Predicting the Adoption of Digital Printing in the Label Printing Industry: A Reasoned Action Study

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Certificate of Approval

Predicting the Adoption of Digital Printing in the Label Printing Industry:

A Reasoned Action Study

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Abstract

The package printing industry is a vibrant and growing industry and digital printing technology is improving quickly—yet the adoption of digital printing has not fully penetrated the label printing market, a subset of packaging, and digital printing has seen slower adoption in its decade-long history in labels than expected. This research attempts to explain why this may be the case by understanding the factors affecting the intention to adopt digital printing. This study utilizes Fishbein and Ajzen's Theory of Planned Behavior (TPB) in a cross-sectional survey of individuals in a decision-making role in label printing companies. The study was intended to gather timely, descriptive information to understand the adoption of digital printing for commercial production in the label printing industry in the next 12 months. The study attempts to measure dependent variable, the Intention to adopt and the independent variables: Attitude, Subjective Norm, and Perceived Behavioral Control.

Questionnaire instruments were mailed to 260 companies, of which 51 responded, a response rate of nearly 19%, and of those, 31 qualified for data analysis. A high percentage (86%) of the respondents represented companies with fewer than 50 employees. The results of the research indicate that the outlook on digital printing technologies remains optimistic, however, those in charge of the adoption are concerned about budget within the next 12 months. The customer, sales, and marketing are the most influential groups supporting the adoption, contrasted with the president, and owners/ shareholders with the most reserved view.

The normative referents in the organization were shown to have the highest degree of influence and effect on Intention, illustrating the clarity of that construct in this specific research context. The discussion of the results covers three themes relevant to digital adoption in labels: budgetary concerns, customer-driven demands, and optimization of the production of sold goods.

Chapter 1: Introduction

This chapter will introduce the significance of the topic found in the present research as relevant to the current marketplace. Subsequently, the reason for the researcher's interest will be discussed.

Significance of Topic

Packaging is a growing, vibrant segment of printing, especially in North America. Simultaneously, digital printing technologies are improving at astonishing rates. Digital printing continues to increase in quality and speed; faster production has the ability to increase profits and decrease lead times. The current literature shows that print run lengths are shortening, thus digital printing, a more economical process for short print runs, is poised to gain a significant advantage in the label printing industry.

Digital printing has gained widespread use in many commercial printing markets, however, it has seen a slower adoption in the packaging industry (InfoTrends, 2013). A search for up-to-date scholarly literature on the factors affecting the adoption of digital printing in the label industry is met with a scarcity of searchable, published research. The found current body of literature has not specifically addressed a key component to the adoption of this technology: the beliefs of the decision-making managers in companies that may benefit from the adoption of digital printing technologies. Although it is recognized that industry reports and data describing digital press sales may provide some insight, the attitudes and beliefs of the executives and managers in decision-making roles play an important part in the adoption process—the present study aims to contribute to this domain.

Reason for Interest

The packaging industry is a vibrant, changing, and growing industry that utilizes some of the best creative design to solve unique problems. Packaging fills a wide variety of roles; one such example is utility packaging, which safely protects the product as it moves from its origin to its destination. Other times, packaging plays an active role in selling the product to the customer, as is the case with point-of-purchase displays. Because of the dynamic and exciting state of the packaging industry, the researcher has a personal interest in the package printing industry, its processes, and technologies.

The researcher enjoys investigating new technologies and their suitability across a wide variety of applications. The combination of digital printing and packaging has seen promising innovations and new equipment in both inkjet and electrophotographic processes. Furthermore, the managerial decision-making process and the beliefs about the technology are of interest to the researcher that he hopes to one day be in this decision-making role.

Chapter 2: Theoretical Background

The following section reviews the theoretical literature relevant to the present research. It starts with how technological innovations are diffused through a social system, how diffusion can be measured by marketers or organizations, followed by the theoretical background for predicting human social behavior. Together, these theories provide a framework for the present research.

Diffusion Models

Rogers (1995) defines *diffusion* as "the process by which an innovation is communicated through certain channels over time among the members of a social system" and *adoption* as "a decision to make full use of an innovation as the best course of action available." Rogers' (1962) Diffusion of Innovations sparked a wide range of research related to diffusion of an innovation throughout a social system. The diffusion model was introduced to explain the rate of adoption of a technological innovation over time, from its introduction to its decline. The research proposed a bell-shaped curve illustrating the diffusion of innovations that has been widely utilized by businesses and both supported and criticized by the academic community. Based on the model, five distinct adopter categories have been identified, each with their own attributes: Innovators, Early Adopters, Early Majority, Late Majority, and Laggards (Rogers, 1995).

Moore (1991) argues there is a chasm, or gap, between the Early Adopters and the Early Majority. Moore argues that in order to overcome this gap, the organization introducing the innovation must have a plan and fight vigorously to jump this chasm. The model was designed to assist businesses with the deployment of a new technology into a marketplace. While a good resource to help plan the introduction of disruptive technologies, Moore's Chasm and Rogers' Diffusion theories do not necessarily address how to predict success of a product, rather offer a model to describe its diffusion.

Diffusion Models for Marketing

Rogers (1995) explains that the use of diffusion models for marketing has vastly increased since the 1960s in order to predict the rate of adoption for new products. One such model is the Bass forecasting model that was proposed by Bass in 1969 to "offer plausible answers to the uncertainty associated with the introduction of a new product in the marketplace" (Rogers, 1995, p. 81).

The Bass (1969) model describes two communication channels that affect the rate of adoption for a new product: mass media, having an impact over the entire release but with a greater effect in the early stages, and interpersonal word-of-mouth which expands during the first half of the model and retracts during the second half (Rogers, 1995). The model assumed that the first half and second half of the adoption cycle were symmetrical and thus enabled the prediction of the cumulative number of adopters based on initial data (Rogers, 1995).

Technology-driven Diffusion Models

Another approach to studying the diffusion of innovations was developed by Davis (1989), who proposed a model to predict and explain the use of information technology among individuals. The model, named the Technology Acceptance Model (TAM), consists of two constructs, the perceived usefulness (PU) and perceived ease of use (PEU) which were shown by regression analysis to explain the adoption of information technology among white collar subjects.

Reasoned Action Approach

Another approach, collectively referred to as the Reasoned Action approach, the Theory of Reasoned Action and it's successor, the Theory of Planned Behavior, were developed by social scientists Fishbein and Ajzen. The theoretical approach uses a small

number of constructs to predict human social behavior across a wide variety of settings (Fishbein & Ajzen, 2010).

Theory of Reasoned Action

Prior to Fishbein and Ajzen's work in the mid- and late-1970s, the concepts of beliefs, attitude, behavior, and intentions were neither well-defined nor well-connected; the researchers defined in practical terms the concept of each and how they are related (Fishbein & Ajzen, 1975). Additionally, prior researchers attempted to explain human behavior with a different method in each distinct case: the model to predict voting behaviors was drastically different from the model to predict and explain consumer behaviors. The Theory of Reasoned Action (TRA), at the time of its publication, was a "very different approach", taking into account a "small number of concepts within a single theoretical framework" capable of being applied across a wide variety of fields and applications, including: health and safety, politics, marketing, the environment, among others (Ajzen & Fishbein, 1980, p.5; Fishbein & Ajzen, 2010).

Ajzen and Fishbein argue that "people consider the implications of their actions before they decide to engage or not engage in a given behavior" and that humans are rational and use information available to them (1980, p.5). Therefore, the name Reasoned Action is appropriate—the theory does not believe that humans make subconscious or thoughtless decisions. Not surprisingly, the intention of the subject to engage in the behavior is one of the most important and direct measures within the TRA (Ajzen & Fishbein, 1980). For example, if a researcher were studying an individual purchasing a car, the best measure would simply be to ask the individual whether they intend to purchase the car. This relationship is both supported by empirical research and modeled by Reasoned Action theory as the *Intention* construct.

According to Ajzen and Fishbein (1980), while Intention is the strongest indicator toward the actual behavior, two other variables were described by the TRA that were shown to be determinants of Intention. These variables help to understand the behavior in question, where Intention is only capable of predicting it. The two determinants are the attitude toward the behavior, named *Attitudes*, and the social pressure perceived by the individual, named *Subjective Norm*.

In the theory, Attitudes are functions of beliefs; if an individual believes that the outcome of engaging in a behavior is positive, they will also exhibit a positive attitude toward engaging in the behavior. It is important to note that the attitude toward engaging in a specific behavior is of interest to the TRA, whereas attitudes directly toward objects, people, and targets are outside the scope. For example, a person's attitude of whether they find a car favorable is not within the interest of study as it does not involve a behavior—instead the interest lies within their attitude toward the purchase of a specific car, with purchase acting as the specific behavior.

In addition to the individual's attitude toward the behavior, the social pressure perceived by the individual is also shown to have a determinant effect on Intention. Named *Subjective Norm,* this normative component consists of the subject's perception of other's beliefs; where the subject believes others think they should or should not engage in the specific behavior. As shown in Figure 1, the Attitudes and Subjective Norm act as determinants of Intention, which has a direct relationship to Behavior.

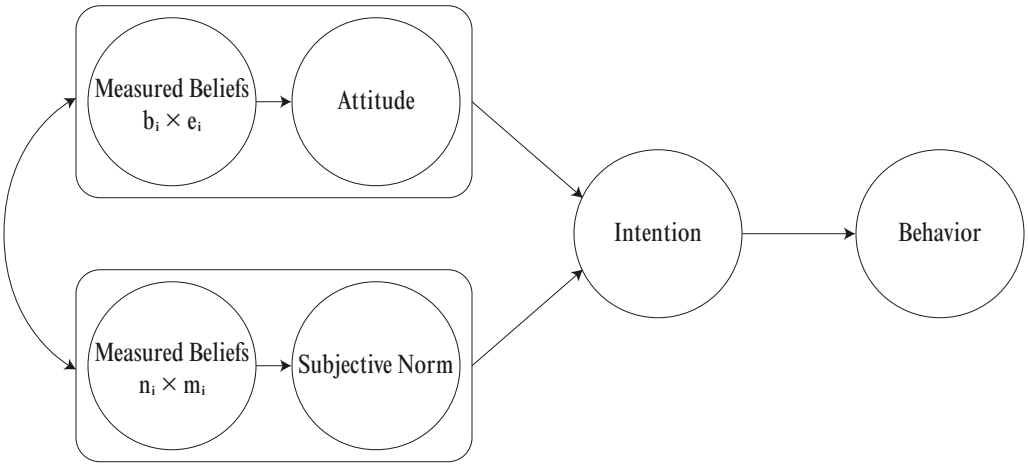

Figure 1: The Theory of Reasoned Action. Source: Adapted from Fishbein & Ajzen, 1980 and 2010.

Attitude Theory

The attitude of an individual is one of the most significant and important factors in social psychology (Ajzen, 2012). Fishbein and Ajzen "define attitude as a latent disposition or tendency to respond with some degree of favorableness or unfavorableness to a psychological object" (2010). Measuring attitude using Fishbein's summation theory, later renamed the expectancy-value model, consists of the subject's strength of belief toward a behavior, multiplied by the evaluation of that attribute (Ajzen, 2012). This is modeled by the following:

$$A \propto \sum_{i=1}^{n} b_i e_i \qquad (1)$$

where the attitude (A) is directly proportional to the product of the strength of the belief (b_i), and the evaluation of the attribute (e_i), summed over all salient belief attributes (i) (Fishbein & Ajzen, 2010).

Subjective Norm

In addition to the internal factors that have been shown to influence behavior, external social environments have been shown to "exert a strong influence on people's intentions and actions" (Fishbein & Ajzen, 2010). This phenomenon is captured by the *subjective norm* component of the TRA. It is defined as the subjective probability that a normative referent influences the person to engage in the specific behavior (Ajzen, 2012). In the TRA, it was modeled as:

$$SN \propto \sum_{i=1}^{n} n_i m_i \qquad (2)$$

where the subjective norm (SN) is directly proportional to the product of the normative belief (n_i), and the motivation to comply with the referent (m_i), summed over all salient referents (i) (Fishbein & Ajzen, 2010).

