Government of Canada
Industry Canada
National Research Council Canada

Gouvernement du Canada
Industrie Canada
Conseil national de recherches Canada

Connectedness in Manufacturing

Results of a Survey on Standards Adoption in Canada

Canada

Report

Connectedness in Manufacturing: Results of a Survey on Standards Adoption in Canada

Acknowledgments

The Manufacturing and Processing Technologies Branch of Industry Canada and the Integrated Manufacturing Technologies Institute of the National Research Council Canada prepared and conducted the Connectedness in Manufacturing Survey. Dr. Darren Meister of the Queen's School of Business, Queen's University, analyzed the survey data and prepared this report.

Appreciation goes out to the large number of people who took the time to complete and return the survey.

This publication is also available electronically on the World Wide Web at the following address:
http://strategis.ic.gc.ca/manufacturing_connectedness

This publication can be made available in alternative formats for persons with disabilities, upon request.

For more information, contact:
Integrated Manufacturing Technologies Institute
National Research Council Canada
800 Collip Circle
London ON N6G 4X8

Tel.: (519) 430-7094
Fax: (519) 430-7032
E-mail: **canadian.stepcentre@nrc.ca**

For additional copies of this publication, please contact:
Manufacturing and Processing Technologies Branch
Industry Canada
235 Queen Street
Ottawa ON K1A 0H5

Tel.: (613) 954-3278
Fax: (613) 941-2463
E-mail: **manprotech.strategis@ic.gc.ca**

Cat. No. C2-456/1999E
ISBN 0-662-28072-5
52868 E

Aussi disponible en français sous le titre *Connexité en milieu industriel : résultats d'une étude sur l'adoption des normes au Canada*

Executive Summary

Being connected electronically to suppliers, contractors and customers is becoming increasingly important for Canadian manufacturers. But where does the manufacturing sector stand in terms of taking up electronic tools for business and adopting standards to facilitate that business?

This report reviews the results of a May 1999 survey that measures just that, based on information from representatives of more than 400 Canadian manufacturers about their current and planned use of electronic collaboration in business — that is, sharing business and technical data through electronic linkages, within and across organizational boundaries.

The survey is part of the larger Connectedness in Manufacturing Project of the Manufacturing and Processing Technologies Branch of Industry Canada and the Integrated Manufacturing Technologies Institute of the National Research Council Canada.

The main findings of the survey are as follows:

- Four out of five responding companies have had experience with electronic collaboration.
- The most important factor in determining if a company has undertaken electronic collaboration is industry sector. The leading sectors are automotive, aerospace and defence, information and communication technologies, and electrical and electronics.
- Companies not involved in electronic collaboration perceive a lack of need, inadequate infrastructure, a lack of benefits or priorities, a lack of awareness of opportunities, or security concerns.
- Most companies are electronically linked to some or most but not all companies in their supply chain.
- Automotive was the only sector with greater than average use of electronic business transactions and data exchange (of both design and manufacturing data).
- The most commonly adopted standards to facilitate electronic commerce are DXF, ISO 9000 and HTML.
- Standards likely to increase significantly, on a percentage basis, in adoption in the next two years are ISO 14000, XML and STEP (in order of importance).
- Standards use varies across functions, with HTML being used most consistently – for procurement, inspection and control, distribution and after-sales service.
- ISO 9000 is perceived as both the single most beneficial standard to adopt and the most problematic.

This survey found that Canadian manufacturing companies as a whole have had some experience with connectedness. Furthermore, companies perceive that successful implementation of some standards has brought benefits. What is perhaps surprising is the perceived importance of performance benefits, as opposed to market benefits. This seems reasonably consistent across standards. Companies appear to view standards as enabling efficient execution of their operational plans rather than as helping develop new markets through either new products or increased market share. Companies also regard collaboration benefits as more important than market benefits, but do not rate them as highly as performance benefits.

From the lessons learned respondents provided, it is clear that standards adoption is not something a firm can do on its own. Rather, it is something that must be done in combination with supply chain partners or throughout an industry. Similarly, cooperation between large companies that drive the supply chain and the software vendors that implement the standards is the only way to address many problems. However, even after implementation, changes to the definition of the standard continue to cause problems.

In conclusion, there are still barriers to overcome to enhance the success of existing or in-progress implementation and to increase the diffusion of standards throughout Canadian industry. Connectedness standards will only attain their potential through a coordinated effort within industries and across the manufacturing sector.

Contents

List of Tables

List of Figures

Introduction

As Canadian manufacturers look for ways to do business better, many are turning to electronic solutions to improve the way they work in-house and with customers, contractors and suppliers. This electronic collaboration, or "connectedness," refers to the sharing of business and technical data through electronic linkages, within and across organizational boundaries. A related concept is "connectedness standards" — industry-wide standards for data exchange or business processes that facilitate electronic collaboration.

This report provides a snapshot of the state of connectedness standards adoption in Canada's manufacturing sector using the results of a May 1999 survey of Canadian firms. The primary purpose of the survey was to determine companies' current level of connectedness. A second purpose was to evaluate initiatives that could help companies adopt connectedness standards.

The survey is part of the larger Connectedness in Manufacturing Project of the Manufacturing and Processing Technologies Branch of Industry Canada and the Integrated Manufacturing Technologies Institute of the National Research Council Canada. The goal of the project is to develop and disseminate information to manufacturers about connectedness standards and to bring together existing pockets of Canadian expertise to promote standards adoption. (For more information about the project, go to **http://strategis.ic.gc.ca/manufacturing_connectedness**.)

The project team distributed 4370 surveys, of which 413 surveys were returned.[1] This is a reasonable response rate given that companies participated voluntarily. The next section of this report presents the characteristics of the responding companies. The following section presents the current state of connectedness, including barriers, benefits and aids to further implementation. There are four appendices: Appendix A contains a glossary and Appendix B a copy of the original survey. Appendix C contains aggregate survey data and Appendix D features all the respondents' handwritten comments on lessons learned, broken down by sector and firm size.

Readers will notice that different tables include a different number of survey responses. This is because some respondents did not answer all the questions, and the authors did not consider the non-response for those questions. The most common reason for non-response was that the company had little or no experience with electronic collaboration.

Respondent Characteristics

The initial survey questions asked respondents to provide basic data about themselves and their company, including location, sector, size and organization. Responding companies are located in Ontario (51.1%), Quebec (20.8%), Alberta (8.7%) and British Columbia (5.3%), as well as all other provinces except Prince Edward Island. (For a further breakdown of the responses, see Table C-1 in Appendix C.) These results match the overall survey sample well.

The responding companies represent a wide range of industries, the most common being automotive (17.2%), metals and minerals processing (13.8%), industrial and commercial equipment (13.6%) and electrical and electronics (13.3%). (See Table C-2 for a complete breakdown of the results.)

[1] Another 27 surveys came in after the due date; the project team did not include them in the analysis.

Many companies categorized themselves as "other." The project team created additional categories and placed these companies appropriately using information from corporate directories. The complete list is as follows (added categories in *italics*):

- *Advanced materials and plastics*
- Aerospace and defence
- Automotive
- Electrical and electronics
- *Fashion, leisure and household*
- Food processing
- *Industrial and commercial equipment*
- *Information and communication technologies*
- Health and biotechnology
- *Metals and minerals processing*
- Resource processing
- Other (includes companies that do not fit in original or additional categories).

The "typical" responding company is a small- to medium-sized enterprise (SME) with its head office and manufacturing facilities located in Canada. However, the survey sample includes the complete range of companies, from large multinationals based outside of Canada to small, locally operating companies. (See tables C-3 to C-6 for more information on company size (by number of employees and revenue), head office location and organization.)

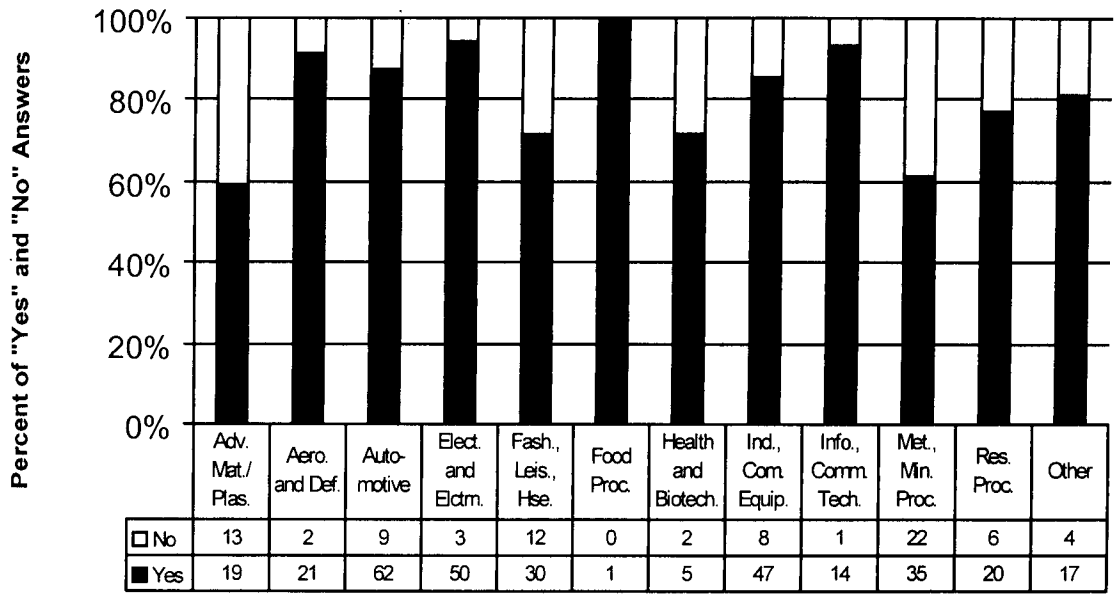
Overall, the respondents were senior managers, most commonly president/chief executive officer (45), general manager (37), information systems manager/vice-president (30), operations manager/vice-president (37), controller/chief financial officer (33) and manufacturing manager (29).

State of Use

The next part of the questionnaire asked respondents to indicate the level of electronic collaboration in which their company was engaged. Nearly 80% of the companies (321) reported electronic collaboration experience, in contrast to 82 companies that claimed no prior experience. Ten (10) companies did not respond to this question (Table C-7).

Readers should note that the estimates of the degree of electronic collaboration activities within Canadian industry resulting from this survey are likely to be overestimates. This is because companies that view electronic collaboration as either irrelevant or unimportant are less likely to complete this type of voluntary survey.

Figure 1: Electronic Collaboration Experience by Industry Sector



The most important factor in determining if a company has undertaken electronic collaboration is industry sector (Figure 1). This relationship is more significant than that of company size, organizational structure or head office location. A company in the automotive (87%), aerospace and defence (91%), information and communication technologies (93%), or electrical and electronics (94%) sectors is more likely to have had experience with electronic collaboration than a company in other industry sectors. Companies in the advanced materials and plastics (59%), and metals and minerals processing (61%) sectors are less likely to have had experience; however, in each sector at least three out of five companies said that they had had prior electronic collaboration experience.

Certain of the industry sectors show similar profiles for electronic collaboration, and, using advanced statistical techniques, the project team placed them in three groups, from most likely to have electronic collaboration experience to least likely, as follows:

Group 1 — most likely (90% have had electronic collaboration experience; n=217): aerospace and defence, automotive, electrical and electronics, information and communication technologies, and industrial and commercial equipment sectors. Within Group 1, companies with fewer than 50 employees (68% with experience; n=25) are less likely to have connectedness experience than firms with 50 or more employees (92% with experience; n=192). There are no other statistically significant differences within this group.

Group 2 — likely (73% with experience; n=75): resource processing, health and biotechnology, and fashion, leisure and household sectors. Within Group 2, companies with head offices outside Canada (100% with experience; n=12) are more likely to have connectedness experience than those with Canadian head offices (68% with experience; n=63). This is the only significant difference within this group.

Group 3 — least likely (61% with experience; n=89): metals and minerals processing, and advanced materials and plastics sectors. Within this group, there are no statistically significant differences.

The project team did not group companies in the "other" category (n=20), the food processing sector (n=1) or not classified (n=2).

There is no statistically significant difference across provinces or regions with regard to electronic collaboration (Figure C-1). In each case, approximately 80% of the firms have collaborated electronically, while 20% have not. The data on number of employees (Figure C-2), company revenue (Figure C-3), organizational structure (Figure C-4) and head office location (Figure C-5) show statistically significant differences but less than for industry sector. In general, larger companies, in terms of revenue and employees, are more likely to have had electronic collaboration experience, along with firms with multiple sites and head offices outside of Canada.

It is interesting to look at the reasons companies gave for not yet implementing any form of electronic collaboration. These fall into five categories:

- Lack of need (29 respondents)
- Inadequate infrastructure (13 respondents)
- Decision not to participate, lack of benefits or priorities (9 respondents)
- Lack of awareness of opportunities (8 respondents)
- Security concerns (4 respondents).

Table C-8 contains the full response set. A few representative comments include the following:

> "No need to do so due to competitive edge."
>
> "We will connect to Internet within 12 months, at which point we will be transferring CAD drawings with customers, subcontractors — until 1999 few customers were looking for electronic data transfer capabilities."
>
> "I guess we've assumed a company couldn't bear the startup costs involved, although we never investigated if this were true."

The first comment states the view of some companies that electronic collaboration is not a source of competitive advantage. However, it takes the argument one step farther to imply that the lack of electronic collaboration capabilities is not a source of competitive disadvantage either. While this may have been true in the past, it may not continue to be so. In the same way good product quality has moved from a competitive advantage to a customer expectation, it would not be surprising if electronic collaboration capabilities become an important customer issue, as the second company has found in 1999. The third comment illustrates the difficulty that several companies, especially small enterprises, have had in keeping up with trends and developments.

Company Activities

Given that a large number of companies are collaborating electronically, the logical question is, Who is collaborating with whom? Table 1 shows respondents' degree of connectedness with other companies and within their own company. Table C-9 shows detailed data by industry sector.

