Journal of Forest Products Business Research
Volume No. 2, Article No. 3

E-business in the Québec Forest Products Industry: Perceptions, Current Uses, and Intentions to Adopt

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ABSTRACT

E-business, its perceptions, current uses, and the intentions of companies to adopt these practices in the Québec forest products industry are discussed based on the results of an exploratory survey of this industry carried out during spring 2002. In accordance with other surveys, it is shown that despite its location in a country where the information technology (IT) adoption level is generally high, the Québec forest products industry still lags behind other sectors. E-business uses by the surveyed companies in the Québec forest products industry value chain are explored by category, year of establishment, number of employees, and annual revenue. Survey participants included sawmills, other value-added building material manufacturers, furniture factories, and pulp and paper mills. Perceptions, currents uses, and adoption intentions are described with a comparison to the same industry in North America. In particular, this paper discusses this industry lack of a strategic vision concerning the exploitation of IT tools. Finally, a critical review of the limitations of this study is stated and future research directions are developed.

Keywords: e-business, Québec forest products industry, information technology

Introduction

The forest products industry is a key player in the Canadian economy. Despite its relative high importance in the economy and its localization in a country where information technology (IT) is flourishing, the Canadian forest products industry lags behind other sectors in terms of IT adoption (Bakker 1999). In a context where IT clearly appears as a necessary tool to communicate and support decision making for business organizations, this paper explores IT use, perceptions, and the intentions of companies to adopt these practices in the Québec forest products industry. It is organized in four main sections.

First, a review of the literature of recent studies in North America regarding the use of IT in the forest products industry is presented. These studies unanimously highlight the general low IT adoption rate of the forest products industry. This industry is described as quite conservative. While these studies were conducted in different regions of North America, no study has specifically covered the Québec forest products industry, which is a key player in the Canadian economy.

After the literature review, the second section of this paper introduces research questions which are devoted to finding out if the low adoption rate observed elsewhere in North America is similar in Québec. The suggested exploratory analysis also aims at describing patterns of surveyed companies using a multiple criteria scheme based on uses, perceptions, and intentions to adopt. A discussion of these results is presented in the third section. Additionally, a comparison with similar companies across North America is presented. Finally, in section four some of the limitations of this study are stated along with avenues for future research.

Research Context and Review of the Literature

The Forest Products Industry in Canada and in the Province of Québec

International trade statistics[1] rank Canada as a forest products world leader, topping all other countries in wood simply worked, pulp, and waste paper. Canada is ranked fifth when it comes to wood in rough, squared, chips, and waste. Overall, exports of wood and related products (i.e., lumber and sawmill products, wood pulp and other wood products, newsprint and other paper and paperboard products) contributed to 9 percent of the national balance of payments in 2002[2]. Within Canada, Québec is the second key player in the Canadian forest products industry (for net merchantable volume of round wood harvested[3]). Furthermore, according to the same source, the Province of Québec has the largest timber-productive forestland in Canada. The forest products industry of the Province of Québec is thus a significant part of the Canadian industry.

(1) International Trade Statistics by Product Group from the database of the International Trade Centre available at www.intracen.org/tradstat/.

(2) Source: Exports of goods on a balance-of-payments basis, Statistics Canada (www.statcan.ca/english/Pgdb/gblec04.htm).

(3) Source: Compendium of Canadian Forestry Statistics, National Forestry Database, available at http://nfdp.ccfm.org/.

The Forest Products Industry: An IT Laggard?

Because the forest products industry is ranked a key contributor to exports in Canada, one would expect it to embrace the current information technology revolution at a respectable level. This, however, is not the case. The forest industry is among the sectors which are currently lagging behind (see **Table 1**, summarized from Bakker 1999).

In Canada, research studies have focused on macro-economic levels to describe and explain rates of e-commerce adoption. Few industry-oriented studies have dealt with specific factors, while it appears that within Canada different levels of adoption have been observed between sectors (Bakker 1999). No research has been undertaken to explain such an internal digital divide as shown in **Table 1**, in spite of continuous research interest in the adoption of e-commerce by North American companies in the forest products industry. This divide is particularly noticeable with regard to the use of the Internet (20% below the average, see blue lines in **Table 1**), the use of e-mail (23.9% below the average), and the use of personal computers (PC) (16.2% below the average). Moreover, this divide is also confirmed with regard to the lack of plans by forestry companies to use these technologies (see red lines in **Table 1**).

Table 1. IT adoption rates in the forest product industry (FPI) vs. private sector (summarized from Bakker 1999).

Use and plans to use the Internet	FPI	All private sectors	Standard deviation
% of enterprises that use Internet	32.8	52.8	16.2
% of enterprises that plan to use Internet within one year	5.5	6.5	2.9
% of enterprises that plan to use Internet after one year	3	3.5	1.7
% of enterprises with no plans to use Internet	58.7	37.1	15.4
% of enterprises that use e-mail	28.7	52.6	18.3
% of enterprises that plan to use e-mail within one year	5.2	5.9	2.4
% of enterprises that plan to use e-mail after one year	4.6	2.8	1.5
% of enterprises with no plans to use e-mail	61.5	38.8	16.7
PC use and plans to use	**FPI**	**All private sectors**	**Standard deviation**
% of enterprises that use PCs	65.7	81.9	9.6
% of enterprises that plan to use PC within one year	1.4	1.0	0.8
% of enterprises that plan to use PC after one year	2.2	0.7	0.6
% of enterprises with no plan to use PC	30.7	16.4	9.2
% of employees with access to a computer	34.6	55.6	18.1
% of employees with access to e-mail	15	34.4	21.4
% of employees with access to Internet	17	28.4	18.6
% of enterprises with a Web site	5.7	21.7	12.7
Commercial use of Internet (to buy or sell goods)	**FPI**	**All private sectors**	**Standard deviation**
% of enterprises that use Internet to sell goods or services	1.1	10.1	5.0
% of enterprised that use Internet to purchase goods or services	7.4	13.8	10.7

Vlosky (1999) surveyed 1,000 wood products and 300 pulp and paper companies throughout Canada and the United States (18% response rate). The respondents were asked to discuss their current and planned e-business strategies and the impact of interactions with customers and suppliers. Results show that companies in the forest industry are ready to expand their use of e-business technologies in order to increase productivity, efficiency, and competitiveness. While this pioneering study gives clear indications about the benefits, needs, and imperatives of adopting e-business, it does not try to identify the profile and location of recent success stories. Similarly, the factors that contribute to successful IT adoption remain an unanswered question. Indeed, the study of the factors behind recent and anticipated successes could shed more light on strategies to move forward on IT adoption.