The original normative construct was designed to explain the subject's perception of what referent individuals want them to do. Behavior theorists have different schools of thought on *how* social pressure influences the behavior, with theorists conceptualizing social pressure in differing ways, including "strict rules, general guidelines, or simply as empirical regularities" (Fishbein & Ajzen, 2010, p. 129). The Reasoned Action approach provides a framework that "norms are more narrowly defined and are focused on the performance of a particular behavior," the pressure to perform or not to perform a behavior (Fishbein & Ajzen, 2010, p. 130).

Recently, the subjective norm was expanded to include both injunctive and descriptive norms (Ajzen, 2012). *Injunctive norms* are those stated previously, while *descriptive norms* may be thought of as the perceptions of what the referents are actually doing.

Theory of Planned Behavior

The Theory of Planned Behavior (TPB) is a direct extension of the TRA, with the addition of one measurable construct: the perceived behavioral control (PBC). The TRA was designed with the notion that the subject possessed complete volitional control over the behavior in question; this limitation was expanded upon to make the model more robust, resulting in the TPB (Ajzen, 1991). The TPB model is well supported by empirical evidence, and the addition of the behavioral control perception was shown to "account for considerable variance in actual behavior" (Ajzen, 1991, p.171).

According to the theory, the intention of a human engage in a behavior appears to be modeled on three general categories as seen in Figure 2: the beliefs about engaging in the behavior (A), the opinions and influence of important referents (SN), and how much control the subject perceives they possess over the behavior (PBC).

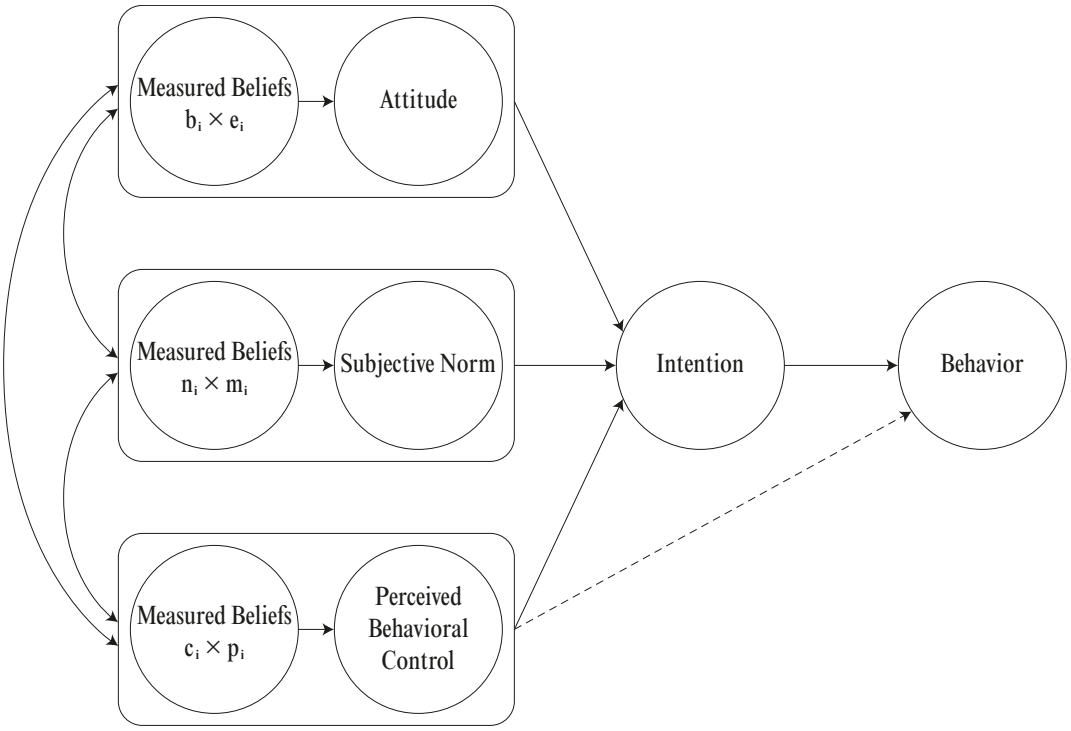

Figure 2: The Theory of Planned Behavior. Source:

Adapted from Fishbein & Ajzen, 2010.

As with the other components of the Reasoned Action framework, there are various schools of thought in the psychological literature that attempt to explain the psychological 'control' factor. Fishbein and Ajzen capture the important component by measuring the *perceived* behavioral control, how much control the subject believes they have over the behavior. This can be accomplished by asking questions about their perceived capability to perform, or not to perform, a behavior (Fishbein & Ajzen, 2010). The beliefs are then "assumed to determine perceptions of behavioral control and should therefore correlate with a direct measure" (Ajzen, 2010, p. 156).

The PBC can be described by the following equation:

$$PBC \propto \sum_{i=1}^{n} c_i p_i \tag{3}$$

where the PBC is directly proportional to the product of the belief that the control factor will be present (c_i) and the power of the factor to facilitate or impede performance (p_i), summed over all salient control beliefs (i) (Fishbein & Ajzen, 2010).

In the simplest form, the TPB can be explained by the formula:

$$BI \propto w_1(A) + w_2(SN) + w_3(PBC) \tag{4}$$

where Behavioral Intention (BI) is directly proportional to the sum of the products of the components (A, SN, PBC) and their respective empirically derived weights (w_n).

Davis' TAM and Reasoned Action

As Davis' Technology Acceptance Model was designed specifically for information technology, its use outside of the scope of information technology was limited. B. L. Myers (2004) sought to measure the effectiveness of the TAM against Fishbein and Ajzen's TPB in a context outside of information technology. As the TPB

requires an elicitation study and consists of three constructs, the model requires a larger sample size and longer study duration than the more parsimonious TAM, which can be conducted with a smaller sample size and no prerequisite elicitation study (Myers, 2004). Myers concluded that in the context of the study, the "TAM did not outperform the TPB in the ability to explain behavioral intention among potential [...] adopters" and thus discovered an "important boundary condition" for the usage of the TAM (p. 128).

Conclusion

The present chapter reviewed the theoretical literature relevant to the present research. It discussed how innovations are diffused through a social system and discussed the Theory of Planned Behavior. Together, these theories provide a framework for the present research.

Chapter 3: Review of the Literature

This literature review starts with an overview of digital printing technology, its economic forecast, followed by the importance of the label printing industry as a component of the packaging industry.

Digital Printing

Digital printing is a printing process that prints directly from a digital file (Kasdorf, 2003) to a printing press where the page is "recreated each time" (Whitbread, 2009, p. 312). It has been defined by Romano (1997) as "printing with dots from digital data." There is no single, master imaging component on the press; instead, the raster image processor tells the device to mark, or not to mark, a component of a larger image, such as a pixel or dot. Romano (2000) credits Robert Howard with the invention of digital printing in its earliest form: the dot matrix printer, which was commercialized through Centronics and later through Epson. In 1978, Xerox introduced the 9790, the first non-impact sheet-fed laser printer with a price tag of $400,000; it was capable of 120 pages per minute and started the saturation of machines into this market segment (Romano, 2000).

Digital printing in the commercial printing industry has slowly grown over its lifetime; starting with the black-and-white Xerox DocuTech to a wide variety of fast color presses available today (Zwang, 2013). The DocuTech was designed for long periods of uninterrupted service and was rated for a million impressions per month (Romano, 2000). This type of press was perfect for printing on preprinted "shells," and almost exclusively served the document services industry.

The development of full color printing was slower-than-expected, taking most of the 1990s, and by 2000 the market was still very young (Romano, 2000). Over the next decade, the technology was improved by the document and commercial printing markets.

Today, the presses, substrates, and colorants are more versatile and are well-suited for packaging printing—and the review will now focus on those technologies pertinent to the package printing market.

Hewlett-Packard took over Indigo in 2001 and rebranded the presses as they are known today: the HP Indigo series (Smith, Tritton & Birkenshaw, 2003). Since that time, substrates, liquid toners, and HP Indigo presses have improved to be able to print on an even wider variety of materials. According to Cahill (2004) of Printing Industry Research Association (PIRA), the liquid-toner based HP Indigo and dry-toner based Xeikon presses were both able to print on materials suited for industrial applications; materials like PE, PVC, PET, oriented PP, and others. The Xeikon was marketed directly at the label printing industry with its capabilities for roll-to-roll, inline cutting and embossing, on a variety of pressure sensitive plastic films and papers (Cahill, 2004).

New printing technologies are in continuous development, testing, deployment, and improvement. One current example includes new liquid-toner, continuous-feed presses with the ability to print high quality images at a high image coverage, making them particularly suitable for packaging and commercial printing segments (Zwang, 2013). As the technology continues to improve and develop, printers find new ways to utilize the technology to enhance productive pressrooms.

Hybrid Digital Printing

In addition to packaging printing with purely digital presses, hybrid technologies that blend the use of analog and digital and are acknowledged here. Flexographic printers in the label industry typically print using web-fed presses in a roll-to-roll application. For this market, an inkjet printing head can easily be placed in a fixed position on the press creating a hybrid press. This approach combines digital and analog printing allowing the printer to widen their product offerings while leveraging existing equipment

(Myers, 2014). Digital inkjet heads can print in black or full color in a variety of resolutions. Myers of Flexo Magazine claims this is a "good first step for label printers and converters" (2014, p. 49). It allows printers to get a feel for the requirements of new digital technology while still fully utilizing existing operators with minimal training requirements.

Myers states that the next step beyond hybrid print technology is a fully-digital press investment (2014). There are many options available today, including the HP Indigo and Xeikon technologies that have matured for more than a decade. Another promising technology, inkjet printing, continues to evolve and its use in the industry is growing (Bohan & Dezzutti, 2013). There have been many developments in inkjet for label printing processes as well as other market segments (Bohan & Dezzutti, 2013).

Current Issues and Trends

Digitally printed materials will continue to grow significantly over the next several years as predicted by the Printing Industries of America (PIA). From 2009 to 2010, digital printing saw a large increase in the composition of a printer's total sales, from 13% to 20% (Davis, 2011) as seen from the NAICS codes for the American printing segments and presented in the PIA's 2011 *Print Market Atlas*. "By 2020 digital printing volume should increase to around $26 billion or an annual growth rate of around 3%–4% per year" (Davis, 2011, p.46). The growth in digital is due to the migration of print from conventional and new business from the capabilities of digital printing, including shorter runs (Davis, 2011).

An InfoTrends study by Valentini (2013) showed that more than half of in-plant printers intend to invest in new technology, either software or hardware, during 2014. Digital color printing saw 30.6% of survey respondents budgeted for 2014 and 32.7% of survey respondents considering adopting high-speed color inkjet. Having reviewed the

current status of digital printing and hybrid printing technology, the literature review now shifts to a discussion of the packaging industry.

The Packaging Industry

Packaging "is a complex, dynamic, scientific, artistic and controversial business function [and the physical package] contains, protects/preserves, transports and informs/ sells" the product which it contains (Soroka, 2002, p.3). The definition of packaging is widely inclusive; any structure or item that contains, protects, transports, and informs can be included in a discussion of packaging technologies. The World Packaging Organization (2008) segments the global packaging into five distinct markets: paper and board, rigid plastics, flexible plastics, metal, glass, and other. Not all of these packaging segments easily translate to the printing industry. Rigid plastics, metal, and glass packaging markets would most likely utilize screen, pad, or other specialty printing due to the ability to print on round, rigid, or substrates of unusual dimension.

Across all package printing segments, packaging printers are among the fastest growing in the commercial printing market in North America (Bland, 2013). Among package printers, there are several categories to describe various markets. Industry analysts Karstedt Partners (2013) identify four such categories: labels, folding carton, corrugated, and flexible packaging.

Of interest to the current study are packaging printers eligible for digital printing. Two of the four categories make it difficult to adopt digital printing based on current technological offerings. It is reasonable to presume that the majority of corrugated printers are unlikely to adopt current digital technology due to the limitations of the manufacturing process. According to Ward (2014) of *PackagePrinting,* flexible packaging printers tend to print on a variety of substrates, typically flexible polymer films and

foils. The current digital printing technologies struggle to print on such a wide variety of substrates without extensive testing and material certification.

