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Commercial Print: Strategies for Improving Profit in a Contracting Market

CAPSTONE REPORT

Clint Wolford
Solutions Development Manager
RICOH USA

University of Oregon
Applied Information
Management
Program

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Academic Extension
1277 University of Oregon
Eugene, OR 97403-1277
(800) 824-2714

Approved by

Dr. Kara McFall
Director, AIM Program

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Clint Wolford

RICOH USA

Abstract

Pressure applied from the proliferation of digital media has constricted commercial print demand. This study identifies sources to inform the best workflow practices and technologies for commercial printers to reduce costs and manage profitability in the competitive environment. The audience for this paper is owners of commercial print shops that have experienced the reduction in print volume. This annotated bibliography provides potential strategies to overcome the reduced demand in the printing industry.

Keywords: commercial printers, cost control, workflow, print shop profitability, print volume contraction, printing industry, digital media.

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Introduction

Problem

In recent years, the commercial print industry has come under siege from a number of actors. For the purpose of this study, commercial print will be defined as an industry composed of:

establishments primarily engaged in printing on apparel and textile products, paper, metal, glass, plastics, and other materials, except fabric (grey goods). The printing processes employed include, but are not limited to, lithographic, gravure, screen, flexographic, digital, and letterpress. Establishments in this industry do not manufacture the stock that they print but may perform post-printing activities, such as bending, cutting, or laminating the materials they print, and mailing.

(2016 US Print and Market Outlook, 2016, p. 1)

One circumstance contributing to the reduction of print is the propagation of information via digital media; as one source posits, “the growth of digital communications and media has had a tremendous impact on print demand. For the most part, the impact has been negative, with digital communications replacing print communications” (Davis, 2014, p. 3). Other sources echo that sentiment, with one stating, “The Association of American Publishers reports that ebook sales revenue was \$345 million from January to October 2010, a 171 percent growth from the same time period in 2009” (Hu & Smith, 2016, p. 3).

Significantly lower cost is another factor bolstering the growth in electronic publishing, as this methodology results “in reduced costs of duplication” (Oiestad & Bugge, 2013, p. 57).

Maxim and Maxim (2012) postulate, “in the absence of physical printing and distribution, prices [of ebooks] should be significantly lower than in the case of traditional books” (p. 4).

Another advantage driving the use of digital media is that advanced technology can be embedded in content to provide a richer user experience as “more authors are taking advantage of the ability to use animations, video, and even interactive material—none of which can be part of the printed journal” (Alberede et al., 2008, p. 1). Cherian (2015) indicates that digital distribution of information has played an important role in the demise of commercial print volumes over the last decade stating, “as the online news sites have greatly satisfied the expectations of the readers, there has been a decrease in the circulation of print newspapers” (p. 2). As Lichtenberg (2012) notes, “in the spirit of TV’s Jeopardy, we might see the following answer: ‘The biggest loser as reading migrates to dedicated e-readers and other electronic devices,’ to which the question would be, ‘what’s a printer’” (p. 23).

In addition to pressure applied by electronic dissemination of information, economics also has a hand in the reduction of print volumes. Although many elements impact production print levels, “the number one factor is the economy. For the most part, the [print] industry closely follows the direction of the economy” (Davis, 2014, p. 4). Davis (2014) also declares that the print industry “declines more and faster [than other industries] in economic downturns and recovers more slowly as the economy recovers” (p. 4). Kapel (2014) declares, “while the country begins to emerge from the ‘Great Recession,’ the print industry remains in decline” (p. 1). Although the economy has been on a slow yet steady incline, print will continue to lag behind other industries and potentially may never fully recover to previous levels (Davis, 2014; Kapel, 2010). In a 2010 study Kapel (2010) cited National Association for Printing Leadership (NAPL) economists in noting that “as of August 31 [2010], sales were down 19.9% from their pre-

recession peak and 22.5% from their all-time peak” (p. 1). Davis (2014) found that commercial printers analyzed in a 2014 study “attained average profit rates of 2.7 percent on sales--up from 1.8 percent last year. This is the highest level in the past six years, but it is still not back to the prerecession level of 3.1 percent in 2008” (Davis, 2014, p. 4).

The sheer volume of commercial print shops has exacerbated the economic issues the industry is experiencing. Gallagher (2009) writes, “print is an over-capacity industry. It is a major issue and it is the reason why there is major consolidation and redundancies are being made” (p. 1). Many of these consolidations and closures have already occurred; a study performed in 2010 reveals that the “latest data indicates approximately 7,200 establishments - or 20.5% of the industry - have disappeared since 2000” (Kapel, 2010, p. 1). This industry contraction continues to force remaining printers to be more productive with the same resources (Kapel, 2010, p. 1).

Finally, the escalation of postal delivery rates is having an unfavorable effect on commercial print volumes. The increase in standard mail rates is mirrored by a decline in print as Davis (2014) offers, “for every 1 percent increase in postage rates, the dollar volume of print distributed through the mail decreases by 0.4 percent” (p. 3). Accordingly, this relationship can be expected to have ongoing implications for the commercial print industry as postal rates continue to rise.

The reduction in print volumes due to these external forces has put substantial pressure on commercial and in-plant printers to do more with the same resources as “sales per employee have increased nearly 40% in the past 10 years” (Kapel, 2010, p. 1), putting pressure on existing staff to produce more work. The increase in sales volumes per employee is due not to improvements in sales approaches, but because the contraction in print levels has led to the

reduction and consolidation of commercial print businesses. Overall, the reduction in commercial print that occurred during the Great Recession has resulted in fewer printers to handle the current volume of sales (Kapel, 2010).

As the sales of printed materials have declined, the practice of printing and storing physical inventories of book titles has produced a strain on the associated operating income and profit. Lichtenberg (2012) writes that the “lost revenue involved in the process of manufacturing, warehousing, distributing, and retailing of physical products is one of the reasons that publishing margins have become historically thin” (p. 24). There is evidence to suggest that the transformations in publishing could have a catastrophic impact on printers and the manufacturers of print technology; according to Gallagher (2008) with “this wave of digitisation and new platforms and devices to access texts, there are fears that traditional printers could face a fight for survival” (p. 1). Therefore, finding novel approaches to address the financial issues facing the print industry is critical to the short and long term success of commercial printers and printer manufacturers.