Dupuy and Vlosky (2000) explain the use of electronic data interchange (EDI) in Canada and the United States. Company size is found to be the greatest contributor to the adoption of EDI. In fact, 85 percent of companies with 1997 sales of US$ 5 billion or greater were EDI capable, if and when customers requested the service. Such requests do not seem to be common in the forest industry which adopted EDI in the early 1990s even though the technology had been available since the 1960s. In addition to the prerequisite of customer request, the implementation of EDI faces barriers inherent to its high cost, a trend that is reversing with the emergence of Internet-EDI as a low-cost alternative to Value-Added Network (VAN)-facilitated EDI. With costs decreasing and customers rapidly moving to the Internet, the room for growth is tremendous, even in the forest products industry. Dupuy and Vlosky (2000) highlight that 16 percent of the forest industry was using EDI in 1997 and another 28 percent were planning on implementing it by 2002.

Delving further, Pitis and Vlosky (2000b) also study the World Wide Web (hereafter Web) use by U.S. primary wood products exporters. Their results indicate that respondents use the Web mostly for promotional activities. Value chain management and business processes are less frequently IT enabled. These authors, nevertheless, expect the highest growth to occur in these two important activities.

Contrasting their results observed in 1992 with 1997 figures, Roadcap et al. (2000) confirm the dramatically increasing adoption of EDI in the U.S. homecenter industry. A similar increase is observed in Internet use by U.S primary wood exporters. Interestingly, Pitis and Vlosky (2000a) point out that promotional benefits and increasing effectiveness are the benefits pursued by export companies adopting the Internet. Moreover, 80 percent of the companies surveyed use the Internet. According to their findings, neither technical issues, nor internal factors, nor acceptance of technology appear to be significant obstacles to becoming Internet capable. However, Internet use seems to be limited to the use of e-mail and Web navigation. On-line sales, for example, are indeed far from current use and are not part of future intentions. With the readiness and commitment to e-business described by the authors, one would expect companies to adopt and implement other e-business technologies as well, which extend far beyond e-mail and Web navigation. These technologies include those which Weill and Vitale (2001) have termed “atomic e-business models” which comprise:

1. direct to consumer,
2. full-service provider,
3. whole of enterprise,
4. portals, agents, auctions, aggregators, and other intermediaries,
5. shared infrastructure,
6. virtual community,
7. value net integrator, and
8. content provider.

There is still a long way to go for the forest industry to fully adopt the potential of e-business. Shook et al. (2002) came to a similar conclusion after a survey of forest product manufacturers in the

U.S. Pacific Northwest area (i.e., Idaho, Montana, and Washington), thus confirming that the forest products industry is more conservative in applying Internet technology. However, this trend of low IT adoption of the industry seems to be quite different from the trends apparent in the retail part of the supply chain. Indeed, Roadcap et al. (2002) note a rapidly expanding use of the Internet in the homecenter industry. In particular, the authors note that the Internet is used by companies to perform a multitude of business functions with customers accessing inventory in real time and at their convenience rather than waiting for a weekly fax.

New applications are also identified by Vlosky and Westbrook (2002) in the homecenter industry. The authors include logistics, order entry, information sharing, and transmission of information between exchange partners. In 1999, 78 percent of homecenters surveyed had a website, compared to 34 percent of forest products manufacturers in the United States in the same year. Respondents represented all regions of the United States. The study raises an interesting question as to which sector will drive the rest of the forest industry toward closing the gap in the technology race. According to the authors, the homecenter business seems to be this driver.

Such a role is understandable as organizations are becoming more involved in the management of their global supply chain network of upstream firms that provide raw material as well as the network of downstream firms that distribute products to the final customer. Firms providing raw material are often different from those distributing the final product outputs and e-commerce adoption rates might vary in the two segments. Smith (2002) delves further and reveals what he terms as differences in usage patterns between buyer segments, referring to purchasers of northern hardwood lumber in the northern region of the United States. The following criteria, among others, are used by Vlosky (2002) to analyze the Louisiana forest products industry: primary business, number of years in business, number of full-time employees, number of part-time employees, level of education, age of respondents, wholesale sales, and retail sales. Such criteria shed more light in understanding IT adoption.

Kozak (2002) proposes a study of Canadian e-business practices in the forest value-added products industry. Spatially distributed all over Canada, this study highlights patterns of use according to criteria such as the number of employees and the number of computers. This study corroborates most of the findings of all of the previously mentioned studies in the U.S. forest industry: modest attitudes toward the adoption of Internet technology and e-business initiatives, willingness to adopt Internet solutions, and trends toward electronic retailing adoption. The findings in Kozak (2002) are similar with the conclusions reached by different Canadian public institutions reports. The data aggregated from Bakker (1999) in **Table 1** clearly demonstrated that, compared to other Canadian economic sectors, the forest products industry is a laggard when it comes to e-business adoption. Moreover, compared to the rest of the private sector it has even fewer plans to use IT in the near future.

Research Question and Objectives

As previously mentioned, research reported by Canadian public institutions confirm the disparities among the different sectors of the economy. Even though the Canadian forest products industry is relatively important both domestically and internationally, it is considered as a laggard as far as IT adoption is concerned. Little research has been devoted to the study of this low adoption rate, particularly the analysis of the patterns of adoption. This paper attempts to close this gap by providing answers to four main research questions through an exploratory survey:

- What are the IT perceptions of Québec forest product companies?
- Are there barriers restraining the industry from adopting IT?
- Is the low IT adoption rate equally distributed across the industry?
- Does the industry have significant intention to raise its low IT adoption rate?

The primary objective of this paper is to analyze the reasons behind the lagging position of the forest products industry, focusing on the Province of Québec as one of the key players. In order to delve further into the analysis of the patterns of adoption, this study builds on previous work found in the literature, and proposes to evaluate IT adoption rate according to the following criteria:

- industry value chain position,
- year of company establishment,
- number of employees, and
- annual revenue.