Table 1: Degree of Electronic Collaboration Along Supply Chain

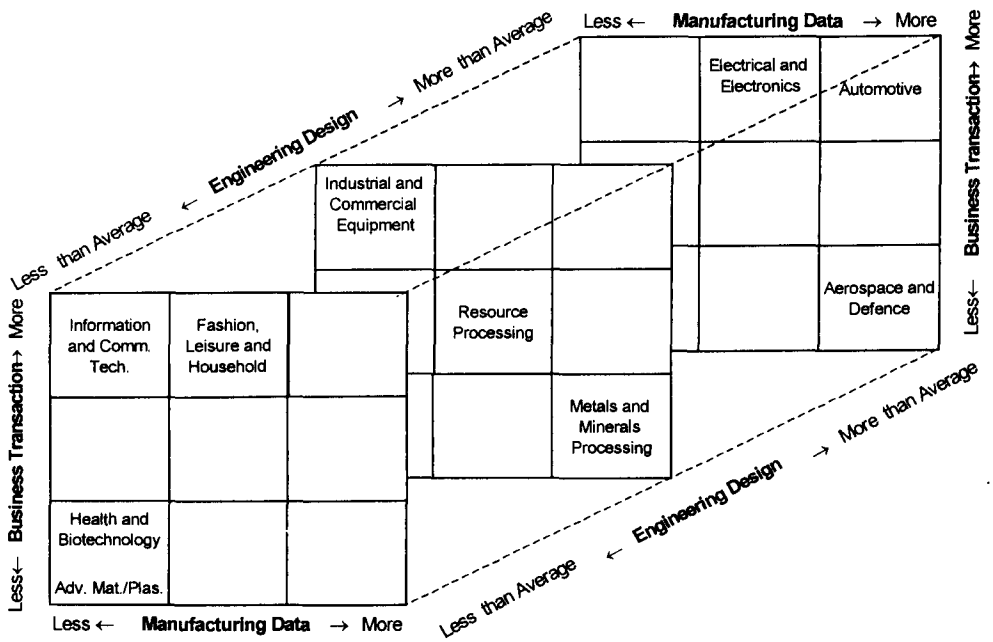
Connect to	None	Some	Most	All	N/A
Partners (n=328)	18%	34%	20%	12%	16%
Subcontractors (n=329)	32%	40%	15%	4%	10%
Suppliers (n=337)	25%	50%	19%	4%	3%
Customers (n=339)	12%	50%	26%	10%	1%
Own Sites (n=332)	13%	12%	15%	41%	19%

Due to rounding not all rows add up to 100%.

More detailed analysis shows that the most common configuration is for a company to have connections to most (15 companies) or some (23 companies) of its partners, subcontractors, suppliers and customers and all of its own sites. Only four companies have connections with all of their partners, subcontractors, suppliers, customers and own sites. Eight companies have connections to neither other companies nor their own sites. Presumably, they collaborate electronically by mailing disks or tapes. Another eight companies only practise electronic collaboration with other sites within the company.

The scope of activities is broadly based for the 321 companies with electronic collaboration experience. More than two thirds (67%) conduct business transactions, and 80% exchange engineering design data and 54% manufacturing data. Thirty-seven percent of the companies exchange all three types of data. Indeed, this is the most common of the possible configurations, followed by companies that exchange engineering design data and conduct business transactions but do not exchange manufacturing data. Table C-10 provides detailed data by industry sector.

Figure 2: Status of Collaboration Activities by Industry Sector



Note: This figure does not include the food processing sector as only one company in this sector responded to the survey.

Figure 2 shows the relative status of collaboration activities in each industry sector. The project team evaluated each sector against the total sample to see if it made less than average use of a certain type of exchange, more than average or average (±5%) for each data type. Automotive is the only sector ahead of the average for all three data types. Aerospace and defence is ahead for engineering design and manufacturing data but behind in business transactions, with only 50% of companies exchanging this type of data (versus 67% in the sample as a whole). Electrical and electronics companies are also ahead of the curve for two data types — business transaction and engineering design — and are average for manufacturing data.

Sectors of some concern might be health and biotechnology, and advanced materials and plastics as they are behind the average for all data types.

Standards Implementation

The next section in the survey asked respondents to indicate the current level of implementation of connectedness standards (for data exchange for business processes to facilitate collaboration). Respondents indicated

- if the standard has been tried but is no longer used
- if the standard is currently in use
- if the standard will be used within two years
- if there are no plans for use/it does not apply, or
- if respondent does not know.

Table 2: Use of Standards by Number of Companies Reporting

	Tried	Current	Planned	Success $= \frac{\text{current}}{\text{current} + \text{tried}}$	Growth $= \frac{\text{planned}}{\text{current}}$	No Plans or N/A	Don't Know
ANSI X.12	4	90	23	96%	26%	80	61
CP/PD	0	13	3	100%	23%	119	104
DXF	4	179	11	98%	6%	57	37
EDIFACT	2	47	25	96%	53%	109	61
Gerber	4	37	1	90%	3%	128	75
HTML	0	139	30	100%	22%	54	41
IGES	7	110	6	94%	5%	95	50
ISO 14000	0	13	38	100%	292%	136	63
ISO 9000	0	153	40	100%	26%	64	29
PDF	4	108	15	96%	14%	77	57
PostScript	6	83	2	93%	2%	105	53
RTF	4	93	7	96%	8%	83	59
SGML	0	15	6	100%	40%	119	100
STEP	4	16	15	80%	94%	123	83
UPC	5	77	35	94%	45%	100	41
XML	0	13	17	100%	131%	110	102

Table 2 provides data on the number of companies with experience in each standard (see Appendix A for a glossary). The standard most frequently in current use is DXF, followed by ISO 9000 and then HTML. The less commonly used standards are new and emerging standards such as CP/PD, XML, SGML and STEP. These standards appear to have lower visibility as respondents frequently included them in the "don't know" category.

The project team used two measures to better understand the responses. The first

$$\text{success} = \frac{\text{current}}{\text{current} + \text{tried}}$$

calculates the proportion of companies that continue to use a standard and have not abandoned it. From the data, it would appear that most companies are successful in implementing standards once they have made the decision to do so. Part of the reason for this is that companies often implement standards in response to a customer request. A second reason may be that in the case of standards such as ISO 9000 and ISO 14000, the public registration process makes failure an embarrassment, motivating the company to keep trying until it achieves success.

The second equation

$$\text{growth} = \frac{\text{planned}}{\text{current}}$$

determines the anticipated rate of growth of a standard over the next two years and measures the proportion of companies that plan to adopt a standard in the next two years relative to those currently using it.

From this data, it would appear that ISO 14000 is poised for explosive growth in Canada. XML and STEP also appear to be candidates for rapid growth in usage between now and 2001.

Table 3: Use of Standard by Functional Area

	Design and Engineering	Procure-ment	Processing, Fabrication and Assembly	Inspection and Control	Distribution	After-sales Service
ANSI X.12	15	47	19	5	51	12
CP/PD	9	4	7	3	1	2
DXF	164	32	54	20	7	11
EDIFACT	6	39	14	8	31	10
Gerber	34	14	12	5	1	0
HTML	65	39	29	22	45	65
IGES	108	18	28	20	3	9
ISO 14000	12	9	17	15	4	2
ISO 9000	113	122	146	143	101	86
PDF	68	32	31	26	27	38
PostScript	59	23	24	11	11	15
RTF	55	28	32	20	21	33
SGML	7	4	3	3	4	8
STEP	23	5	6	1	2	3
UPC	15	32	54	39	63	21
XML	6	4	4	1	4	9

Respondents also indicated the functional areas in which they had considered standards (Table 3). The most commonly used standards (listed in order) in each functional area are as follows:

Design and engineering	DXF, IGES, PDF
Procurement	ANSI X.12, EDIFACT, HTML
Processing, fabrication and assembly	DXF, UPC, RTF
Inspection and control	UPC, PDF, HTML
Distribution	UPC, ANSI X.12, HTML
After-sales service	HTML, PDF, RTF

An area of some concern is the proliferation of different standards across a company. For example, most departments use HTML, with the exception of design and engineering, in which PDF is more common and processing in which RTF is more common. In addition, inspection and control, and after-sales service use PDF; after-sales service also uses RTF. It is not hard to visualize a situation in which after-sales service personnel receive document information from the design department in PDF, from processing in RTF and from procurement and distribution in HTML, leaving them to manage silos of information, all originating within the same company.

For this question, respondents could also note additional standards they use. Relatively few were submitted, as can be seen from the data in Table 4.

Table 4: Other Suggested Standards

Other "Standards" Used	Number of Companies Submitting
Vendor specific (e.g. CATIA, Pro/Engineer, Unigraphics)	19
Suites (e.g. Microsoft and Lotus)	14
AutoCAD DWG	10
ASCII/Flat File	5
Graphics (e.g. GIF, JPEG, TIFF)	5
TCP/IP Services (e.g. E-mail, FTP, Telnet)	3
ERP Systems (e.g. SAP, Baan)	2
VRML	2

Many of these standards are not standards *per se* but rather vendor file specifications. However, this raises an important issue given that these formats support considerable data exchange. The difficulty for a company relying on these formats is that their form and functionality may change unpredictably. Within companies, intermediary file formats such as PDF, RTF and HTML partially overcome the limitations of exchanging Microsoft Office files, for example, between users of different releases or different packages. This contributes to a proliferation of data formats and requires departments needing data from across the company to integrate disparate file formats. However, trends towards vendor support of open-file exchange are encouraging (i.e. Microsoft Office 2000's use of HTML as a native format). Nevertheless, these *de facto* standards will remain important to data exchange.

It would appear then that most software-oriented standards enter a company through design and process-oriented standards by way of the processing, fabrication and assembly functions. The exception to this may be Web-based standards, such as XML and HTML, that appear to have strong functionality for external work as well as specific applications for EDI. The managerial implication here is twofold. First, organizational expertise relevant to standards implementation processes and management likely may reside in the design and engineering department and, second, multiple points of entry suggest a cross-functional approach to standards management.

Table 5: Most Beneficial and Problematic Standards as Proportion of Use

		Companies identify standard as ...			
		Most beneficial		*Most problematic*	
	Number of companies having used this standard *(tried + current in Table 2)*	*Number of companies*	*% of companies having used*	*Number of companies*	*% of companies having used*
ANSI X.12	94	20	21%	23	24%
CP/PD	13	1	8%	0	0%
DXF	183	42	23%	3	2%
EDI	n.a.	19	n.a.	22	n.a.
EDIFACT	49	4	8%	5	10%
Gerber	41	4	10%	4	10%
HTML	139	20	14%	8	6%
IGES	117	42	36%	18	15%
IS0 14000	13	1	8%	1	8%
IS0 9000	153	81	53%	61	40%
PDF	112	11	10%	7	6%
PostScript	89	1	1%	6	7%
RTF	97	6	6%	2	2%
SGML	15	2	13%	0	0%
STEP	20	2	10%	12	60%
UPC	82	3	4%	10	12%
XML	13	0	0%	3	23%

Benefits and Barriers

Respondents next named the standard that was most beneficial to their company as well as the standard that was most problematic to implement. Table 5 summarizes this data. The most commonly mentioned standard, both positively (53%) and negatively (40%), was ISO 9000:[2] 27 companies identified it as both the most beneficial and most difficult standard to adopt. While ISO 9000 is by no means exclusively a connectedness standard, it ensures companies have documented and defined processes for working with other companies in general and electronically in particular. As well, ISO 9000 registration brings market benefits.

Proportionally, the most beneficial standards are ISO 9000 (n=81 companies), EDI (n=43[3]), IGES (n=42), and DXF (n=42). Similarly, the most problematic standards are ISO 9000 (n=61), EDI (n=50), IGES (n=18), and STEP (n=12). Table C-11 shows the number of companies reporting each standard.

The next two sections provide opinions about the importance of specific benefits and barriers for the sample in total and for the four most common standards in each case.

[2] As respondents were free to select any standard as either most beneficial or problematic, they mentioned many standards. Due to their similarities, the project team grouped ISO 9001, 9002 and 9003, QS 9000 and AS 9000 into ISO 9000 for the purposes of analysis.

[3] This figure represents the combined total for ANSI X.12, EDI and EDIFACT in Table 5. Respondents mentioned each of these specifically, but as they focus on the same business purpose, they are combined under the name EDI for the rest of this report.

Benefits

Respondents rated on a five-point scale the importance of several positive effects of adopting the most beneficial standard. Table 6 shows the importance of the benefits for all standards and for the four most frequently mentioned beneficial standards: ISO 9000, EDI, IGES and DXF.

Table 6: Importance of Benefits

	Total	*ISO 9000*	*EDI*	*IGES*	*DXF*
Systems Benefits					
Compatibility across a wider range of applications	3.97	3.73	3.54	4.28	4.03
Reusability of software modules in new applications	3.43	2.80	2.97	3.41	3.89
Easy reconfiguration of network architecture	3.17	2.53	3.31	2.97	3.33
Easier to add new functionality to applications	3.43	2.99	3.17	3.05	3.80
Standard software maintenance agreements	3.10	2.61	3.26	2.82	3.50
Collaboration Benefits					
Easier collaboration	4.04	3.54	4.03	4.07	4.18
More flexible trading partnerships	3.76	3.46	4.13	3.80	3.67
Increased capability to meet data exchange requirements	3.92	3.17	4.07	4.02	4.11
Performance Benefits					
Faster delivery	4.02	3.64	3.93	3.95	4.33
Improved overall quality	4.15	4.58	3.63	3.75	4.24
Increased ability to tailor business processes to a specific partner or product	3.67	3.74	3.86	3.37	3.71
Reduced costs	3.62	3.63	3.45	3.31	3.87
Better information availability	4.08	4.03	3.81	3.85	4.19
Market Benefits					
Faster time to market	3.60	3.37	3.26	3.75	3.84
Increased market share	3.47	3.78	3.26	3.16	3.31
Increased profitability	3.62	3.66	3.30	3.50	3.78
Overcoming standards related trade barriers	3.40	3.70	3.29	3.19	2.74

1=no importance; 5=high importance

From this data, it would appear that the most important benefits, overall, are improved quality (4.15 out of 5), better information availability (4.08), easier collaboration (4.04) and faster delivery (4.02).

What is perhaps surprising is the perceived importance of performance benefits, as opposed to market benefits, which is reasonably consistent across standards. Companies appear to view standards as enabling efficient execution of their operational plans rather than helping develop new markets through either new products or increased market share. Respondents also regard collaboration benefits as more important than market benefits, but do not rate them as highly as performance benefits.

If a company is seeking system or performance benefits, it would appear that it should adopt DXF. It would most likely accrue market benefits through ISO 9000 registration. Either EDI (for business transactions) or DXF or IGES (for engineering design) seems to best address collaboration benefits. Either DXF or IGES might address manufacturing collaboration depending on the specific circumstances. DXF, IGES and EDI all seem to bring benefits in developing easier collaboration and improving data exchange.

Barriers

Next, respondents were asked to rate on a one-to-five scale the importance of several factors as barriers to adopting the most problematic standard. Table 7 (see next page) shows the importance of the barriers for all standards and for the four most frequently mentioned problematic standards: ISO 9000, EDI, IGES and STEP.