The primary focus for this Capstone project is the identification of means of reducing the cost of production print manufacturing, which assists in addressing the reduction in profits that arise from the continuing contraction of commercial print volumes. This reduction has and will continue to have significant repercussions for commercial and in-plant print operations through all vertical market segments (Tan, 2008). The goal of exploring this topic is to inform the development of a potential course of action for print providers to respond to the continuing diminution of demand for print products.

Purpose statement

The purpose of this literature review is to present literature that describes potential strategies that may be employed by commercial printers to control costs, serving to address profitability concerns due to eroding print volumes. This study pursues those strategies through vigorous research review. For the purposes of this study, the competitive pressures in the print industry are defined as myriad digital technologies such as computers, tablets, and smartphones that have the potential to take the place of traditional printed materials. In addition, this paper presents literature that can be used in building a roadmap to mitigate these risks with best practices in the areas of process automation and new technology that will yield lower costs.

Research Questions

Main question. What are best practices and technologies that can be employed to reduce costs for commercial printers?

Sub-questions. How can those technologies and business processes be implemented by commercial printers? Are there additional benefits to stakeholders in using these technologies and practices?

Audience

The primary stakeholders for this annotated bibliography are commercial print shop owners and operators, as well as the sales management of production print equipment manufacturers. These parties are responsible for steering the course of the print industry and they are acutely impacted by the reduction in commercial print volumes. As stakeholders in the print industry navigate the changing market conditions, they need to be aware that “reengineering can bring in significant benefits to companies in the printing industry, despite

the fact that it is a strategy of complex, thorough and difficult change” (Susanu, Nicoleta, Susanu, & Micu, 2012, p. 1). This study is an important component in the discussion of why the industry is in decline and ideally can be employed to construct potential solutions allowing commercial printers to survive and thrive in the evolving landscape of the print industry.

Search Report

Search strategy. The primary method of gathering data employs queries using key words in Google Scholar and the UOLibraries to facilitate a literature review. Several queries from Google Scholar return sources that are then accessed via UOLibraries. Further sources are found in the reference lists of those works returned from initial queries and by employing key words found in those lists.

Keywords. An initial search term of commercial print produces references to several other key words that are applied to further searches. The following is a list of key words utilized in the searches:

- *commercial print industry*
- *commercial print management*
- *commercial print services*
- *commercial print technology application*
- *commercial print economics*
- *print industry trends*
- *printing technology*
- *commercial printing costs*
- *management information systems*

- *print process automation*
- *web to print*
- *offset print industry*
- *offset printers*
- *quickprint*
- *lean manufacturing*
- *digital printing systems analysis*
- *ebooks*
- *jdf workflow*
- *CIP4*
- *production print*

Search engines and databases

Searches are conducted in the UO Library and Google Scholar. Query results are found in a number of database sources:

- EBSCO host
- Academic One File
- Academic Search Premier
- Proquest Educational Journals
- Lexis Nexis Academic
- JSTOR
- Web of Science
- Computer Source
- UO Local Catalog

- Elsevier Science Direct Journals Complete
- Web of Science
- IEEE Explore Discovery Documents

Documentation Method

Documentation approach. All references are documented using two complimentary methods. First, a reference citation is created in a Microsoft Word document using the citation tools in the UO Libraries search engine. All bibliographic entries are audited and edited, if necessary, to comply with the American Psychological Association (APA) standards. The abstract is also copied into this document for later reference and potential use in the annotated bibliography.

Next, an entry for each document is created in a Microsoft Excel spreadsheet. The column headers of this spreadsheet include the author, title, date published, key words used to find the document and page numbers of in-text citations, if appropriate. In addition, each entry is color coded to assist in a quick visual inspection of how the document is used in the paper. Documents that have been cited are color coded blue. Documents that inform the problem of a decline in commercial print volumes are color coded red. Finally, documents that pertain to potential cost reduction best practices or technologies are color coded green.

All reference documents are downloaded as Portable Document Format (PDF) files that are put into a directory based on the supporting category. Documents are also printed and areas of potential citation are highlighted. All electronic documents are backed up in the cloud on Dropbox.

Reference Evaluation

Reference evaluation criteria. To assess the legitimacy of sources collected for this literature review, all reference material is evaluated against a set of five criteria outlined by the Center for Public Issues in Education. According to their guidelines, “Evaluating information sources is an important skill that involves deciding where to look for information, sifting through it, and deciding what to accept” (Center for Public Issues, 2014). The five criteria for evaluation of sources are authority, timeliness, quality, relevancy, and lack of bias (Center for Public Issues, 2014). Authority for an article is derived from the author’s credentials and whether the article is from a peer-reviewed source. Given the fact that this review is focused on the current state of commercial print, timeliness is also an important consideration in the validity of referenced sources. To that end, sources older than ten years are excluded. Next, the quality of a given reference is determined by elements such as proper grammar, punctuation, and spelling, as well as the overall organization and flow of the document. References are analyzed to determine if they include information pertinent to the cause of commercial print volume retraction or proposed solutions for cost control to determine relevancy. Finally, sources that display bias by the promotion or selling of any product are excluded. References must have well established and supported conclusions that demonstrate an interest in multiple perspectives.

Annotated Bibliography

The following annotated bibliography contains 15 references that inform the problem of contracting commercial print volumes and provide insight into potential strategies to reduce cost in the manufacture of commercial print. The intent of these selected sources is to convey this information to commercial print shop owners, managers, and operators in order to bolster their understanding of the paradigm shift in publishing from traditional to digital media due to technical advantages, consumer preferences, and economic factors. These references have been organized into the following categories to facilitate a logical information flow:

- Root causes of reductions in commercial print volumes, and
- Technologies and best practices for reducing cost in commercial print.

Each annotation includes three components. The first element is a complete bibliographic citation in APA format. Next, the published abstract for each citation provides the author's notes on the content of the source. Finally, a summary of the source is included to provide an interpretation of how each reference relates to the problem and purpose of this literature review.

Root Causes of Reductions in Commercial Print Volumes

Albarède, F., C. Constable, C. Duffy, S. Fuselier, J. Penner, R. Preller, D. Strobel, K. Suyehiro, & Verstraete, M. (2008). The demise of print, *Eos Trans. AGU*, 89(28), pp. 257–257, doi:10.1029/2008EO280005

Abstract. No print subscriptions to AGU journals will be available after 2010. Since 2002, when the electronic journal was made the version of record, it was clear that the day would come when the print version would be unsustainable.