The label printing segment is well positioned for digital printing technology due to the nature of the materials being manufactured. Labels are flat, available in a variety of stocks and substrates, and are easily transported from printing to the final product where it is applied. Many other forms of packaging printing must print directly onto the package itself.

According to Mc Loone (2010) in a *PackagePrinting* article, the label market was in good shape after the recession and positioned well for the future. While pressure sensitive labels are very popular, other labeling technologies, including heat-shrink, stretch sleeve, in-mold, and thermal transfer add to the label printer's portfolio of products. In 2010, there was optimism that U.S. label shipments would increase at an annual 4.5% (Mc Loone, 2010). Digital printing was expected to see an increase in usage—up to doubling the number of digital shipments up to 2013 (Mc Loone, 2010).

Digital Printing in Label Industry

The digital printing industry is not new, the technology has had the chance to develop over its several decade history (Zwang, 2013). Throughout this time, presses and equipment have existed that are specifically targeted for label printers and converters. Digital printing has found success in the general commercial printing segment, yet the adoption has been slower than expected in the packaging markets (InfoTrends, 2013).

Today, digital technology is still being looked at optimistically by all packaging segments (Bland, 2013; Polischuk, 2008). According to Jack Miller (2013) in an article for PackagePrinting, the global label volume is expected to grow an average annual compound rate of 3.4% from 2012 to 2016; and while flexo will still dominate the label market, the outlook on digital printing is optimistic with a growth rate of 27% per year.

A major trend in the label industry is the proliferation of stock-keeping units (SKUs) that split long print runs into several shorter runs (e.g. Karstedt Partners, 2013; Miller, 2013). Digital printing gains its advantage in the ability to print short runs with minimal downtime in between. Of the label printers that have adopted digital printing, approximately 83% of the digital label volume has been printed with toner-based electrophotography, which is seeing a 22% growth per year; inkjet is growing even faster, seeing 57% growth annually (Miller, 2013). Among the toner-based market, HP Indigo and Xeikon dominate and "Printfuture estimates that Indigo has a 70% share of the [electrophotographic] market" (Miller, 2013, pg. 16).

Technology Adoption in a Printing Industry Context

The literature review now turns to focus specifically on technology in a printing industry context. Over time, several researchers have utilized technology adoption theories to explain adoption phenomenon in the commercial printing industry.

One such example is by Nwako (1990) who utilized Rogers' Diffusion of Innovations to explain the adoption of electronic image processing systems in the United States printing industry. The research concluded with several salient beliefs from adopter and non-adopter categories in the 1990 electronic image processing system market.

In addition to the theoretical implications of B. L. Myers (2004) research of the TAM and TPB in an industry specifications context as reviewed in Chapter 2, the research also brings forward several practical implications to be considered by industry specifications committees. The study showed that the most salient beliefs regarding the adoption of Flexographic Image Reproduction Specifications & Tolerances in a flexographic printing company were as follows for each construct in the TPB:

1. Attitude: improved consistency of products, catalyst for continuous improvement, improved communications, among others.

2. Subjective Norm: upper management, production personnel, quality assurance personnel, and customers
3. Perceived Behavioral Control: limits to creative problem solutions, technology within the company, having the same specifications as competitors, among others.

Technology Adoption Forecasting

There are several studies that forecast market conditions with a large amount of historical and current sales data.One particularly relevant example in the printing industry is a study by Van de Capelle (2004) who used 5-10 years of annual sales data for the Xerox DocuTech Family and all available data for digital color presses applied to the Bass diffusion model. The research proposed an extension to the Bass model that overcomes some of the model's practical limitations. The Bass model presumes that the researcher understands the market size under study or has sufficient initial sales data to predict the size of the market (Van de Capelle, 2004). As actual sales data from one product is often used to predict the success of a separate product in a similar market, Van de Capelle proposes a mathematical framework for the Bass model with "time dependent market size" and "time-independent diffusion parameters" (Van de Capelle, 2004, p. 33). Van de Capelle finds that "digital color presses diffuse faster in the marketplace than digital black-and-white presses, mainly because of a stronger imitation factor" (2004, p. 29).

Conclusion

While there are several noteworthy published works regarding the topic of the present research, the current body of found literature has not specifically addressed the attitudes, subjective norms, and perceived behavioral control in a TPB study for the

adoption of digital printing technology in a label printing company. The attitudes and beliefs of the executives and managers in decision-making roles play an important part in the adoption process. The present research seeks to measure those variables.

Chapter 4: Research Objectives

The present chapter provides the objectives for the present research. Utilizing the theoretical framework presented in Chapter 2, these research questions will provide a study not addressed by the current body of found literature discussed in Chapter 3.

Research Questions

Utilizing the Reasoned Action approach for purchasing and using (adopting) digital printing equipment for commercial production in a label printing company in the next 12 months, the present research attempts to address the following research questions:

1. what is the direct measure of the dependent variable, the intention to adopt?
2. what are the most significant independent variables affecting the intention to adopt?

Research Sub Questions

3. What are the attitudes (A) of decision-making managers in label printing companies toward the adoption of digital printing?
    a. What are the respective salient beliefs, their strengths, and the subjective evaluation of the belief attribute?
    b. What are the implications of the correlations?
4. What are the subjective norms (SN) involved with the intention of the adoption of digital printing in labels.
    a. What are the normative beliefs, their strengths, and the motivation to comply with the normative beliefs?
    b. What are the implications of the correlations?

5. What is the perceived behavioral control (PBC) of digital printing adoption within the organization?
    a. What are the control beliefs, their strengths, and the perceived power over the control beliefs?
    b. What are the implications of the correlations?

Chapter 5: Methodology

The present chapter will cover the methodology utilized in the present study. The use of a cross-sectional survey, its mode of communication, construction, and testing will be discussed. The sampling frame, an estimate of the population, and the ability to generalize data from the survey to the population will be discussed. The present chapter concludes with discussion of data collection, levels of measurement, and processing of the resultant data.

Questionnaire Construction

The methodology selected to complete this Reasoned Action study was a cross-sectional survey sent to executives and decision-makers within packaging printing companies. A survey was selected on the basis that it is possible to reach many people in an efficient manner and to maintain consistency with prior research using the Reasoned Action approach (Myers, 2004). The power of a survey comes from its ability to estimate characteristics of a population by sampling a few elements within the population (Dillman, 2009).

Of concern to modern surveyors is the availability of the Internet, email, mail, and telephone communications. Designing a survey to sample populations that may or may not have Internet access can be tricky, requiring the surveyor to use multiple means to communicate to the subject—this would require a "mixed mode survey" as outlined by Dillman (2009). For the modern printing industry, it is unlikely that a business within this population would have never adopted the use of the Internet, nevertheless, these factors were taken under consideration in the design of the questionnaire.

A mail survey was selected due to the difficulty in acquiring email addresses and names of individuals at a wide range of companies. In order to work through this limitation, two response methods were available to the subjects: they were presented

the option of completing the physical, mailed questionnaire or could complete the questionnaire online. According to Dillman, providing the online option does not necessarily increase response rate, but allows the subject to participate according to their preference (2009).

According to Fishbein and Ajzen (2010), constructing a reasoned action questionnaire consists of two parts: the first involves formative research including an elicitation study (pilot questionnaire); the second, the construction of a standard questionnaire instrument for the main study.

Formative Research

Formative research for Reasoned Action studies includes defining the action, target, context, and time, and performing an elicitation study to identify modal salient beliefs. During the formative research, the sampling frame was defined for the research population and a strategy for the elicitation study pilot questionnaire was developed. The sampling frame for the elicitation study was a group of label and packaging printers developed with the assistance of Karstedt Partners, LLC (KP LLC), a firm which is intimately familiar with digital printing in a packaging supply chain environment. This industry-focused firm was selected on the basis that the firm has regularly advised brand owners, graphic designers, and packaging printers how to navigate the digital packaging printing industry (KP LLC, 2013).

Eliciting Salient Beliefs

The salient beliefs were elicited by survey for each determinant construct in the TPB: Attitude, Subjective Norm, and Perceived Behavioral Control. These were open-ended questions with eight lines for responses. Subjects were instructed to place one belief on each line. Each group of questions was preceded by a paragraph intended to

help the respondent answer the group of questions. For example, normative referents were grouped together so that they may consider all people who would approve or disapprove of the behavior.

Care was taken to word the questions so as not to lead the respondent to a biased answer. For example, in the question "there are often advantages and disadvantages associated with the purchase." The word purchase was chosen because it is relatively neutral—alternative choices could be "investment" which may have been seen as positive, or "expense" which may have been seen as negative.

Administering the Pilot Questionnaire

Fishbein & Ajzen (1980) recommend a survey instrument with 20-30 responses to yield enough elicited salient beliefs to select the modal occurrences and to construct the main survey. However, due to limitations in the research population and the availability of company contacts, a questionnaire was conducted as an asynchronous focus group; elicited salient beliefs were coded as questionnaires were returned. Homogeneity between responses was high and the elicitation was stopped at ten responses with little need to follow-up with any non-responders. Responses were captured with coding for meaning and planning for careful wording on the main survey.

Preparing a Standard Questionnaire

Each salient belief and its expected outcome were determined from the pilot study with the greatest occurrence (mode). Belief responses were coded to capture meaning and to combine several phrasings that were synonymous. For example, "can't print special or metallic colors" and "thick substrates," can be captured by the final survey question "limited substrates and colorants."

The distinction between injunctive and descriptive normative beliefs was minimally operationalized due to an irregularity from the resulting elicitation data. The variability in answers was due to the nature of market research—often social referents for organizations are mostly from internal individuals. Therefore, several job titles within the company were identified as social referents. Externally, all other social referents could be coded so that they were represented by three types of organizations: customers, competitors, and suppliers.

The resulting salient beliefs were then formulated into a semantic differential to assess the strength of the belief-based variable and the outcome or motivation to comply with the belief.

Sample Frame

Selecting the size of the sample affects the ability to make inferences about the researched population. Seeking high statistical power increases the minimum sample size, increasing the cost of the survey. Therefore, it is necessary to balance the factors affecting statistical power in order to maintain both the ability to make inferences about the population and practically conduct the necessary research.

A common method to determine the minimum sample size for a regression model is a 20/1 ratio of sample size to number of variables (Myers, 2004). In this study, as four variables are present, a sample of 80 was sought to yield sufficient statistical power.

Due to the general nature of the action being measured (adopting a new technology) and the difficulty of forming a list within a somewhat small research population, it was concluded that it was unnecessary to restrict the elicitation frame to current non-adopters.

Population

The research population for the main survey consisted of all label printing companies in the 50 states of the United States of America, excluding overseas territories, which meet the following criteria:

1. Identify with the label printing industry and all or part of their business is involved in the production of labels
2. Is a current non-adopter of large-scale commercial digital printing, including both electrophotographic and inkjet printing processes
3. Is a company with significant enough operations to identify with the commercial printing industry

The estimates for the population of label printers in the North American market widely vary. In 2008, Freedonia, an industry research firm estimated from 3,000 to 5,000 companies were involved with label stock supply or printing and converting, however, there were predictions for a strong decrease in number over the next several years due to widespread mergers and acquisitions (Polischuck, 2008).

Generalizability

The ability to generalize to the research population was considered during every decision during the research process. Random selection procedures are commonly utilized in survey research where possible to ensure the statistical validity of the results and to ensure the generalizability to the sampled population (e.g. Myers, 2004). Random selection was applied in the present research where possible to ensure the results could be generalized back to the population.

Due to the lack of freely available, high-quality business databases, the list was compiled through a university-wide subscription to a business and industry database, Hoover's, a subsidiary of Dun & Bradstreet. During the building of the sample frame,

the most limiting business attribute was the NAICS code under which the business was organized. “There is no central government agency with the role of assigning, monitoring, or approving NAICS codes for establishments,” and as such, the ability for the NAICS code to capture all businesses within a target population is limited (U.S. Department of Commerce, 2013). In order to work within this limitation for the means of this research, the NAICS code that was selected or assigned during the incorporation of the business was assumed to have no effect on the variables being measured by the present study.