It would appear that the most important barriers are the capabilities of customers and suppliers (3.47 out of 5), lack of compatibility (3.43), lack of information about the standards (3.32) and lack of technical skills (3.22). The barriers associated with the capabilities of customers and suppliers are especially relevant. The impact of the adoption of data standards is directly determined by how many companies in a supply chain adopt that standard. Without multi-company adoption, the benefits are limited to intraorganizational data transfer. The bigger need for and benefit of standards adoption occur when companies need to exchange information.

It is also worth noting that respondents rated the barriers for ISO 9000 as relatively unimportant. It would appear that the difficulty of adopting ISO 9000 is not related to any one issue but rather is due to the scope of the initiative. Securing adequate resources also appears to be an issue.

For EDI, the major problem is incompatible implementations of ANSI X.12 or EDIFACT standards. Large corporate purchasers at the end of the supply chain, before the customer, need to work together to address these problems.

Similarly, different implementations of IGES within software packages cause problems. These issues most likely require the coordination of vendors to provide seamless exchange formats that directly and faithfully support open standards.

STEP suffers from its inability to represent certain information at the present time and a lack of vendor collaboration. As with IGES, STEP would benefit from increased vendor coordination in the support and implementation process.

Table 7: Importance of Barriers

	Total	*ISO 9000*	*EDI*	*IGES*	*STEP*
Information and Standards					
Lack of information on how to use	3.32	2.23	3.58	4.56	3.40
Inability to represent some information	2.86	2.16	2.81	3.13	3.90
Lack of technical skills	3.22	2.51	3.40	4.22	3.67
Lack of compatibility	3.43	2.62	4.02	4.25	3.78
Lack of vendor collaboration	2.90	2.31	2.90	3.50	3.80
Mismanagement and misuse of information	2.28	1.81	2.31	2.28	3.30
Required functionality not available	2.92	2.37	3.00	2.88	3.78
Capability of suppliers and/or customers	3.47	2.96	3.82	3.71	4.25
Uncertainty about mainstream adoption	2.60	2.45	2.51	2.73	3.50
Network and Security					
Lack of networking capability	2.82	2.82	2.96	2.29	2.00
Inadequate data security	2.93	2.47	3.34	2.87	3.38
Management and Organization					
Lack of information at management level	3.08	2.52	3.38	3.11	3.40
Lack of understanding about benefits	2.64	2.00	2.88	2.67	2.78
Lack of senior management support	2.89	2.53	3.04	3.00	3.27
Difficulty in justifying costs and quantifying the benefits	2.56	2.43	2.54	2.38	3.11
Lack of know-how to manage the implementation	2.14	1.69	2.17	2.19	2.40
Lack of collaboration among supply chain members	2.48	2.39	2.18	2.39	2.89
Lack of effective electronic links throughout the supply chain	2.92	2.58	2.96	2.94	3.20
Lack of money	3.16	2.70	3.14	3.06	2.60
Process incompatibility between functional areas and/or across organizations	2.18	1.78	2.18	2.00	2.30
Lack of technical support	3.03	3.09	2.82	2.94	3.20
Unwillingness to share data	3.02	3.13	2.94	2.88	3.20

1=no importance; 5=high importance

Aids to Implementation

Respondents then ranked on a one-to-nine scale a set of possible initiatives or activities for helping companies implement standards (see Table 8). Respondents could also suggest an additional option. These included resource provision (4 companies), increased mandating of standards (3) and improved standards (3).

Table 8: Aids to Implementation

	Average	Companies Ranking as Most Valuable
Good business cases for standards adoption	4.56	71
Success stories and lessons learned for your industry	5.15	44
Training programs (for managers)	4.65	49
Access to demonstration facilities	5.51	27
More communication with colleagues experiencing similar problems	5.41	37
Training programs (for technical personnel)	4.35	52
Pilot project(s) in your company	5.75	35
Access to problem solving expertise	4.66	45
Up to date information on the standards (what functionality supported, etc.)	5.03	62

1=most helpful; 9=least helpful

The initiatives perceived as most helpful are training programs for managers and technical personnel (4.65 and 4.35 out of 9 respectively), business cases for adoption (4.56) and access to problem solving (4.66). While it is possible to develop reasonably sound technical training programs from standards definition and requirements, the other desirable initiatives (i.e. good business cases, success stories and lessons learned) require documentation of ongoing activities. Although it appears that pilot studies or peer workshops are less popular, they might be necessary to develop the resources to deliver the more desirable initiatives.

Lessons Learned

The last question of the survey asked respondents, "What were the main DRAWBACKS and/or LESSONS your organization has LEARNED from implementing connectedness standards?" Many respondents took the time to provide valuable feedback about their implementation experience. These comments fall into two categories:

- Management issues
  - Interorganizational relationships: relationship between firms in the supply chain, often of different size and power in the relationship. Customer demands are an important factor in adoption decisions. Larger customers seem to be more important.
  - Internal commitment to change: support for the change process required to adopt a standard for use.

- Standards
  - Development and definition: the defined capabilities of a standard, its actual use in practice and amendment of the standard.
  - Implementation: the procurement of resources and knowledge to apply a standard after the adoption decision has been made.

In addition to the summary in the following pages, readers would be well served by reading the complete comments in Appendix D to get a broad understanding of these hard-learned lessons.

Interorganizational Relationships

A connectedness standard is only useful if two or more companies agree to use it to exchange information. In many management situations, coordination with other companies is important; however for data exchange and standards, coordination with other companies is essential. The following comments are representative of the interorganizational concerns that exist:

> "Lack of awareness/willingness on the part of customers to re-think their business models and attitudes on sharing information and investment in networking."
>
> "No matter what standard you adopt, your first new customer or supplier that you get after you adopt won't use it."
>
> "Not all on supply chain have same capability or willingness to obtain same."
>
> "Adopt when mainstream business community has implemented — be follower, not leader."

The adoption of standards is not, therefore, something that a firm can do on its own, but rather it must be done in conjunction with supply chain partners or throughout an industry.

Internal Commitment to Change

Several respondents mentioned the need for executive leadership of the standards-adoption process. Comments included the following:

> "Management commitment is the most critical."
>
> "Adoption of principles by management."
>
> "Training of personnel is paramount along with reinforcement of necessity & benefits from upper management. Most of our employees are younger but can still be resistant to changes."
>
> "Teamwork is a prerequisite. Commitment at upper levels must be evident."

It is important, therefore, that the organization views standards adoption as a priority. It is easier to motivate a company to change when faced with a crisis or ultimatum. This is one of the reasons why a company that may not have seen the need for a standard one day sees it the next; the difference is that an important customer now demands the change. On the other hand, if a company wishes to adopt a standard proactively, the executive-level sponsor who ensures that the adoption continues will play an important role.

However, managers cannot simply demand that the company adopt standards. Managers must accept that in order for standards to be effective, companies must commit to discontinuing proprietary formats.

Several respondents mentioned the need to get a broad consensus, which is important for two reasons. First, initial consensus lessens the chance that an individual or small group will be able to derail implementation. Second, a broad consultative process may uncover areas or issues requiring special attention.

Standards Development and Definition

In theory, a standard is a set of protocols that all those using the standard adopt. A standard in one company is the same in another. In practice, that is not true. Different companies and software vendors implement many standards in different ways, sometimes subtle and other times not. Many respondent comments reflect this frustration.

> "Not everyone implements "standards" the same way. Everyone believes they've done it the "right" way. Many standards are not detailed enough at the implementation level."
>
> "We found using IGES through various applications to be so inconsistent that we avoid work involving IGES like the plague."
>
> "[Industry] "Standards" are not followed by the Big [OEMs]. Even EDI standards are "tweaked" so they become customer specific and as such are not "standard". This adds cost and unnecessary complexity that does not add value."
>
> "The technology is changing so rapidly that at times it looks like we are constantly aiming at a moving target."
>
> "Drawbacks — company's adopting their own standards. TOO MANY STANDARDS! Standards changing too often, making it costly."

The large companies that drive the supply chain and the software vendors that implement the standards can only address these difficulties through cooperation. However, after implementation, changes in the definition of the standard continue to cause problems.

> "Longevity of standards; they change frequently."
>
> "Usually the adoption drags out and then is replaced by new technology before the standard is implemented."

Unstable or evolving standards cause two problems. One, the existing implementation may become dysfunctional. Two, companies may become discouraged about standards adoption because they feel that the standard will have changed by the time they have adopted it, requiring them to modify their implementation. The frustration that many small and medium-sized companies feel with regard to standards adoption is an issue that must be addressed.

Standards Implementation

After a company commits to adopting a standard, managers should remember at least some of the following comments:

> "Take estimated implementation time and multiply [by] 3."
>
> "The cost of implementing [is significant]."
>
> "All of our personnel have more to learn. Staff training has been the most costly and the most difficult."

"Lack of qualified companies to implement connectedness. We have utilized 2 of the so-called top computer companies in [CITY] and due to lack of ATTAINABLE results we dropped them and have gone to a systems expert from a large firm (part time business) but he is having troubles also. We are not cheap or non-informed and know what we want."

"Difficulties in implementing and reorganizing while remaining productive (lack of personnel)."

"Success requires good project management."

A company must allocate adequate resources at the start of the project. Failure to do so will cause implementation difficulties, and it is always harder to get additional resources for a failing project than for a new and promising one. Companies also need to resolve technical training issues early on as this training is often unavailable in communities across the country. This might be an opportunity to develop multimedia or Internet-based training programs. Finally, companies are concerned that personnel will focus too much attention on standards implementation and not enough on the operational concerns of the business. This problem is more likely to appear with process standards, such as ISO 9000 and ISO 14000 than with data standards.

Summary

This survey found that Canadian manufacturing companies as a whole have had some experience with connectedness. Furthermore, firms perceive that successful implementation of some standards has brought benefits. What is perhaps surprising is the perceived importance of performance benefits, as opposed to market benefits. This seems reasonably consistent across standards. Companies appear to view standards as enabling efficient execution of their operational plans rather than helping develop new markets through either new products or increased market share. Respondents also regard collaboration benefits as more important than market benefits, but do not rate them as highly as performance benefits.

From the respondents' lessons learned, it is clear that adopting standards is not something a firm can do on its own. Rather, it is something that must be done in conjunction with supply chain partners or throughout an industry. Similarly, the large companies that drive the supply chain and the software vendors that implement the standards can only address many problems through cooperation. However, even after a standard has been implemented, changes in the definition of the standard continue to cause problems.

In conclusion, there are still barriers to overcome to enhance the success of existing or in-progress standards implementation, and to increase the diffusion of standards throughout Canadian industry. Connectedness standards will only attain their potential through a coordinated effort within industries and across the manufacturing sector.

Appendix A: Glossary

Standard	Description
ANSI X.12	ANSI X.12 are standards that the industry uses for the electronic interchange of business transactions — electronic data interchange (EDI). In 1979, the American National Standards Institute (ANSI) chartered the Accredited Standards Committee (ASC) X.12 to develop the uniform structure, format and data content of these electronic business transactions.
CP/PD (Concurrent Product/Process Definition)	CP/PD is a method for developing and producing better, more competitive products in less time. It is critical that the processes used to manage, develop, manufacture, verify, test, deploy, operate, support and train people, and eventually dispose of the products be considered during product development. Product and process design and performance should be kept in balance. Processes should be developed concurrently with the products that they support.
DXF (Data eXchange File)	DXF is an ASCII-encoded vector graphic format that was developed by Autodesk for the interchange of data between different versions of AutoCAD. AutoCAD is the most widely used CAD package and it is extremely important in many areas of architecture and engineering. The DXF format has thus become a common format for data interchange in CAD, and virtually all CAD packages now support this format to some extent.
EDI (Electronic Data Interchange)	EDI is the computer-application-to-computer-application exchange of business information in a standard electronic format. Translation software aids in the exchange by converting data extracted from the application database into standard EDI format (e.g. ANSI X.12 or EDIFACT) for transmission to one or more trading partners.
EDIF (Electronic Design Interchange Format)	EDIF is a neutral, platform-independent format for the interchange of integrated circuit design data from design to manufacturing organizations.
EDIFACT (Electronic Data Interchange for Administration, Commerce and Transport)	These United Nations rules comprise a set of internationally agreed upon standards, directories and guidelines for the electronic interchange of structured data related to trade in goods and services between independent computerized information systems (ISO 9735).
Gerber	Gerber is a standardized format the printed circuit board fabrication industry uses to generate artwork. A Gerber file is ASCII code and can have slightly different content depending on which format generated the code.
HTML (HyperText Markup Language)	HTML is a subset of SGML and was developed with a standard document type definition for hyperlinked text and graphics accessible on the World Wide Web.
IGES (Initial Graphics Exchange Standard)	IGES was the first specification for CAD data exchange, published in 1980 as a NBS (National Bureau of Standards) report in the U.S. ANIS accepted and released IGES version 1.0 as a standard in 1981. All the important CAD vendors support IGES, and it is currently the most widespread standard for CAD data exchange.

Standard	Description
IS0 14000	The ISO 14000 series, a project of the International Organization for Standardization (ISO), is a collection of voluntary consensus standards that helps organizations achieve environmental and economic gains through the implementation of effective environmental management systems.
ISO 9000	ISO 9000 is a series of international standards that provides quality management guidance and identifies quality system elements that are necessary for quality assurance. In other words, the ISO 9000 series standards have two main roles: to provide guidance for suppliers of all types of products that wish to implement effective quality systems (or improve existing ones), and to provide the generic requirements against which those quality systems can be evaluated.
PDF (Portable Document Format)	PDF captures all the elements of a printed document as an electronic image that users can view, navigate, print or forward to someone else. PDF files are created using Adobe Acrobat, Acrobat Capture or similar products.
PostScript	PostScript is a programming language that describes the appearance of a printed page, it was developed by Adobe in 1985 and has become an industry standard for printing and imaging. All major printer manufacturers make printers that contain or can be loaded with PostScript software, which also runs on all major operating system platforms.
RTF (Rich Text Format)	RTF is a file format that lets you exchange text files between different word processors in different operating systems.
SGML (Standard Generalized Markup Language)	SGML is a standard that defines a language for document representation that formalizes mark-up and frees it of system and processing dependencies. SGML provides a coherent and unambiguous syntax for describing whatever a user chooses to identify within a document.
STEP (STandard for the Exchange of Product model data)	STEP is an international standard (ISO 10303) providing a neutral mechanism for describing, sharing, storing and exchanging product data throughout the complete life cycle of a product. The first release was available in April 1995. It consists of many parts to support specific industries or product types, such as mechanical parts, automobile, electronics, shipbuilding and construction.
UPC (Universal Product Code)	A UPC symbol consists of a series of parallel, adjacent bars and spaces. Predetermined width patterns code actual data into the symbol.
XML (eXtensible Mark-up Language)	XML is a flexible way to create common information formats and share both the format and the data on the World Wide Web, Intranets and elsewhere.