First, the printed version would increasingly differ from the electronic one. One of AGU's goals for the conversion to electronic delivery was to take the journal beyond the printed page. More authors are taking advantage of the ability to use animations, video, and even interactive material—none of which can be part of the printed journal. Also, more authors are choosing to have color only in the electronic journal.

Summary. The primary focus of this article is reasons why the American Geophysical Union (AGU) has opted to forgo traditional printing of its monthly journal in favor of digital publishing. The authors begin with a discussion of the evolution of the digital version of the journal and how it differs substantially from the printed version due to the use of technologies such as video and animations that enhance the user experience and serve to more adequately illustrate important concepts than traditional printed text.

In addition, the authors espouse the benefits of digital publication, finding that this method provides more useful access to the information contained in the journal via content search capabilities not found in paper formats, better portability, and ease of access.

One negative consideration of the movement to electronic presentation of the journal noted by the authors is the fact that there are some subscribing groups that may not have access to the Internet or computer facilities to access the new model. The AGU is committed to assisting those organizations with the transition.

The article goes on to cite economic reasons for moving to digital publishing, as traditional print is costlier than digital publishing and hardcopy subscriptions have declined, resulting in all members bearing the cost of print while not all derive benefit.

The goal of the AGU is to continue to provide a high level of useable content while lowering costs to subscribers.

This article is relevant for this study because it provides research on the reasons why traditional print volumes are in decline while digital delivery methods are continuing on a path of rapid growth.

Cherian, J. (2015). Emergence of digital publishing – a great challenge to the print publications.

Procedia Economics and Finance, 23, pp. 576-586. doi:10.1016/S2212-5671(15)00361-5

Abstract. In this modern age, people are provided with a wide range of traditional and digital channels. Currently online news sites have greatly satisfied the expectations of the readers, and there has been a decrease in the circulation of print newspapers. This study examines the consumer choice of print and online media with respect to demographics and preference of format. The study adopted a primary quantitative data collection approach wherein a paper-based survey of 102 journalists was carried out. This research paper inspected the impact of the variables involved (online media and print media) on each other as well as the cause-effect relationship between them. It also highlighted the two main categories of input — descriptive research and explorative research. To tabulate results of the former, the qualitative data that had been collected (after conducting the Elite and Specialized Interview, and the Focus Group Interview). These three facets were then examined simultaneously on the basis of certain hypotheses made, which were fittingly measured with the help of the Chi-Square (or the Null Hypothesis) test. It was concluded that there is no association between the type of media and personal attributes. Large majority of the respondents, irrespective of their gender, nationality, age, education

and income, prefer online media, particularly, Internet. The only exception is the senior citizen with age above 50 years, still prefer to go with the print media, specifically, newspapers. It confirms that there is no statistically significant association between reasons and the preference for the type of media. It means that according to the type of media, the reasons do not vary significantly. It can empirically conclude that online media affects print media. Impact of online media on print media happens on the various aspects of print media viz. demand, subscription, market share, print revenue, advertising revenue and profitability.

Summary. This article presents a qualitative study comparing the use of newspapers that are published online versus newspapers produced with traditional print methods. The author begins with a discussion of the efficacy of delivering information online and some of the benefits of that delivery model such as portability and the ability to easily search material via online query tools.

Cherian goes on to describe use of a survey of 102 journalists to help understand what factors are advancing the escalation of online newspaper readership. The author finds that younger generations of readers prefer online access. Another aspect of the study is the collection of recommendations for elevating readership of printed newspapers by revamping form, content, and pricing models.

The author concludes that the proliferation of online newspapers is having a significantly negative impact on the subscribership of traditional printed newspapers with the same content.

This article is relevant for this study because it demonstrates that age alone does not dictate the preference of users for digital media over printed media. Other benefits of

digital media such as portability and accessibility play a larger role in the growing adoption of digital media, which continues to put pressure on commercial print volumes.

Davis, R. H. (2014). Focus on industries and markets business economics and the printing industry. *Business Economics*, 49(2).

<http://go.galegroup.com/ps/i.do?id=GALE|A371507472&v=2.1&u=s8492775&it=r&p=AONE&sw=w&asid=1a16f92e382365520967e3ea9ff8c300>

Abstract. The printing industry has a large economic footprint that is dispersed through all 50 states. Based on the work of the Center for Print Economics and Market Research of the Printing Industries of America, this paper describes and analyzes the industry's segments, functions, and processes; macroeconomic drivers and competition; industrial structure; profitability; and prospects. This article provides an overview of the printing industry from the perspective of the Printing Industries of America (PIA), a trade association and nonprofit foundation. (1) Much of the analysis in this paper is based on key tracking metrics the association provides to its members.

Summary. Davis's article begins with a presentation of the commercial printing industry and a description of its economic impact in the United States. The article goes on to discuss some of the primary elements impacting the decline in commercial print volumes. Actors described in the article include economic conditions, the cost of mailing dictated by the US Postal Service, trends in marketing and advertising, and the substitution of digital media for traditional print media.

Davis does conclude that there have been positive aspects of the evolution in digital media for traditional print providers. These stakeholders have become more

involved in the development of digital communications and marketing by leveraging existing relationships to develop those opportunities with their customers.

The article articulates the position of traditional printers as the largest small manufacturing business in the country. This condition persists as printing is one of a few industries that scale up or down while production costs remain relatively consistent. The article concludes with a prediction that the traditional print industry can maintain profitability through the adoption of streamlined production processes and the inclusion of value-added services such as electronic communication.

This article is relevant for this study because it employs data directly from commercial printers to inform the state of the industry. This data defines some of the reasons that commercial print volumes are in decline.

Hu, J., & Smith, M. (2013). The Impact of Ebook distribution on print sales: Analysis of a natural experiment. Retrieved from <http://dx.doi.org/10.2139/ssrn.1966115>

Abstract. Digital distribution channels introduce many new strategic questions for the creative industries, notably how the use of new digital distribution channels will impact sales in established channels. We analyze this question in the context of ebook and hardcover sales by exploiting a natural experiment that exogenously delayed the release of a publisher's new Kindle ebooks in April and May 2010. Using new books released in March and June 2010 as the control group, we find that delaying ebook availability results in a 43.4% decrease in ebook sales and no increase in print sales on Amazon.com or other retailers. We also find that the decrease in ebook sales is more severe for books with less pre-release buzz. Together our results suggest that consumers are strongly tied

to their chosen consumption format and channel, meaning that delaying digital releases is unlikely to be effective at sustaining sales in established physical channels.

