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Assessing the impact of using the Internet for competitive intelligence

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Abstract

The Internet, as an information-rich resource and an interorganizational communications tool, has transformed the way that firms gather, produce and transmit competitive intelligence (CI). Yet, there is little empirical work on the impact of the Internet on CI and the subsequent effects on the organization. This study fills that gap by studying downstream impact of Internet usage on both CI and the organization. A questionnaire survey is used to gather data for the study. The findings indicate that research and external use of the Internet is significantly related to quality of CI information. However, the relationship between internal use and quality of CI information is not significant. The study also provides empirical evidence that quality of CI information is positively related to organizational impact. Implications of the results are discussed.

Keywords: Internet; Competitive intelligence; Quality; Benefits; Information use; Structural equation modeling

1. Introduction

Over the past two decades, competitive intelligence (CI) has grown from a small area of interest into an internationally recognized and practised discipline. CI is not just market research [26] or business scanning. CI is a process of knowing what the competition is up to and staying one step ahead of them, by gathering information about competitors and, ideally, applying it to short and long-term strategic planning [21].

Among the newest sources of data is the Internet. It provides access to on-line databases as well as an exploding set of other resources. As a CI resource, the Internet is both an additional source of information and a cost-effective means of disseminating information to decision-makers [30]. Marketing is able to use the Internet to obtain knowledge of customer preferences through interactive Web sites and agents. On-line sales reveal information that facilitates continuous forecast of sales, resulting in competitive advantages in terms of better production planning and less inventory stockpiles. It allows manufacturing to improve supplier selection [6] and learn about competitors' process technologies. Top management is also able to access critical external knowledge, market research and economic trends to allow more effective strategic planning.

Although there is an expanding number of articles concerning the use of the Internet for CI activities, none have addressed its organizational impact in an empirical study. Recent studies involving the Internet have concentrated on upstream effects such as its

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diffusion and its acceptance as an innovation [51]. Research made on the business use of the Internet has primarily been exploratory in nature [5,12].

In the area of CI research, several empirical studies have explored the relationship between usage of CI and corporate performance. A review of several studies by Glueck and Jauch [27] demonstrated a positive correlation between environmental assessment and performance. However, the studies conducted were independent of Internet usage.

This study aims to fill that gap by studying downstream impact of Internet usage on both CI and the organization. Specifically, this research seeks to examine the relationship between Internet usage and quality of CI information as well as the relationship between quality of CI information through the Internet and organizational strategic benefits (in terms of revenue generation, cost reduction and managerial effectiveness). The results provide some insights on the impact of the Internet on the quality of CI information and its subsequent impact on organizational performance.

2. Literature review

CI is a process of knowing what the competition is up to and staying one step ahead of it, by gathering information about competitors and ideally, applying this information in short- and long-term strategic planning. It refers to actionable information about the external business environment that could affect a company's competitive position [24]. CI is *not* industrial espionage. A key maxim of CI is that 90% of all information that a company needs to make critical decisions and to understand its market and competitors is already public or can be systematically developed from public data [43].

CI involves three major functions: the collection and storage of data, the analysis and interpretation of data, and the dissemination of intelligence [9]. The process can have a discrete beginning and end or it can be ongoing and iterative, designed to gather and disseminate information throughout an individual organization, or ultimately, throughout an entire business ecosystem.

A considerable amount of research has emerged on the subject of CI and its relationship to the strategic planning process. The literature based on CI often stresses its importance on organizational performance. Glueck and Jauch [27] examined several studies (e.g. [31,44]) and determined that in all of the studies that they reviewed, a positive correlation between environmental assessment and performance was demonstrated.

Intelligence gives a company a competitive advantage [18] and better firm performance [16] by allowing better business planning [28]; new product introduction success and new market development [1]. Brockhoff [10] contends that better information, including competitor technological intelligence information, is needed to better support strategic decisions. A study on CI activities among companies in Singapore [40] also shows a positive relationship between use of CI and higher organizational effectiveness.

Organizations also try to measure the CI's value to organizations [35]. Subramanian and Ishak's [50] empirical study of 85 firms' competitor analysis practices revealed that firms having advanced systems to monitor their competitors' activities exhibited greater profitability than firms that did not have such systems.