Appendix B: Survey (including cover letter)

National Research Council
Canada
Integrated Manufacturing
Technologies Institute

Conseil national de recherches
Canada
Institut des technologies
de fabrication intégrée

NRC · CNRC

Monday April 12, 1999

Dear Manufacturing Stakeholder:

Would you like to know where your organization benchmarks compared to other manufacturing companies with regard to your overall adoption of connectedness standards? At a recent workshop, Canadian manufacturing managers wanted to know what other firms were doing with respect to developing a connectedness capability. To help develop this reference database, simply return the enclosed short questionnaire *on or before May 5.* A report of your responses compared to the aggregated results of respondents will be sent to you.

On behalf of Industry Canada and the National Research Council, we invite you to participate in this survey of Canadian companies, which is being conducted to determine the degree of adoption of various connectedness standards in major Canadian manufacturing sectors and their related service infrastructure. We are trying to determine the problems and barriers experienced by companies in implementing (or trying to implement) these standards, as well as the business benefits that they have experienced. The survey will also assist in identifying companies who would be good candidates for a pilot site implementation of proposed solutions to especially challenging problems.

This survey is designed to be answered by a senior manager responsible for research and development, manufacturing or supply chain management. If your responsibilities do not include these areas, please forward this package to the appropriate person in your organization.

It should take no more than 20 minutes to complete. Please be assured that individual responses will be kept strictly confidential.

Best regards,

Susan Gillies
Manager, CanSTEP
Integrated Manufacturing Technologies Institute
National Research Council

CONNECTEDNESS AND MANUFACTURING

User Survey of Standards Adoption in Canada

The *Connectedness and Manufacturing Project* is being conducted to provide awareness and guidance with respect to the adoption of connectedness standards by Canadian manufacturing companies. From a company perspective, improved connectedness must result in increased productivity and, ideally, to an environment that fosters innovation. Connectedness in the manufacturing sector refers to the degree of sharing of business and technical data through electronic linkages within and across organizational boundaries, such as between partners, suppliers, customers and subcontractors. Connectedness standards are industry wide standards for data exchange or business processes that are intended to facilitate collaboration between firms.

Your answers will help to identify the degree of adoption of various non-proprietary connectedness standards and the effects experienced in implementing (or trying to implement) these standards. As well, the survey will endeavour to capture barriers, successful "workarounds" and significant "lessons learned".

This project is being conducted by the Integrated Manufacturing Technologies Institute of the National Research Council and is sponsored by the Manufacturing and Processing Technologies Branch of Industry Canada.

Notes before you begin:

- **You can expect to complete this survey in 20 minutes.**
- **Your personal response will be kept strictly confidential. Only aggregated data will be released.**

Instructions:

1. **Please answer the questions as they appear on the survey.**
2. **When you have finished, fold the survey in half, place it in the postage-paid return envelope and mail it to us as soon as possible, or fax your response back to (519) 430-7032.**

THANK-YOU in advance for your time filling out this survey! Your answers are important and are greatly appreciated.

Susan Gillies
Manager, CanSTEP
Integrated Manufacturing Technologies Institute
National Research Council
800 Collip Circle
London, Ontario N6G 4X8

RESPONDENT IDENTIFICATION

1) Please staple your business card here, or indicate your:

a) Name: _____

b) Main function: _____

c) Firm: _____

d) City: _____

e) Province: _____

f) Postal Code: _____

g) Email: _____

h) Phone: _____

i) Fax: _____

ORGANIZATIONAL PROFILE

2) Please indicate [check one] the primary industry sector with which your company is grouped:

1 ☐ Aerospace & Defence
2 ☐ Automotive
3 ☐ Resource Processing
4 ☐ Electrical & Electronics
5 ☐ Health & Biotech
6 ☐ Food Processing
7 ☐ Other, please specify:

_____

3) Please indicate [check one] the approximate number of employees working in your company (all sites combined):

1 ☐ Less then 50
2 ☐ 50 to 99
3 ☐ 100 to 249
4 ☐ 250 to 499
5 ☐ 500 or more

4) Please indicate [check one] where the head office of your controlling firm is located:

1 ☐ Canada
2 ☐ USA
3 ☐ Europe
4 ☐ Pacific Rim
5 ☐ Other foreign, please specify: _____

5) Please indicate [check one] the geographical organization of your firm:

1 ☐ Single site
2 ☐ Multiple sites (Canada only)
3 ☐ Multiple sites (Canada and USA only)
4 ☐ Multiple sites (international)

6) Please indicate [check one] your firm's approximate annual revenue:

1 ☐ Less than $ 1 M
2 ☐ $ 1 M - $ 10 M
3 ☐ $ 10 M - $ 25 M
4 ☐ $ 25 M - $ 50 M
5 ☐ $ 50 M - $ 100 M
6 ☐ More than $ 100 M

DEGREE OF ADOPTION OF CONNECTEDNESS STANDARDS

7) Has your company EVER collaborated electronically with another company (e.g. exchanged or shared business or technical data)?

1 ☐ Yes
2 ☐ No If no, please indicate why not and return the questionnaire.

8) Does your company have an electronic network or dial-up connection (including Internet) with your:

a) Partners?
1 ☐ None 2 ☐ Some 3 ☐ Most 4 ☐ All 5 ☐ N/A

b) Subcontractors?
1 ☐ None 2 ☐ Some 3 ☐ Most 4 ☐ All 5 ☐ N/A

c) Suppliers?
1 ☐ None 2 ☐ Some 3 ☐ Most 4 ☐ All 5 ☐ N/A

d) Customers?
1 ☐ None 2 ☐ Some 3 ☐ Most 4 ☐ All 5 ☐ N/A

e) Own sites?
1 ☐ None 2 ☐ Some 3 ☐ Most 4 ☐ All 5 ☐ N/A

9) Do your company's electronic collaboration activities involve:

a) Business transaction information? (e.g. purchase orders and invoices) 1 ☐ Yes 2 ☐ No

b) Engineering design information? (e.g. CAD files) 1 ☐ Yes 2 ☐ No

c) Manufacturing information? (e.g. CAM or CNC files) 1 ☐ Yes 2 ☐ No

10) List the main standard(s) facilitating connectedness in your organization and indicate with a check mark whether the standard is no longer in use, is currently being used, will be used within the next 2 years or if there are no plans for its use. Also indicate with a check mark the functional area(s) in your company where the standard is, was or will be used.

	Current Status					Functional Area(s) Standard Used In					
Standard	**Tried, but no longer in use**	**Currently in use**	**Planned to use within 2 years**	**No Plans for Use / *Does not apply***	**Don't Know**	**Design and Engineering**	**Procurement**	**Processing, Fabri-cation and Assembly**	**Inspection and Control**	**Distribution**	**After Sales Service**
a) IGES (Initial Graphics Exchange Specification)											
b) DXF (Data eXchange File)											
c) PostScript (.ps file)											
d) GERBER File Format											
e) EDIF (Electronic Design Interchange Format)											
f) STEP (STandard for the Ex -change of Product model data)											
g) ANSI X12 (EDI or Electronic Data Interchange)											
h) EDIFACT (EDI or Electronic Data Interchange)											
i) UPC (Universal Product Code)											
j) ISO 9000 series											
k) ISO 14000 series											
l) CP/PD (Concurrent Product/ Process Definition)											
m) SGML (Standard Generalized Markup Language)											
n) HTML (HyperText Markup Language)											
o) XML (eXtensible Markup Language)											
p) PDF (Portable Document Format)											
q) RTF (Rich Text Format)											
r) Other: _____											
s) Other: _____											
t) Other: _____											

11) Which STANDARD identified in question # 10 has brought the most benefit to your organization?

a) Standard: _____
b) Functional Area: _____

Please rate the importance of the following POSITIVE EFFECTS in your organization related to the adoption of the standard identified in question #11a:

	Importance					
Systems	**None**				**High**	Don't know
c) Compatibility across a wider range of applications	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	☐
d) Reusability of software modules in new applications	☐	☐	☐	☐	☐	☐
e) Easy reconfiguration of network architecture	☐	☐	☐	☐	☐	☐
f) Easier to add new functionality to applications	☐	☐	☐	☐	☐	☐
g) Standard software maintenance agreements	☐	☐	☐	☐	☐	☐
Collaboration						
h) Easier collaboration	☐	☐	☐	☐	☐	☐
i) More flexible trading partnerships	☐	☐	☐	☐	☐	☐
j) Increased capability to meet data exchange requirements	☐	☐	☐	☐	☐	☐
Performance						
k) Faster delivery	☐	☐	☐	☐	☐	☐
l) Improved overall quality	☐	☐	☐	☐	☐	☐
m) Increased ability to tailor business processes to a specific partner or product	☐	☐	☐	☐	☐	☐
n) Reduced costs	☐	☐	☐	☐	☐	☐
o) Better information availability	☐	☐	☐	☐	☐	☐
Market						
p) Faster time to market	☐	☐	☐	☐	☐	☐
q) Increased market share	☐	☐	☐	☐	☐	☐
r) Increased profitability	☐	☐	☐	☐	☐	☐
s) Overcoming standards related trade barriers	☐	☐	☐	☐	☐	☐
Other (specify):						
t) _____	☐	☐	☐	☐	☐	☐
u) _____	☐	☐	☐	☐	☐	☐

12) Which STANDARD identified in question #10 has been the most problematic to adopt?

a) Standard: _____
b) Functional Area: _____

Please rate the importance of the following factors to your organization as BARRIERS to the adoption of the standard identified in question #12a:

	Importance					
	None				High	Don't know
Information & Standards						
c) Lack of information on how to use the standard	☐	☐	☐	☐	☐	☐
d) Inability to represent some information (e.g. codes, complex data, meaning of data)	☐	☐	☐	☐	☐	☐
e) Lack of technical skills	☐	☐	☐	☐	☐	☐
f) Lack of compatibility (upward and with other systems)	☐	☐	☐	☐	☐	☐
g) Lack of collaboration between vendors/developers when they implement the standards	☐	☐	☐	☐	☐	☐
h) Mismanagement and misuse of information	☐	☐	☐	☐	☐	☐
i) Required functionality not yet available	☐	☐	☐	☐	☐	☐
j) Capability of suppliers and/or customers	☐	☐	☐	☐	☐	☐
k) Uncertainty about mainstream adoption	☐	☐	☐	☐	☐	☐
Network & Security						
l) Lack of networking capability	☐	☐	☐	☐	☐	☐
m) Inadequate data security	☐	☐	☐	☐	☐	☐
Management & Organization						
n) Lack of information at management level	☐	☐	☐	☐	☐	☐
o) Lack of understanding about the benefits	☐	☐	☐	☐	☐	☐
p) Lack of senior management support (e.g. other prioritles)	☐	☐	☐	☐	☐	☐
q) Difficulty in justifying costs and quantifying the benefits	☐	☐	☐	☐	☐	☐
r) Lack of know-how to manage the implementation	☐	☐	☐	☐	☐	☐
t) Lack of collaboration among supply chain members	☐	☐	☐	☐	☐	☐
u) Lack of effective electronic links throughout the supply chain	☐	☐	☐	☐	☐	☐
u) Lack of money	☐	☐	☐	☐	☐	☐
v) Process incompatibility between functional areas and/or across organizations	☐	☐	☐	☐	☐	☐
w) Lack of technical support	☐	☐	☐	☐	☐	☐
x) Unwillingness to share data	☐	☐	☐	☐	☐	☐
Other (specify):						
y) _____	☐	☐	☐	☐	☐	☐
z) _____	☐	☐	☐	☐	☐	☐

13) Of the following items, which would be the most helpful for you to increase the level of standards adoption in your organization? Please rank the items from 1 to 9 (or to 10 if you specify an additional item), where 1 indicates the most helpful and 9 (or 10) indicates the least helpful.

a) Good business cases for standards adoption	
b) Success stories and lessons learned for your industry	
c) Training programs (for managers)	
d) Access to demonstration facilities	
e) More communication with colleagues experiencing similar problems	
f) Training programs (for technical personnel)	
g) Pilot project(s) in your company	
h) Access to problem solving expertise	
i) Up to date information on the standards (what functionality supported, etc.)	
j) Other (specify) :	

14) What were the main DRAWBACKS and/or LESSONS your organization has LEARNED from implementing connectedness standards?

This completes the survey.

Please fold the survey in half, place it in the postage-paid return envelope and mail it to us as soon as possible, or fax your response back to (519) 430-7032.

Thank you for your participation!

Appendix C: Aggregate Data

Table C-1: Survey Response by Province

Province	Frequency	Percent
Alberta	36	8.7
British Columbia	22	5.3
Manitoba	15	3.6
New Brunswick	4	1.0
Newfoundland	2	0.5
Nova Scotia	7	1.7
Ontario	211	51.1
Prince Edward Island	0	0.0
Quebec	86	20.8
Saskatchewan	7	1.7
Minnesota (U.S.)	1	0.2
Not Specified	22	5.3
Total	413	99.9

Due to rounding, the percent column does not add up to 100%.

Table C-2: Survey Response by Industry Sector

Industry Sector	Frequency	Percent
Advanced Materials and Plastics	32	7.7
Aerospace and Defence	25	6.1
Automotive	71	17.2
Electrical and Electronics	55	13.3
Fashion, Leisure and Household	42	10.2
Food Processing	1	0.2
Health and Biotechnology	7	1.7
Industrial and Commercial Equipment	56	13.6
Information and Communication Technologies	15	3.6
Metals and Minerals Processing	57	13.8
Resource Processing	26	6.3
Other	20	4.8
Not Specified	6	1.5
Total	413	100.0

Number of surveys sent out by Standard Industrial Classification (SIC)

SIC	Description	Frequency	Percent
2511-2599	Furniture and Fixtures	327	7.5
3011-3089	Rubber and Miscellaneous Products	537	12.3
3411-3499	Fabricated Metal Products, Except Machinery and Transportation	1012	23.2
3511-3599	Industrial and Commercial Machinery and Computer Equipment	1059	24.2
3611-3699	Electronic and Other Electrical Equipment and Components	612	14.0
3711-3799	Transportation Equipment	414	9.5
3812-3873	Measuring, Analyzing, and Controlling Instruments	200	4.6
3911-3999	Miscellaneous Manufacturing Industries	209	4.8
Total		4370	100.1

Due to rounding, the percent column does not add up to 100%.