Summary. This study presents research on the impact of the distribution of ebooks on the sales of traditionally printed books of the same title. The article describes the growth and adoption of the ebook platform as threats to hardcopy books, citing statistics on the growth of ebook sales. The authors have found that although it may seem that the introduction of ebooks could cannibalize sales of hardcopy books, the strategic release of electronic versions of the same book can actually enhance the sale and brand awareness of books printed on paper.

The authors provide a review of marketing literature in analyzing the impact of the release timing of ebooks on sales of hardcopy books and reports the results of an experiment wherein sales results of hardcopy books are tracked in circumstances where electronic versions of the books are also released. Control groups are created using companies that release only hardcopy versions of books. The outcome indicates that ebooks cannot positively uplift the sales of traditional print over extended periods.

This paper serves to contribute to and enhance the existing body of literature on the impact of digital media channels on traditional print. The article is relevant for this study because it establishes the negative impact of digital media delivery channels on traditional print volumes.

Kapel, D. (2010, December 1). Lean & mean. *American Printer*, 127(12). Retrieved from

<http://go.galegroup.com/ps/i.do?p=AONE&sw=w&u=s8492775&v=2.1&it=r&id=GALE|A243891824&sid=AONE&asid=f4af414aacc6036e35643f24dafc91b2>

Abstract. The article assesses the performance of the printing industry in light of the global recession, highlighting the steady decline in sales since the pre-recession peak. It cites data from the National Association for Printing Leadership (NAPL) showing 20.5 percent or some 7,200 firms closing shop since 2000. It notes however that for the first three quarters of 2010 magazine closures slowed down compared to the same period in 2009, and the newspaper sector particularly in Asia registering strong growth.

Summary. Denise Kapel, the former managing editor of *American Printer*, begins her article by citing statistics on the effect of the Great Recession that began in December 2007 on the commercial print industry. These statistics help to inform the topic of the reduction in commercial print volumes over the last ten years. The author discusses closures and consolidations of commercial printers and also the loss of revenue and profit.

The article's focus is specifically narrowed to the magazine industry and contends that launches of new periodicals were outpacing the closure of these business types in 2010. Along with this uptick in new magazines, Kapel shows evidence that at the time many subscribers wanted a digital version of a magazine to augment the printed version, not as a substitute.

Kapel concludes with a discussion of how commercial printers are working with customers to get more involved with marketing plans earlier to assist with the management of variable data campaigns and mail processing, activities that are growing revenue and bolstering client relationships.

This article is relevant for this study because it provides additional information that supports the contention that commercial print volumes are in decline, which is also precipitating the closure and consolidation of several small and medium sized printers.

Maxim, A. & Maxim, A. (2012). The role of e-books in reshaping the publishing industry.

Procedia - Social and Behavioral Sciences, 62, pp.1046-1050, ISSN 1877-0428.

Retrieved from <http://dx.doi.org/10.1016/j.sbspro.2012.09.178>.

Abstract. This paper examines the impact that e-books and ecommerce have on the current and future evolution of the book industry, by focusing on its various stakeholders: authors, publishers, online and traditional distributors, and readers. This is an exploratory research, based mainly on qualitative methods and analysis of secondary data. The developments in the US and several European markets are examined in order to generate hypotheses about the changing roles of the various actors. Brick-and-mortar bookstores are affected as their customers increasingly prefer to shop online for both regular and electronic books. The publisher- author relationship is also transformed, as the writers are now able to publish their works directly to the website of a distributor. Although printed books will probably continue to exist, publishers and bookstores need to investigate the changing preferences of their target market and revise the way they produce and deliver content to their customers.

Summary. This authors start by framing the topic of the adoption of digital technologies over traditional delivery methods with a discussion of other industries, such as music, that have undergone a transition from direct delivery of analog content to a digital delivery model. Many of the same reasons that have compelled the digital transition in

the music industry are driving the shift in the commercial print industry, including accessibility, portability, and economics. In addition, the authors credit Apple's iTunes and other music services for advancing this conversion due to the large volumes of popular music these services have made available, the portability of the format, and the affordability of the product.

Maxim and Maxim discuss the changing roles of actors in the printing industry such as authors, publishers, distributors, and readers. The topics for consideration are readers' views towards ebooks, types of literature appropriate for electronic publishing, and the identification of benefits of and threats posed by digital publishing.

The study is conducted using four focus groups to collect information about the topics presented, using primarily quantitative methods. Several benefits of ebooks and electronic delivery are discovered as a result of the study and are determined to be contributing to the demise in traditional print volumes, among them digital media's search capability, ease of access, and immediacy of access.

The advancement of digital media is also shown to be advantageous for the relationship between authors and publishers, giving authors more direct access to delivery channels for their work and also giving unknown authors a better chance of getting their materials on the market. However, electronic publishing is shown to have a detrimental impact on bookstores and libraries as many people opt for the convenience of electronic versions over traditional hardcopy volumes.

The article concludes that printers and publishers need to adopt new models of pricing and new practices such as print-on-demand (POD) in order to better match the demand and changing needs of consumers. This article is relevant for this study because

it demonstrates the impact of digital delivery channels, such as ebooks, on the printing industry.

Technologies and Best Practices for Reducing Cost in Commercial Print

Cross, L. (2012). The age of digital printing. *Publishers Weekly*, 259(44), pp. 18-22.

Abstract. The article looks at the use of inkjet printers for the on-demand digital print production of books, with particular focus on cost effectiveness. The benefits of digital print technology include reduction of risk, opportunities for personalization and customization, and the ability to print copies after selling them. Various digital printing services are profiled, such as Strategic Content Imaging (SCI) and the BookFWD printing program by Webcom.

Summary. The author examines the use of inkjet printers for the on-demand digital print production of books, with particular focus on cost effectiveness. The benefits of digital print technology include reduction of risk, opportunities for personalization and customization, and the ability to print copies after selling them.