The various categories of the industry value chain position we studied include sawmills, other value -added building material companies, furniture manufacturers, and pulp and paper mills. Sawmills are intentionally differentiated from other value-added building materials as in the Province of Québec; they also supply raw materials to pulp and paper mills. The other products of sawmills are sold to companies selling or producing value-added building materials which are listed in a separate category. The age of the company, although rarely used in previous research, is an important indicator in regards to technology and innovation adoption within organizations. In theory, older companies have been exposed to IT longer than new enterprises. Both Rogers' (1983) innovation diffusion model and Moore and Benbasat's (1991) technological life cycle model indicate that time and subsequent experience influence technology adoption. Finally, in order to assess the impact of company size in IT adoption, the annual revenue and the number of employees are added to the analysis criteria.

The final objective of this paper is to describe the current use, the perception, as well as the intentions to adopt IT in the Québec forest industry using the above-mentioned patterns.

Methodology

Sample

In order to address these research questions, a telephone survey was conducted in May 2002 among 695 companies operating in the Québec forest industry from sawmills to value-added products manufactures. Companies were first chosen from the Québec Ministry of Natural Resources database. The list was completed using databases from professional organizations such as the Québec Wood Export Bureau (QWEB) and the Québec Petites et Moyennes Entreprises (Québec Small and Medium Sized Companies). A total number of 695 companies were identified from these different databases as well as the names of their plant managers or people in charge. Three-hundred twelve of the selected companies responded to the survey, delivering usable information and thus assuring a response rate of

45 percent, which is high considering that typical response rates for industrial studies range from 15 to 35 percent (Adams 1986).

Questionnaire Development and Pretest

From a methodological standpoint, the questionnaire conceived by FOR@C[4] was designed to provide answers in an exploratory manner to the research questions mentioned previously. In order to make sure the questionnaire was appropriate to collect the needed information, it was first validated by professionals from various public and private institutions[5]. Then, once validated, the questionnaire was sent to a private survey company which pre-tested the questionnaire. This pre-test was conducted through computer-assisted telephone interviews. Interviewers were asked to address their questions to the identified plant managers. In case of absence, they were also asked to schedule an appointment in order to make sure that questions were answered by the right person. Biases related to language were tackled by allowing respondents to use French or English according to their preferences. The pre-test was carried out with a sample of 100 randomly selected managers of firms within the population database. During the pre-test, particular attention was paid to the following criteria: wording, phrasing, length of questionnaire, answering time, and perceived difficulty with technical terms. The questionnaire was then amended according to remarks yielded during this pre-test. A potential response rate was estimated at 33.3 percent with an average of 16.7 minutes spent with each respondent.

(4) FOR@C is a research consortium based at the Université Laval, Québec, Canada, dedicated to the study of e-business and supply chain management in the forest products industry (www.forac.ulaval.ca).

(5) The authors would like to thank staff members from Forintek, Québec Wood Export Bureau, the Ministére des Ressources naturelles, du Québec, the Ministére de l′ industrie et du Commerce du Québec, the Conseil de l′ industrie forestiére du Québec (CIFQ), and the Université Laval.

Questionnaire and Survey

In order to assess the uses of IT in the industry, respondents were first asked to state the current functions of their IT infrastructure with regard to various processes including accounting, operations planning, supply planning, inventory management, process control, ordering, and sales. Additional questions were asked referring to the existence of a website and the type of e-business interactions with customers. E-marketplace use was also considered. Next, in order to better understand IT implementation, respondents were asked for their own perception of associated benefits by expressing their rate of agreement with certain factors associated with IT implementation. A Likert scale (strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4), strongly agree (5)) was used for this aspect of the survey. Similarly, companies were asked to report their perception of problems associated with information technology tools and applications. The following items were used for questions to be responded to on a interval scale ranging from not important at all (1), slightly important (2), important (3), very important (4), to extremely important (5): security, personnel training, change of routine

processes, availability of technical resources, implementation and maintenance costs, accessibility, loss of direct contact with customers, exposing firm strategy to competitors, lowered salespersons contact, reengineering cost of the sale force, and highly demanding customers. In order to further our study of IT use and perceptions, respondents were finally asked additional questions about their current intentions of adoption.

During the survey, which was similarly carried out with the amended questionnaire, data and responses were coded using SPSS. The age of companies was added later using a database from the Centre de Recherche Industriel du Québec (Québec Center for Industrial Research). Further codification and data aggregation were initiated by the authors in search of better patterns and subsequent understanding.

Non-Response Bias Test

Non-response bias test methods typically include a comparison of the distribution of respondents and non-respondents' characteristics if they are known. Similar independent surveys can also serve as base of comparison for selected characteristics. When characteristics of non-respondents are unavailable from either the survey or from independent survey, the researcher can retrieve them from an independent data source. In this paper, data from the I-CRIQ database was used to compare respondents (n = 145) and non-respondents (n = 139) of the sawmill category, which is the largest group in our survey. A two-sample t-test, performed after verifying that the samples are similar in shape, showed no statistically significant response bias between the respondents and the non-respondents with regard to number of employees and year of establishment.

Results and Discussions

In the following section, the profile of respondents, perceived benefits and drawbacks, the results of the analysis of the current uses, and finally the intentions to adopt IT in the Québec forest industry are presented. Discussions of these results are conducted with references to selected previous studies.