Table C-3: Survey Response by Number of Employees

Number of Employees	Frequency	Percent
Less than 50	57	13.8
50 to 99	160	38.7
100 to 249	111	26.9
250 to 499	29	7.0
More than 500	51	12.3
Not Specified	5	1.2
Total	413	99.9

Due to rounding, the percent column does not add up to 100%.

Table C-4: Survey Response by Company Revenue

Company Revenue	Frequency	Percent
Less than $1 million	3	0.7
$1-10 million	134	32.4
$10-25 million	122	29.5
$25-50 million	56	13.6
$50-100 million	30	7.3
More than $100 million	50	12.1
Not Specified	18	4.4
Total	413	100.0

Table C-5: Survey Response by Head Office Location

Head Office Location	Frequency	Percent
Canada	330	79.9
United States	55	13.3
Europe	17	4.1
Pacific Rim	3	0.7
Not Specified	8	1.9
Total	413	99.9

Due to rounding, the percent column does not add up to 100%.

Table C-6: Survey Response by Company Organization

Company Organization	Frequency	Percent
Single Site	172	41.6
Multiple Sites (Canada)	96	23.2
Multiple Sites (Canada and United States)	58	14.0
Multiple Sites (International)	82	19.9
Not Specified	5	1.2
Total	413	99.9

Due to rounding, the percent column does not add up to 100%.

Table C-7: Survey Response by Prior Electronic Collaboration

Prior Electronic Collaboration	Frequency	Percent
No	82	19.9
Yes	321	77.7
Total	403	97.6
No Response	10	2.4
Total	413	100.0

Table C-8: Reasons for No Electronic Collaboration by Industry Sector

Industry Sector	Reason
Advanced Materials and Plastics	All technology to remain in group.
	Currently in process with a few customers, but not on line yet.
	System capabilities, of company and suppliers.
	Not seen as a requirement at this time.
	It has never come up.
	No need for electronically with another company.
	We are moving towards this area.
	Very competitive market for a small company.
	We are only beginning to with Walmart Canada.
	No need up to this point.
	Confidentiality issues at risk.
Aerospace and Defence	No requirement.
Automotive	This plant is not set up at this present time.
	No need at this time.
	Our facility has not been set up by our corporate offices yet.
	No need for it.
	We are in the process of installing new software and then will begin on this.
	Technology not developed within the company as yet.
	We are just starting to develop a system to use. We have done some with home comp. use.
Electrical and Electronics	Not into this as yet: have web site in completion stage.
	There was never a need to.
	Due to the general nature of the business, we are beginning to explore some possible applications.
Fashion, Leisure and Household	We have just hooked up to the Internet internally and are not aware of the opportunities.
	Too much competition to share business or data.
	Any collaboration is done with our own company and subsidiaries.
	Have not had the time or opportunity to pursue.
	Will do so only if upon the request of a substantial customer.
	*No need.
	Currently reviewing areas where this may be appropriate and cost-effective for us.
	No need!
	Not connected to Internet yet.
Health and Biotechnology	*The need for it hasn't arisen yet.
Industrial and Commercial Equipment	No need to.
	Have not seen the benefits as of yet.
	Not economically feasible at this time.
	There has been no need.
	We are still a small company in growth.

Industry Sector	Reason
	Security reasons.
	Corporate policy -- head office control.
Information and Communication Technologies	Systems tried were awkward to use.
Metals and Minerals Processing	The company belongs to the Galvanizing Association and we get all information required through them.
	Opportunity never arose.
	The need to do so has not presented itself.
	Our network is intercompany only--we do not share with competition or others business or technical data.
	We do not exchange information with our competition.
	No relevant data to exchange.
	Have not explored this opportunity.
	We have not heard about this type of data exchange process.
	*Not necessary.
	I guess we've assumed a company couldn't bear the startup costs involved, although we never investigated if this were true.
	There are no needs at this point.
	Some banking, some e-mail, but neither our systems people or us know nothing of the standards.
	We will connect to Internet within 12 months, at which point we will be transferring CAD drawings with customers, subcontractors - until 1999 few customers were looking for electronic data transfer capabilities.
	The necessity has not risen, nor the request from suppliers, customers.
	No need.
	*Not ready at the moment, many projects in production in the short term (1 year).
Resource Processing	*A few weeks ago, we started using email to send (via Internet) steel piece cut-outs to two suppliers.
	We have no interest in sharing business, technical or financial data. We are a sole proprietorship.
	The sporadic exceptions show promise, but also point to the lack of interest in our industry in our area. Our company does have a Web site and is exploring more.
	No interest now.
Other	*Never had the opportunity to do it.
	*We are only beginning in that field.
	No need to do so due to competitive edge.

Comments preceded by an asterix (*) were originally submitted in French.

Table C-9: Connection to Supply Chain by Industry Sector

Connect to		Total (Number of Responses)	Total (% of Resps. Answering Question)	Advanced Materials and Plastics	Aerospace and Defence	Automotive	Electrical and Electronics	Fashion, Leisure and Household	Food Processing	Health and Biotechnology	Industrial and Commercial Equipment	Information and Communication Technologies	Metals and Minerals Processing	Resource Processing	Other
Partners	None	60	18%	33%	13%	15%	15%	19%	0%	33%	15%	8%	19%	24%	33%
	Some	110	34%	38%	30%	31%	40%	44%	100%	33%	28%	25%	27%	29%	40%
	Most	66	20%	14%	26%	25%	25%	16%	0%	0%	20%	25%	14%	24%	13%
	All	39	12%	0%	4%	16%	8%	6%	0%	17%	7%	33%	24%	19%	0%
	N/A	53	16%	14%	26%	13%	12%	16%	0%	17%	30%	8%	16%	5%	13%
Subcontractors	None	106	32%	57%	17%	31%	24%	34%	0%	17%	32%	50%	26%	33%	56%
	Some	130	40%	33%	52%	40%	44%	47%	100%	50%	32%	33%	32%	48%	25%
	Most	49	15%	0%	22%	15%	22%	3%	0%	0%	21%	8%	21%	14%	6%
	All	12	4%	5%	0%	5%	4%	3%	0%	0%	2%	0%	8%	0%	6%
	N/A	32	10%	5%	9%	10%	6%	13%	0%	33%	13%	8%	13%	5%	6%
Suppliers	None	83	25%	38%	14%	25%	15%	27%	0%	33%	24%	23%	26%	23%	41%
	Some	168	50%	48%	59%	48%	48%	55%	100%	67%	49%	69%	37%	59%	41%
	Most	64	19%	5%	18%	19%	33%	9%	0%	0%	18%	8%	26%	18%	18%
	All	13	4%	5%	5%	5%	2%	6%	0%	0%	4%	0%	8%	0%	0%
	N/A	9	3%	5%	5%	3%	2%	3%	0%	0%	4%	0%	3%	0%	0%
Customers	None	42	12%	32%	0%	3%	10%	15%	0%	17%	17%	0%	16%	23%	18%
	Some	169	50%	55%	52%	38%	42%	58%	100%	67%	50%	85%	50%	50%	59%
	Most	89	26%	9%	30%	34%	42%	24%	0%	0%	21%	0%	24%	23%	24%
	All	34	10%	5%	17%	25%	4%	3%	0%	0%	8%	15%	8%	5%	0%
	N/A	5	1%	0%	0%	0%	2%	0%	0%	17%	4%	0%	3%	0%	0%
Own Sites	None	43	13%	27%	0%	10%	2%	24%	0%	0%	13%	7%	19%	14%	29%
	Some	41	12%	18%	4%	8%	19%	15%	0%	17%	15%	14%	6%	14%	6%
	Most	49	15%	18%	13%	18%	15%	12%	0%	33%	17%	29%	3%	10%	12%
	All	137	41%	27%	57%	46%	52%	39%	0%	17%	28%	43%	39%	43%	41%
	N/A	62	19%	9%	26%	18%	12%	9%	100%	33%	26%	7%	33%	19%	12%

Table C-10: Electronic Collaboration Activity by Industry Sector

Activity		Total	Total (%)	Advanced Materials and Plastics	Aerospace and Defence	Automotive	Electrical and Electronics	Fashion, Leisure and Household	Food Processing	Health and Biotechnology	Industrial and Commercial Equipment	Information and Communication Technologies	Metals and Minerals Processing	Resource Processing	Other
Business Transaction	No	113	33%	41%	50%	23%	21%	27%	100%	67%	41%	14%	45%	33%	41%
	Yes	226	67%	59%	50%	77%	79%	73%	0%	33%	59%	86%	55%	67%	59%
Engineering Design	No	67	20%	59%	9%	6%	10%	25%	0%	67%	18%	46%	15%	15%	44%
	Yes	270	80%	41%	91%	94%	90%	75%	100%	33%	82%	54%	85%	85%	56%
Manufacturing	No	153	46%	73%	26%	30%	44%	45%	0%	100%	54%	69%	40%	45%	56%
	Yes	182	54%	27%	74%	70%	56%	55%	100%	0%	46%	31%	60%	55%	44%

Table C-11: Responses Identifying Benefit and Barrier Standards

Standard	Benefit	Barrier	Total
ISO 9000 Series	81	61	142
IGES	42	18	60
DXF	42	3	45
ANSI X.12	20	23	43
EDI	19	22	41
HTML	20	8	28
PDF	11	7	18
STEP	2	12	14
EDIF	7	6	13
UPC	3	10	13
EDIFACT	4	5	9
Gerber	4	4	8
RTF	6	2	8
PostScript	1	6	7
DWG	3	0	3
XML	0	3	3
ISO 14000 Series	1	1	2
JPEG	2	0	2
Microsoft Office	2	0	2
SGML	2	0	2
ASCII	1	0	1
CP/CD	1	0	1

Figure C-1: Electronic Collaboration Experience by Region

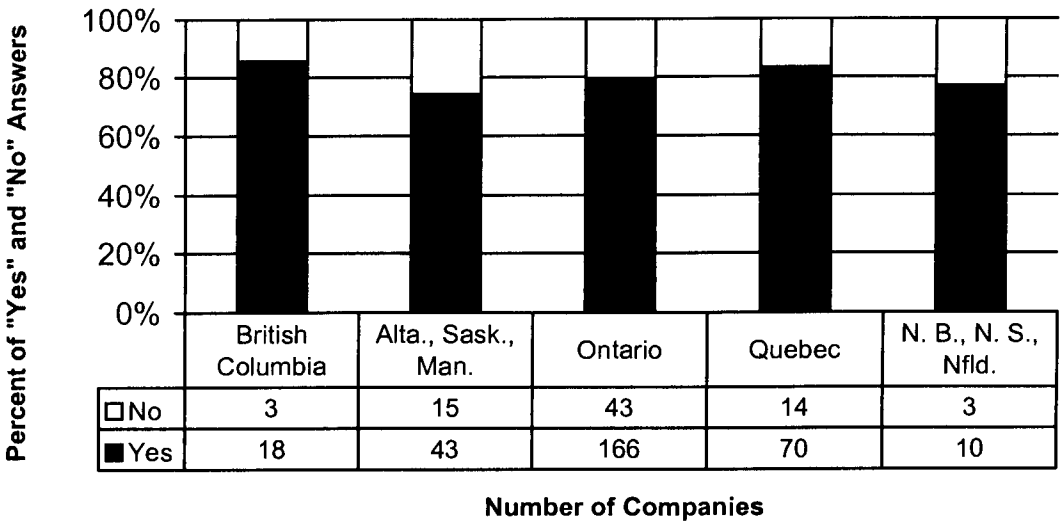


Figure C-2: Electronic Collaboration Experience by Number of Employees

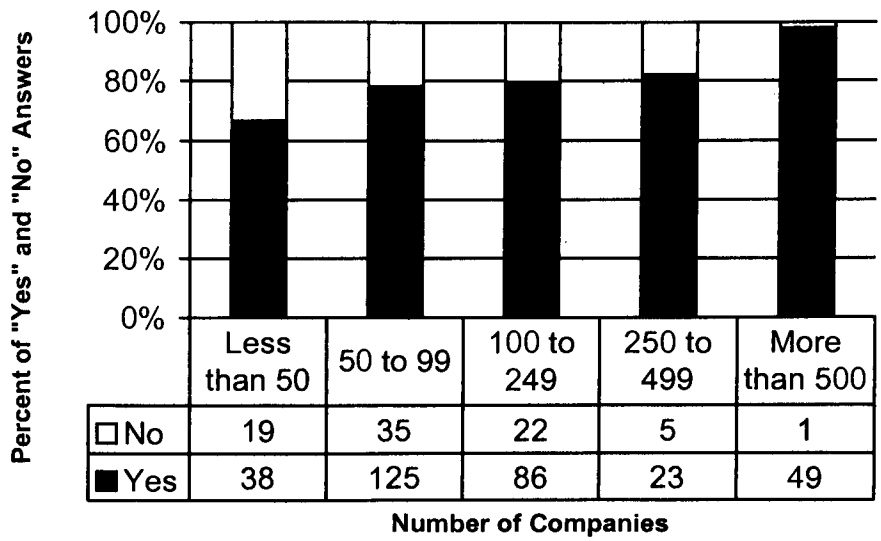
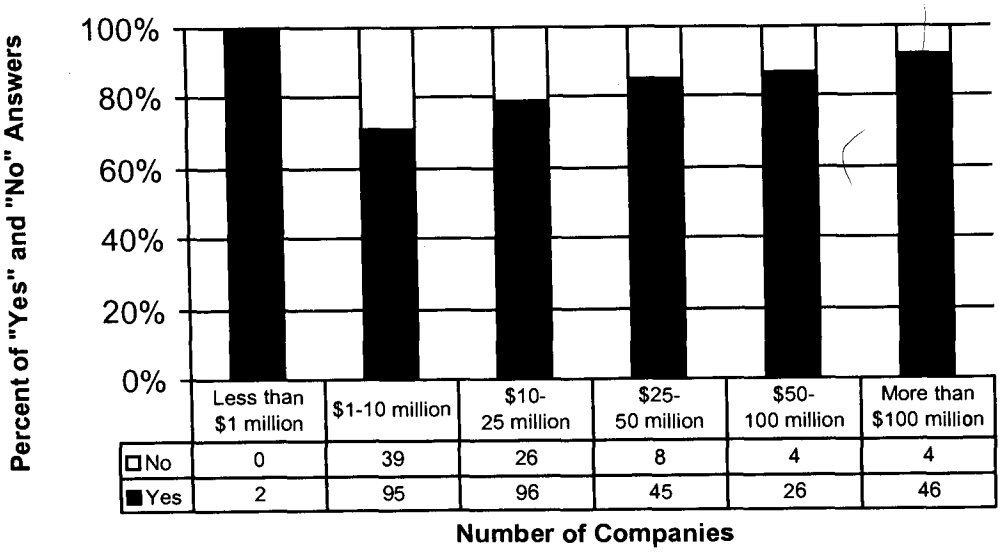
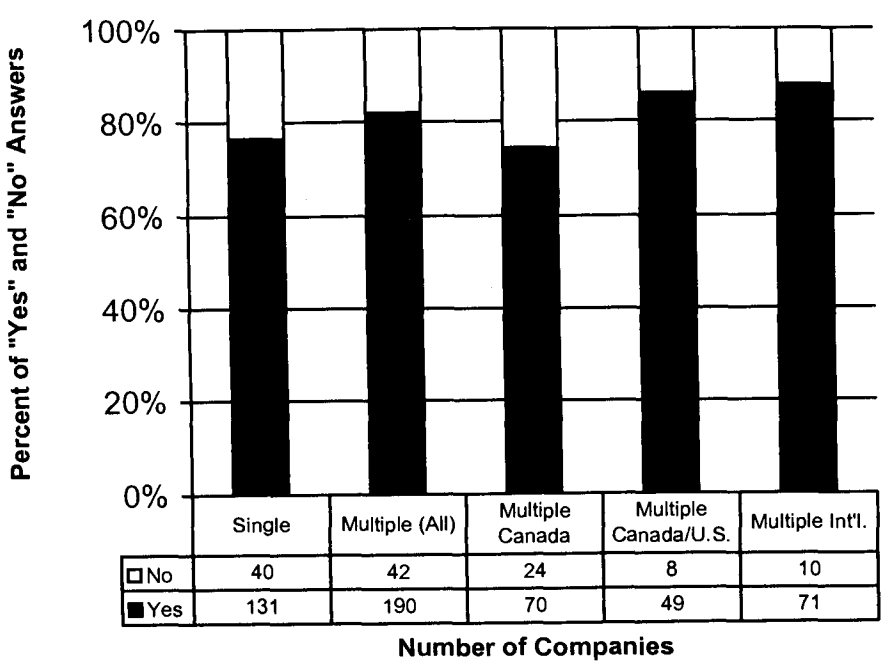