The general trend of these studies has been to suggest theoretical models of competitor analysis. Empirical studies on the topic were also performed, along with periodic perspectives on the ethical issues of competitor analysis practices.

The growth of the Internet has led to CI professionals exploiting its information richness and hypermedia capabilities for CI activities [29]. Commercial enterprises of all shapes and sizes are finding that the Internet provides opportunities for competitive advantage [15]. Small- and mid-sized businesses are also interested in making use of the Internet to obtain additional resources [32]. This includes information gathering and intelligence dissemination.

It is important to note that the Internet is quite different from traditional computer applications in that the Internet is inter-organizational and supports multiple business functions, from human communications to business transactions [46]. By using the Internet, a company can monitor (manually or by using intelligent agents) the presence, posture, products, and prices of other players in its industry. It can track the views of customers and seek out new ideas and expertise internationally. It can also draw upon files and databases from government agencies, foundations, universities, and research centers to broaden

its thinking and help it be aware of the needs of the marketplace [13].

Potential primary resources for CI include conference speakers, patent holders, former employees, technical recruiters, authors, reporters, even discussion list posters-all identifiable on the Internet [38]. Firms can easily post a query on a bulletin board or join a discussion group and receive advice on how to solve a problem. They can also establish on-line correspondence with business partners or customers to provide information or receive feedback via the Internet.

More and more companies are mining the Internet for CI data. Most of the management literature advises companies on how they could leverage the Internet for customer research, customer service, customer relations, patent research, and market research. This study hopes to bridge the gap between theory and practice by examining empirical evidence on the use and impact of the Internet for CI activities.

3. Research model and hypotheses

3.1. The system-to-value chain

System-use is a pivotal construct in the *system-to-value chain* that links the upstream research on the causes of the system success with downstream research on the organizational impacts of IT. Doll and Torkzadeh [19] describe a 'system-to-value chain' of system success constructs. The constructs vary from beliefs, to attitudes, to behavior (system-use), to the social and economic impacts of IT.

The '*system-to-value chain*' suggests an alternative role for the usage construct in a downstream research agenda — as an *independent* variable. Doll and Torkzadeh [20] adapted the multidimensional measure of system-use identified by Hirschhorn and Farduhar [36] to measure downstream impact of system usage on work. They assert that a multidimensional system-use measure enables investigation into the patterns and extent of system usage along organizationally relevant dimensions. In a similar vein, we examine the downstream effects of using the Internet on quality of CI information and its subsequent effects on organizational performance (Fig. 1).

The use of the Internet for CI activities and its impact on quality of CI information are measured using the variables adapted from various previous studies and research on the functions of CI. Usage is measured in terms of research, internal use and external use (corresponding roughly to the notions of usage of Internet, intranet and extranet). Since the quality of information is a critical aspect of CI, it

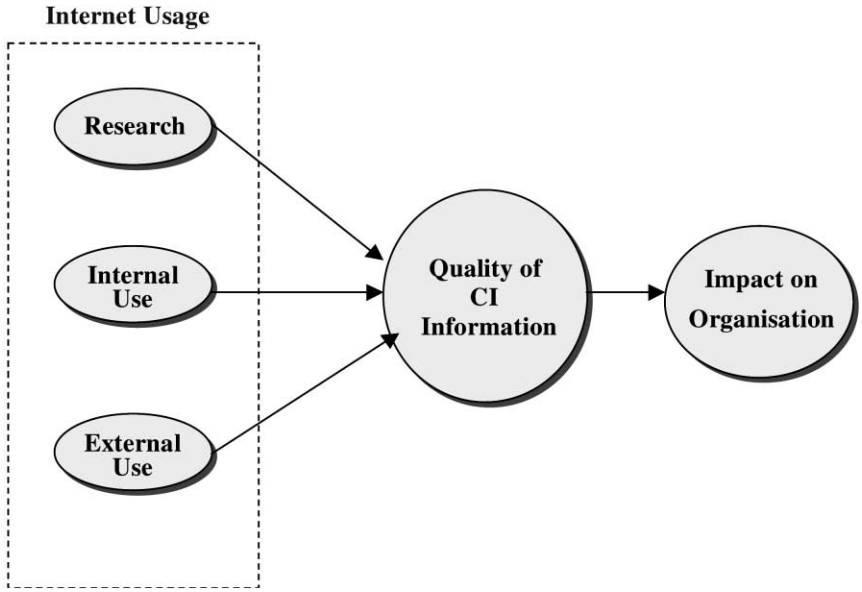

Fig. 1. Research model.

would be essential to measure the *information quality* (defined in terms of accuracy, timeliness, etc.) from Internet resources. The subsequent organizational impact of using the Internet for CI activities is measured according to three strategic benefits: (1) revenue generation; (2) cost reduction and (3) managerial effectiveness.