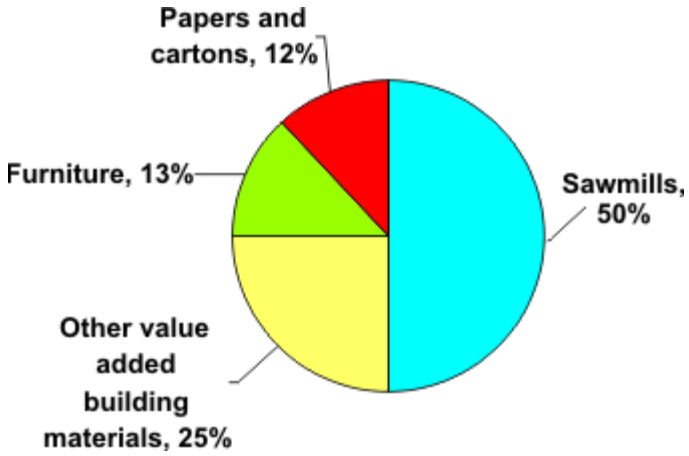
Profile of Respondents

The forest products industry is categorized in different ways by various authors and sources. For instance, the international trade statistics of the World Trade Organization use a nomenclature based on groups of products. Statistics Canada uses different classification systems[6] including North American Product Classification System (NAPCS), the International Standard Industrial Classification (ISIC), the North American Industry Classification System (NAICS), and the Standard Industrial Classification (SIC). In this paper, a classification based on the forest industry value chain which includes sawmills, other value-added building material manufacturers, furniture manufactures, and pulp and paper mills is adopted. The classification of the surveyed firms was cross validated using data from the Centre de Recherche Industriel du Québec. **Figure 1** details the profiles of respondents with regard to their value chain position.

(6) Source: Statistic Canada available at www.statcan.ca/english/concepts/industry.htm.

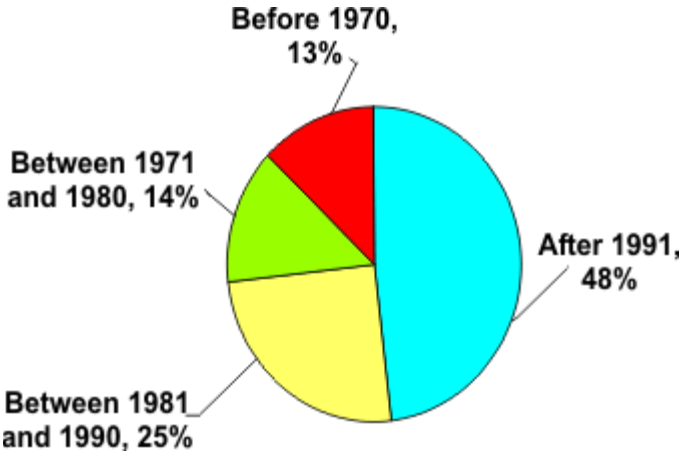
Sawmills accounted for almost half of the population surveyed because a database from the Québec Ministry of Natural Resources, which mainly contains sawmill related information, was used for building the respondents database.

Figure 1. Value chain position distribution (percentage of companies per sector).



The distribution of the year of establishment of the respondents is shown in **Figure 2**. Concerning the revenue distribution, each category represented approximately 25 percent of the respondents from which this information was collected.

Figure 2. Distribution of the respondents per year of establishment.



Previous studies in the forest industry IT business used slightly different samples. Vlosky (1999) surveyed 1,000 solid wood products and 300 pulp and papers companies in the United States and Canada. Pitis and Vlosky (2000b) studied how 324 U.S. primary wood products exporters used the Web to conduct business. Roadcap et al. (2000) limited their research to EDI and bar-coding in the 500 largest U.S. businesses. Shook et al. (2002) conducted a census of 1,438 secondary products manufacturers operating in Idaho, Montana, and Washington. Vlosky and Westbrook (2002) examined e-business exchanges between the top 250 companies belonging to homecenter retailing and wood products supplying. Finally, Kozak (2002) focused on value-added wood producers across Canada. However, none of the previous studies were comprehensive enough to deliver conclusions applicable to the entire sector. Our sample, although limited to the previously uncovered Québec area, seems to be the first to address a large number of companies of different sizes and with activity along the entire value chain of the forest industry.

Uses of IT Applications

For a description of the different rates of IT uses, the mentioned criteria were summarized in **Table 2**.

Table 2. IT usages (% by categories, *n* = number of respondents).

	Accounting	Operation planning	Supply planning	Inventory manage-ment	Process control	Buying	Selling	Websites	e-market place
Category	***n* = 255**	***n* = 11**	***n* = 2**	***n* = 8**	***n* = 12**	***n* = 1**	***n* = 2**	***n* = 197**	***n* = 27**
Sawmills	83.8%	3.4%	0.0%	2.7%	5.4%	0.0%	0.0%	56.1%	23.7%
Building materials	86.8%	3.9%	1.3%	1.3%	3.9%	0.0%	0.0%	59.0%	19.4%
Furniture	78.6%	4.8%	2.4%	4.8%	0.0%	0.0%	0.0%	71.4%	4.2%
Papers and cartons	84.2%	2.6%	0.0%	2.6%	2.6%	2.6%	2.6%	89.5%	19.2%
% within categories	*83.9%*	*3.6%*	*0.7%*	*2.6%*	*3.9%*	*0.3%*	*0.7%*	*62.9%*	*18.6%*
Year founded	***n* = 209**	***n* = 10**	***n* = 1**	***n* = 7**	***n* = 8**	***n* = 1**	***n* = 2**	***n* = 166**	***n* = 20**
After 1991	85.9%	5.0%	0.0%	2.5%	3.3%	0.0%	0.8%	69.9%	12.1%
1981 to 1990	52.0%	1.0%	1.0%	3.0%	1.0%	1.0%	1.0%	60.3%	27.6%
1971 to 1980	90.9%	0.0%	0.0%	0.0%	3.0%	0.0%	0.0%	60.0%	30.0%