Figure C-3: Electronic Collaboration Experience by Revenue



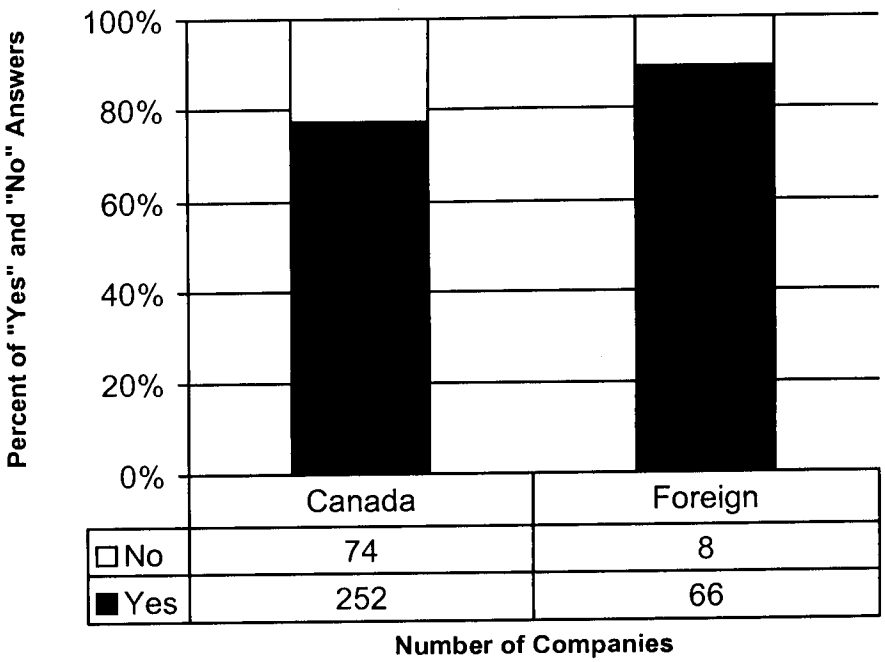
	Less than $1 million	$1-10 million	$10-25 million	$25-50 million	$50-100 million	More than $100 million
No	0	39	26	8	4	4
Yes	2	95	96	45	26	46

Figure C-4: Electronic Collaboration Experience by Organizational Structure



	Single	Multiple (All)	Multiple Canada	Multiple Canada/U.S.	Multiple Int'l.
No	40	42	24	8	10
Yes	131	190	70	49	71

Figure C-5: Electronic Collaboration Experience by Head Office Location



Appendix D: Lessons Learned

This appendix contains the verbatim transcripts of the comments and/or lessons learned that respondents made on their survey returns. Comments preceded by an asterix (*) were originally submitted in French. The project team removed information identifying a respondent or his/her company (as noted in square brackets: [ ]). The industry is given for each response, except for health and biotechnology, and food processing, which are categorized as "other." Too few written comments were received from these sectors to reasonably safeguard anonymity.

Contents

Advanced Materials and Plastics

There are not any main drawbacks or lessons learned. We have found the ISO 9000 standard to be a very positive standard within our organization. Job functions are documented, procedures are written, employees trained, reduced costs, etc. We have found that this procedure also makes the employee feel as though they are a part of the overall finished product; they have become accountable for their contribution. Also, it has promoted good discussion when it comes to problems encountered, etc.

Saves a lot of time. Mostly used for software updates.

Lack of technical skill from trading partner. It's time consuming. Have to be patient.

Standards do not always allow complete connectivity between different software applications and different versions. Translators do not seem to be consistent across the board of good programs out there. STEP appears to be a great improvement over IGES, but is not widely used in industry at this point.

*This is a long process to implement and requires a great deal of changes to the material as well as staff training. It takes a long time to implement/establish. It requires a lot of adaptation of equipment and staff.

Implementation tends to take longer than expected, with higher costs and it tends to take several training/retraining sessions to get all parties on board.

There are many different types and customers and suppliers may/may not be the same as yours, therefore you may require many types to satisfy and communicate with all.

Aerospace and Defence

We are always caught by being too far ahead or behind the technology curve. The gaps are large in both directions and there seems to be no practical jumping off point. We are defining capabilities that relate to our core, being engineering and manufacturing but would like to explore how to keep this forward in other areas.

Vendor selection -- different standards at each vendor. Good business case for adoption for an industry-wide standard. Adoption of principles by management. Backward compatibility.

Because of the size of our company, getting everyone to agree is difficult/impossible.

We found using IGES through various applications to be so inconsistent that we avoid work involving IGES like the plague.

Large firms do not have the most current resources, especially Aerospace. Automotive much further ahead with EDI. Not cost effective to pursue with customers. Companies may exchange e-mail, we have EDI ability, no customers have EDI, including large USA defense.

The main drawback was the fact that STEP was unable to handle the geometry given. There seemed to be different interpretations of the standard by the software developers (i.e. CATIA & Unigraphics).

Suppliers and customers in the process need to agree to adopt. Standards need to add value to business with respect to time to market profit margins etc. Standards need to be current and supported by current software and hardware.

The installation causes problems. We have problems related to the installation (implementation) of standards, but our employees are very capable of working with it. We have improved connectedness.

There are many versions of "IGES" available in translators. It would be good to have a language that has true compatibility.

We learned that connection standards are only a small part of viable information exchange. Other factors include: standard ways of using tools (e.g. CAD drawing standards, document templates); file configuration management procedures.

We implement a standard when it helps us to exchange data with our partners/suppliers/customers. Period. We don't need any of the items listed in question 13.

Re: Q. 12 - cannot state an example to this question because we have found generally adoption of any standard no matter how narrow generates an improvement. Drawbacks -- infrastructure change cost; procedure rewriting lagged implementation; loss of focus on long-term implementation; failure to agree on standard (e.g. CAD data standard). Lessons – need strong champion; need clear business case; need to get buy in from all stakeholders.

A general lack of industry/government commitment and understanding of the standards and their application.

Automotive

High implementation costs and steep learning curve for ANSI X12 standard EDI. The standard is very "flexible" from one customer to another. Therefore previous knowledge and expertise can only be partially applied. Once implemented and working there are significant benefits in data accuracy and timeliness.

Evolving technology (rapid). Changing of standards. Y2K. Deviation from standard. Testing facilities/time. Security. Corporate structure/philosophy.

EDI with [LARGE CUSTOMER] using a VAN [value-added network] which has a significant cost with little "value added". It would be great if there was a "standard" EDI format for ALL trade that allows: order placing -- order forecasting with confirmation order shipping -- shipping notices – electronic funds transfers – all using internet. This would be able to be used seamlessly with internal information systems. Current EDI & EDIFACT is cumbersome and cannot be made seamless. Transfer of CAD files over 2MEG is still a time consuming fashion.

I feel VAN services are overrated and Internet use should be more widespread due to the costs associated with value-added-networks.

The main drawback has to deal with the willingness on information exchange between companies. Typically competitors are very unwilling to share any information between one and other. Also the education level is not enough between departments to fully take advantage of the system. Lessons learned: effective data/standard transfer is very good in facilitating communication between companies. Time & paperwork are reduced as a result.

Duplication of data.

Once you agree on a standard to provide adequate time for supply base to upgrade to same systems need to provide information in that format exclusively.

Lack of internationally-accepted methods. Not all on supply chain have same capability or willingness to obtain same.

There are very few pure standards.

More organized. Increased productivity. Reduced quality issues.

Data does not transfer completely.

As a multi-disciplined, multi-sited organization we had to ensure that all facets of the company were linked concurrently. Past upgrades for each division were augmented autonomously. Not very satisfactory situation.

EDI particularly has been difficult to implement. Each of our customers use the "standard" ? differently. We custom design EDI interfaces and then redesign as our customers change/improve.

Customer driven. Vendor selection crucial.

Leading a change in this area adds to the level of success. The ability to bring others on line to meet internal requirement was the best method.

The main problem with standards is that there are so many to choose from. Even in the IGES standard not all systems support all entity types. It is still not a true standard.

Must involve all end-user groups in communication and evolution of the standards.

Teamwork is a prerequisite. Commitment at upper levels must be evident.

Proper training at the beginning of a standard will make things much smoother in the long run. Good communication between customers and suppliers is key.

Communication among those involved in projects. Standardization across the organization. Time constraints -- Lesson Learned!! Implementation of electronic network currently in progress.

Train employees to much hesitation. Lost time and production. Not enough information.

Being in the Automotive field the biggest issue is that each customer wants their own standard. To grow your company you have to diversify your customer base but then you have to deal with their standards. This is true from the standpoint of order processing, project management information communication to data exchange, i.e. engineering information and math data. It ends up being very expensive and difficult to deal with.

Frankly, our company has a long way to go in all of these areas.

Always have an alternate method to fall back on if connectedness standard fails. Invest in a standard only after it is proven and widely used.

A.I.A.G. "Standards" are not followed by the Big 3. Even EDI standards are "tweaked" so they become customer specific and as such are not "standard". This adds cost and unnecessary complexity that does not add value.

Not everyone is using the same standard. No input in developing the standard. Implementation of new standard a requirement for continuing business. High cost of standards. Service fees charged by Big 3 for access to standards. Each standard has technical problems. Then these problems are resolved by introducing a new standard.

Harmony between Canadian and U.S. standards.

a) Connectedness standards are implemented when they make business sense. b) Communication standards need to be global. c) Native CAD files work. An industry standard or global standard such as STEP would be great if it worked. Example: -- savings in cross training and therefore people flexibility; savings in hardware/software.

We have learned that it is imperative that you do not blindly accept EDI data, as an example, and you should cross reference received data with your customer to verify data integrity.

In EDI "standards" is a term that should be used very loosely. Everyone takes a standard, then twists it into their own standard. There is too much latitude within the standards that you end up customizing work for each trading partner.

Get all the people involved very early on.

Clear definition or meaning of standard. Lack of examples or explanation.

The largest problem is software companies are allowed to purchase small companies and eliminate the support they once provided. STEP needs to be used as a universal translator. This would allow companies such as ourselves to use only 1 main CAD system and eliminate having to use offsite translator companies to give us the data we require from the native files given to us by the big "3" automotive companies.

Adoption of standards involves many players. They must all support and use the standards. This has not happened with STEP nor with ANX. Usually the adoption drags out and then is replaced by new technology before the standard is implemented.

Less down time and increased production.

Electrical and Electronics

Success requires good project management.

Need to involve the whole company design, manufacturing, testing, sales as standard has to work for all in our organization.

Do more research on the actual work and costs required versus actual long term benefits. Too many times we have jumped into something only to find additional costs, delays and results not quite up to expectations. "Did we really need to do it?"

S/W standards were not, in our experience, problematic to adopt and use as they are by their nature defined and widely used. ISO 9000, due to its scope and intent, requires most effort, investment and maintenance.

Many suppliers and clients don't adopt the same standards. There is a lack of consultation and communication between partners.

Expensive.

Profitability is not always guaranteed. "EDI?" a question of volume.

Rate of change in updates/formats and hardware interface cause continuous change in standard to be used. Obsolescence in such period, not forward compatible.

It is treated as a cost of doing business and does not create real leverage to generate sales or profit for the company directly.

Being forced by large organizations to implement standards which create more work for us, e.g. EDI.

Web and e-mail is vital. EDI is a lot of work, and costly to implement -- for us -- traditional EDI is overrated.

Planning up-front and education of how and why should have been better. Goals, deadlines and/or schedules should have been set for departments. Roles of individuals defined.

The connectedness standards used (as indicated in #10) for the most part eased communication with vendors/customers yet had no marked impact on business other than the ISO series. The other file/info formats became additional "tools" after adopted.

Implementation of new standards/systems requires a significant amount of time, money, training and experience.

*The standard's advantages should be integrated to the process.

Lack of stability of standards, adoption from company to company. Questionnaires like these should be done through e-mail and a website.

The corporation must focus open maintaining and apply the standards once implemented.

Weak with implementation plan. Once implemented, weak maintaining standard due to other business constraints.

Group work. Requires a lot of effort.

Establish a strong team with clear goals and budget to meet the challenge.

The careful preparation at the smallest level of detail is the only measure of success.

