. As such, in the short term the market share of eBooks is expected to continue to grow, although at a slower pace than before. The long-term future for reading eBooks on dedicated eReaders is less optimistic. The future of enhanced eBooks will likely be found on other IT media, such as smartphones or tablets, where multi-functionality is key. Enhanced reader-interactivity with a digital text will soon be made available for the mass market, with hyperlinks acting as online footnotes, atmospheric soundscapes, or critical commentary, a mere click away. However, even if there is no long-term future for eBooks than something else will come along, something (part) digital, that will take over a significant part of the book print market (see section 4.2).

With regard to the future of eReaders; the trend is to switch to reading books on smartphones or tablets, instead of on dedicated eReaders. In 2015 41% of readers in NA primarily read their eBooks on tablets (2012: 30%), 32% on eReaders (2012: 50%), and 14% on smartphones (2012: 9%) (Interquest, 2016a). Although people still prefer reading eBooks on an eReader or tablet to reading on a smartphone, this is expected to change. Many readers prefer the convenience of reading books on smartphones, especially when commuting or in situations where a larger electronic device or printed book is not practical.

An eReader is a stable platform created by Amazon for a conservative market. According to a Marketing Lead at Amazon: *"The challenge Amazon faces for the future of reading, is for this to effectively compete with other forms of media. We see that, and many publishers recognize this, books do not compete with other books, but with other forms of media, such as social media, Spotify, video's, games, or with the internet."* So, the future does not necessarily involve a dedicated eReader. Amazon recognizes its limited lifespan and is building towards a natural transition. For instance, by developing a phone with enhanced eReading capabilities (although the Amazon Fire phone has not been a success), and by integrating multiple IT media; combining eBooks and audiobooks.

Appendix D: Digital- & Offset Printing Technology

A book block can be printed using several printing technologies. The most used are digital- and offset printing technology. This appendix describes each technology, the decision criteria, and the consequences of selecting either one to print books, without going in too much depth with regard to the technical process.

Offset Printing Technology

Offset printing technology, introduced in 1875, uses a series of rotating cylinders to apply ink to paper, where each set of cylinders corresponds to a specific ink colour. By successively administering layers of ink that permeate the paper, an image is printed on a sheet or roll of paper. It starts as the paper passes a cylinder with a treated printing plate around it that transfers the image that is to be printed. As it spins it determines to which areas of the paper ink should be administered, and to which areas a water solution repelling the ink. An offset cylinder turning in the opposite direction removes the water solution from the printing plate cylinder, and transfers the ink to a rubber blanket in a mirror image. Then, a third cylinder; the impression cylinder, turning in the opposite direction, presses the ink of the final image on the paper.

A printing plate made of a thin sheet of either plastic or aluminium has to be specifically manufactured for every image that is printed. This takes time and brings about relatively high fixed production set-up costs. The variable costs of book production in higher volumes are very low, so when offset printing technology is used to produce books in high volumes, the average cost price goes down significantly.

Digital Printing Technology

Digital printing technology is a newer technology building on innovations in Xerography (1938), inkjet printing (1951), laser printing (1969), and thermal printing (1972). It differs in many aspects from offset printing. The biggest difference is that it does not use replaceable printing plates to transfer an image to paper. Digital printing electronically transfers an image to a print press, and then administrates the image to paper using toner in a single pass, or ink in a single- or multi-pass. The ink or toner that is used in digital printing does not permeate the paper, but forms a thin layer on the paper surface using a variety of fluids that fuse toner to paper using heat, fuse ink to paper using UV-light, or dry ink on paper using heat.

Digital Inkjet- and Electro-photographic Printing Technology

There are several types of digital printing technologies. Relevant for this study is distinguishing between digital electro-photographic (EPG) printing technology, which uses toner, electrostatic charges, and (sometimes) light to print an image on paper, and digital inkjet printing technology, which uses liquid ink droplets, and thermal- or piezoelectric printheads that administer drops of inkjet to print an image on paper. The digital inkjet technology used for book printing is generally faster, than EPG book printing technology. However, EPG book print presses are usually several times cheaper, and currently offer higher printing quality. Digital inkjet technology is a more recent innovation and its development is going more rapidly. Therefore, the expectation is that in the future digital inkjet technology will offer higher print quality, faster, at lower running costs, on as many different kinds of paper substrates as EPG printing technology.

Digital inkjet printing is the fastest growing segment within the book print market (see Figure 4.5), and significant quality-enhancing improvements are being made. As such, the print quality of both digital inkjet- and EPG print presses is approaching offset print quality, although further development is required.

Web-fed- and Sheet-fed Printing Technology

Another relevant distinction is between web-fed print presses and sheet-fed print presses. Sheet-fed print presses feed individual sheets of paper through a print press, while web-fed print presses feed a continuous roll of paper. Web-fed presses are generally faster and capable of reaching higher monthly volumes. Web-fed print presses offer production efficiency, whereas sheet-fed print presses offer application flexibility. Although sheet-fed print presses cannot compete on monthly volume or speed, they handle more diverse

media, and offer more media flexibility within a job. Furthermore, they are on average more (cost-)efficient for short runs due to shorter set-up times between print jobs. Digital inkjet-, digital EPG-, and offset print presses can all be used in combination with either sheet-fed technology or web-fed printing technology.

Book Printing Technology Decision Criteria

Digital printing does not require producing and changing printing plates. As such, digital print presses realize faster production, without incurring high fixed costs. However, offset printing realizes higher-quality output, especially in full-colour, while its low variable costs result in lower average unit cost for books produced in longer print runs. As such, deciding between printing technologies is not a simple choice. There are many decision criteria influencing the outcome of the decision process. This section illustrates the key decision criteria, and the consequences of selecting a printing technology for book production.