Sampling Frame

The sampling frame for the standard questionnaire was selected from the aforementioned Hoover’s database with *all* of the following filtering criteria: Location is in the United States, NAICS 323111: Commercial Printing (except Screen and Books), and *any* of the following keywords: label, labels, flexo, flexographic, flexography.

The search was completed in late September 2013 and resulted in 462 companies. Each company’s website that was provided by Hoover’s was visited to check whether the company has already adopted digital printing and publicly makes that information available. Many printers have a capabilities section where they share information on the latest press equipment. 51 companies indicated on their website that they had already adopted digital printing and therefore, it was unnecessary to send them a survey just so they could disqualify themselves.

All companies that had a website and could be identified as “within the label printing industry” and “has not adopted digital printing” would receive a survey invitation in the mail. 164 companies were in this category. This group is such a large portion of the total population acquirable by NAICS code that the total inclusion of the list was compulsory for adequate response amongst this group.

If a company did not have a website provided by Hoover's, the company was placed in a separate category. This group was selected from the list by the use of a simple random number generator to participate on the basis that there is higher risk of self-disqualification, leading to a higher cost per qualifying response. 198 companies fell into this category of which 100 were randomly selected via simple random number generator.

Companies that clearly serve a different market than label printing were disqualified. Among those disqualified were several machine shops that serve the flexographic industry (gears, print cylinders, and tooling), or businesses that appear to be extremely small-scale craft and hobby. Several fabric label printers were disqualified. Websites that were not functional at the time of visit were disqualified. Printers from Puerto Rico were included in the Hoovers database for United States companies but were removed, as they are not included in the defined research population. One company that was used in the elicitation study was disqualified for the main survey. The combination of these factors resulted in a total of 49 companies being disqualified from the present study.

Levels of Measurement

The present research utilizes interval level measurement through the semantic differential developed by Osgood and his associates (1957), which was recognized to be an effective measure of attitude (Osgood, Suci, & Tannenbaum, 1957 in Ajzen & Fishbein, 1980). Since then, the seven-point bipolar adjective scale and Likert scales have been consistently used for measurement in TRA and TPB studies. With the seven-point scale, the middle figure can represent a zero, while each increment toward the bipolar adjectives can represent a positive or negative point, the extremes of the scale being 3 and -3. A bipolar scale was used consistent with prior research and at the advice of Fishbein and Ajzen (2010) who argued that in most expectancy-value cases, it is superior to unipolar scoring which uses 1 to 7.

Questionnaire Testing

Both the pilot questionnaire and the standard questionnaire for the main study were reviewed by a committee of scholarly peers prior to being sent to the subjects. This committee was responsible for reviewing and suggesting improvements for wording, context, grammar, structure, and design. This committee was assembled within the School of Media Sciences at Rochester Institute of Technology and was composed of researchers with experience in survey design and a familiarity with the label printing industry.

Survey

A pre-notice letter was mailed one week prior to the main questionnaire instrument. The pre-notice letter, as recommended by Dillman (2009), served to introduce the study and alerted the company that the full questionnaire instrument would arrive by postal mail. Included with the pre-notice letter was a card with a URL where they were presented the option to complete the questionnaire online immediately and an About the Researcher description to provide background information. The full survey, mailed a week later, included a cover letter, the questionnaire, a postcard to indicate their completion, a pre-stamped return envelope, and the same card with the online questionnaire URL.

A reminder postcard was mailed to non-responders two weeks later with instructions to complete and return the paper questionnaire or complete the online version. For companies with an email address listed on their website, an email was sent in lieu of a postcard. A final reminder postcard was mailed two weeks later to all non-responders.

Data Analysis

Consistent with prior research in this domain, the most advantageous index is the correlation coefficient, Pearson's r. Correlation ranges from -1 to 1 and represents a measure of the linear relationship between two variables (Ajzen & Fishbein, 1980). The statistical significance of the correlation, as measured by the probability of occurrence *(p),* indicates the resultant correlation could not occur solely by chance.

The collected data were time-stamped according to estimated completion time. For questionnaires returned by postal mail, the postmark date was used. The completed, returned mailed questionnaires were manually entered into the online survey tool. Upon receipt of a postcard indicating a participant's completion, the company was removed from the list and would not receive any follow-up reminders; at this time, a handwritten postcard was mailed to the company thanking them for their time.

Semantic differential data were recorded online on a unipolar scale (1 to 7). The data were linearly scaled to a bipolar (-3 to 3) scale by subtracting four from the final data. If a respondent answered 1, they would be scaled to -3, a 4 to zero, and a 7 to a +3. Scaling the interval level data does not affect the meaning of the response, as the distance between the intervals is maintained in the process (Fishbein & Ajzen, 2010). Semantic differentials were recorded with agreement on the left side of the scale and thus an agreement was recorded with a score of -3. To aid with clarity of presentation, the data were transposed so that an agreement was represented by a positive number.

Belief strengths (b_i , n_i , c_i) and outcome evaluations (e_i , m_i , p_i) were analyzed for arithmetic mean and standard deviation for Attitude (A), Subjective Norm (SN), and Perceived Behavioral Control (PBC), respectively. Means and standard deviations were also calculated for the products of each b_ie_i , n_im_i , c_ip_i for A, SN, and PBC, respectively.

Conclusion

The present chapter covered the methodology utilized in the present study by use of a cross-sectional survey. Survey construction and testing were discussed. The sampling frame for the estimated population and the intent to generalize resulting data from the present study were discussed. Data collection, levels of measurement, and processing of the resultant data were covered.

Chapter 6: Results

The present chapter discusses the final sample, limitations of the present study, the results from the elicitation study, and a presentation of the data from the main survey questionnaire.

Description of the Final Sample

After an extensive review of available sources, a complete sampling frame that meets the criteria of the present research was not available: a comprehensive list of label printers who had not yet adopted production digital printing equipment is simply not obtainable. As the present research is regarding user intention to adopt, respondents were sought from this specific population. Furthermore, as the unit of analysis for the present study is the organization itself, decision-making individuals that represent their respective organizations were required from each company to complete the survey instrument.

As discussed in Chapter 5, a list of potential companies was developed using a filtering process with keywords in the Hoover's database. Using this method, a total of 462 companies were identified as producers of labels, however relevant contacts within those organizations were not available. Individual contact information was sought via Internet searches and used where possible, as it is widely recognized that reaching out to individual contacts at a company will increase survey response rates. The yield from such searches was minimal, and when relevant contacts were not obtained, surveys were addressed to the company.

With 260 questionnaire instruments mailed, 51 companies responded with a response rate of nearly 19%. Of these, 31 companies qualified for data analysis in the present research. The number of usable responses is not entirely unexpected given the unknown population and the previously discussed sampling frame challenges.

While the sample size limits certain statistical procedures due to the lack of statistical power, namely a regression analysis with an ANOVA output, descriptive statistics can provide insight into the theorized factors that contribute to digital printing technology adoption by label printing organizations. A regression analysis was completed for informational purposes and included in Appendix F.

Sampling Frame Demographics. A high percentage of respondents were representative of relatively small organizations. As seen in Figure 3, of respondents who completed the demographic portion of the questionnaire, the highest frequency of respondents (50%) represented organizations with 10-49 employees, followed by organizations with 1-9 employees (35.7%). Combined, companies with less that 50 employees represented 85.7% of survey responses.

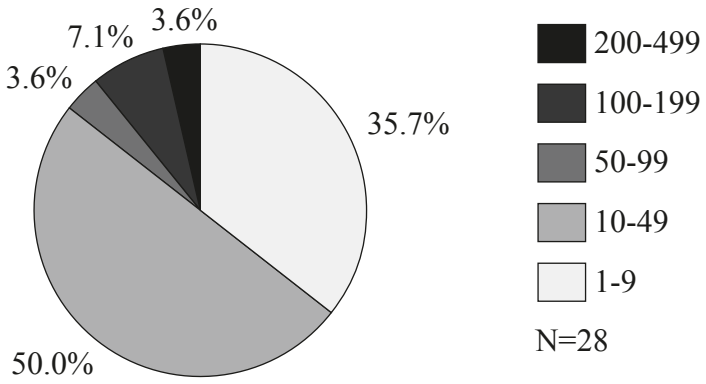

Figure 3: Frequency of Responses by Company Size as Measured by Number of Employees

Elicitation Results

The pilot questionnaire resulted in a set of beliefs for each construct described in the Theory of Planned Behavior: Attitude, Subjective Norm, and Perceived Behavioral

Control toward the adoption of digital printing technology in a label printing company in the next 12 months. As seen in Table 1, the elicited items that were measured by the elicitation survey instrument had a modal occurrence of greater than one. Customers, competitors, and suppliers constituted a special case as discussed in Chapter 5 and were implemented after the elicitation study to capture a wide variety of responses given to the questions designed to elicit external normative referents, "Please list the type of organizations outside your company who are most likely (and least likely) to adopt digital printing presses." Additionally, the beliefs for the Perceived Behavioral Control construct were homogenous especially for budget and training aspects. Orders suited for digital printing was included as it represents a unique belief not captured by the other control beliefs.

Table 1

Coded Elicitation Items and their Frequencies

Construct	Coded Belief	*f*
Attitudes	Being prepared for future disruptive technologies	7
	Not having to make printing plates	7
	A costly press investment	6
	A new profit opportunity	6
	Ability to print short runs	6
	Fast makeready and turnaround	6
	Limited substrates and colorants	5
	The ability to use variable imaging	4
	Training employees on a new technology	3
	High costs on long runs	2
	Lower print quality	2
Subjective Norms	President	8
	Production/Operations	8
	Sales	4
	Operators	3
	Prepress	2
	Marketing	2
	Owners/Shareholders	2
	Quality Control	2
	Customers	1
	Competitors	—
	Suppliers	—
PBC	Budget	9
	Training program	7
	Existing customer base	3
	Sales strategy	3
	Enough work	2
	More product offerings	2
	Orders suited for digital	1

Direct Attitude Measures

A questionnaire was employed to measure the construct of attitude directly and consisted of five semantic differential questions. These five questions were created using the researcher's a priori understanding of the adoption of digital printing in the label printing industry. Fishbein and Ajzen (2010) advise that direct measures "should have a high degree of internal consistency" (as measured by Cronbach's alpha) and performing a confirmatory factor analysis is one means to investigate factor loading and reducing the number of questions to improve the quality of the results (p. 452). According to Comrey and Lee (1992), for a full dimension-reducing factor analysis, a sample size ranging from 100-500 and as high as 1000 are needed, even if the number of variables are relatively low. Due to the limitations in sample size, a factor analysis alone would be unlikely to yield accurate results, and therefore, bivariate correlations and Cronbach's alpha will be used to determine the internal consistency and reliability of the five questions.

The frequencies of responses are shown in Table 2. As seen, the majority of respondents tend to show a positive attitude toward digital printing technologies. The positive arithmetic means indicate a central tendency toward Good, Advantageous, Beneficial, Well-judged, and Planned while the data are skewed left for the smaller number of respondents who disagreed. The data are consistent with a positive outlook discussed during the literature review and the present data may serve to reinforce that label printers continue to have an optimistic view of the technology.

Table 2

Direct Attitudes: Frequency (%)

	Extremely			Neutral			Extremely	
	-3	-2	-1	0	1	2	3	
Bad	3.7	7.4	3.7	29.6	11.1	33.3	11.1	Good
Disadvantageous	0.0	0.0	11.1	11.1	25.9	33.3	18.5	Advantageous
Harmful	3.6	0.0	7.1	14.3	21.4	32.1	21.4	Beneficial
Reckless	7.7	3.8	3.8	15.4	15.4	30.8	23.1	Well-Judged
Unplanned	3.6	3.6	3.6	21.4	14.3	17.9	35.7	Planned

Internal Consistency

Cronbach's alpha measuring internal consistency was calculated for the five questions. The scale using all questions (N=5) showed a high degree of internal consistency, as determined by a Cronbach's alpha of 0.888. The Item-Total Correlation, as seen in Table 3, provides insight into the reliability of each question and the "Cronbach's Alpha if Item Deleted" calculations show that the final question, the Planned-Unplanned semantic differential was detracting from the internal consistency, and if removed would improve the measure of the construct with a Cronbach's alpha of 0.909. The reliability of Planned-Unplanned is therefore suspect and once removed would improve the internal consistency of the scale.