Before 1970	69.7%	9.1%	0.0%	3.0%	6.1%	0.0%	0.0%	61.8%	10.5%
% within first year	*83.9%*	*4.0%*	*0.4%*	*2.8%*	*3.2%*	*0.4%*	*0.8%*	*65.1%*	*17.2%*
Employees	***n* = 251**	***n* = 11**	***n* = 2**	***n* = 8**	***n* = 11**	***n* = 1**	***n* = 2**	***n* = 192**	***n* = 27**
1 to 50	81.0%	3.8%	0.0%	3.0%	3.8%	0.0%	0.0%	43.3%	24.4%
51 to 100	91.2%	3.5%	0.0%	1.7%	3.5%	0.0%	0.0%	68.4%	22.2%
101 to 500	81.9%	4.3%	2.1%	2.1%	4.3%	1.0%	1.1%	84.0%	14.3%
501+	93.7%	0.0%	0.0%	6.2%	0.0%	0.0%	0.0%	81.2%	18.2%
% within employees	*83.7%*	*3.7%*	*0.7%*	*2.7%*	*3.7%*	*0.3%*	*0.7%*	*62.3%*	*19.0%*
Revenue	***n* = 173**	***n* = 4**	***n* = 1**	***n* = 6**	***n* = 2**	***n* = 1**	***n* = 1**	***n* = 122**	***n* = 17**
0 to $3.5 M	91.1%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	34.0%	27.3%
$3.5 to $10 M	87.3%	1.8%	0.0%	5.4%	1.8%	0.0%	0.0%	50.0%	13.0%
$10 to $40 M	85.4%	2.1%	2.1%	4.2%	0.0%	0.0%	0.0%	75.0%	11.1%
$40 +	89.6%	2.1%	0.0%	2.1%	2.1%	2.1%	2.1%	85.4%	22.9%
% within revenue	*88.3%*	*2.0%*	*0.5%*	*3.0%*	*1.0%*	*0.5%*	*0.5%*	*60.4%*	*17.7%*

For all of the criteria, the use of accounting software, which is the dominant use of IT, showed no significant difference. Differences appear regarding operations planning. Companies founded between 1971 and 1990 seemed to show less interest in that application. Those created before the 1970s yielded higher scores. To explain this result, one can assume that older companies have grown to a size requiring the support of such tools. Companies created after the 1990s scored high as well, perhaps because they were founded at a time when such technologies were becoming more accessible and were considered necessary to be competitive.

The use of websites was equally distributed for all criteria with the exception of annual revenue, where small companies lag behind. Similarly, companies with fewer employees and small revenue were found to have a smaller number of e-business interactions with suppliers than other companies. Conducting business over an e-marketplace seems to be equally attractive (19% to 24%) for all respondents except for furniture manufacturers (<5%). Furniture manufacturers sell value-added products which may not be suitable for e-marketplaces where large companies engage in trading commodities on-line. This is probably one of the reasons why furniture manufacturers are reluctant to join such a B2B marketplace. Logistics management with computer support is more often used by paper and carton mills with high revenue. In this case, the size of the company and the amount of transactions performed certainly play an important critical mass-effect role in the adoption of IT logistics management support.

IT support for inventory management, process control, supply planning, and sales varies considerably when revenue criteria were considered. Paper and carton mills scored higher for these criteria, because they may have more processes to manage and more interactions with partners along their value chain. Also, pulp and paper companies are generally larger and have more financial resources than other companies in the forest industry. Similar findings were reached by Dupuy and Vlosky (2000) in their survey of EDI usage in Canadian and U.S. companies.

Table 2 shows that most surveyed companies performed only basic IT applications (i.e., mainly accounting and non-transactional websites). This corroborates findings in similar companies throughout North America (Pitis and Vlosky 2000a, Kozak 2002, Shook et al. 2002). Such a low level of IT adoption on both sides of the border may confirm the existence of a shared corporate culture in a similar industrial environment.

Table 3 shows the results of the analysis of variation (ANOVA), and where statistical differences were noticed, presents the Duncan post hoc tests used to identify the groups of users of websites and accounting systems.

Table 3. One-way ANOVA for IT uses tested by categories, classes of revenue, and year of establishment.

	Specific IT use	*n*	F value	*p*-value (sig.)
Test by categories (position in the value chain).	Website	289	5.542	0.001[a]
	Accounting	281	0.489	0.690
	Advanced IT uses	281	0.028	0.994
Test by classes of revenue	Website	201	2.742	0.044[a]
	Accounting	195	0.877	0.454
	Advanced IT uses	195	1.503	0.215
Test by classes of year of establishment	Website	254	2.189	0.090
	Accounting	248	0.786	0.503
	Advanced IT uses	248	1.288	0.279
[a] Significance level set at p value < 0.05.				

As far as the value chain position is concerned, there were no statistically significant differences in the use of accounting software (sig. = 0.690). The same thing was noted in advanced IT applications which performed poorly in all categories (sig. = 0.994). The only significant difference was found in website use (sig. = 0.001). A Duncan post hoc analysis revealed that paper and carton mills' uses of websites (89.5% of companies) were significantly different from sawmills and building materials' uses (56.1% and 59.0% of companies, respectively). Furthermore, it revealed that furniture companies' uses of websites (71.4% of companies) were statistically similar to the uses of both paper and carton mills and sawmills and building materials.

When revenue was considered, the significant difference appeared with website use (sig. = 0.044). Once again, a Duncan post hoc analysis was conducted. It revealed that companies with the lowest and the highest revenue clearly belong to two distinct groups of users, while companies with revenue between $3.5 and $40 million showed similitude with these two groups. Accounting systems (sig. = 0.454) and advanced IT applications (sig. = 0.215) were used at a statically similar level in all the companies. Companies with the highest revenue were the ones which had the highest rate of website use.

Finally, when the year of establishment was considered, no statistical significant difference was observed for all current uses of IT. Significance levels for accounting systems, website, and advanced IT applications were 0.090, 0.503, and 0.279, respectively.

Perceived Benefits of IT

Using factor analysis, the loadings of the 14 items used to assess the perceived IT benefits (i.e., benefits identified in the questionnaire) that make up the construct and the relationships between the items were verified. After principal component analysis and varimax rotation with Kaiser normalization, the items loaded significantly on the construct in three factors. They yielded a Cronbach standardized coefficient of 0.86, a score superior to the 0.70 is generally accepted in social sciences. No inter-item correlations were detected.

As shown in **Table 4**, all companies unequivocally strongly agreed with IT as a factor facilitating access to industrial information, which is aided by the fact that this type of application only requires the installation of a web browser. E-business was generally perceived as a way to boost company sales. Similarly, deliveries were perceived to be accelerated with e-business. Strong benefits were expected as far as relations with customers and suppliers are concerned. Such optimism was absent for inventory reduction and market share increase. A similar lack of enthusiasm was highlighted in Vlosky (1999).

For all of the 14 items, a one-way ANOVA analysis was conducted through the value chain position of the respondents, their year of establishment, their size represented by the number of employees, and their revenue. The only statistically difference was detected in revenue. Post hoc analysis revealed that this difference was located in large companies, which showed higher perceptions of benefits than smaller ones.