*The standard should be useful; a report should detail its actual use. Moreover, the price (costs) should be profitable.

Some standards are not totally defined, there are variations that are not enforced. Standards are not always explained in simple terms with lots of examples. Access to technical help is not always easy to find or impossible.

Take estimate implementation time and multiply x 3.

Finding a "one size fits all" approach from some to large corporation links. Inter-net solutions are now becoming the most easy to manage for integration.

Unfortunately most of the systems used were done at the corporate level. We were hooked up electronically with dumb terminals. It makes it difficult to answer the last half of this survey.

Although connectedness standards are in place and in use, they are not available company-wide. This means that employees rely heavily on a few to use these standards.

Any standards that we have tried have been short-lived.

Need a clear picture of what we want to accomplish, not just doing something because it can be done.

Training of personnel is paramount along with reinforcement of necessity & benefits from upper management. Most of our employees are younger but can still be resistant to changes.

Fashion, Leisure and Household

Often very costly to implement and maintain.

Be prepared to spend more money than you think.

N/A

Change in mediums, e.g. Going from syquest to zipfiles to jpeg to internet. Everyone keeps changing to new or better way.

Proper data preparation is essential to a successful implementation.

Clients and retailers are not all at the same level. This creates several levels of communication.

Need commitments and resources to do the implementation.

We have not yet looked into this area and therefore are not in a position to answer any of this.

Drawbacks -- high cost, low flexibility Lessons: high security We prefer to use low cost and high flexibility with medium securities rather than high cost, low flexibility and high security.

No matter what standard you adopt, your first new customer or supplier that you get after you adopt won't use it.

You need time and the right people to do it!!

Cost too much. Not enough people follow standards.

Many companies are not able to implement due to their business nature, e.g. oil well drilling, telephone/utility repair company, because a large percentage of their key staff do not have computers.

Industrial and Commercial Equipment

Difficulties in implementing and reorganizing while remaining productive (lack of personnel)

Before implementing these standards it is necessary that all employees are well informed as to the benefits. It is difficult to evaluate the sectors where people or standards are incorrectly implemented -- which in turn renders the operation as a whole I
Lack of formal training.

We need to set standards for the organization first and establish a method of monitoring the standards and how they are being used. Without this, the various departments will move off in whatever direction they please with no regard for the organization as a whole. This causes additional costs and creates confusion in the workplace.

Drawbacks -- incompatibility, instability, speed, lack of knowledgeable support, changes occurring faster.

Gained a greater understanding of the applications of our products (equipment). Improves the service provided to clients.

It takes time and money.

For a small company with no IT Department it is difficult to handle info exchanges and any problems arising from them. I don't think the majority of this survey applies to our company. For the most part, we are only using e-mail and data transfer rarely.

EDI is of no benefit when trading partners fail to use it.

Although the standards are said to be universal, they are not. We have had, and continued to have, much frustration with the data exchange files (e.g.: DXF). We work with Bentley's Microstation. When we would like to send data in DXF we have to save it in DXF (time loss), email it or send it via FTP site and then be informed by our client that some of the data is illegible. In short, it takes time, costs a lot, and is frustrating. Recently we have switched from DXF to Autocad (DWG format) and it seems to be going better even if our clients do not use Autocad.

Data Format standards have not been as important as the application formats that supercede them. Most often, the native document format (DWG, DOC, GIF, etc) is used to share data as the majority of people use the standard packages (Auto CAD, MS Office). Those who do not have learned the importance of being able to import from the major native formats. Hence generic (i.e.: DXF, RTF) formats do not gain the importance that they would otherwise.

Lesson -- use only well adopted standards. Drawbacks -- lack of consistency in standards; proprietary standards.

People education is a large problem in any system.

All programs begin with management due to the lean operating nature of our business. We find time constraints placed on our management often limits our effectiveness in the operation/implementation of any program even though the benefits are justifiable.

The technology is changing so rapidly that at times it looks like we are constantly aiming at a moving target. Maintaining focus with personnel etc. is a demanding goal. Change itself appears to be the one stable element as we pursue these business tools.

Large variety available. No standard usage. Difficulty of use across board without significant effort.

Software vendors are not willing to demonstrate full compliance with standards. Simple assurances are usually given, which often fall short.

Finding the winning path is essential to program success. Unless it is a critical issue for one's business (customer requirement or MAJOR competitive advantage/threat), often seems least costly to let some 3rd party providers incorporate into mainstream software applications before adopting, i.e. wait for Pro/E & Autocad to incorporate STEP; EDI seems lacking here – waiting for clean emergence of 3-commerce standard on web for supplier – EOM transactions.

The items mentioned in question have had been cursory review. Some of the items were discounted as a result of implementation cost, need in our industry or other complications they impose. In some instances we are developing methods of our own, i.e., EDI – instead we send faxes through computers & eliminate hard copies.

Costly to implement and maintain versions.

Make sure team of dedicated individuals is in place with some incentives. Must be deadline driven. Absolute management support. Let all employees know, what is it, what we plan to do and what will be the benefits -- benefits must be seen by employees as helping them than as a result helping Company.

Drawbacks - company's adopting their own standards. TOO MANY STANDARDS! Standards changing too often, making it costly.

Information and Communication Technologies

Inevitable considering the direction of technology and its tendencies. The standards are all positive in the realm of technology. They are difficult to implement in the business and administrative areas. (e.g. ISO 9001)

We are a software design company. Our clients use telecommunications means to find our products.

ISO 9000 must above all make sense (cents). If a company implements for the sake of being compliant, it will experience additional bureaucratic cost. It must be effective first and then compliant.

Process and procedures and policies must be under constant review towards process improvements and effectiveness at all levels and areas.

ISO 9000 took the longest and was a lot of work to set up.

Time and money constraints. Management buy in. $ justification.

Implementation is difficult. Productivity improved once implementation was complete.

Adopt when mainstream business community has implemented--be follower, not leader.

Initial lack of general information necessary to begin a course in that direction. (Third party information.)

Not everyone implements "standards" the same way. Everyone believes they've done it the "right" way. Many standards are not detailed enough at the implementation level.

Metals and Minerals Processing

Lots of work without knowing if it will pay off in the end.

PDF was a very good purchase.

As far as I can tell this subject doesn't apply to our company.

None implemented to date.

Implementation and malfunctions.

Lack of technical implementation data at the higher levels. Weak software module development.

Lack of qualified companies to implement connectedness. We have utilized 2 of the so-called top computer companies in [CITY] and due to lack of ATTAINABLE results we dropped them and have gone to a systems expert from a large firm (part time business) but he is having troubles also. We are not cheap or non-informed and know what we want. In fact I worked for [LARGE COMPANY] in the early 80's and was responsible for CAD implementation & standards development for site which was and is still a success today. I am very disappointed with local qualified support. We have customers in USA, China, Korea, Africa, India, Canada and soon in S. America!

Difficult to get people to conform to a new standard and leave old problem behind.

All of our personnel have more to learn. Staff training has been the most costly and the most difficult.

Have had no real problems with adapting. On staff system coordinator helps.

They can be a very useful tool for your company but they can be very expensive as well. It is important to know exactly what you want and how it should perform. You need to have technical support and cooperation from partners, customers and other end users.

*Undeveloped programs with a high level of maintenance.

Re: question 10 -- Probably use several of these if I could understand what they mean!

From talking with EDI users and attending EDI seminars, it is apparent that EDI is a very complex undertaking requiring substantial capital and people commitment. While the advantages are widely touted by those advocating its adoption, those of us who don't yet use it are not convinced.

Not to become totally reliant on systems.

Resource Processing

Difficulties with respect to implementing new systems. It all requires a change of mentality that has presented itself with other collaborations: motivation and staff commitment. Longevity of standards; they change frequently.

The cost of implementing.

The EDI standards, which have been a customer demand, use expensive resources. Only large businesses have the capability to absorb the cost of Networks, hardware, software, and personnel to maintain them, with the current EDI standards.

We have implemented these electronic transfers as the need or opportunity arose. We have fumbled our way through as each occasion presented itself. It has been learn by doing with no formal training or implementation.

This is N/A to us. We only have one very limited purchasing application with one supplier.

Management commitment is the most critical. Defining, presenting a solid business case.

Requires top end support. Requires good commitment with outside partners. There is a tremendous lack of knowledge in this industry on all aspects of this.

Prohibitive costs for public communication lines (telephone lines) for transferring info from site to site. Problems related to this.

Met up with some reservation from suppliers and others who feel that sharing too much information is giving away your product ideas, especially when exporting to other countries. Chances of losing your design to cloning.

Drawbacks--wait times while compatible standards are implemented; having to update equipment as well as software on an 'urgent' basis to maintain compatibility.

Other

No drawbacks. Lessons learned: increased efficiency increased accuracy of transactions better communication central storage and administration faster delivery

Drawbacks: Not many of our suppliers/customers have endorsed connectedness as part of their course of normal business. Lessons: Value of standardization.

Lessons: Success Depends on how quickly the benefits can be realized and seen. Drawbacks: Need technical expertise in-house. Contract services are too costly.

It is vital to share information within a company.

Having a very understanding and patient relationship with your trading partner. We both help each other out in resolving our technical issues and kept on top of any problem to ensure they were resolved in a timely manner.

Better project margins and business.

*Don't know.

*Will require high implementation costs in the future.

Lessons learned: advantages of having a pre-existing documentation and controls system at Johnson & Johnson. Not to take on more than what one is capable of doing in order to meet a requirement, e.g. coming up with elaborate plans on paper that do not get implemented.

Easier to maintain/troubleshoot.

Convincing people that the benefits of a project sometimes justify the expense. If they do not perceive a need, no savings in cost, or time will justify the disturbance.

Have a macro vs. micro overview of the implementation of the system or solution, otherwise you end up with a "patchwork" solution.

Lack of awareness/willingness on the part of customers to re-think their business models and attitudes on sharing information and investment in networking. The need for verification of UPC outputs. The necessity to budget for ongoing systems development as opposed to maintenance.

None of this applies in our line of work. Autocad is the only program we use in an info-sharing system.

Small-sized Firms (Less than 100 Employees)

Training of personnel is paramount along with reinforcement of necessity & benefits from upper management. Most of our employees are younger but can still be resistant to changes.

Drawbacks - company's adopting their own standards. TOO MANY STANDARDS! Standards changing too often, making it costly.

Many companies are not able to implement due to their business nature, e.g. oil well drilling, telephone/utility repair company, because a large percentage of their key staff do not have computers.

The largest problem is software companies are allowed to purchase small companies and eliminate the support they once provided. STEP needs to be used as a universal translator. This would allow companies such as ourselves to use only 1 main cad system and eliminate having to use offsite translator companies to give us the data we require from the native files given to us by the big "3" automotive companies.

Costly to implement and maintain versions.

Cost too much. Not enough people follow standards.

Any standards that we have tried have been short-lived.

Not to become totally reliant on systems.

Although connectedness standards are in place and in use, they are not available company-wide. This means that employees rely heavily on a few to use these standards.

Re: question 10 -- Probably use several of these if I could understand what they mean!

You need time and the right people to do it!!

Lack of awareness/willingness on the part of customers to re-think their business models and attitudes on sharing information and investment in networking. The need for verification of UPC outputs. The necessity to budget for ongoing systems development as opposed to maintenance.

Large variety available. No standard usage. Difficulty of use across board without significant effort.

No matter what standard you adopt, your first new customer or supplier that you get after you adopt won't use it.

The technology is changing so rapidly that at times it looks like we are constantly aiming at a moving target. Maintaining focus with personnel etc. is a demanding goal. Change itself appears to be the one stable element as we pursue these business tools.

All programs begin with management due to the lean operating nature of our business. We find time constraints placed on our management often limits our effectiveness in the operation/implementation of any program even though the benefits are justifiable.

Met up with some reservation from suppliers and others who feel that sharing too much information is giving away your product ideas, especially when exporting to other countries. Chances of losing your design to cloning.

Harmony between Canadian and U.S. standards.

*Undeveloped programs with a high level of maintenance.

They can be a very useful tool for your company but they can be very expensive as well. It is important to know exactly what you want and how it should perform. You need to have technical support and cooperation from partners, customers and other end users.

*This is a long process to implement and requires a great deal of changes to the material as well as staff training. It takes a long time to implement/establish. It requires a lot of adaptation of equipment and staff.

People education is a large problem in any system.

Always have an alternate method to fall back on if connectedness standard fails. Invest in a standard only after it is proven and widely used.

Lesson -- use only well adopted standards. Drawbacks -- lack of consistency in standards; proprietary standards.

Not everyone implements "standards" the same way. Everyone believes they've done it the "right" way. Many standards are not detailed enough at the implementation level.

We have not yet looked into this area and therefore are not in a position to answer any of this.

Standards do not always allow complete connectivity between different software applications and different versions. Translators do not seem to be consistent across the board of good programs out there. Step appears to be a great improvement over IGES, but is not widely used in industry at this point.

We learned that connection standards are only a small part of viable information exchange. Other factors include: standard ways of using tools (e.g. CAD drawing standards, document templates); file configuration management procedures.

Data Format standards have not been as important as the application formats that supercede them. Most often, the native document format (DWG, DOC, GIF, etc) is used to share data as the majority of people use the standard packages (Auto CAD, MS Office). Those who do not have learned the importance of being able to import from the major native formats. Hence generic (i.e.: DXF, RTF) formats do not gain the importance that they would otherwise.

*The standard should be useful; a report should detail its actual use. Moreover, the price (costs) should be profitable.

Although the standards are said to be universal, they are not. We have had, and continued to have, much frustration with the data exchange files (e.g.: DXF). We work with Bentley's Microstation. When we would like to send data in DXF we have to save it in DXF (time loss), email it or send it via FTP site and then be informed by our client that some of the data is illegible. In short, it takes time, costs a lot, and is frustrating. Recently we have switched from DXF to Autocad (DWG format) and it seems to be going better even if our clients do not use Autocad.

Train employees to much hesitation. Lost time and production. Not enough information.

The installation causes problems. We have problems related to the installation (implementation) of standards, but our employees are very capable of working with it. We have improved connectedness.

The careful preparation at the smallest level of detail is the only measure of success.

Proper training at the beginning of a standard will make things much smoother in the long run. Good communication between customers and suppliers is key.

For a small company with no IT Department it is difficult to handle info exchanges and any problems arising from them. I don't think the majority of this survey applies to our company. For the most part, we are only using e-mail and data transfer rarely.

It takes time and money.

Gained a greater understanding of the applications of our products (equipment). Improves the service provided to clients.