Table 3

Direct Attitudes: Internal consistency (Cronbach's alpha)

	Scale Mean if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Good-Bad	5.192	0.849	0.915	0.835
Advantageous-Disadvantageous	4.692	0.704	0.747	0.873
Beneficial-Harmful	4.692	0.830	0.893	0.842
Well-judged-Reckless	4.923	0.776	0.726	0.853
Planned-Unplanned	4.654	0.541	0.629	0.909

Valid Cases N=26

The correlation matrix for direct Attitude measures is shown in Table 4. Most of the questions were correlated to each other with significance at the $p = .05$ level. However, it can be seen that the Planned-Unplanned measurement does not correlate well to the other four measures.

Table 4

Direct Attitudes: Correlations (Pearson r)

	Advantageous-Disadvantageous	Beneficial-Harmful	Well-judged-Reckless	Planned-Unplanned
Good-Bad	.850**	.933**	.640**	.453*
Advantageous-Disadvantageous	—	.802**	.528**	.267
Beneficial-Harmful		—	.670**	.397*
Well-judged-Reckless			—	.735**

** $p < .01$ level (2-tailed).
* $p < .05$ level (2-tailed).
Listwise N=26

The internal consistency analysis and the lack of correlation between Planning and the other four questions seem to illustrate that the planning of purchasing printing equipment may be distinct from the subject's positive-negative opinion about the adoption. The implications of the present analysis suggest that the Planned-Unplanned question should be used with caution or removed from the data as it may capture a concept other than the respondent's attitude.

From Cronbach's alpha data seen in Table 3 and the correlation matrix in Table 4, it appears that Good-Bad, Advantageous-Disadvantageous, Beneficial-Harmful, and Well-judged-Reckless display internal consistency and can be used reliably to describe the attitude construct. For the remainder of the present study, *adjusted mean direct attitude* will refer to the arithmetic mean of the first four semantic differential questions and Planned-Unplanned will not be used. It is worthy of further investigation to understand the discrete factors present in attitudes toward digital printing in the label printing industry.

Direct Measure of Perceived Norm

Similar to the direct measures of Attitude, direct normative beliefs were measured capturing both the injunctive (those individuals within the company) and descriptive (companies like the subject's) aspects of normative pressure. The injunctive measure indicated that for a larger number of respondents, there was a belief that most people in the organization would support the adoption of digital printing. The arithmetic mean for this measurement is $\bar{x} = 1.00$ As seen in Table 5, the data are skewed left (median is greater than mean) by those respondents who do not believe the people in their organization would support the adoption.

The descriptive aspect recorded a more neutral response; the modal response being neutral with only a slight arithmetic mean toward agreement that most

organizations like the respondents have adopted or will be adopting a digital printing press in the next 12 months.

The arithmetic mean of the two questions will serve as the *mean direct norm* for the remainder of the present research.

Table 5

Direct Measures of Normative Beliefs

		VS Disagree					VS Agree		Descriptives	
		-3	-2	-1	0	1	2	3	M	SD
Most people in my org. would support the adoption	*f*	0	4	2	3	4	11	4		
	Valid %	0	14.3	7.1	10.7	14.3	39.3	14.3		
									1.00	1.66
Most orgs. like mine have/will be adopting	*f*	0	2	6	8	5	5	2		
	Valid %	0	7.1	21.4	28.6	17.9	17.9	7.1		
									0.39	1.40

Note: VS = Very Strongly
N=28 (both questions)

Direct Measure of Control

Direct control measures are shown in Figure 6. The first question, measuring *capacity* aspects of control, as described by Fishbein and Ajzen (2010), indicates a bimodal distribution with one local maximum very strongly agreeing with the statement: "I am confident that my organization has the ability to adopt a digital printing press in the next 12 months" and the other local maximum strongly disagreeing.

The *autonomy* aspect of control was measured by the second statement with a stronger tendency toward agreement. Those respondents who strongly agree represent organizations that have an autonomous decision making process; those who disagreed may be a facility location within a larger corporate environment or may exhibit some other external control factor.

Table 6

Direct Measures of Control Beliefs

		VS Disagree						VS Agree	Descriptives	
		-3	-2	-1	0	1	2	3	M	SD
I am confident that my org. has the ability to adopt	*f*	2	7	3	4	3	3	6		
	Valid %	7.1	25.0	10.7	14.3	10.7	10.7	21.4		
									.14	2.085
The decision to adopt is up to my org./facility	*f*	0	2	3	5	3	3	12		
	Valid %	0.0	7.1	10.7	17.9	10.7	10.7	42.9		
									1.36	1.747

Note: VS = Very Strongly
N=28 (both questions)

Direct Measure of Intention

As mentioned in Chapter 2, the simplest way to measure the intended behavior of an individual is to simply ask the subject. As seen in Table 7, the distribution is not normal nor clearly indicates a bimodal distribution. A categorization of three distinct groups helps to statistically analyze means between the following adopter groups: those with no degree of intention to adopt, those with a neutral opinion and those with some degree of intention to adopt. As seen in Table 7, there were 8 respondents who display some degree of intention to adopt and may be categorized as *intended adopters*, 14 respondents displayed some degree of no intention to adopt and can be categorized as *do not intend to adopt*, and the remaining 6 indicated a neutral response.

Table 7

Direct Measure of Intention

		VS Disagree					VS Agree		Descriptives	
		-3	-2	-1	0	1	2	3	M	SD
I intend to adopt digital printing for production purposes	*f*	6	7	1	6	4	3	1		
	Valid %	21.4	25.0	3.6	21.4	14.3	10.7	3.6		
									-.71	1.863

Note: VS = Very Strongly
N=28

These categories play an important role in the discussion of the data. It should be noted that the grouping of individuals in this nature reduces the measurement level of the data and these groupings will only be used for analyses of a descriptive nature in the present cross-sectional study.

Attitudes Measured by Expectancy-Value

The salient attitudes that were elicited during the pilot questionnaire and their modal occurrence are shown in Table 8. These items were measured, consistent with prior research, as an expectancy-value, such that the strength of the belief (b) that the object has attribute (i), and the evaluation (e_i) of the attribute (i) are measured then multiplied together for each respondent (b_ie_i). The arithmetic means and standard deviations for the individual beliefs, evaluations, and their products, (b_ie_i), are given in Table 8 and sorted along the mean of the products. These values were then correlated to the adjusted mean direct attitude.

Table 8

Attitudes Measured by Expectancy-Value

	b_i		e_i		b_ie_i		b_ie_i correlation with adjusted mean direct attitude	
	M	SD	M	SD	M	SD	Pearson r	Sig. (2-tailed)
Fast makeready and turnaround	2.32	0.82	2.07	0.83	5.30	2.69	.132	.531
The ability to use variable imaging	1.57	1.00	1.70	1.27	3.70	3.00	.275	.183
Ability to print short runs	1.71	1.24	1.81	1.24	3.19	3.96	.364	.073
A new profit opportunity	1.89	1.07	1.37	1.31	3.07	3.78	.548**	.005
Training employees on a new technology	0.93	1.12	1.85	1.35	2.04	2.78	.506**	.010
Lower print quality	-1.82	0.82	-0.56	1.40	1.26	3.15	.084	.690
Being prepared for future disruptive tech.	1.46	1.04	0.67	1.66	1.11	3.60	.308	.134
High costs on long runs	-1.71	1.05	-0.30	2.03	0.52	4.96	.231	.267
Not having to make printing plates	1.85	1.13	-0.70	2.07	-0.42	4.78	-.162	.438
Limited substrates and colorants	-0.96	1.04	0.52	1.74	-0.63	2.95	.373	.067
A costly press investment	-0.21	1.20	1.85	1.38	-0.75	2.65	.185	.377

** $p < .01$ level (2-tailed).
Correlations listwise N=25

Subjective Norm Measured by Expectancy-Value

In the same manner as attitudes, subjective normative beliefs were elicited by use of a pilot questionnaire resulting in the modal beliefs as previously shown in Table 1. These items were measured as normative beliefs (n_i), the respondent's motivation to comply (m_i). The arithmetic means and standard deviations for the beliefs, motivations, and their products ($n_i m_i$) are given in Table 9 and sorted along the mean of the products.

The normative (n_i) means for the two groups Sales and Marketing showed a stronger central tendency toward agreement, indicating that on average those groups/ individuals would support the adoption of digital printing. The motivation to comply (m_i) data indicated that the President, Owners/Shareholders were the strongest motivation to comply individuals respectively, followed by Production/Operations and Customers (with a slightly larger standard deviation).

Almost all of the subjective norm beliefs are strongly correlated to the mean of direct norm at a high significance level and a positive linear relationship, indicating that an increase in a perceived normative referent is likely to increase the overall normative belief.

Perceived Behavioral Control Measured by Expectancy-Value

In the same manner as attitudes, PBC beliefs were elicited by use of a pilot questionnaire resulting in the modal beliefs. These items were measured as control beliefs (c_i) and their power (p_i). The means and standard deviations for the individual beliefs, powers, and their products, ($c_i p_i$), are given in Table 10 and sorted along the mean of the products.

Table 9

Norms Measured by Expectancy-Value

	n_i		m_i		$n_i m_i$		$n_i m_i$ correlation with mean norm	
	M	SD	M	SD	M	SD	Pearson r	Sig. (2-tailed)
Customers	0.89	1.15	1.63	1.33	1.85	3.23	.517**	.006
Marketing	1.15	1.17	0.96	1.29	1.59	2.74	.489**	.010
Sales	1.15	1.46	1.19	1.14	1.48	3.20	.502**	.008
Quality Control	0.30	1.35	0.70	1.41	0.96	2.59	.440*	.021
Competitors	-0.42	1.33	-0.30	1.35	0.70	3.34	.345	.078
Suppliers	0.46	0.84	0.33	1.21	0.64	1.57	.449*	.019
Production/Operations	0.15	1.66	1.63	1.04	0.59	3.71	.632**	.000
Prepress	0.22	1.12	0.48	1.31	0.59	2.08	.438*	.022
Operators	-0.04	1.29	0.79	1.32	-0.04	2.56	.487**	.010
Owners/Shareholders	-0.11	1.93	1.96	1.07	-0.50	4.68	.548**	.003
President	-0.25	1.94	2.04	0.96	-0.96	4.73	.697**	.000

** $p < .01$ level (2-tailed).
* $p < .05$ level (2-tailed).
Correlations listwise N=27

Table 10

PBC Measured by Expectancy-Value

	c_i		p_i		c_ip_i		c_ip_i correlation with mean direct control	
	M	SD	M	SD	M	SD	Pearson r	Sig. (2-tailed)
Orders suited for the quality of digital printing	1.46	1.23	0.07	1.41	1.04	2.52	.164	.404
More product offerings for my customers	1.25	1.32	0.18	1.31	0.93	2.37	.363	.058
A training program for a new digital press	0.71	1.67	-0.68	1.19	0.32	2.80	-.139	.482
An existing customer base for a digital press	1.96	1.14	-0.21	1.55	0.11	3.40	.504**	.006
A sales strategy for digitally printed products	1.75	1.14	-0.36	1.34	0.07	2.72	.198	.313
The budget to afford a digital press	0.79	1.97	-0.50	1.64	-0.54	3.49	.022	.910
Enough work for a digital press	2.00	1.31	-0.54	1.40	-0.68	3.38	.466*	.013

** $p < .01$ level (2-tailed).
* $p < .05$ level (2-tailed).
Correlations listwise N=28

Attitude, Subjective Norm, and Perceived Behavioral Control Effect on Intention

A detailed regression output of the independent variable is provided in Appendix F for reference. It is especially noteworthy that several indicators illustrate the relative importance of Attitude (A), Subjective Norm (SN), and Perceived Behavioral Control (PBC).

In examining the constructs that were theorized to comprise the independent variables, a two-tailed *t* test was conducted to determine which, if any, indicated a statistically significant difference when segmented as intended adopters and those that do not intend to adopt. Of the constructs that comprise Subjective Norm, nine exhibited a statistically significant difference, where Perceived Behavioral Control exhibited three, and only one of the Attitude constructs indicated a difference.