Table 4. Perceived benefits and drawbacks of IT (% by categories, *n* = number of respondents).

	Access to industry information		Increase sales		Quicker delivery		Security problems		Implementation problems and maintenance costs	
	Disagree	Agree	Disagree	Agree	Disagree	Agree	Less important	Very important	Less important	Very important
Category	***n* = 2**	***n* = 135**	***n* = 17**	***n* = 69**	***n* = 45**	***n* = 72**	***n* = 24**	***n* = 87**	***n* = 33**	***n* = 40**
Sawmills	1.7%	93.1%	12.0%	52.0%	35.2%	55.6%	18.6%	61.0%	24.1%	24.1%
Building materials	0.0%	97.2%	12.1%	57.6%	41.2%	38.2%	14.7%	58.8%	32.3%	29.4%
Furniture	0.0%	91.7%	15.0%	45.0%	34.8%	56.5%	21.7%	52.2%	18.2%	27.3%
Papers and cartons	4.0%	96.0%	16.7%	62.5%	16.7%	66.7%	11.5%	73.1%	16.7%	41.7%
%within categories	*1.4%*	*94.4%*	*13.4%*	*54.3%*	*33.3%*	*53.3%*	*16.9%*	*61.3%*	*23.9%*	*29.0%*
Year founded	***n* = 1**	***n* = 108**	***n* = 17**	***n* = 54**	***n* = 41**	***n* = 52**	***n* = 19**	***n* = 70**	***n* = 28**	***n* = 35**
After 1991	0.0%	91.2%	9.1%	52.7%	37.0%	44.4%	14.0%	61.4%	14.3%	35.7%
1981 to 1990	0.0%	100.0%	25.0%	50.0%	39.3%	50.0%	21.4%	57.1%	37.0%	25.9%
1971 to 1980	0.0%	100.0%	33.3%	66.7%	25.0%	62.5%	0.0%	90.0%	50.0%	20.0%
Before 1970	5.3%	94.7%	17.6%	41.2%	44.4%	50.0%	26.3%	52.6%	26.3%	31.6%
% within first year	*0.9%*	*94.7%*	*16.2%*	*51.4%*	*38.0%*	*48.1%*	*16.7%*	*61.4%*	*25.0%*	*31.2%*
Employees	***n* = 2**	***n* = 132**	***n* = 17**	***n* = 67**	***n* = 44**	***n* = 71**	***n* = 23**	***n* = 86**	***n* = 32**	***n* = 40**

1 to 50	0.0%	97.5%	23.5%	55.9%	34.3%	42.9%	23.1%	59.0%	33.3%	25.6%
51 to 100	0.0%	92.3%	13.6%	63.6%	34.6%	53.8%	25.9%	40.7%	30.8%	26.9%
101 to 500	1.6%	95.2%	8.3%	51.7%	32.8%	57.4%	9.7%	71.0%	13.3%	33.3%
501+	9.1%	81.8%	11.1%	33.3%	27.3%	63.6%	9.1%	72.7%	27.3%	27.3%
% within employees	*1.4%*	*94.3%*	*13.6%*	*53.6%*	*33.1%*	*53.4%*	*16.5%*	*61.9%*	*23.5%*	*29.4%*
Revenue	***n* = 1**	***n* = 90**	***n* = 9**	***n* = 46**	***n* = 33**	***n* = 44**	***n* = 17**	***n* = 56**	***n* = 24**	***n* = 27**
0 to $3.5 M	0.0%	100.0%	0.0%	88.9%	20.0%	70.0%	20.0%	60.0%	18.2%	27.3%
$3.5 to $10 M	0.0%	95.4%	26.3%	47.4%	45.0%	35.0%	26.1%	43.5%	31.8%	22.7%
$10 to $40 M	0.0%	96.1%	9.1%	45.4%	46.1%	50.0%	15.4%	69.2%	32.0%	40.0%
$40+	2.9%	94.3%	5.7%	54.3%	30.3%	51.5%	14.3%	62.9%	20.0%	25.7%
% within revenue	*1.1%*	*95.7%*	*10.6%*	*54.1%*	*37.1%*	*49.4%*	*18.1%*	*59.6%*	*25.8%*	*29.0%*

Perceived Barriers of IT

A factor analysis was conducted to ensure the 11 items used to assess the perceived barriers significantly load on the construct under study. Two factors emerged containing all of the 11 items after a cut point of 0.50. Reliability analysis was conducted for a further assessment of the psychometric properties of the construct. The 11 items yielded a 0.89 Cronbach coefficient. No inter-item correlations were detected.

Concerning security, 82 percent of the surveyed companies considered it as a very important factor. Such a high score was also observed in the companies surveyed by Vlosky (1999), throughout Canada and the United States. A full 70 percent of respondents considered lack of trained personnel and other technical resources as a very important barrier to IT implementation. The same proportion was observed when companies think of the difficulties inherent to changing their current processes. When it comes to IT implementation and maintenance costs, opinions were unequally distributed between those who believe that such costs are very important (71%) and those who consider it as less significant (21%).

In order to identify the differences of perception throughout the various categories of classification of the industry, a one-way ANOVA analysis was conducted for categories, revenue, number of employees, and year of establishment. Slight differences (**Table 5**) were noticeable for revenue (p = 0.03) and number of employees (p = 0.05). Post hoc analysis revealed that large companies were less sensitive to barriers. For categories and year of establishment, all the significant levels were higher than 0.05 for the 11 items included in the construct of the perceived barriers. Consequently, although one must be careful generalizing, it seems that the industry has a common perception of the identified barriers.

Table 5. Comparison of perceived benefits and perceived barriers.

	Perceived benefits	Perceived barriers

	n	F	*p* value	*n*	F	*p* value
Year of establishment	113	1.13	0.34	112	1.40	0.25
Categories	140	1.55	0.20	139	0.26	0.85
Revenue in millions $	93	2.96	0.04[a]	92	3.01	0.03[a]
Number of employees	139	1.48	0.22	138	2.60	0.05[a]
[a] Significance level set at *p* value < 0.05.						