Data is presented that demonstrates myriad applications that are helping to grow the digital production segment including: books, direct mail, trans promo, brochures, catalogs, and magazines. The difficulty of forecasting required print volumes for these applications makes them perfectly suited for digital output as products are produced on demand as opposed pre-printing large inventories of output that is then used for fulfillment. Several representative print services are profiled including Strategic Content Imaging (SCI) and the BookFWD printing program by Webcom.

The article is relevant for this study because it highlights how digital on-demand printing can reduce cost and provide better pricing models for variable output.

Duan, Q., Zeng, J., Chakrabarty, K., & Dispoto, G. (2015). Real-time production scheduler for digital-print-service providers based on a dynamic incremental evolutionary algorithm. *IEEE Transactions on Automation Science and Engineering*, 12(2), pp. 701-715.

doi: 10.1109/TASE.2014.2304177

Abstract. We present a high-performance and real-time production scheduling algorithm for digital print production based on a dynamic incremental evolutionary algorithm. The optimization objective is to prioritize the dispatching sequence of orders and balance resource utilization. The scheduler is scalable for realistic problem instances and it provides solutions quickly for diverse print products that require complex fulfillment procedures. Furthermore, it dynamically ingests the transient state of the factory, such as process information and resource failure probability in print production; therefore, it minimizes the management-production mismatch. Discrete-event simulation results show that the production scheduler leads to a higher and more stable order on-time delivery ratio compared to a rule-based heuristic. Its beneficial attributes collectively contribute to the reduction or elimination of the shortcomings that are inherent in today's digital printing environment and help to enhance a print factory's productivity and profitability

Summary. This article is based on the presentation of a real-time production-scheduling software application for digital print production based on a dynamic incremental evolutionary algorithm. The primary objective of the authors is to optimize scheduling of production print work in electronic print environments. The authors explain how their

software can dynamically determine the best route for print jobs by assessing multiple variables such as type of job and equipment availability.

The authors draw their conclusions from the theoretical application of the proposed algorithm to specific areas of the production print process via computer modeling. This method demonstrates the benefits of the proposed solution in terms of efficiency and cost effectiveness as compared to traditional workflows. The authors also describe how process automation can contribute to the reduction or elimination of the shortcomings that are inherent in today's digital printing environment and help to enhance a print factory's productivity and profitability.

This article is relevant for this study because it introduces the use of scheduling technology as a method for driving efficiency and reducing cost in a commercial print environment.

Gallagher, V. A (2009, April 17). Printers aiming for the baseline. *The Bookseller*, 5378, p. 8.

Retrieved from

<http://go.galegroup.com/ps/i.do?id=GALE%7CA198931781&v=2.1&u=s8492775&it=r&p=AONE&sw=w&asid=aa130d8584694b81f7e433ec69c26348>

Abstract. The article discusses the economic difficulties facing the printing industry in Great Britain, as well as structural trends that may point toward the industry's future. Topics discussed include data from the British Printing Industries Federation (BPIF), and the growing popularity of print-on-demand services as a way of reducing the cost of storage and excess inventory.

Summary. This paper begins with a discussion of the impact of the economic downturn in 2008 on the commercial printing industry. The author describes the glut of printers that existed prior to the financial decline and how the recession precipitated the consolidation of many medium-sized print companies. The author speaks to the recession as an opportunity for many commercial printers to reinvent how they approach print through the adoption of new workflows and technology. The article also puts forth the advantage of print-on-demand (POD) models for printers to reduce the overhead in pre-printing and storing of titles and also be more accommodating to customer demand. The paper concludes with other possible courses of action such as outsourcing of print to companies overseas as a method for cost reduction.

This article is relevant for this study because it bolsters the premise that on-demand printing can serve as a method for delivering products in a more efficient and cost effective way than the practice of pre-printing large inventories of books and documents that are used to fulfill orders.

Garg, A. K., & Naidoo, S. (2012). Lean manufacturing as an alternative operational process in a small printing organization in Johannesburg. *Pakistan Journal of Social Sciences*, 32(2).

Retrieved from

<http://go.galegroup.com/ps/i.do?p=AONE&sw=w&u=s8492775&v=2.1&it=r&id=GALE|A364069386&asid=18cdaeb6250501fbd00a252d29acf00d>

Abstract. A small printing company in Johannesburg has experienced a steady decline in profits over the past four years, and wishes to reverse this trend. The objective of this study was to assess the implementation of Lean Manufacturing in that context, and to

determine the impact it had on the printing company's profit margin. A process-mapping of the printing organization was performed; this process-mapping is referred to as Value Stream Mapping, which is a Lean Manufacturing technique. The results achieved strongly suggest that Value Stream Mapping contributed to the achievement of greater availability, better quality and increased revenues for the printing company. The improvements contributed to increasing the Sheeter department availability from 55% to 75%, the Litho department availability from 65% to 76% and the Gluing department from 55% to 91%. This study found that over a one-year period, over 10.6 million Rands could be saved by implementing Lean Manufacturing in those departments. These findings have significant implications for the printing company, and could make a positive contribution to improving the availability of machines, which implies increased product production, and the possibility of increased profits.

Summary. Garg and Naidoo's paper starts with a description of the many pressures that small and medium sized commercial printers face on a daily basis. These pressures include higher demands from customers in terms of quality, speed of turnaround, and cost, and the reduction of demand for commercial print volumes. The article goes on to discuss the other difficulties in commercial print including waste and lost productivity due to inefficient workflow processes.

Garg and Naidoo's premise is that small and medium sized commercial printers can leverage cost savings and efficiency through the application of lean manufacturing techniques. Garg and Naidoo's approach applies value stream mapping (VSM) to the print manufacturing process as a means of improving the efficacy and profitability of commercial print plants. The article describes lean manufacturing as the modification of

production processes to leverage lean principles such as value stream, flow, pull and perfection to reduce waste and use resources in a more productive way.

The study approach maps the workflow process of several medium-sized print plants to discover areas of inefficiency and waste that can be eliminated to decrease cost, improve on-time delivery of product and increase profitability. The authors conclude that profit can be increased in every plant observed but note that maintaining the improved financial condition requires constant reevaluation of the printing process to determine if new technologies or workflows might be of benefit.

This article is relevant for this study because it articulates how best practices defined by lean manufacturing methods can be applied to the commercial print industry to reduce cost and drive profit.