Those constructs with a significant difference between the two adopter groups are presented in Table 11. As an example, it can be seen in Subjective Norm that the construct of President highlights the polarity of these two groups. For example, a respondent could believe the President strongly disagrees with adopting (-2) and the company very strongly believes what they should what the President thinks they should do (3), which create a product of -6. It can be seen that the means of the two groups are significantly different $t(15.6) = -4.97$, $p < .05$.

While all constructs were reasonable in their effect on Intention, Subjective Norm appears to be the strongest in the present context. A ranking of the three constructs in the present study would therefore be, in order of effect on Intention:

1. Subjective Norm
2. Perceived Behavioral Control
3. Attitude

Table 11

Two-tailed t test for Equality of Means

		Group Statistics						
		Do not intend to adopt			Intended adopters (N=8)			
		N	M	SD	M	SD	*t*	*df*
SN	President	14	-4.36	3.67	3.38	3.42	-4.97	15.6
	Owners/Shareholders	14	-3.50	3.86	3.88	3.83	-4.33	14.8
	Production/Operations	13	-1.92	1.93	4.38	3.93	-4.23	9.1
	Sales	13	0.08	2.22	4.75	3.15	-3.67	11.3
	Marketing	13	0.69	1.18	4.50	3.12	-3.31	8.3
	Quality Control	13	-0.23	1.59	3.13	3.27	-2.71	9.1
	Customers	13	0.54	2.73	3.63	3.20	-2.27	13.1
	Operators	14	-1.21	2.81	1.63	2.00	-2.76	18.8
	Prepress	13	-0.38	1.50	2.13	2.42	-2.64	10.4
PBC	Existing customer base	14	-1.14	3.82	2.75	2.19	-3.04	20.0
	Enough work	14	-2.14	3.32	1.75	3.33	-2.64	14.7
	More product offerings	14	-0.07	1.64	2.75	3.01	-2.45	9.4
A	Variable imaging	13	2.38	1.94	6.25	3.37	-2.96	9.9

Note: All significant at $p < .05$, equal variances not assumed

Chapter 7: Summary and Conclusions

This chapter will discuss the implications of the present research, provide suggestions for further research in this area of study, and conclude the present study.

Attitudes

The Attitudes, when measured directly, indicated a positive outlook for the technology with means indicating that an adoption of digital printing in a label printing company within the next 12 months would be an advantageous and beneficial decision. The present research may serve to contribute to the optimistic attitude toward new technologies as discussed in the literature review.

Several beliefs were shown to be the most influential among the measured beliefs. A fast makeready and turnaround was believed to be the most positive simultaneously being the most likely to occur, therefore making this particular construct the most influential. The ability to use variable imaging was ranked second, followed by the ability to print short runs.

A new profit opportunity and training employees were both correlated to the adjusted mean direct attitude at a statistically significant level ($p < 0.01$), indicating that as an individual increases their adjusted mean direct attitude by believing the adoption of digital printing would be good, advantageous, beneficial, and well-judged, they are likely to display an increase in their beliefs regarding profit opportunity and training employees.

The present data may serve to illustrate the most important beliefs of digital printing technology for the decision makers. The ability to receive an order and print it with a fast turnaround is a strong selling point and where digital gains its advantage over conventional printing technologies. Variable imaging is seen as another important belief and represents another advantage over conventional printing. Variable imaging affords greater flexibility in production scheduling and order fulfillment strategies; these

solutions enable adopters to utilize a greater breadth of product offerings. Furthermore, variable imaging has the ability to lower warehouse and shipping costs associated with more traditional printing and distribution strategies. Creative solutions to quick turnaround and order fulfillment have the potential to be realized with digital printing.

Manufacturers and marketers of digital technology could benefit from understanding the negative beliefs demonstrated to be held by label printers, including a costly press investment and a limitation of substrates and colorants. A plan to mitigate these negative beliefs may be necessary for the successful adoption of digital printing technologies in the label market space.

Normative Referents

The most influential normative referent supporting an adoption of a digital press is the customer. Marketing and sales divisions within the organization are typically located at the front of the business, interacting with customers and making their needs known. Customers may be requesting digital printing knowing the price on small orders would likely decrease compared to that of conventional.

On the other hand, the president, owners/shareholders, and those at the back of the business tend to hold a more reserved view. After all, they control the budgets and are responsible for ensuring the business growth strategies are met.

The data from the present study illustrate a gap that exists within the organizations themselves. Label customers, sales divisions, and marketing operations are receptive to the product and would support its adoption. Those in charge of purchasing the equipment show concern for the monetization of the press. Digital press manufacturers are therefore advised to focus on the decision makers at the back of the company responsible for the decision. This could come in the form of helping the company build a business model

to monetize the equipment or to address concerns regarding the integration of digital technology into a conventional workflow.

Operators were seen to have little normative pressure on the subject and production/operations and suppliers play very weak normative roles. As there seems to be little pressure from those who would implement and operate the machinery. This is likely to occur if communication about new technologies is limited on the pressroom floor. If this is the case, open communication with operations may alleviate some concerns with new printing processes and help with a successful adoption. In the best of situations, little pressure from operations may indicate that an adoption is not likely to disrupt the existing workflow.

As previously discussed, 85.7% of the survey respondents represented companies with fewer than 50 employees. It is logical that in smaller organizations, the normative referents are likely to play a significant role in the decision to adopt new technology.

Implications of Control Beliefs

The strongest control belief in the present data include orders suited for digital printing, which, combined with the strongest negative belief of enough work for a digital press shows that management is concerned with how many orders presently exist and how many new orders they can create. Management often likes to know there are sufficient customer orders in place before installing a new press. In a conventional press environment, once the production schedule is consistently filled and a seemingly never-ending backlog of work exists, the need for a new press is quite clear. With digital printing technologies, the business case for a new press is not quite as apparent. Stated another way, a new technology outside of an organization's core competency may present a risk that seems to great to consider the investment required.

The budget for a press was shown to be a negative control belief with the companies on average believing that having a budget would enable the adoption and companies believed they would not have the budget in the next 12 months. This data may further contribute to the budgetary implication for digital press manufacturers and marketers—companies simply may not have enough cash at the present time to feel comfortable installing this equipment. Understanding further monetary requirements of the label printer may yield valuable results and the limitations of the present study creates a need for future researchers to investigate matters in this area.

Label printers who have operated with conventional printing presses are accustomed to accounting for the life of a conventional press, ranging from 10 to 30 years, after which the press may still have resale value. When compared to conventional presses, today's digital presses typically require an initial investment that is less costly but are generally associated with a higher operating cost. Many are sold with a "click-charge" pricing structure, which is frequently tied to consumable and equipment service contracts. After the useful life of a digital press, the technology is eclipsed by newer, faster, and more advanced digital machines. Planning in the past may have required fewer rigors knowing that a used press maintained some amount of resale value. Digital presses today are often not owned by the printer; they are leased on a click-charge model that is tied closer to a supply service model.

Suggestions for Future Research

Consistent with the scientific method, the methodology, data collection and results of the present research should be retested, replicated, and corrected by other researchers interested in technology adoption, behavioral sciences, and decision-making. A wide variety of TRA and TPB exists in the social science literature but few in a printing industry context. The present research would benefit from future studies applying the

TPB in a similar context across an even larger sample and scale. Future studies could investigate different technologies of concern to the commercial printing industry.

The present research utilized a cross-sectional survey to measure the present state of the industry. This type of research is limited in time and long-term trends are unlikely to emerge. A more comprehensive longitudinal study may be able to provide a depth of information not present in the present cross-sectional research. Many time-sensitive variables could be measured in this fashion: adoption rates over time, changes in intention, and optimism towards a printing process, among others.

Survey research by nature balances costs, nonresponse error, question order effects, in order to gain quantitative data representative of the target population. Research of a quantitative nature may lack the richness of data that a qualitative study can provide. Case studies and in-depth interviews can provide insight into issues that do not surface during survey research that requires a breadth of individuals.

Results that did not emerge in the present study may serve as a basis for further research in this domain. Future technology improvements are expected to be introduced and the promise of these improvements may affect the present rate of technology adoption. As the present technology has matured over its history, a decrease in production cost is not expected. Companies may be waiting for the next disruptive technology before making a purchasing decision.

A follow-up to the present study with data on actual adoption trends measured 12 months after the present study could provide further insight on intended adoption relating to actual adoption in this domain.

Conclusions

The goal of the present research was to provide timely insight into the adoption of digital printing technology in a label printing company. The research measured attitudes,

subjective norms, control beliefs, and intentions directly; it also measured the salient elicited beliefs, which were operationalized through the expectancy-value model. These items were ranked by their influence over their respective construct from Fishbein and Ajzen's TPB.

The discussion of the results produced three themes relevant to digital adoption in labels: budgetary concerns, customer-driven demands, and optimization of the production of sold goods. These themes involve several stakeholders in the adoption of digital printing: the printers themselves, their suppliers, trade associations, and competitors along with the printer's customers, print buyers, and brand owners.

The present research demonstrates that the outlook for digital printing technology continues to be optimistic, however, the practical adoption of the technology is met with challenges. Customers, sales, and marketing support the adoption, which generally contrasts to the executives and management. Those in charge of the decision are concerned about budget within the next 12 months. The printer is therefore advised to continue seeking optimizing solutions for the pressroom; lowering costs with greater efficiency, and where applicable, implementing new technologies to streamline the manufacturing process. For some, this may mean the actual adoption of digital printing to optimize costs on short runs and provide a faster turnaround for the customer. Improvements in scheduling can be made through an adoption of digital printing, however, for those companies that do not intent to adopt, the scheduling department may be the first place to look to see if a large number of digitally-capable jobs are meeting already tight production schedules.

Suppliers, especially digital press manufacturers, benefit from the present research in the form of insight into budgetary concerns within the label market. Printers are concerned with the budget to bring in a new press. Click-charges and supply contracts

differ from conventional print manufacturing and the different business model is met with the additional concern that technology improves at a rapid pace.

Trade associations may benefit from the present research by reinforcing the positive outlook on digital printing. Trade magazines are researching, discussing, and advising on the digital printing technologies (e.g. Myers, 2014; Bohan & Dezzutti, 2013). Trade associations help their members understand how new technologies can impact their business and would benefit from continuing to do so. Trade associations are now discussing and digesting several printing processes for the label market rather than relying on one process. Continuing to discuss all relevant technology pertinent to label printing in a process-independent manner will benefit label printers looking to meet the needs of their customer.

Print buyers, brand owners, and label customers are shown to be one of the strongest driving forces in the adoption of digital printing. Sales departments understand the needs of the customer yet a gap seems to exist between the front of the house and the executives making the adoption decision. Expressing the needs for short runs and digital capabilities would help the printer understand the future jobs that are capable of digital production. The discussion between the printer and print buyer would benefit with a discussion of customer needs; forecasting job requirements and analyzing print length trends may help the printer understand not just the present but the future needs of their most valued customers.

Final Remarks

It is hoped that the present research investigating managerial beliefs regarding the adoption of digital printing in a label printing context may serve to both inform the present stakeholders in the label market and stimulate future investigations in this domain.

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Appendix A

Elicitation Survey Instrument (Online)

R·I·T

Thank you in advance for your help with this study.Your input is extremely important and will benefit the label printing industry by providing insight into the adoption of digital printing technologies.

I don't anticipate any risks associated with completing the survey other than those ordinarily encountered in daily life. You may choose not to participate or quit the study at any time without penalty.

If you have any questions regarding this study, please call this dedicated number: (585) 512-8857 or email trevor.schroeder@rit.edu. You may also contact the School of Media Sciences department head, Christopher Bondy at (585) 475-2755 or christopher.bondy@rit.edu. For questions regarding your rights as a participant of this study, you may contact Heather Foti, Associate Director of the HSRO at (585) 475-7673 or hmfsrs@rit.edu. Please save or print this page for your records.

The study should take approximately 10-20 minutes to complete. Your answers will be kept confidential and answers are recorded in anonymity. This research depends on your generous help. As a thank you for your time, we will be providing an executive summary of the results for those who participate. I hope you enjoy the questionnaire and the opportunity to express your thoughts in our industry.