Management commitment is the most critical. Defining, presenting a solid business case.

This is N/A to us. We only have one very limited purchasing application with one supplier.

We have implemented these electronic transfers as the need or opportunity arose. We have fumbled our way through as each occasion presented itself. It has been learn by doing with no formal training or implementation.

The main problem with standards is that there are so many to choose from. Even in the IGES standard not all systems support all entity types. It is still not a true standard.

Have had no real problems with adapting. On staff system coordinator helps.

All of our personnel have more to learn. Staff training has been the most costly and the most difficult.

More organized. Increased productivity. Reduced quality issues.

Lack of stability of standards, adoption from company to company. Questionnaires like these should be done through e-mail and a website.

*The standard's advantages should be integrated to the process.

The main drawback was the fact that STEP was unable to handle the geometry given. There seemed to be different interpretations of the standard by the software developers (i.e. CATIA & Unigraphics).

Adopt when mainstream business community has implemented--be follower, not leader.

Implementation of new standards/systems requires a significant amount of time, money, training and experience.

Duplication of data.

Implementation is difficult. Productivity improved once implementation was complete.

Implementation and malfunctions.

Saves a lot of time. Mostly used for software updates.

*Don't know.

The connectedness standards used (as indicated in #10) for the most part eased communication with vendors/customers yet had no marked impact on business other than the ISO series. The other file/info formats became additional "tools" after adopted.

Better project margins and business.

Time and money constraints. Management buy in. $ justification.

N/A

Large firms do not have the most current resources, especially Aerospace. Automotive much further ahead with EDI. Not cost effective to pursue with customers. Companies may exchange e-mail, we have EDI ability, no customers have EDI, including large USA defense.

Be prepared to spend more money than you think.

Drawbacks - incompatibility, instability, speed, lack of knowledgeable support, changes occurring faster.

ISO 9000 took the longest and was a lot of work to set up.

Profitability is not always guaranteed. "EDI?" a question of volume.

The cost of implementing.

Expensive.

Difficulties with respect to implementing new systems. It all requires a change of mentality that has presented itself with other collaborations: motivation and staff commitment. Longevity of standards; they change frequently.

I feel VAN services are overrated and Internet use should be more widespread due to the costs associated with value-added-networks.

There are not any main drawbacks or lessons learned. We have found the ISO 9000 standard to be a very positive standard within our organization. Job functions are documented, procedures are written, employees trained, reduced costs, etc. We have found that this procedure also makes the employee feel as though they are a part of the overall finished product; they have become accountable for their contribution. Also, it has promoted good discussion when it comes to problems encountered, etc.

EDI with [LARGE CUSTOMER] using a VAN which has a significant cost with little "value added". It would be great if there was a "standard" EDI format for ALL trade that allows: order placing -- order forecasting with confirmation order shipping -- shipping notices – electronic funds transfers – all using internet. This would be able to be used seamlessly with internal information systems. Current EDI & EDIFact is cumbersome and cannot be made seamless. Transfer of CAD files over 2MEG is still a time consuming fashion.

As far as I can tell this subject doesn't apply to our company.

Lack of formal training.

PDF was a very good purchase.

We are always caught by being too far ahead or behind the technology curve. The gaps are large in both directions and there seems to be no practical jumping off point. We are defining capabilities that relate to our core, being engineering and manufacturing but would like to explore how to keep this forward in other areas.

Drawbacks: Not many of our suppliers/customers have endorsed connectedness as part of their course of normal business. Lessons: Value of standardization.

Lots of work without knowing if it will pay off in the end.

Before implementing these standards it is necessary that all employees are well informed as to the benefits. It is difficult to evaluate the sectors where people or standards are incorrectly implemented -- which in turn renders the operation as a whole I

Difficulties in implementing and reorganizing while remaining productive (lack of personnel)

Medium-sized Firms (100-499 employees)

Less down time and increased production.

There are many different types and customers and suppliers may/may not be the same as yours, therefore you may require many types to satisfy and communicate with all.

Make sure team of dedicated individuals is in place with some incentives. Must be deadline driven. Absolute management support. Let all employees know, what is it, what we plan to do and what will be the benefits -- benefits must be seen by employees as helping them than as a result helping Company.

Drawbacks--wait times while compatible standards are implemented; having to update equipment as well as software on an 'urgent' basis to maintain compatibility.

Need a clear picture of what we want to accomplish, not just doing something because it can be done.

The items mentioned in question have had been cursory review. Some of the items were discounted as a result of implementation cost, need in our industry or other complications they impose. In some instances we are developing methods of our own, i.e., EDI – instead we send faxes through computers & eliminate hard copies.

Finding the winning path is essential to program success. Unless it is a critical issue for one's business (customer requirement or MAJOR competitive advantage/threat), often seems least costly to let some 3rd party providers incorporate into mainstream software applications before adopting, i.e. wait for Pro/E & Autocad to incorporate STEP; EDI seems lacking here – waiting for clean emergence of 3-commerce standard on web for supplier – EOM transactions.

From talking with EDI users and attending EDI seminars, it is apparent that EDI is a very complex undertaking requiring substantial capital and people commitment. While the advantages are widely touted by those advocating its adoption, those of us who don't yet use it are not convinced.

Get all the people involved very early on.

We have learned that it is imperative that you do not blindly accept EDI data, as an example, and you should cross reference received data with your customer to verify data integrity.

Software vendors are not willing to demonstrate full compliance with standards. Simple assurances are usually given, which often fall short.

None of this applies in our line of work. Autocad is the only program we use in an info-sharing system.

Have a macro vs. micro overview of the implementation of the system or solution, otherwise you end up with a "patchwork" solution.

Finding a "one size fits all" approach from some to large corporation links. Inter-net solutions are now becoming the most easy to manage for integration.

Take estimate implementation time and multiply x 3.

Drawbacks - high cost, low flexibility Lessons: high security We prefer to use low cost and high flexibility with medium securities rather than high cost, low flexibility and high security.

Some standards are not totally defined, there are variations that are not enforced. Standards are not always explained in simple terms with lots of examples. Access to technical help is not always easy to find or impossible.

Convincing people that the benefits of a project sometimes justify the expense. If they do not perceive a need, no savings in cost, or time will justify the disturbance.

A.I.A.G. "Standards" are not followed by the Big 3. Even EDI standards are "tweaked" so they become customer specific and as such are not "standard". This adds cost and unnecessary complexity that does not add value.

Frankly, our company has a long way to go in all of these areas.

We implement a standard when it helps us to exchange data with our partners/suppliers/customers. Period. We don't need any of the items listed in question 13.

There are many versions of "IGES" available in translators. It would be good to have a language that has true compatibility.

Communication among those involved in projects. Standardization across the organization. Time constraints -- Lesson Learned!! Implementation of electronic network currently in progress.

EDI is of no benefit when trading partners fail to use it.

Prohibitive costs for public communication lines (telephone lines) for transferring info from site to site. Problems related to this.

Establish a strong team with clear goals and budget to meet the challenge.

Easier to maintain/troubleshoot.

Initial lack of general information necessary to begin a course in that direction. (Third party information.)

Group work. Requires a lot of effort.

Teamwork is a prerequisite. Commitment at upper levels must be evident.

Need commitments and resources to do the implementation.

Weak with implementation plan. Once implemented, weak maintaining standard due to other business constraints.

Lessons learned: advantages of having a pre-existing documentation and controls system at Johnson & Johnson. Not to take on more than what one is capable of doing in order to meet a requirement, e.g. coming up with elaborate plans on paper that do not get implemented.

Must involve all end-user groups in communication and evolution of the standards.

The corporation must focus open maintaining and apply the standards once implemented.

Customer driven. Vendor selection crucial.

As a multi-disciplined, multi-sited organization we had to ensure that all facets of the company were linked concurrently. Past upgrades for each division were augmented autonomously. Not very satisfactory situation.

*Will require high implementation costs in the future.

There are very few pure standards.

Difficult to get people to conform to a new standard and leave old problem behind.

The EDI standards, which have been a customer demand, use expensive resources. Only large businesses have the capability to absorb the cost of Networks, hardware, software, and personnel to maintain them, with the current EDI standards.

Lack of qualified companies to implement connectedness. We have utilized 2 of the so-called top computer companies in [CITY] and due to lack of ATTAINABLE results we dropped them and have gone to a systems expert from a large firm (part time business) but he is having troubles also. We are not cheap or non-informed and know what we want. In fact I worked for [LARGE COMPANY] in the early 80's and was responsible for CAD implementation & standards development for site which was and is still a success today. I am very disappointed with local qualified support. We have customers in USA, China, Korea, Africa, India, Canada and soon in S. America!

Proper data preparation is essential to a successful implementation.

Lack of technical implementation data at the higher levels. Weak software module development.

Lack of internationally-accepted methods. Not all on supply chain have same capability or willingness to obtain same.

Planning up-front and education of how and why should have been better. Goals, deadlines and/or schedules should have been set for departments. Roles of individuals defined.

None implemented to date.

Change in mediums, e.g. Going from syquest to zipfiles to jpeg to internet. Everyone keeps changing to new or better way.

Having a very understanding and patient relationship with your trading partner. We both help each other out in resolving our technical issues and kept on top of any problem to ensure they were resolved in a timely manner.

Web and e-mail is vital. EDI is a lot of work, and costly to implement -- for us -- traditional EDI is overrated.

Being forced by large organizations to implement standards which create more work for us, e.g. EDI.

Rate of change in updates/formats and hardware interface cause continuous change in standard to be used. Obsolescence in such period, not forward compatible.

The main drawback has to deal with the willingness on information exchange between companies. Typically competitors are very unwilling to share any information between one and other. Also the education level is not enough between departments to fully take advantage of the system. Lessons learned: effective data/standard transfer is very good in facilitating communication between companies. Time & paperwork are reduced as a result.

We found using IGES through various applications to be so inconsistent that we avoid work involving IGES like the plague.

Many suppliers and clients don't adopt the same standards. There is a lack of consultation and communication between partners.

It is vital to share information within a company.

We need to set standards for the organization first and establish a method of monitoring the standards and how they are being used. Without this, the various departments will move off in whatever direction they please with no regard for the organization as a whole. This causes additional costs and creates confusion in the workplace.

Lessons: Success Depends on how quickly the benefits can be realized and seen. Drawbacks: Need technical expertise in-house. Contract services are too costly.

Evolving technology (rapid). Changing of standards. Y2K. Deviation from standard. Testing facilities/time. Security. Corporate structure/philosophy.

Often very costly to implement and maintain.

Do more research on the actual work and costs required versus actual long term benefits. Too many times we have jumped into something only to find additional costs, delays and results not quite up to expectations. "Did we really need to do it?"

We are a software design company. Our clients use telecommunications means to find our products.

Need to involve the whole company design, manufacturing, testing, sales as standard has to work for all in our organization.

Success requires good project management.

Large-sized Firms (More Than 500 Employees)

Adoption of standards involves many players. They must all support and use the standards. This has not happened with STEP nor with ANX. Usually the adoption drags out and then is replaced by new technology before the standard is implemented.

Implementation tends to take longer than expected, with higher costs and it tends to take several training/retraining sessions to get all parties on board.

Clear definition or meaning of standard. Lack of examples or explanation.

In EDI "standards" is a term that should be used very loosely. Everyone takes a standard, then twists it into their own standard. There is too much latitude within the standards that you end up customizing work for each trading partner.

Unfortunately most of the systems used were done at the corporate level. We were hooked up electronically with dumb terminals. It makes it difficult to answer the last half of this survey.

A general lack of industry/government commitment and understanding of the standards and their application.

Re: Q. 12 - cannot state an example to this question because we have found generally adoption of any standard no matter how narrow generates an improvement. Drawbacks -- infrastructure change cost; procedure rewriting lagged implementation; loss of focus on long-term implementation; failure to agree on standard (e.g. CAD data standard). Lessons – need strong champion; need clear business case; need to get buy in from all stakeholders.

a) connectedness standards are implemented when they make business sense. b) communication standards need to be global. c) Native CAD files work. An industry standard or global standard such as STEP would be great if it worked. Example: -- savings in cross training and therefore people flexibility; savings in hardware/software.

Not everyone is using the same standard. No input in developing the standard. Implementation of new standard a requirement for continuing business. High cost of standards. Service fees charged by Big 3 for access to standards. Each standard has technical problems. Then these problems are resolved by introducing a new standard.

Being in the Automotive field the biggest issue is that each customer wants their own standard. To grow your company you have to diversify your customer base but then you have to deal with their standards. This is true from the standpoint of order processing, project management information communication to data exchange, i.e. engineering information and math data. It ends up being very expensive and difficult to deal with.

Requires top end support. Requires good commitment with outside partners. There is a tremendous lack of knowledge in this industry on all aspects of this.

Lack of technical skill from trading partner. It's time consuming. Have to be patient.

Leading a change in this area adds to the level of success. The ability to bring others on line to meet internal requirement was the best method.

Clients and retailers are not all at the same level. This creates several levels of communication.

EDI particularly has been difficult to implement. Each of our customers use the 'standard' ? differently. We custom design EDI interfaces and then redesign as our customers change/improve.

Suppliers and customers in the process need to agree to adopt. Standards need to add value to business with respect to time to market profit margins etc. Standards need to be current and supported by current software and hardware.

Data does not transfer completely.

Once you agree on a standard to provide adequate time for supply base to upgrade to same systems need to provide information in that format exclusively.

It is treated as a cost of doing business and does not create real leverage to generate sales or profit for the company directly.

Because of the size of our company, getting everyone to agree is difficult/impossible.

Vendor selection -- different standards at each vendor. Good business case for adoption for an industry-wide standard. Adoption of principles by management. Backward compatibility.

S/W standards were not, in our experience, problematic to adopt and use as they are by their nature defined and widely used. ISO 9000, due to its scope and intent, requires most effort, investment and maintenance.

ISO 9000 must above all make sense (cents). If a company implements for the sake of being compliant, it will experience additional bureaucratic cost. It must be effective first and then compliant. Process and procedures and policies must be under constant review towards process improvements and effectiveness at all levels and areas.

High implementation costs and steep learning curve for ANSI X12 standard EDI. The standard is very "flexible" from one customer to another. Therefore previous knowledge and expertise can only be

partially applied. Once implemented and working there are significant benefits in data accuracy and timeliness.

Inevitable considering the direction of technology and its tendencies. The standards are all positive in the realm of technology. They are difficult to implement in the business and administrative areas. (e.g. ISO 9001)

No drawbacks. Lessons learned: increased efficiency increased accuracy of transactions better communication central storage and administration faster delivery.