Comparison Between Québec and North American Forest Companies

The perceptions identified in our survey were directly compared to those of two studies conducted by Vlosky (1999, 2001). A comparative analysis was made on the weighted average of all responses for each listed impact. In general, it appeared that Québec and North American companies in the forest industry showed similar patterns for most of the listed items. This seems to highlight patterns concerning some of the key issues related to the adoption of e-business technology that were similar within the forest products industry as a sector. However, Québec forest companies had a higher belief in the benefits expected from IT than their North American counterparts. Many factors may explain such a difference. One of them is probably related to the fact that North American companies in general might have embraced IT before Québec companies, thus showing less enthusiasm as far as expectations are concerned. Drawbacks following the dot.com meltdown in the late 1990s might have played a role in dampening the enthusiasm of North American forest companies. This point highlights the need to further investigate and analyze the divide between pre- and post-adoption perceptions. This divide may play a role in explaining why in the studies reported by Vlosky (1999, 2001) the perception of benefits appeared to decrease between 2001 and 1999.

In other words, the higher expected benefits of Québec companies could thus be related to the fact that they might still be in a pre-adoption phase compared to their North American counterparts. Finally, this higher optimism may also be explained through some methodological differences. Indeed, survey by telephone similar to the one we conducted in the Province of Québec may yield more positive attitudes than with a written survey as used in the two North American studies.

Apart from these differences, the overall results showed a rather low rating of perceived benefits, especially when compared to data provided in Zank and Vokurka (2003). As shown by the authors, in the plastic and power transmission manufacturing sectors, e-business is usually expected to have minimal to slightly positive impacts. Unfortunately, compared to the data from the forest products industry, these same perceptions were clearly more negative, demonstrating a rather low level of perceived usefulness. However, perceived usefulness was ranked by empirical findings as a key factor in IT adoption. In particular, perceived usefulness was tested in a group of other attributes by Hu et al. (2003). The group of attributes included: perceived usefulness, perceived ease of use, intention to use, computer self-efficacy, subjective norm, compatibility, and job relevance. Their findings suggested a prominent and significant influence pattern from job relevance to technology usefulness and then user acceptance. As this perception of usefulness seemed to be lower in the North American forest industry, one of the consequences was a lower rate of IT adoption.

IT Adoption Intentions

Table 6 presents the results of this part of the survey. Respondents with no IT adoption intention in mind by far outnumbered those thinking of buying and selling on-line. Only 10 percent of the respondents intended to adopt EDI, while less than 7 percent were planning to implement Internet access. Scholars should delve further in order to trace the roots of such a lack of intention to adopt IT in an area where technology was available and intensively used by other sectors of the economy. To push the explanation further and confirm the lack of intention to adopt IT, future research should compare the innovativeness rates of all sectors, taking into account the past adoption of major technologies. If the innovativeness rate in the forest industry happens to compare favorably with other sectors, then the potential reasons behind its lack of interest may include other factors such as their culture, their remote location, or their lack of awareness. Moreover, forest product companies are extended throughout a huge territory where the trading of a rather small number of commodities are geographically limited to small numbers of actors who barely need more than a basic technology to complete their transactions. Most of the surveyed facilities, particularly the sawmills, were integrated into larger corporations. Consequently, one can expect these facilities to have less contact with the final customers as marketing activities are generally dealt with centrally.

Table 6. IT adoption intentions.

	Extranet		Other future intentions					
	Yes	No	No intention	EDI	Selling online	Buying online	Supply processing	CRM
Category	***n* = 75**	***n* = 46**	***n* = 61**	***n* = 14**	***n* = 8**	***n* = 1**	***n* = 8**	***n* = 3**
Sawmills	55.90%	33.90%	40.68%	10.17%	8.47%	0.00%	5.08%	1.69%
Building materials	55.56%	30.56%	44.44%	11.11%	2.78%	0.00%	2.78%	2.80%
Furniture	41.67%	33.33%	33.33%	12.50%	4.17%	0.00%	8.33%	0.00%
Papers and cartons	46.15%	26.92%	50.00%	3.85%	3.85%	3.85%	7.69%	3.85%
% within categories	51.70%	31.70%	42.07%	9.66%	5.52%	0.69%	5.52%	2.07%
Year founded	***n* = 64**	***n* = 34**	***n* = 48**	***n* = 10**	***n* = 7**	***n* = 1**	***n* = 7**	***n* = 1**
After 1991	55.17%	27.59%	43.10%	6.90%	6.90%	0.00%	5.17%	0.00%
1981 to 1990	68.97%	20.69%	37.93%	10.34%	6.90%	0.00%	6.90%	3.45%
1971 to 1980	30.00%	60.00%	40.00%	20.00%	0.00%	10.00%	0.00%	0.00%
Before 1970	47.37%	31.58%	42.11%	5.26%	5.26%	0.00%	10.53%	0.00%
% within first year	55.20%	29.30%	41.38%	8.62%	6.03%	0.86%	6.03%	0.86%
Employees	***n* = 74**	***n* = 45**	***n* = 61**	***n* = 14**	***n* = 8**	***n* = 1**	***n* = 8**	***n* = 2**
1 to 50	39.02%	51.22%	53.66%	7.32%	9.76%	0.00%	2.44%	2.44%
51 to 100	59.26%	29.63%	29.63%	7.41%	3.70%	0.00%	7.41%	3.70%
101 to 500	57.14%	19.05%	46.03%	9.52%	1.59%	1.59%	7.94%	0.00%
501+	54.55%	36.36%	18.18%	27.27%	18.18%	0.00%	0.00%	0.00%
% within employees	52.11%	31.69%	42.96%	9.86%	5.63%	0.70%	5.63%	1.41%
Revenue	***n* = 49**	***n* = 32**	***n* = 35**	***n* = 11**	***n* = 7**	***n* = 1**	***n* = 8**	***n* = 1**
0 to $3.5 M	27.27%	45.45%	45.45%	0.00%	18.18%	0.00%	0.00%	9.09%
$3.5 to $10 M	39.13%	56.52%	47.83%	8.70%	8.70%	0.00%	4.35%	0.00%
$10 to $40M	51.85%	22.22%	33.33%	14.81%	0.00%	0.00%	11.11%	0.00%
$40+	65.71%	22.86%	28.57%	14.29%	8.57%	2.86%	11.43%	0.00%
% within revenue	51.04%	33.33%	36.46%	11.46%	7.29%	1.04%	8.33%	1.04%

In addition to such a limited scope of exchanges, there was also an absence of leadership to push IT implementation across the sector. Such a leadership role seemed to be played by the homecenter industry in the United States, according to Vlosky and Westbrook (2002). However, to make sense and reap all the benefits of IT, a leader needs to work in an environment where all actors are aware of the move. To make such a move possible, an important emphasis has to be put on the nature of the technology itself to make sure that it meets the real needs and expectations of the companies involved. In particular, job relevance was found to play a prominent and significant influence to technology perception of usefulness by Hu et al. (1999).