Sincerely,

Trevor S. Schroeder

Graduate Candidate, M.S. Print Media
School of Media Sciences
Rochester Institute of Technology

The following questions are about the possibility of adopting a digital printing press for production use in the next 12 months. There are no right or wrong answers. Please list the thoughts that come immediately to mind, writing each thought on a new line.

Example. Please fill out one thought per line, up to eight. You do not need to use every line.

1. What are your top vacation destinations?

1. New York, New York
2. Vienna, Austria
3. Fishing in Belize
4. An over-water bungalow in Bora Bora
5. Yellowstone National Park
6. The Great Wall of China
7.
8.

When it comes to adopting a digital printing press, there are often advantages and disadvantages associated with the purchase. Please list any advantages or disadvantages as you see them.

1. What are the advantages of adopting digital printing for production purposes in the next 12 months?

1.
2.
3.
4.
5.
6.
7.
8.

2. What are the disadvantages of adopting digital printing for production purposes in the next 12 months?

1.
2.
3.
4.
5.
6.
7.
8.

3. What else comes to mind when you think about adopting digital printing for production purposes in the next 12 months?

1.
2.
3.
4.
5.
6.
7.
8.

When it comes to adopting a digital printing press, there may be some individuals important to you who think you should or should not adopt a digital press.

4. List the job titles of people within your company who would approve of the adoption.

1.
2.
3.
4.
5.
6.
7.
8.

5. List the job titles of people within your company who would disapprove of the adoption.

1.
2.
3.
4.
5.
6.
7.
8.

Sometimes, when we do not know what to do, we look to other organizations or groups of organizations.

6. Please list the type of organizations outside your company who are most likely to adopt digital printing presses.

1.
2.
3.
4.
5.
6.
7.
8.

7. Please list the type of organizations outside your company who are least likely to adopt digital printing presses.

1.
2.
3.
4.
5.
6.
7.
8.

Often, when you look to new technology or printing equipment, there are factors that may help or hinder your ability to adopt the printing equipment.

8. Please list factors that would make it easy for your organization to adopt

1.
2.
3.
4.
5.
6.
7.
8.

9. Please list factors that would make it difficult for your organization to adopt

1.
2.
3.
4.
5.
6.
7.
8.

10. Any additional thoughts?

11. This information will be used by the researcher to verify your completion. This information is confidential and will not be shared.

You may choose to leave these fields blank but may receive follow-up emails.

First Name

Last Name

Company

12. Would you like to receive a summary of the results as a thank you for your time?

◯ Yes, I would like to receive a summary of the results by email at the conclusion of the study.

◯ No, I do not wish to receive a summary of the results at the conclusion of the study.

13. Email Address

Your email address will not be shared or subscribed to a mailing list.

Please accept my sincere thank you for your time and help.

If you have any questions or comments about the study, please email trevor.schroeder@rit.edu or call (585) 512-8857.

Appendix B

Pre-notice Letter Mailed Prior to Main Survey

R·I·T

Rochester Institute of Technology

College of Imaging Arts & Sciences
School of Media Sciences
Frank E. Gannett Hall
69 Lomb Memorial Drive
Rochester, NY 14623-5603
585-475-5992 Fax: 585-475-5336

February 28, 2014

<Company>
Attn: <Contact (if applicable)>
<Address1>
<City>, <State> <Zip>

Dear <Contact or Company>:

I am writing to ask for your help in an important study as part of my graduate research at Rochester Institute of Technology. This study is intended to gather timely, descriptive information to understand the adoption of digital printing in our label printing industry.

This letter and the subsequent survey are intended for the decision-maker in your company responsible for adopting new technology and presses. Thank you in advance for your help forwarding this to the correct individual.

I believe your company is a valuable part of the label printing industry. Your company was one of only 230 selected, therefore, your response is critical to ensure the validity of the research. In about a week, you will receive an invitation, by mail, to participate in this study by answering several questions about your thoughts on digital printing. These questions will include rating items on a scale and demographic information such as company size. I am writing this letter because most people prefer a few days notice prior to receiving a questionnaire. If you prefer, you may take the survey immediately online at the web address provided on the enclosed card.

This research depends on your generous help. As a thank you for your time, I will be providing a summary of the results at the conclusion of the study.

If you would like to change contact information or have questions regarding this study, please email trevor.schroeder@rit.edu or call this dedicated number: (585) 769-8738. You may also contact the School of Media Sciences department head, Christopher Bondy at (585) 475-2755 or christopher.bondy@rit.edu. For questions regarding your rights as a participant of this study, you may contact Heather Foti, Associate Director of the HSRO at (585) 475-7673 or hmfsrs@rit.edu.

Sincerely,

T. Schr

Trevor S. Schroeder
Graduate Candidate, M.S. Print Media
School of Media Sciences
Rochester Institute of Technology

Appendix C

Cover Letter and Main Survey Instrument

R·I·T

Rochester Institute of Technology

College of Imaging Arts & Sciences
School of Media Sciences
Frank E. Gannett Hall
69 Lomb Memorial Drive
Rochester, NY 14623-5603
585-475-5992 Fax: 585-475-5336

March 7, 2014

<Company>
Attn: <Contact (if applicable>
<Address1>
<City>, <State> <Zip>

Dear <Contact or Company>:

I am writing regarding the survey of managers in the label printing industry being conducted by Rochester Institute of Technology. You should have received a letter in the past few days introducing you to the research study.

This study is intended to gather timely, descriptive information to understand the adoption of digital printing in our label printing industry. Your participation will benefit the label printing industry by providing insight into the adoption of digital printing technologies. I believe you are a valuable part of the label printing industry. Your company was one of only 230 selected, therefore your response is very important to ensure the validity of the research.

Your completion of this voluntary study will indicate your consent to participate. I don't anticipate any risks associated with completing the survey other than those ordinarily encountered in daily life. You may choose not to participate or quit the study at any time without penalty.

If you have any questions regarding this study, please call this dedicated number: (585) 512-8857 or email trevor.schroeder@rit.edu. You may also contact the School of Media Sciences department head, Christopher Bondy at (585) 475-2755 or christopher.bondy@rit.edu. For questions regarding your rights as a participant of this study, you may contact Heather Foti, Associate Director of the HSRO at (585) 475-7673 or hmfsrs@rit.edu.

The study should take approximately 15–20 minutes to complete. Your answers will be kept confidential. This research depends on your generous help. As a thank you for your time, we will be providing an executive summary of the results for those who participate. I hope you enjoy the questionnaire and the opportunity to express your thoughts in our industry.

Sincerely,

T. Schr

Trevor S. Schroeder
Graduate Candidate, M.S. Print Media
School of Media Sciences
Rochester Institute of Technology

Section 1: Qualifying Questions

1. Does any part of your facility identify with the label printing industry?

☐ Yes, all or part of my company is involved in the production of labels.

If you answered Yes, please continue to the next question below.

☐ No, no part of my company is involved in the production of labels.

If you answered No, please do not continue with the questionnaire, simply return it in the pre-stamped envelope provided. Please also send the postcard separately indicating your completion of the survey. Thank you for your participation.

Important note

This survey is seeking information about large-scale, commercial, digital printing presses. The term "digital printing" is used in this survey to refer to these types of presses. These presses may be roll-to-roll or sheet-fed, electrophotographic or inkjet. Examples of this type of press would include: HP Indigo, Xeikon, Xerox iGen, or similar. For the context of this study, please exclude instances of thermal transfer, desktop printing devices, or digital printing for proofing applications.

2. Has your facility already adopted a large-scale, commercial, digital printing press for the production of labels?

☐ No, my facility or organization has **not** adopted an HP Indigo, Xeikon, or similar large-scale, commercial, digital printing press. However, my organization may utilize thermal transfer, desktop printing devices, or digital printing for proofing.

If you answered No, please continue to the next question on the following page.

☐ Yes, my facility or organization **has** adopted an HP Indigo, Xeikon, or similar large-scale, commercial, digital printing press.

If you answered Yes, please do not continue with the questionnaire, simply return it in the pre-stamped envelope provided. Please also send the postcard separately indicating your completion of the survey. Thank you for your participation.

Section 2: Instructions

Do not write your name or company on the survey in any way that can identify you.

Many questions in this survey use a rating scale with seven places—please mark the box that best describes your opinion. Mark only one box on each row.

At the conclusion of the survey, please fold all survey pages in half and return it in the pre-stamped envelope. Please mail the postcard separately to indicate your completion and preference for receiving the results of the study.

Example

If you were asked to rate "drinking coffee" on this scale, it could be interpreted as follows:

If you think that drinking coffee is *extremely good*, then you would mark the first box.

	extremely	quite	slightly	neither	slightly	quite	extremely	
good	X							bad

If you think that drinking coffee is *quite bad,* then you would mark the second-to-last box.

	extremely	quite	slightly	neither	slightly	quite	extremely	
good						X		bad

If you think that drinking coffee is *neither good nor good,* then you would mark the fourth, or middle box.

	extremely	quite	slightly	neither	slightly	quite	extremely	
good				X				bad

Section 3: Label Survey, Part 1

1. If your organization were to adopt a digital printing press for production purposes in the next 12 months, that adoption would be…

	extremely	quite	slightly	neither	slightly	quite	extremely	
good								bad
advantageous								disadvangateous
beneficial								harmful
well judged								reckless
planned								unplanned

Section 3: Label Survey, Part 1

For the following questions, mark the box that best describes how much you agree or disagree with the statement.

2. Most people in my organization would support the adoption of a digital printing press in the next 12 months.

	very strongly	strongly	slightly	neither	slightly	strongly	very strongly	
agree								disagree

3. Most organizations like mine have adopted or will be adopting a digital printing press in the next 12 months.

	very strongly	strongly	slightly	neither	slightly	strongly	very strongly	
agree								disagree

4. I am confident that my organization has the ability to adopt a digital printing press in the next 12 months.

	very strongly	strongly	slightly	neither	slightly	strongly	very strongly	
agree								disagree

5. The decision to adopt a digital printing press in the next 12 months is up to my organization (facility).

	very strongly	strongly	slightly	neither	slightly	strongly	very strongly	
agree								disagree

6. I intend to adopt digital printing for production purposes in the next 12 months.

	very strongly	strongly	slightly	neither	slightly	strongly	very strongly	
agree								disagree

Section 4: Label Survey, Part 2

For the following section, mark the box that best describes your opinion in order to complete the phrase.

	extremely good	very good	good	neither good nor bad	bad	very bad	extremely bad
1. Not having to make printing plates is							
2. A costly press investment is							
3. Ability to print short runs is							
4. Training employees on a new technology is							
5. Limited substrates and colorants is							
6. A new profit opportunity is							
7. The ability to use variable imaging is							
8. High costs on long runs are							
9. Fast makeready and turnaround is							
10. Lower print quality is							
11. Being prepared for future disruptive technologies is							

Section 4: Label Survey, Part 2

If my organization (facility) adopts a digital printing press in the next 12 months, it will cause…

	extremely likely	very likely	likely	neither likely nor unlikely	unlikely	very unlikely	extremely unlikely
12. …us to not have to make printing plates							
13. …a costly press investment							
14. …the ability to print short runs							
15. …us to train employees on a new technology							
16. …a limitation of substrates and colorants							
17. …a new profit opportunity							
18. …the ability to use variable imaging							
19. …high costs on long runs							
20. …fast makeready and turnaround							
21. …lower print quality							
22. …us to be prepared for future disruptive technologies							

Section 4: Label Survey, Part 2

The following group/individuals thinks my organization **should** adopt a digital printing press in the next 12 months:

	very strongly agree	strongly agree	slightly agree	neither agree nor disagree	slightly disagree	strongly disagree	very strongly disagree
1. President							
2. Production/ Operations							
3. Sales							
4. Prepress							
5. Marketing							
6. Owners/ Shareholders							
7. Operators							
8. Quality Control							
9. Customers							
10. Competitors							
11. Suppliers							

Section 4: Label Survey, Part 2

In general, my organization (facility) wants to do what the following group/individuals think we should do:

	very strongly agree	strongly agree	slightly agree	neither agree nor disagree	slightly disagree	strongly disagree	very strongly disagree
12. President							
13. Production/ Operations							
14. Sales							
15. Prepress							
16. Marketing							
17. Owners/ Shareholders							
18. Operators							
19. Quality Control							
20. Customers							
21. Competitors							
22. Suppliers							

Section 4: Label Survey, Part 2

Having _____ would enable me to adopt a digital printing press in the next 12 months.

	very strongly agree	strongly agree	slightly agree	neither agree nor disagree	slightly disagree	strongly disagree	very strongly disagree
1. the budget to afford a digital press							
2. an existing customer base for a digital press							
3. enough work for a digital press							
4. a sales strategy for digitally printed products							
5. a training program for a new digital press							
6. more product offerings for my customers							
7. orders suited for the quality of digital printing							

Section 4: Label Survey, Part 2

I will have _____ in the next 12 months.

	extremely likely	very likely	likely	neither likely nor unlikely	unlikely	very unlikely	extremely unlikely
8. the budget to afford a digital press							
9. an existing customer base for a digital press							
10. enough work for a digital press							
11. a sales strategy for digitally printed products							
12. a training program for a new digital press							
13. more product offerings for my customers							
14. orders suited for the quality of digital printing							

Section 5: Demographics

Demographics

The next few questions will help me understand a little about your company. There are no right or wrong answers. These questions are optional.