Average Print Run Length

Unit cost-wise digital printing is more appropriate for printing books in short print runs, while offset printing is more appropriate for printing in long print runs. Therefore, the length of a book print run generally determines the choice to use digital- or offset printing technology. Based on findings from the first interview round, it can be concluded that the run length break-even point currently lies, depending on the specifics of a book (i.e. its page length, amount of colour, finishing method, type and weight of paper substrate, etc.), somewhere between 200-700 books. This break-even point used to be higher (i.e. run length 1,000–2,000), but technology improvements in offset printing technology (e.g. automatic, simultaneous printing plate changes) have depressed the break-even point. As shown in Figure D.1, it is not cost-efficient to print a book using offset printing technology in run lengths below the break-even point, while for run lengths above the break-even point it is not cost-efficient to produce it using digital printing technology.
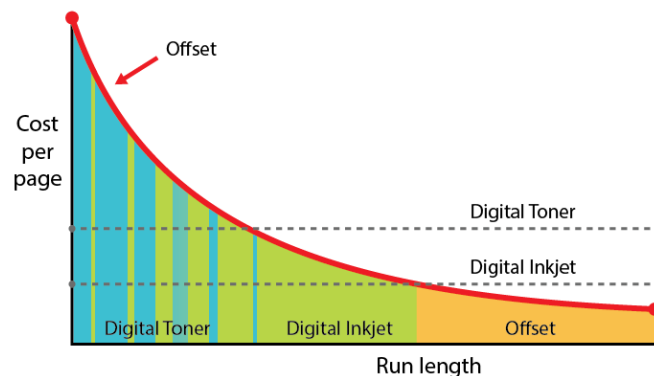

Figure D.1: Cost per Page for different Run Lengths for each Printing Technology (Ricoh Europe, 2014)

For example, digitally printing a 220-page book on 80 gsm (80 g/m²) paper in black and white would cost about €3.60 per book regardless of run length. Offset printing ten units of the same book would be more costly (i.e. > €100.- per book), but 5,000 units a lot cheaper than digital printing (≈ €1.-/€2.- per book).

There are also books that, regardless of their production volumes, are better off with digital printing. For instance, books that use variable data printing, such as customized- or personalized books. Such books cannot be produced using offset printing technology, as then for every version of a book a new, expensive printing plate would have to be manufactured, which would raise the unit costs exponentially.

Production Lead Time

Another decision criterion that influences the choice for a printing technology is the production lead time of a book. Digital printing has short set-up- and production times, which enables it to manufacture a book much faster than offset printing. An order of book(s) can be digitally printed immediately upon delivery of a digital file, while offset printing can only take place after manufacturing printing plates, and after accumulation of a book volume that warrants cost-efficient production. Even when all these preconditions are fulfilled offset production times are still longer due to the time it takes to change plates in-between runs.

Therefore, for books that have to be produced and shipped fast, digital printing is the only option. Depending on the specifics of a book, a typical digital print provider would be able to fulfil a customer order within 24 hours. An offset print provider would normally not be able to print and ship the order within 72 hours after receiving it. In that sense digital printing enables near-instant availability. Thus, when fulfilling orders fast is vital, then digital printing is preferred, despite that it might result in higher unit costs. For example, when not fulfilling a customer order within 48 hours would result in a lost sale.

Inventory Management
Digital printing does not necessitate producing to stock, because of its negligible set-up- and production times, coupled with its ability to cost-efficiently print a book in (very) short print runs. Therefore, it is seldom used to produce books to stock, but nearly always to produce to order. This in contrast to offset printing, which is always used to produce to stock based on forecasts, due to its long set-up- and production times, in combination with its required minimal print run length. Therefore, simply comparing unit costs based on an order's print run length is not sufficient to make a deliberate choice for a printing technology. Then one fails to account for costs that could be saved on keeping inventory. Since inventory costs are usually one of the highest accounts on publishers' balance sheets, this offers a huge cost-saving opportunity.

In addition, as producing to stock based on demand forecasts is always inaccurate, just using offset printing would result in either too little inventory and the loss of sales, or, more likely, to overproduction and to waste. Choosing to use digital printing eliminates this inaccuracy and waste. This highlights that digital- and offset printing technology can complement each other. For a forecasted demand of 2,000 books one would typically schedule an offset print run of 2,000 books. However, one can also use offset printing to print the book only 1,800 times, and saving the book as a digital file. Then it can immediately be digitally printed and shipped to a customer as a backorder as soon as the initial stock reaches zero. In that way lost sales, waste, and inventory costs can be substantially reduced, while fulfilling all orders.

Print Dimensions
Although most books can be printed on all print presses, some with oversized dimensions can only be printed on offset print presses. Still, a book's print dimensions is a decision criterion. Digital print presses generally print on paper less wide than offset print presses. For instance, an Océ VarioPrint i300 prints up till B3-format (i.e. 353x500 mm), and an Océ ColorStream 6000 on a max paper width of 540 mm. In contrast, a Heidelberg Speedmaster XL offset print press prints up till B1-format (i.e. 707x1,000 mm).