Koprowski, G. (2006). Building the foundation for content success. *EContent*, 29(5), pp. 38-42.

Abstract. New, global software standards are emerging for the publishing industry, promising to allow content to do more and make more. Today, standards like Job Definition Format (JDF) and Personalized Print Markup Language, based on Web Services darling XML, are maturing. Yet Martin Bailey of Global Graphics Software says it has been hard to quantify the productivity gains from standards like JDF. The ISO recently announced it has approved a suite of four ebXML OASIS standards for conducting business over the Internet. As these and other standards emerge and are adopted, experts say, digital asset management systems should be integrated with other data systems -- including financial databases -- throughout the enterprise to improve overall corporate performance. According to Theresa Regli of Molecular Inc asset

management projects are not simple; they are cross-functional and require a focus on methodology before they can be implemented. New software coming to market may help facilitate that, if embraced by the publishing industry.

Summary. The focus of this article is the implementation of novel technical and workflow approaches to enhance deliverables in the commercial print industry. The article begins with a description of the adoption of technologies such as Adobe Postscript and tagged image file format (TIFF) by the commercial print industry and the benefits that these technologies bring.

Koprowski goes on to introduce new technologies such as Job Definition Format (JDF) and print-on-demand (POD) that can propel printers through the next evolution of production print. JDF allows for print job instructions to accompany a print job as an electronic job ticket. This technique allows jobs to go directly to an output device and be completed with very little operator intervention. POD eliminates the costly practice of printing massive volumes of books or other publications and warehousing them for fulfillment. The author contends that although the piece cost may be higher for these documents, there is far less waste and printers are able to be much more flexible in accommodating customer requirements and the rapid fluctuations in the printing market.

The author concludes with an investigation of new opportunities for print providers such as digital asset management (DAM). The author concludes that DAM is a perfect avenue for providers to develop additional revenue streams and solidify relationships with customers.

This article is relevant for this study because it demonstrates how new technologies and print-on-demand practices can leverage print process automation to reduce cost for

commercial printers.

Kriesen, G. (2011). Print still matters in an e-learning world, and training companies need to properly manage it. *Journal of Organizational Behavior Management*, 31(3), pp. 179-195. doi: 10.1080/01608061.2011.589721

Abstract. This report demonstrates how the application of Behavioral Systems Analysis (BSA) methods assist in assessing a small training company's Print Production Management (PPM) system. PPM is the process by which printed materials are conceptualized, estimated, released to a commercial printer, proofed, and delivered to the client. The current PPM process had not been evaluated or updated to reflect shifts in both the training and printing industries. The assessment found that the unrevised process was becoming obsolete, hindering performance, and costing the organization time and money. Recommendations were made for staffing and workflow, and implementation of tools were developed to support performance and contribute to successful execution of projects with printed elements. This report includes a follow-up evaluation made eight months after study completion.

Summary. This article presents a study with focus on the purchase and production of commercial print in corporate environments. The author describes some of the issues with the acquisition and manufacturing process including the evolution of print into more digital methodologies and the growing complexity of print and its relationship to critical corporate communications such as transactional print and marketing material.

The project presented by Kriesen includes a description of the inclusion of Behavioral Systems Analysis (BSA) to identify how print purchasing and manufacture

are affected by the level of experience of staff performing the work and the systems being applied for those processes. The BSA includes mapping of the workflow process, surveying staff and vendors, and performing focused interviews to gain insight into inefficiency in the process. The BSA produced findings indicating that changes in production print process such as staff training, automation, and machine placement yield substantial advantages in efficacy and cost. The article concludes with a follow-up survey on the impact of the recommended changes.

This article is relevant for this study because it substantiates the claim that changing existing workflow and production print processes can have positive impacts on cost management and efficiency for commercial printers.

Lichtenberg, J. (2012, October 29). Building the new business model: In the digital age.

Publishers Weekly, 259(44), 23+. Retrieved from

<http://go.galegroup.com/ps/i.do?id=GALE%7CA307076781&v=2.1&u=s8492775&it=r&p=AONE&sw=w&asid=735624f7bdf3f3e6fe64298898b5f960>

Abstract. The article discusses the effect of digital technology on the relationship between printers and publishers in the book industry. Technological innovations adopted in the industry include digital manufacturing and printing processes and development of content for electronic book readers. Topics include the change to smaller, on-demand print runs, the potential for serving niche markets, and a strategy for printers to focus on supply chain management.

Summary. The main theme of this article is how the introduction of electronic readers such as the iPad and Kindle can potentially impact the traditional printing industry. The

author discusses aspects of the commercial print industry such as the warehousing and distribution of traditional books, the introduction of variable data and its place in print, and print-on-demand (POD).

The article finishes with a discussion of the how digital press manufacturers Xerox, KODAK, HP, and RICOH may be able to help traditional printers to evolve and continue to have a place in this new digital landscape through the use of workflows and technologies that will increase efficiency, reduce waste, and lower costs.

This article is relevant for this study because it supports the proposition that the print-on-demand methodology is an important element of cost reduction in commercial print. In addition, the article introduces new services such as multi-channel marketing, variable data, and web development as potential methods of driving revenue.

Øiestad, S., & Bugge, M. (2014). Digitisation of publishing: Exploration based on existing business models. *Technological Forecasting and Social Change*, 83, pp. 54-65. Retrieved from <http://dx.doi.org/10.1016/j.techfore.2013.01.010>

Abstract. Like other creative industries, the book publishing industry is currently experiencing a shift from analogue to digital technologies and formats. This shift challenges existing business models and impels firms to re-examine their product portfolios and core competencies. Through a qualitative case study of the three largest publishing houses in Norway, Aschehoug, Cappelen Damm and Gyldendal, this paper investigates how digitisation affects business models in the book publishing industry. The paper argues that the publishing houses are two-faced in meeting new digital technologies. The industry has come relatively far in developing industry standards and

joint distribution systems. However, the functionality and user experience of digital products is still poor, prices are still high, and the share of Norwegian language digital titles is low. In addition, knowledge acquisition from consumers and lead users are suboptimal. Due to divergence in goals, formats and markets, there is a lack of a common dominant design for digital publishing. This represents a substantial uncertainty for the publishers, who are moving step-by-step into the new digital era and whose exploration of new market opportunities and alternative business models remains anchored in traditional and analogue business models. The paper also discusses how current institutions contribute to preserve the analogue publishing regime.