1. What is the size of your facility in number of employees?

   ☐ 1-9 ☐ 100-199

   ☐ 10-49 ☐ 200-499

   ☐ 50-99 ☐ 500+

2. What is your job title?

   _____

3. In your organization or facility, how many employees would be involved in the decision to purchase a large-scale digital press?

   _____

4. What percentage of your business consists of short, medium and long runs? This is a rough estimate based on scheduled production time.

Short runs (jobs less than 30 minutes)	*Medium runs (jobs 31-90 minutes)*	*Long runs (jobs greater than 91 minutes)*	*Total*
			100%

5. How many shifts do you operate on a regular daily basis?

   ☐ 1 ☐ 2 ☐ 3 ☐ Other: _____

6. Do you make your printing plates in house?

   ☐ Yes

   ☐ No

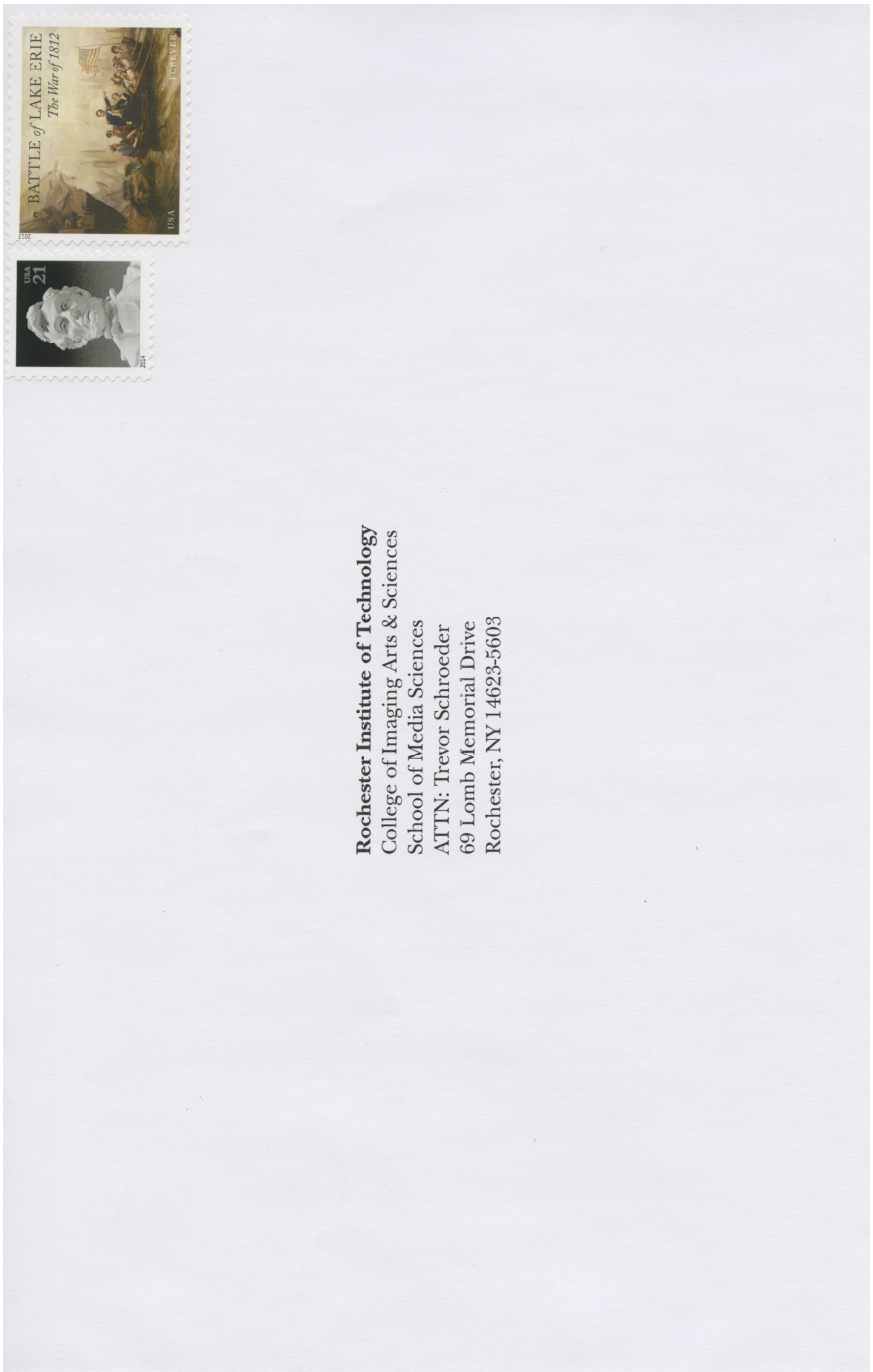
7. Approximately, how much do you budget each year for new press technology? *(confidential and optional)*

   _____

Thank you for your time and help. Please fold this survey in half and return in the prepaid envelope. Please mail the postcard indicating your completion and preference for results separately. If you have any questions or comments about the study, please email trevor.schroeder@rit.edu or call (585) 512-8857.

Appendix D

Return Envelope, Return Postcard, About the Researcher Postcard, and Reminder Postcard



School of Media Sciences
Graduate Research
Digital Adoption in the Label Printing Industry

I have completed and returned my survey in the pre-stamped envelope. I am sending this postcard separately from the main survey to ensure my anonymity.

☐ Yes, I would like to receive a summary of the results by email at the conclusion of the study. Please send the results to the following email address:

(required) Email address: _____

☐ No, I do **not** wish to receive a summary of the results at the conclusion of the study.

<Company>
<Address1>
<City>, <State> <Zip>

Pre-stamped

Rochester Institute of Technology
College of Imaging Arts & Sciences
School of Media Sciences
ATTN: Trevor Schroeder
69 Lomb Memorial Drive
Rochester, NY 14623-5603

If you prefer to take the survey online

Please accept my sincere thank you in advance.

The study should take approximately 15–20 minutes to complete. Your answers will be kept confidential. The aggregate data from the study will benefit the label printing industry by providing insight into the adoption of digital printing technologies . Only the researcher and academic advisors will have access to the primary data. Reported data will consist of correlation, means, and other statistical measures. I will take several steps to ensure that your responses cannot be traced back to you specifically. I don't anticipate any risks associated with completing the survey other than those ordinarily encountered in daily life. You may choose not to participate or to quit the study at any time without penalty.

Website:	www.surveymonkey.com/s/DigitalLabels
Password *(all uppercase):*	RIT

About the Researcher

My name is Trevor Schroeder and I am a second year graduate student completing research for my masters thesis at Rochester Institute of Technology. Originally from California, I completed my undergraduate degree in Graphic Communication at Cal Poly in San Luis Obispo.

Throughout my studies, I have dedicated time to packaging and flexography, competing in the Flexographic Technical Association's Phoenix Challenge and with my current research in technology adoption.

The School of Media Sciences at RIT has a long tradition in the print industry. While technology is constantly changing, academia, like most of the industry, is continually trying to stay current and understand important trends that will shape the future of the graphic arts.

I sincerely thank you for taking a part out of your busy day to help me.

A few weeks ago I sent your company a questionnaire regarding your opinions on the adoption of digital printing in your organization. I asked for your help with my graduate research because I believe you are a valuable part of the label printing industry. This postcard serves as a reminder to complete the survey.

I am entirely grateful for your help; research like this could not be completed without your generosity.

If you have already returned the questionnaire, I sincerely thank you for your response. If you did not receive the questionnaire or has since been misplaced, and you would still like a paper survey, please call me at this dedicated number (585) 769-8738 or email trevor.schroeder@rit.edu and I would be happy to send one today. To complete the survey online, please go to:

Website: www.surveymonkey.com/s/DigitalLabels
Password: RIT

Sincerely,
Trevor Schroeder

Rochester Institute of Technology
College of Imaging Arts & Sciences
Attn: Trevor Schroeder
69 Lomb Memorial Drive
Rochester, NY 14623-5603

Website:
www.surveymonkey.com/s/DigitalLabels
Password: RIT

Appendix E

Human Subjects Committee Approval

R·I·T

Rochester Institute of Technology

RIT Institutional Review Board for the
Protection of Human Subjects in Research
141 Lomb Memorial Drive
Rochester, New York 14623-5604
Phone: 585-475-7673
Fax: 585-475-7990
Email: hmfsrs@rit.edu

Form C
IRB Decision Form

TO: Trevor Schroeder; Chris Bondy

FROM: RIT Institutional Review Board

DATE: **January 24, 2014**

RE: Decision of the RIT Institutional Review Board

Project Title - Predicting the Adoption of Digital Printing in Packaging: A Reasoned Action Study

The Institutional Review Board (IRB) has taken the following action on your project named above.

☒ Exempt 46.101 (b) (2)

Now that your project is approved, you may proceed as you described in the Form A.

You are required to submit to the IRB any:

- **Proposed** modifications and wait for approval before implementing them,
- Unanticipated risks, and
- Actual injury to human subjects.

Heather Foti, MPH
Associate Director
Office of Human Subjects Research

Revised 10-18-06

Appendix F

Regression Analysis with Correlation Matrix

```
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(95) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT intent
  /METHOD=ENTER A SN PBC.
```

Regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	PBC, A, SN[b]		Enter

a. Dependent Variable: I intend to adopt digital
b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.734[a]	.538	.472	1.328

a. Predictors: (Constant), PBC, A, SN

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	43.178	3	14.393	8.155	.001[b]
	Residual	37.062	21	1.765		
	Total	80.240	24			

a. Dependent Variable: I intend to adopt digital printing for production purposes in the next 12
b. Predictors: (Constant), PBC, A, SN

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-.620	.467		-1.327	.199	-1.592	.352
	A	-.015	.020	-.139	-.742	.467	-.057	.027
	SN	.048	.019	.708	2.456	.023	.007	.088
	PBC	.019	.050	.113	.381	.707	-.085	.124

a. Dependent Variable: I intend to adopt digital printing for production purposes in the next 12 months.

```
CORRELATIONS
  /VARIABLES=intent A SN PBC
  /PRINT=TWOTAIL NOSIG
  /MISSING=LISTWISE.
```

Correlations

Correlations[b]

		I intend to adopt digital printing for production purposes in the next 12 months.	A	SN	PBC
I intend to adopt digital printing for	Pearson Correlation	1	.333	.725**	.634**
	Sig. (2-tailed)		.104	.000	.001
A	Pearson Correlation	.333	1	.571**	.599**
	Sig. (2-tailed)	.104		.003	.002
SN	Pearson Correlation	.725**	.571**	1	.854**
	Sig. (2-tailed)	.000	.003		.000
PBC	Pearson Correlation	.634**	.599**	.854**	1
	Sig. (2-tailed)	.001	.002	.000	

**. Correlation is significant at the 0.01 level (2-tailed).

b. Listwise N=25