Paper Weight
Paper weight is a decision criterion as some books are printed on very thick, heavyweight paper, or on very thin, lightweight paper. For instance, bibles are printed on paper of 40-50 gsm. Most digital print presses cannot print on such lightweight paper. For instance, the paperweight ranges of the Océ VarioPrint i300, the Océ VarioPrint 6000, and the Océ ColorStream 6000 are respectively 60-300 gsm, 50-300 gsm, and 60-160 gsm. Meanwhile offset print presses print on both lightweight papers, as well as on heavyweight papers.

Substrate Range
The substrate range refers to the amount of substrates a print press can print on. Offset print presses offer a lot of flexibility as they print on a wide range of materials, like machine-coated-, uncoated-, gloss-, and silk paper, but also on board, wood, cloth, metal, leather, and plastic. Digital print presses, especially inkjet presses, print on a smaller substrate range. Since some book categories are only printed on specific paper types that fall outside this range, the applicability of digital print presses in those book categories is limited.

Colour Gamut
The colour gamut refers to the complete subset of colours a printing technology offers. Digital print presses are usually equipped with a four-color gamut described by the acronym CMYK (i.e. Cyan, Magenta, Yellow, and Key/Black). Offset print presses, such as the Heidelberg Speedmaster XL 106, are equipped with an

eight-colour gamut; CMYK, LC, LM, LY, LK, which includes an extra four diluted, lighter colours. A higher colour gamut enhances the look of images, making them more realistic. So, if image quality in a book is of utmost importance, such as for a photo book or a coffee table book, then offset print presses deliver this.

Finishing Options

Finishing refers to all activities performed after printing a book. This includes a wide range of activities, such as: binding, collating, coating, cutting, debossing, die cutting, embossing, foil stamping, folding, gluing, indexing, laminating, trimming, etc. Which finishing options can be performed after book printing is a key decision criterion, as without finishing the book would just be a stack of loose papers; an unsellable product.

Finishing activities can be conducted in-line, off-line, on-line or near-line. In-line finishing refers to when finishing is fully integrated within a print press; a complete end-to-end solution. Off-line finishing refers to when the finishing equipment and print press are completely separated, and there is no communication between the production factors. Near-line finishing refers to a solution in which there is no paper flow from the finishing equipment to the print press, but there is communication. Finally, on-line finishing refers to where there is a paper flow, a direct connection, between the production factors, but no communication.

Digital book printing has the reputation that the quality of its finishing is lower than that of offset printing. Finishing activities, such as, for instance, hardcover bookbinding, cannot keep up with the speed of digital printing. Therefore, often digital print providers just produce book blocks that have to be manually carried to the finishing equipment, where it is finished off-line. This slows down book production enormously, resulting in longer production- and delivery times. It also hampers digital book printing realizing on-demand hardcover book production. Hardcover books form a substantial part of many book categories (e.g. for literary-, fiction-, and non-fiction books).

In-line finishing appears to be the optimal solution as it automates a large part of the book production process, resulting in less paper handling, less required personnel, and less waste, while making job handling easier. However, it is not optimal for all production environments, as it only provides these advantages as long as the produced books are similar in size, shape, and finishing requirements. When this is not the case in-line finishing cannot reach maximal efficiency, which occurs when all modules within the in-line book production system operate at the same speed. In such instances other solutions are preferable.

Most book print providers opt for off-line finishing. Off-line finishing solutions offer versatility by allowing for the combination of printing output from multiple print presses, both offset and digital, in one book production workflow. Furthermore, if a print press is down, then off-line finishing equipment can still operate, and vice versa, which is not the case for in-line finishing solutions. Therefore, the overall system reliability of a book production line with off-line finishing is higher as production does not have to be halted when one of the production factors in the production line malfunctions.

Printing technologies that incorporate in-line finishing are mostly web-fed print presses, whereas sheet-fed print presses usually employ off-line finishing solutions. In the future more automation, integration, and communication will be required in the book production line, also for sheet-fed print presses. Then there will be a shift from off-line- to near-line finishing solutions, and to in-line finishing solutions. This is currently still a slow process as increased integration should not come at the cost of a loss in flexibility.

Appendix E: Categorization by Region & Book Category

The global book print market it is not a coherent market, but one fragmented across book categories and geographic regions. Each differs significantly in terms of print volume, print revenues, industry trends, etc. This makes it difficult to generalize findings. To define important trends and opportunities in the book publishing industry, one must first categorize it per geographic region and book category.

Categorization by Geographic Region

In the global book print market seven geographic regions can be defined that are internally more-or-less homogeneous on the country level, but externally heterogeneous. According to Smithers Pira (2015) those seven regions, and the important countries within those regions, are:
- North America (NA: Canada, US),
- Western Europe (WE: France, Germany, Italy, Netherlands, Spain, UK, other Western Europe),
- Asia (China, India, Japan, South Korea, other Asia),
- Latin America (Brazil, Mexico, other Latin America),
- Eastern Europe (Czech Republic, Poland, Russia, other Eastern Europe),
- Middle East (Turkey, other Middle East),
- Africa (Egypt, South Africa, other Africa), and
- Australasia (Australia, New Zealand).