Summary. The authors frame the topic of the demise of commercial print volumes with a discussion of the static nature of traditionally printed books, as they have existed in the same format for centuries. The authors then discuss the digitization of the music and advertising industries and the impact these transformations have had.

This qualitative study uses three print manufactures as a basis to understand how commercial printers can employ varied business models to improve throughput and reduce costs. Examples of business models the authors explore are brick and mortar (traditional print business), clicks and mortar (hybrid between traditional and Internet-based), collaborative (wherein publishers work with printers to manage the print process), and freemium (publishers provide some content for free while offering premium content for a charge).

The authors bring forth methods for absorbing changes and evolution in the print industry in order to cut costs and plot a course for survival. Some of these methods are the creation of new products, adoption of new workflows, and augmenting core

competencies to grow existing customer relationships.

The study consists of 20 focused interviews within the three selected print shops. The data is analyzed using data reduction and data display and conclusions are drawn based on best practice. The study concludes with a discussion of how adoption of digital printing technologies and new workflows can contribute to the ongoing success of traditional printers, but also cautions those printers concerning the practice of taking steps to protect traditional publishing methods.

This article is relevant for this study because it delineates how the switch from traditional print to digital content delivery can affect volumes in the commercial print business and how digital print technologies may provide more cost effective means of production printing.

Susanu, I. O., Nicoleta, C., Susanu, V., & Micu, A. (2012). Reengineering and its impact upon organizations in printing industry development. *Valahian Journal of Economic Studies*, 3(4), pp. 97-102.

Abstract. The main objective of the present paper is to highlight the importance and impact of the concept of reengineering, both by identifying certain opportunities to improve the performance of Romanian printing companies and some strategies of total redesign of the production process based on highlighting some of their effective combinations as well as the integration of some proper information technologies. Research methodology included techniques and research tools, such as analysis, comparison, application software, case study as well as selective market research methods. In order to identify opportunities for applying the concept of reengineering in

the Romania printing organizations, all three types of research were used: exploratory, descriptive and causal.

Summary. The main objective of this paper is to investigate ways that information technology can be employed to retool traditional print plants. The research aims to assess the impact of such technologies on efficiency and profit.

The authors employed research methods such as analysis, comparison, case study and selective market research. The authors mapped existing workflow models and production print processes in select commercial print facilities. This portion of the study defines a baseline of performance that is used for comparison. Once technologies and process improvements are implemented, the study again measures the resulting output to determine the effect that process automation and more efficient print machine placement have on print efficiency and cost reduction. The authors conclude that there is significant time savings and financial return as a result of optimal equipment placement and automated print processes.

This article is relevant for this study because it reinforces the importance of the adoption of process improvements and best practices as a means of controlling costs in commercial print.

Conclusion

The contraction of commercial print volumes over the last decade is producing a quantifiable effect on print plants of all sizes as “sales of commercial lithography declined nearly 40% between 2000 and 2014” (Papparozi, 2016, p. 3). However, there are strategies that may help printers to survive this trend and continue to produce hardcopy output profitably (Lichtenberg, 2012). Literature for this review is selected to address the main research question of what best practices and technologies can be employed to reduce costs for commercial printers. In addition, this paper pursues sub-questions of how commercial printers can implement those business processes and technologies and whether there are additional benefits to stakeholders in using these technologies and practices.

Sources are selected to identify the root causes of commercial print contraction and identify technologies and best practices for reducing cost in commercial print environments.

Root Causes of Commercial Print Contraction

The primary explanation for the reduction in commercial print is due to increased competition from digital content delivery (Davis, 2014). Digital media has proven to be a negative driver against commercial print volumes as it provides both technical and financial benefits over traditional print methods (Hu & Smith, 2016). In addition, other causes of commercial print contraction include accessibility and portability of digital alternatives (Cherian, 2015).

Technical benefits of digital media. Literature that addresses the problem of declining commercial print volumes presents several explanations for the myriad factors contributing to this phenomenon. Pressure from digital media has surfaced as an important point of focus, with this technology demonstrating several benefits over traditional print methods (Hu & Smith,

2016; Lichtenberg, 2012). Albarède et al. (2008) assert that “online journals offer numerous advantages over the printed media. They allow daily publishing, wider distribution with desktop delivery, constant availability, and the use of dynamic content” (p. 257).

In addition, electronic documents enjoy the benefit of accessibility as they can be downloaded over delivery conduits such as wireless and cellular networks as opposed to requiring users to visit libraries, bookstores, or other repositories (Maxim & Maxim, 2012). Digital versions of literature and content also afford flexibility for users who may have a variety of personal preferences regarding viewing devices, formats, and types, from electronic readers and tablets to computers and phones (Øiestad & Bugge, 2014). In addition, researchers commonly mention the search capability built into many digital versions of text as an important component to enable more effective leveraging of literature to find specific information in voluminous amounts of data (Maxim & Maxim, 2012).

The technical advantages of digital modes of publishing have led to a surge in this media, where “the last few years have witnessed significant growth in ebook platform adoption, and an associated growth in ebook sales” (Hu & Smith, 2013, p. 2).

Financial advantages of digital media. Beyond the technical virtues of digital media, there are significant financial implications putting pressure on commercial print volumes (Kapel, 2010). Many business closures and consolidations have occurred in the commercial print industry due to the economic downturn of 2008, leaving the remaining companies to absorb print volumes, which has stressed staff and resources (Kriesen, 2011). The speed of doing business electronically has also been shown to have financial repercussions on the commercial print industry; Cherian (2015) finds that “the subscription of and revenue from the print media are declining for various reasons, especially, the speed at which the online media is serving the

customers” (p. 581).

The commercial printing industry also succumbs to negative financial circumstances as marketers look to replace costly traditional print with less expensive digital delivery channels, which may be seen as one of the primary factors in the contraction of print volumes (Cherian, 2015). This sentiment is echoed by at least one other source; Davis (2014) observes that the decline in advertising in magazines and other traditional print publications has helped to drive down commercial print volumes. The financial condition of the market as a primary actor on commercial print volumes is also supported by Davis (2014), who suggests “amongst the elements driving the print industry, the number one factor is the economy” (p. 3). Furthermore, aggressive growth in digital publishing will continue to push down commercial print volumes; Hu and Smith (2011) note “Amazon.com, the largest online seller of print and digital books, reported that Kindle sales surpassed Amazon’s total hardcover sales in July 2010, and surpassed total print sales as of April 1, 2011” (p. 2).