The main issue in the Québec forest industry was the rather low level of perceived usefulness and the general lack of IT adoption intentions for more than 40 percent of surveyed companies. Because this might reveal a high degree of presumed ignorance of IT applications and usages, it leaves room for more promotion from external actors, such as centers of expertise, whose role is rarely examined. Van Horne et al. (2005) investigate such a role. External actors might also include associations of producers, government agencies, and equipment and software companies. All of the actors in the Québec forest industry should concern themselves with this situation as their competitive forces are eroding daily in an increasingly global economy. The traditional strategy based on cost leadership in a rather protected market is a source of reduced competitiveness. Transport and communication cost reductions subsequent to technological progress have opened markets to more competitors. Customers are more demanding, easy to recruit, and hard to retain. Companies need to implement more advanced IT tools to help them to adapt to the new rapidly changing business world. While summarizing Canadian forest companies' opinions, Globerman et al. (1998) argued that there was widespread agreement that Canadian forest product companies must put greater emphasis on innovation to compete successfully given ongoing and expected changes affecting the industry. To meet the requirements of the new customer-oriented economy, IT plays a key role and Québec forest companies can no longer ignore this.

Study Limitations, Future Research, and Managerial Implications

From a methodological point of view, although our response rate is very high, we perceive the main limitation of our study in the phone-based interview through which respondents do not have the opportunity to cross evaluate their views and beliefs for an eventual iterative adjustment. Future research could use, for example, a Delphi survey to overcome that limitation. Along the same line, respondents' profiles classification could be improved so as to take into account their culture, their geographical location, as well as their ownership structure (multinationals or private local companies). These factors could indeed help to understand the current and planned IT use in the forest industry. Many questions remain. For instance, and as mentioned previously, internal factors, such as corporate culture, ownership, competitive strategies, and geographical dispersion, among others, should be investigated and analyzed.

So far, as our literature review suggests, research related to IT in the forest products industry has been confined to an exploratory level which confirms an overall lag in IT adoption, but yet does not provide all of the answers. In order to improve our understanding, recent developments in IT diffusion, acceptance, and adoption models could be used as theoretical frameworks to guide such studies. Indeed, as posited by Rogers (1983), cited by Lamb and Kling (2003), the innovation decision process leading to the institutionalization of usage may be conceptualized as a temporal sequence of steps

through which an individual passes from initial knowledge of an innovation, to forming a favorable or unfavorable attitude toward it, to a decision to adopt or reject it, to putting the innovation to use, and to finally seeking reinforcement of the adoption decision made. This research avenue could be particularly interesting in the forest products industry to compare pre- and post-adoption beliefs and attitudes. This also calls for repeated studies and permanent monitoring of the changes in the forest industry using the same samples.

An additional trend to be considered while studying IT adoption in the forest products industry is the concept of social actor used by Lamb and Kling (2003). This approach extends the research beyond the one-user concept by taking it to a broader concept of many social actors who interact with others inside and outside the organization. This conceptualization embraces actors and corporate cultures.

An equally interesting avenue could be the study of how IT collaborative tools are used to enhance customer and supplier relationship management.

Finally, future research could also analyze the contents of the websites of the forest products companies, as 63.9 percent of the respondents possess a website. However, these websites fail to boost IT use and to extend it to applications beyond the now widely accepted e-mail. To the best of our knowledge, in the Québec forest industry, no academic research has been devoted to a content analysis in order to explain that phenomena. Company websites are interesting mirrors of IT use both for internal and external exchanges.

The implementation of a new technology requires awareness and sustainable commitment by various social actors. These include customers, suppliers, promotional boards, and government agencies. Our findings should sensitize them all to the digital divide observed in the entire Québec forest industry. As to forest companies, this study calls for more questioning as to how to boost their productivity using IT, given the identified barriers and low level of perceived benefits. Suppliers of hardware and software should find useful guidance in our analysis if they are willing to enter the vast and untapped forest industry market. The findings should help the industry promotion board and related government agencies in designing better IT policies for the forest sector.

Conclusion

In contrast to conventional wisdom, there is a digital divide between rates of IT adoption through different sectors of the Canadian economy. In the Québec forest industry, the adoption rate is low and intentions to adopt are scarce. Apart from the methodological concerns previously mentioned, the major conclusions of this study are:

- all segments of the Québec forest industry have similar patterns of IT use with the exception of pulp and paper companies for websites;
- the perceived IT benefits are low and equally distributed in the Québec forest industry;
- the perceived barriers are high and statistically similar in the entire industry;
- projected applications are rather scarce;

- Québec forest companies lag behind other sectors of the economy;
- North American forest product companies in general share such patterns. The Québec forest product companies' case is not unique.

However, because North America is usually considered as a pioneer in the field of e-business, these conclusions call for more research in order to understand why it lags behind in terms of IT use.

We have found that rate of implementation is similar to the one observed across North America by various authors. Perceived IT benefits observed in the Québec forest industry are low and similar to those observed elsewhere in North America for the same industry. They do not vary significantly across the different segments of the industry. Perceived barriers behind the low level of adoption have been identified. They are equally distributed across the entire sector.

Our research also demonstrates that no statistically significant differences are observed within sectors of the Québec forest industry. This calls for deeper investigations into the factors behind the low rate of IT adoption. While this study provides a foundation, future research should deal with more precise themes as identified in the limitations and future research section of this paper. We keenly anticipate more work to be useful in completing this early attempt to understand the digital divide between sectors of the Canadian economy. Both practitioners and scholars will benefit from such an extension.

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