Figure E.1 displays the market shares for each geographic region as percentage of the global book print volume in 2015, as well as their forecasted market shares in 2020 (Smithers Pira, 2015). The growth regions for the next five years will be Latin America and Asia. The regions Eastern Europe, Middle East, Africa, and Australasia are combined in the category 'Other', since their individual market shares are very small.
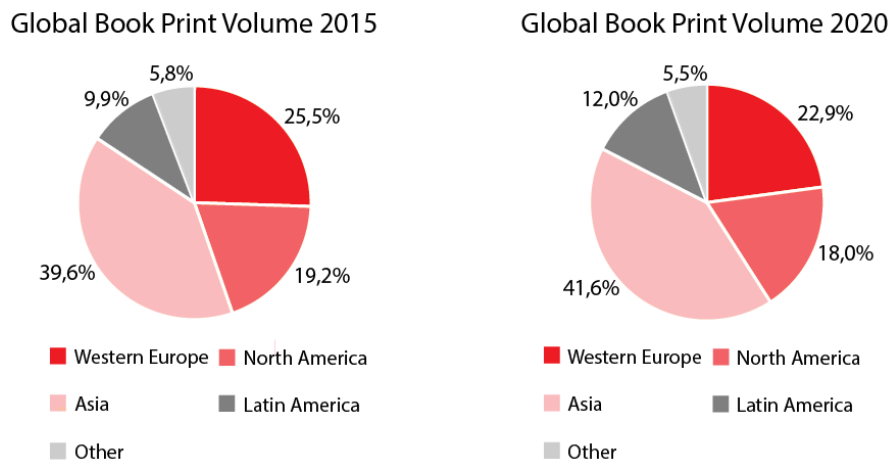
Figure E.1: Global Book Print Volume per Geographic Region (Smithers Pira, 2015)

Categorization by Book Category

Categorizing the global book print market by book category is useful as many actors in the book publishing industry tend to specialize in one or several book categories. Since no generally accepted book category classification exists, this study adopts the categorization of Interquest (2015), a leading market research & consulting firm in digital printing and publishing. They distinguish the following seven book categories:
1. Trade books,
2. Technical/Scientific/Professional (TSP) books,
3. Educational books,
4. Children books,
5. Coffee table books,

6. Religious books, and
7. Miscellaneous books.

Trade books are normal book editions that are released for the general public and available through ordinary sales channels, such as brick-and-mortar bookstores and mainstream online bookstores. Examples are: science fiction books, thrillers, literary books, biographies, art books, travel books, and cooking books.

TSP books are meant for specific audiences, aimed at providing foundational content and quality references to support research, learning, and professional practice in field like: life sciences, physical sciences, engineering, computing, and technology. Examples are: HRM books, law books, anthropology books, and company-specific books.

Educational books are books used in schools, colleges, and universities for the formal study of a subject. Examples of educational books are high-school mathematics books, calculus books, and elementary school-level history books.

Children books are books specifically written for children up to a certain age (≈12 years), and usually combine written work with accompanying illustrations. Examples of children books include short easy-to-read stories, picture books, and fairy tales.

Coffee table books are oversized, high-quality, expensive, usually hardcover books, intended to be looked at rather than read. Coffee table books consist mainly of photographs and illustrations accompanied by short text blocks.

Religious books are books containing scriptures or holy writ, which various religions consider to be sacred.

Miscellaneous books is a category that contains all other books that are not included in previous categories. Examples of miscellaneous books are: catalogues, comic books, guides, manuals, and music books.

Appendix F: Interviewees & Interview Protocol

Two interview rounds were conducted during this inquiry. The first was a semi-structured interview round conducted in step two and three of this inquiry. The second was a structured interview round in step four. The first round was partly for orientation, partly aimed at identifying ways to create and capture value within the book publishing industry. The primary goal of the second interview round was to gather info that could make the selected solution design more detailed, appropriate, and actionable. Its secondary goal was finding out whether actors were willing to support Océ in solution design implementation. This appendix displays the interview protocols for each round, and describes which people were selected and why.

First Round of Semi-Structured Interviews

In order to identify ways to create and capture value within the book publishing industry, the industry dynamics had to be fully understood. Therefore, an interview round was conducted with a subset of people who all worked for or represented a distinctive actor in the industry. In this round a total of 22 semi-structured interviews were conducted. The interviewees were either book buyers, or employed by brick-and-mortar bookstores, book chains, online bookstores, libraries, publishers, self-publishers, distributors, digital print providers, or offset print providers. In this way multiple perspectives were incorporated in the analysis. Each interview took approximately between 30-90 minutes, depending on the time that could be allotted by an interviewee. Table F.1 provides an overview of the people who were interviewed.

Table F.1: Interviewees in the first round of Semi-Structured Interviews

Interviewee	Function	Organization	Type of Actor
Bert Jan Hardenbol	-	-	Book buyer
Kim Gelissen	-	-	Book buyer
Nick Scholten	-	-	Book buyer
Simone Koch	-	-	Book buyer
Wayne Gommans	-	-	Book buyer
Yorinde Kooper	-	-	Book buyer
Jan Verhagen	Director	Boekhandel Van Piere	Brick-and-mortar bookstore
Fanny Gijsbers	Collection Manager	Bibliotheek Eindhoven	Library
Philip van Coevorden	CEO	Managementboek.nl	Online bookstore
Tamara Schouten	Commissioner Education	Industry Study Association	Online bookstore
Markus Colak	Marketing Lead	Amazon	Online bookstore
René Kik	Purchasing Manager	AKO	Brick-and-mortar book chain
Freek Talsma	Publishing Director	Vakmedianet	B2B publisher
Hans Koenen	Portfolio Manager	Thema	Management book publisher
Peter Paul van Bekkum	CEO	Mybestseller & Sweek	Self-publishing platform & Mobile publishing platform
Yrja Danner	Managing Director	Meulenhoff Boekerij	Publisher
Jorine Muller	Manager	Boekscout	Self-publisher
Herman Koetsier	Sales- & Account Manager	CB Logistics	Book distributor/Digital print provider
Rik Thijssen	Technical Director	Digiforce	Digital print provider
Ernst Weijers	Business Developer	Printforce	Digital print provider
Frank Tol	CEO	Scanlaser	Digital print provider
Frank van Zijl	CEO	Wilco	Offset print provider

Selection Procedure

The selection procedure for interviewees differs quite a lot per actor type. For one group; book buyers, interviewees were selected so that the gender distribution was 50% female and 50% male, and different age groups were equally represented. From other groups only one organization was selected. For those actors

the selection criterion was always that their organization should be classified as a typical organization within that actor type (i.e. for brick-and-mortar bookstores, brick-and-mortar book chains, and libraries this was the case). Typically those groups were deemed less relevant to this inquiry.