Potential Solutions to Lower Cost and Grow Profit in Commercial Print

With the aforementioned technical and financial threats to commercial print volumes looming, some printers are looking forward to the strategic use of new technology and workflow processes to reduce cost through gains in efficiency, automation, and waste reduction (Gallagher, 2009). The following are some examples of technologies and best practices discovered during the literature review that may assist in cost reduction.

Digital printing. One technology that may help commercial printers transition to a more cost effective model is digital printing (Gallagher, 2009). Digital printing is less expensive than offset printing, and thus can serve as an attractive replacement for offset printing (Gallagher, 2009). Cross (2012) notes that “technology advancements at all points in book manufacturing are

enabling digital printing to accommodate longer-run production historically dominated by offset printing and in the process promise a boom in the number of pages produced by digital printers” (p. 1). Digital printing also addresses the financial variable, with offset print becoming cost prohibitive due to the requirement for highly paid operators and setup times, while digital print technologies have enabled more economical production of certain types of short run publications and journals (Lichtenberg, 2012).

The commercial print industry has started to embrace digital print technologies, with predictions of growth from pundits (Cross, 2012). “Info Trends projects that digitally produced book pages will grow at a 14.0% compound annual growth rate between 2011 and 2016, and surpass 107 billion pages in 2016, largely driven by more affordable inkjet technologies” (Cross, 2012, p. 2). In fact, some sources posit that “the most critical determinant of a publisher's ability to successfully navigate is improving the financial returns of their printed product” (Cross, 2012, p. 3). In some cases, the transition to digital printing has “reduced the average cost per order for an educational publisher by 49% and a trade publisher by 30%” (Cross, 2012, p. 3).

The final advantage of digital print in contrast to offset print is the ability to produce variable data products such as unique one-to-one marketing pieces. These applications can be seen as a promising source of revenue that cannot be accomplished through traditional offset printing methods (Kapel, 2010).

Scheduling. Scheduling work in a print operation requires a considerable amount of time, which represents an opportunity to lessen costs with automated scheduling options (Duan, Zeng, Chakrabarty, & Dispoto, 2015). One automated scheduling option is the use of a programmatic production scheduler, which “can stabilize and improve the on-time delivery ratio

significantly compared to rule-based heuristics” (Duan, Zeng, Chakrabarty, & Dispoto, 2015, p. 22). Adopting new workflows that streamline print processes and minimize manual break points is critical to the transition of printers to more efficient models (Lichtenberg, 2012). Novel workflows and process automation positively impact productivity while minimizing expense (Garg & Naidoo, 2012). One study found that the application of a real-time scheduling tool could produce synergistic effects by simultaneously generating schedules that create optimized product output from the print plant while maximizing resource utilization (Duan, Zeng, Chakrabarty, & Dispoto, 2015).

Process Improvement Best Practices

Performing an assessment of existing production print processes is an important step in making positive alterations to leverage efficiency, reduce waste, and improve profit (Susanu, Nicoleta, Susanu, & Micu, 2012). Based upon the findings from the assessment, re-engineering offers the opportunity to implement improvements (Duan, Zeng, Chakrabarty, & Dispoto, 2015). “Re-engineering deals with the phenomenon of redesigning the production process in the printing house to achieve an optimal quality level” (Susanu, Nicoleta, Susanu, & Micu, 2012, p. 101).

One approach to maximizing productivity through process improvement is known as value stream mapping (VSM) (Susanu, Nicoleta, Susanu, & Micu, 2012). Many commercial printers are beginning to “utilize VSM as a tool to identify value and eliminate waste with the intention of minimizing cost, rework and lead time to reach competitive dimensions” (Garg & Naidoo, 2012, p. 4). With VSM, assessments are performed and often “findings have significant implications for the printing company, and could make a positive contribution to improving the availability of machines, which implies increased product production, and the possibility of

increased profits” (Garg & Naidoo, 2012, p. 1). Some simple solutions can come out of these assessments; for example, “streamlining workflows and locating equipment closer to workstations could enhance productivity and create functional workspace” (Garg, & Naidoo, 2012, p. 1).

Reduction in manual and undocumented processes is also an important benefit of reengineering that ensures intellectual capital and process approaches become engrained into the organization as a whole, which helps to eliminate guarded pockets of knowledge held by individuals (Kriesen, 2011, p. 192). Automating workflow processes can also yield notable improvements in efficiency that result in lower costs (Koprowski, 2006). Job Definition Format (JDF) is a technology that enables jobs to be completed with little operator intervention and the resulting improvements can be substantial; Koprowski (2006) finds that “throughput for some users of software that employ the JDF standard has increased by 40%” (p. 40). In addition, management of print processes once the JDF standard is adopted can also see improvement as “supervisor time spent managing print projects has dropped by 50%. This is enabling some publishers to reduce staffing costs” (Koprowski, 2006, p. 40). Minimizing management involvement in job production also allows those managers to focus on refining processes and driving more business through sales (Gallagher, 2009).

An additional methodology that has positive impact if implemented in commercial print is print on demand (POD) (Lichtenberg, 2012). Gallagher (2009) indicates that the POD process “enables publishers to print books as they are sold and save money on storage and unwanted titles” (p. 1). Although it may be prudent for some companies to wait until a dominant design emerges, approaches such as POD are a sensible way to conserve cash flow and improve a company’s profit position (Oistad & Bugge, 2013).

Summary

In summary, this literature review presents numerous root causes for the contraction of commercial print volumes, many of which can be traced to the advantages of digital media (Davis, 2014). The digital media advantages include accessibility, search ability, and financial considerations (Davis, 2014). While the experts agree that the commercial print industry is in decline (Maxim & Maxim, 2012), there are many strategies that can be employed to improve efficiency, eliminate waste, and reduce cost, which ultimately increases profit (Cherian, 2015). In the end, application of technology and select methodologies to assist commercial printers in stemming the tide of challenges presented by digital publishing is the direct responsibility of owners and managers of commercial print plants (Cross, 2012). Only through mindful utilization of these strategies will commercial print be able to maintain profitability and continue to grow the legacy of this important manufacturing industry (Gallagher, 2009).

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