From the groups: offset print providers and book distributors, only one organization was selected per group, since in these groups there is only one dominant organization in the industry. This is not the case for publishers, self-publishers, and online bookstores. As such, within those groups several organizations were selected. The organizations that were selected within those groups target different customers, and are active in different book market segments.

Lastly, and most importantly, the interviewed digital print providers were selected on the basis of their size and relevance in the industry. Printforce, Scanlaser, Digiforce, and CB logistics all belong to the group of largest and most influential digital print providers in the NL. Several of these digital print providers are current customers of Océ, but none were approached via Océ contacts.

The choice to utilize these selection criteria might seem arbitrary, but this was not the case. All pertained to realizing the overall goal of the selection procedure: to select interviewees in such a way that a detailed, diverse, and complete picture of the book publishing industry and its dynamics could be obtained from the interviews. As such, whenever subdivisions within a certain actor group existed an effort was made to utilize a selection procedure that would result in including actors of both groups in the interview round.

Interview Protocol

Prior to each interview a brief introduction was sent via email to an interviewee. This email contained an indication of the things that were likely to be discussed during the interview. Below the interview protocol for the first interview round is displayed. Since the interviews were conducted in a semi-structured way with a diverse set of actors, the follow-up questions that were asked differ markedly per interview.

1. **How you would describe the organization that employs you?**
    a. What is the role that your organization fulfils in the book publishing industry?
    b. What distinguishes your organization from the competition?
    c. What is your role within the organization?
    d. With which other organizations does your organization deal while doing business?
2. **How is your organization currently doing in the book publishing industry economically?**
    a. Is the organization experiencing an increase, no change, or a decrease in demand?
        i. Why is that?
        ii. How does this affect your organization?
3. **Which aspects are crucial for your type of organization to be successful in the current Dutch book publishing industry?**
    a. Does your organization experience a change in the aspects that make your organization successful?
        i. If so, which aspects?
4. **In which forms can books appear in the market?**
    a. In which forms can paper books appear in the market?
        i. Which books appearance forms are preferred by what kind of book buyers?
        ii. Are there any trends in the appearance forms of paper books?
            1. What are those trends?
            2. Who initiates those trends?
    b. How is the distribution in online- versus offline book sales?
        i. How has this changed over the last couple of years?
    c. Are there differences in the appearance form of books across market segments?
5. **What is the difference between an offset printed book and a digitally printed books?**
    a. Are there differences in terms of quality, and if so, what are those differences?
    b. Which of the two would book buyers generally prefer, and why?
        i. Would other actors in the book publishing industry have a preference for either one?

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    c. What is your opinion about digitally printed books?

    d. How do you think the quality of digitally printed books can be improved?

6. **How does your organization manage inventory?**

    a. What is your opinions about a zero-inventory model?

7. **Could you tell me something about the Dutch book publishing value- and supply chains?**

    a. Are the value- and supply chains changing, and if so, in what way?

       i. What is the impact of those changes on your organization?

       ii. What is the impact of those changes on other actors in the book publishing industry?

8. **What is the future of the Dutch book publishing industry?**

    a. How do you view the future of the paper book?

       i. What will be the role of digital printing within that future?

       ii. What will be the role of your organization in that future?

          1. In what way will the role of your organization differ from its current role?

9. **What are currently the biggest opportunities and threats for your organization?**

    a. How is your organization dealing with those opportunities and treats?

    b. What should be done to capture the opportunities and to neutralize the threats?

10. **Would the book publishing industry be able to create more value for the book buyer?**

    a. In what ways could more value be created?

       i. Which organizations are required to create this value?

    b. If you were to dream about the future, what could (advances in) digital print technology do or improve for your organization?

       i. How do you view the current rate of technology development in digital print technology?

Second Round of Structured Interviews

After improving the selected solution design using academic findings and theories, it still was not detailed, appropriate, and actionable enough. Therefore, a second round of structured interviews was conducted. This interview round was smaller as it constituted only four interviews with interviewees who were employed by either digital print providers or finishing equipment manufacturers, as shown in Table F.2.

Table F.2: Interviewees in the second round of Structured Interviews

Interviewee	Function	Organization	Type of Actor
Daniel Rainbird	National Sales Executive	CP Bourg distributor	Finishing equipment manufacturer
Fons van Leusden	Manager R&D	Printforce	Digital print provider
Mathijs Suidman	Business Manager Media	CB Logistics	Book distributor/Digital print provider
Paul Keller	Product Manager	Müller Martini	Finishing equipment manufacturer

Selection Procedure

For this round of interviews only print providers and finishing equipment manufacturers were approached. The selection procedure was conducted as follows. First, all interviewees employed by print providers that were interviewed in the previous interview round were asked if they or a colleague wanted to participate in this interview round as well. One of those interviewees declined, two did not reply, and two accepted.

It was difficult to find finishing equipment manufacturers who wanted to participate. Especially since just manufacturers that produce bookbinding equipment were approached, and most of these firms are based abroad. This obstacle was circumvented by attending Drupa, the largest print media fair in the world. Here informal interviews were conducted with employees of bookbinding equipment manufacturers, such as Kolbus, Müller-Martini, and CP Bourg. A Product Manager of Müller-Martini and a National Sales Executive of a CP Bourg distributor later agreed to participate in the structured interview round.

That some actors who were interviewed in the first interview round did not reply or even declined to be interviewed in the second round may have led to some selection bias. The same goes for the finishing equipment manufacturers who were approached at Drupa. For it is possible that the actors that did not

agree to participate hold different opinions with regard to the solution design and its implementation. It is a limitation of this study that warrants further inquiry before final solution design implementation.

Interview Protocol

Like in the first interview round, prior to each interview a brief introduction was sent via email to an interviewee. This email contained an indication of the topics that were to be discussed during the interview. Below the interview protocol for the second round of interviews is displayed:

1. **How would you assess the degree of complementarity (the extent to which two mutually adapted machines can yield superior value in combination) between digital print presses and finishing machines for book printing applications?**
   a. How interconnected are the two processes?
2. **Will the importance of the integration of the digital print press with the finishing process change in the years to come?**
   a. If so, what are the drivers?
3. **In what way differs the integration of offset print presses with the finishing process from the integration of digital print presses with the finishing process?**
   a. Are they of the same quality, and if not, why not?
4. **Who should improve and develop the integrated offering for digital print providers who experience an increase in interconnectedness and automation: digital print press manufacturers, finishing equipment manufacturers, or a combination of both?**
5. **Would your organization be open for more collaboration or for an alliance with a print press manufacturer?**
   a. Why would or would your organization not be open?
   b. If so, who are the preferred partners and why?
6. **In what ways can the integration between digital print presses and finishing equipment be improved?**
   a. Which functionalities should be developed and why?
7. **Does your answer to question 6 differ when it comes to sheet-fed print presses as compared to the integration with web-fed print presses?**
   a. If so, why?
8. **What manner of alliance/collaboration would you deem necessary and/or plausible for digital print press manufacturers with your firm?**
   a. Why would you deem such an alliance necessary/plausible?
   b. How could such an alliance be created and managed?
   c. Who should take initiative and why?
9. **What do you think should occur in order for digital book printing to gain (a lot) more market share from offset book printing, and why?**
   a. To what extent do you think a proposed alliance would help in raising digital printing's value proposition as compared to offset printing in the book print market?
10. **How do you envision the future of printed books; both for offset printed books as for digitally printed books?**

Appendix G: Allocating Solution Decision Criteria Scores

Table G.1 indicates the scores of each concept solution design on the solution decision criteria. Scores are expressed as either a positive score; (++/+), a neutral score; (0), or negative score; (-/--).The importance of a solution decision criterion, and the allocation of a corresponding weighting factor, was done collaboratively with Océ practitioners. Based on which were subjectively agreed on to be the most important criteria. The problem-solving capabilities and the impact on profitability were found to be the most important solution decision criteria, and assigned a weighting factor of three. The risks and the implementation time were found to be the least important criteria, and assigned a weighting factor of one. All other solution decision criteria were assigned a weighting factor of two. The sum of these scores multiplied by a criterion's importance determined which concept solution design was selected. The remainder of this appendix provides the reasoning for allocating scores to concept solution designs.

Table G.1: Comparison of the four Concept Solution Designs based on Solution Decision Criteria Scores

Solution Decision Criteria:	Importance	Concept Solution 1	Concept Solution 2	Concept Solution 3	Concept Solution 4
Problem-solving Capabilities	3	+	-	+	++
Impact on Profitability	3	0	++	+	++
Feasibility	2	-	++	0	++
Implementation Costs	2	0	+	--	-
Degree of Change Involved	2	+	++	-	0
Risks	1	-	+	-	0
Implementation Time	1	-	-	--	0
Total		**+1**	**+13**	**-3**	**+14**

* Importance: 1 = Low Importance, 2 = Medium Importance, 3 = High Importance

Concept Solution Design 1: POD Workflow Automation

Concept solution design 1 does not address the alteration in the mix of book print categories. The same goes for the threat to the existence of the book print market in the long term. Coupling print press software with inventory management software of sales channels automatizes print job sequencing, and helps in accommodating JIT delivery, which are requirements that digital print presses will have to fulfil in the future. However it does not address the change in how print volume will be divided over printing technologies. Hence, its problem-solving capabilities are present but limited.

Its feasibility is questionable as it is doubtful whether a manufacturer of ERP software would be open to developing software with which print press software can be coupled to firms' ERP systems. The technical feasibility is also questionable as it not clear whether the development of such a link is possible. The impact on profitability is positive as the improved value proposition will probably lead to more print press sales. However, it is hard to predict how many, since it is not clear how many firms would like to have such print press functionalities and how many are willing to pay for it. So, whether it will pay for the development- and implementation costs is difficult to predict. The implementation costs of this solution are substantial.

The risks involved are considerable as implementation would require starting a new R&D project, in cooperation with an external party, while the demand for the solution is uncertain. The degree of change involved is low as it does not change the core functionality of the print press, nor the way in which Océ operates. Finally, the implementation time is significant as first an alliance has to be formed, followed by the development of the software, before it can be field-tested and sold.

Concept Solution Design 2: Extensive Printing- and Distribution Network

An extensive printing- and distribution network creates value for book buyers, but it does nothing to solve aspects of the problem. Its feasibility on the other hand is quite high. Océ does not have to develop any

new technology to implement it. It just has to find a digital print provider willing to set up such a network. This will likely not be extremely difficult as the general sentiment towards such an undertaking is positive.

Its impact on profitability is high and positive. A printing- and distribution network would lead to many print press sales, and to more print volume produced on Océ print presses, resulting in more variable earnings. The implementation costs are low, although with a large one-time order Océ may need to make some concessions with regard to the sales- or leasing price. However, this can later be earned back through an increase in variable charges, such as click prices, consumables, and service/maintenance. There is a low degree of change involved, since no new technology is required.

The risks of implementation are low, as besides finding a suitable, trustworthy partner firm there are few uncertainties left once the contract is signed and the print presses are up and running. Océ does not stand to lose a lot once the printing- and distribution network is established. Searching for a digital print provider who is willing to partner up with Océ will take some time, but afterwards implementation can occur swiftly.

Concept Solution Design 3: Low-end Sheet-fed Inkjet POD Print press

Developing a low-end sheet-fed inkjet POD print press is a costly endeavour that takes time, but it does solve part of the problem. By facilitating POD and by cutting out the middle man (i.e. digital print providers) it is an appropriate response to the industry disintermediation following the digital transformation of the industry. However, it does not nothing for the alteration in the mix of book print categories, and little for how book volume is divided over printing technologies. Although bookstores and (self-)publishers might choose to print more books digitally, as opposed to using offset, once they their own POD print press.

Its feasibility is neutral. Although technically it is doubtless feasible to develop a print press tailored to POD, in practice it is uncertain how much Océ would be able to reuse current print press architectures, or whether they have to start from scratch. If so, then the positive impact on profitability by tapping into a new market segment would probably not justify the high development costs. Overall, the solution design poses a large degree of change as it constitutes not just the development of a new print press, but also creating a new market segment with new customers. As such, the risks are quite high. Furthermore, the amount of sales that can be realized in this new market segment is ambiguous. Expressions of intent to buy a POD print press by bookstores and (self-)publishers are not enough to justify its investments.

Concept Solution Design 4: Strategic Alliance with Book Finishing Equipment Manufacturers

Conducting a strategic alliance with book finishing equipment manufacturers potentially solves multiple aspects of the problem. As the mix of book print categories changes due to the digital transformation of the book publishing industry, the books remaining in print will be more aimed at providing an experience. Currently digital book printing is predominantly used for producing books aimed at transferring content. For such books finishing activities usually does not have to live up to the same high standards, as books aimed at providing an experience have to. By increasing the complementarity and integration of finishing equipment with digital print presses, the quality and number of book finishing options is raised, thereby directly addressing one of the problems following the digital transformation of the industry.

Currently more high-quality finishing options for offset printing exist. However, as this solution design raises the value proposition of digital printing, its implementation turns digital printing into a more attractive alternative to offset printing, which helps tip the balance of how book print volume is divided over printing technologies in favour of digital printing. Therefore, its impact on profitability is potentially very high. Furthermore, it reduces production- and set-up lead times, and raises the quality of the final product, which are requirements that digital print presses will have to meet in the future. Nevertheless, this solution design does not solve the entire problem, as it has little effect on the lifespan of book printing.

The feasibility of this concept solution design is quite high as many finishing equipment manufacturers are open to some level of collaboration. Furthermore, as they and Océ do not compete with each other, both

manufacture production factors that complement each other, and both can learn from each other's expertise, they would likely perceive sufficient benefits to form a strategic alliance.

Although a sales collaboration would not cost a lot of resources, conducting an R&D collaboration, or even a joint R&D development project, would make solution design implementation a rather costly project, involving quite some degree of change. The risks are substantial, but these risks can be shared with an alliance partner. Furthermore, the digital print providers would benefit from this solution to such an extent, that there can be little doubt to whether there would be a demand for a digital print press that is easier to integrate with finishing equipment. Lastly, implementing the first two levels of this solution (Lv. 0: Mapping finishing landscape, and Lv. 1: Sales collaboration) takes little time. The next level (Lv. 2: R&D collaboration), and especially the highest level (Lv. 3: Joint R&D development project) takes a lot more time, but as this solution can be scaled up over time, initial implementation is fast.

Comparing Scores

Table G.1 tallies the scores for each solution design. Solution design 2 and 4 score highest; +13 and +14 respectively. Solution design 1 and 3 are immediately eliminated, as their scores are significantly lower; +1 and -3 respectively. The final scores are very close, but after careful consideration in the feedback meeting, it was decided to select solution design 4: Strategic Alliance with book finishing equipment manufacturers. The decisive argument was that although both solution designs appear promising, solution design 2 does not solve any aspect of the problem as defined in the problem statement. Since solution design 4 scores very positive on this solution decision criterion it was selected as the preferred solution design.

Appendix H: Business Model Innovation

A way to visualize how a business model innovation changes a firm's business model is through the construction of a business model map. The most commonly used mapping approach is the Osterwalder mapping approach. Using this mapping approach one creates a business model canvas, which consists of the following nine building blocks (Osterwalder & Pigneur, 2010):

1. *Customer segments*; specifying the groups of users with similar needs to whom the technology is valuable and for whom the value is created and delivered to.
2. *Value proposition*; description of what and how the product creates value for the target user by satisfying the customer's needs, described by its benefits, not its features.
3. *Customer relationships*; the relationships and communication methods of a firm with its customers.
4. *Channels*; the sales- and distribution channels used to deliver the product to the customer.
5. *Revenue streams*; defining what created value a customer must pay for, in what way, form, and frequency.
6. *Key resources*; the required resource endowment to create and deliver a product, and to maintain the channels and customer relationships necessary in order to make a business model function well.
7. *Key activities*; the activities which have to be performed in order to create, deliver, and capture value for the end customer, while maintaining the channels and customer relationships.
8. *Key partners*; the partners which are required to make the business model function well by, for example, co-creating the value proposition, or granting access to channels or to certain customer segments.
9. *Cost structure*; the architecture of the costs of implementing the business model.

Delivering value in a novel way to a firm's customers by changing the building blocks of a business model is only referred to as a business model innovation when two or more building blocks of a business model are altered (Lindgardt et al., 2009). The proposed solution design entails the alteration of three building blocks of the traditional business model of Océ; the value proposition, the key partners, and the key resources (Osterwalder & Pigneur, 2010). As such, it can be classified as a business model innovation.

Indicating how the implementation of the solution design innovates Océ's business model is not straightforward. Océ currently targets the book publishing industry with a variety of digital print presses. These make use of different technologies and offer different benefits. Also, to create and deliver value to the customer each print press requires different activities, resources, and partners. To further complicate matters each print press is not just used for book publishing applications, but also for a variety of other applications, such as transaction and direct mail applications. Consequently, it is impossible to construct a single business model for all Océ's digital print presses targeted at the book publishing industry. However, it is possible to capture how the building blocks of all business models of digital print presses targeted at book publishing applications are altered. Namely, the proposed business model innovation adds some benefits to each business model's value proposition, external resources to the key resources, and a complementary finishing partner to the key partners.

Figure H.1 on the next page indicates in red how the building blocks of Océ's business models for digital book print presses are altered following solution design implementation. It only shows those elements that are added to each building block. It omits the existing key partners, key resources, and benefits offered that are unchanged. Furthermore, the other building blocks that are not altered are deliberately left blank.

Key Partners 🔗	Key Activities ☑	Value Proposition 🎁	Customer Relationships ♥	Customer Segments
Finishing Partner • (Hardcover) Bookbinding Equipment Manufacturer		*Book Publishing* • Higher Complementarity & Improved Integration of Digital Print Press & Hardcover Bookbinding Equipment • Improved Print Process Management, Sequencing, and Monitoring for (Very) Short-run (Hardcover) Book Production		
	Key Resources 🏭 *External Resources* • Knowledge, Skills, and Experience with Print Finishing Integration & Product Development		Channels 🚚	

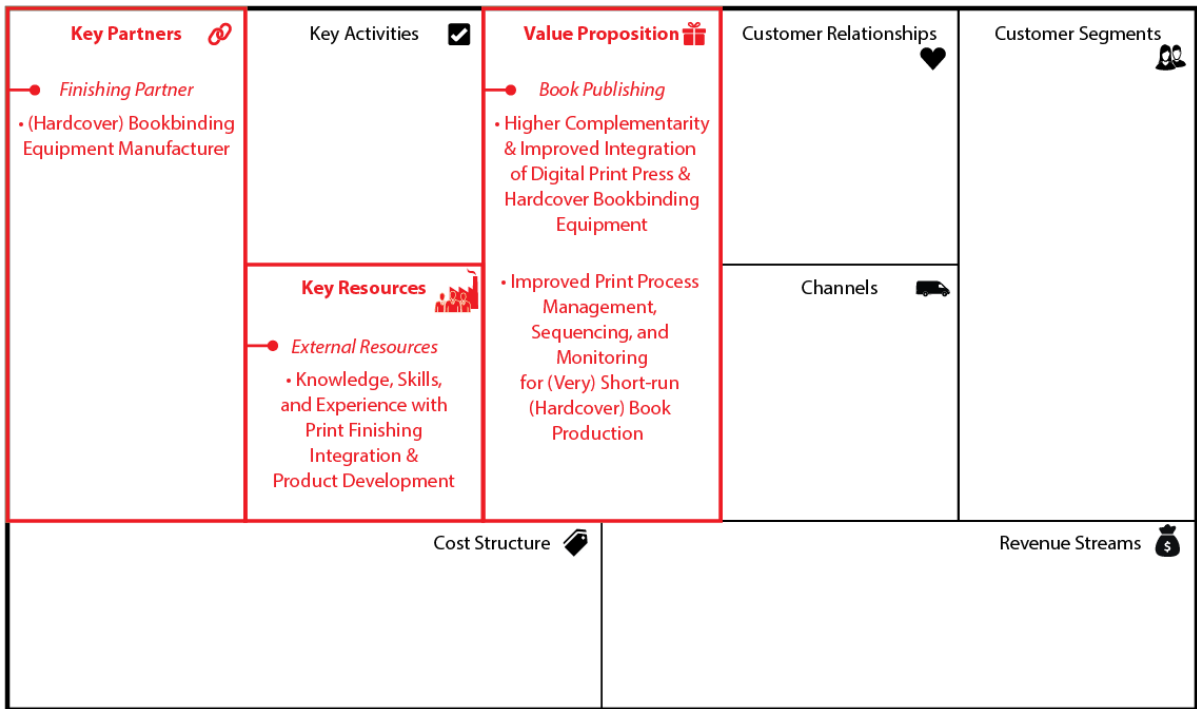| Cost Structure 🏷	Revenue Streams 💰

Figure H.1: Alterations to Océ's Business Models following Solution Design Implementation