3.1.1. Research

The research construct consists of two dimensions: primary and secondary research. Primary research is defined as the gathering of new data specifically for the project at hand. Secondary research is defined as the research for available data, already gathered for some other purpose [49].

The literature review on CI activities shows that primary research is a common function of using the Internet. Primary research is also one of the most common activities that CI professionals perform to collect critical data for production of actionable intelligence.

For example, the Web has the benefit of being a simple and intuitive search interface which allows unsophisticated searchers to conduct on-line searches for patent information with limited, or no, training [47]. Graef's [30] survey found that primary information on current products and new products was one of the most important uses of the Internet.

Any organization must reach out to customers in their targeted market. Monitoring comments and feedback in the Internet newsgroups can allow a company to gauge customer reactions to their own and competitors' products and services [34]. Many customers will utilize the Internet as a tool for evaluating and selecting goods and services that they intend to purchase.

Research for secondary data is also a crucial function of using the Internet for CI activities. Secondary research is important, as CI professionals need to collect data to supplement information that cannot be obtained through primary sources. In fact, it might be more important than primary research as public information is often easier to obtain and the Internet is a significant source of such material.

Auger and Gallaugher's [3] study found that businesses rely on the Internet as a means of evaluating and tracking industry and competitive changes in their marketplaces, and their competitors in particular. Feher and Towell's [22] study showed that 70% of the respondents expected that their source of knowledge to be enhanced by using the Internet. Hence, higher levels of Internet usage in research is expected to lead to better quality of CI information. Therefore, the following hypothesis is putforth.

Hypothesis 1. Research through the Internet is positively related to quality of CI information.

3.1.2. Internal use

Internal use of the Internet for CI activities consists of internal collaboration and dissemination. *Internal collaboration* within the organization enables faster and more effective analysis and evaluation of CI data. The use of the Internet such as e-mail allows more effective way of exchanging and sharing information to produce actionable intelligence.

Feher and Towell's [22] study showed that e-mail is the primary current usage of the Internet and is expected to remain so. The function of e-mail is often used for many purposes, for both internal and external collaboration and dissemination of CI information. In addition to email, intranets and databases also help to store and disseminate information to employees internally. Using the Internet (and intranet) is expected to enhance information empowerment for employees.

Internal dissemination of CI data is also of critical importance. The faster the data are passed on to the relevant parties, the more timely and current the data would be. Since the dissemination of data through the Internet is rapid and very low cost, its use is expected to enhance quality of CI information available for decision making. It is often important for CI to be distributed internally to the firm's employees and even more importantly, to the top management so that strategic decision making can be improved. Hence, it follows the following hypothesis.

Hypothesis 2. Internal use of the Internet is positively related to quality of CI information.

3.1.3. External use

External use of the Internet for CI activities consists of *external collaboration* and *external dissemination*. Previous studies (e.g. [2]) found that the greater the amount of data exchanged between partners, the

greater the possibility for mutual understanding of each others' goals, which can lead to increased cooperation.

In terms of external collaboration, Vijayasarathy and Robey [54] found electronic data interchange (EDI) use lead to improved co-operation between trading partners and greater performance. They also found that the greater the accuracy, speed and completeness of data, the greater will be the co-ordination achieved by partners in a bargaining relationship.

The Internet is fast becoming the medium of choice for EDI, allowing companies to collaborate on an unprecedented scale at a relatively low cost. The Internet allows a low cost and effective way of communication across geographical boundaries. When there are links formed between companies (via extranets), it can be easy for them to collaborate on the Internet. One example is the way IBM and Bellcore use Internet links to share a workstation [52]. The connections are faster and easier to set up than private links.

Thus, users now have another effective channel for exchanging data with external consultants, suppliers, customers, and industry experts. E-mail and video conferencing allows CI data to be delivered through the Internet, allowing organizations the flexibility of exchanging critical CI data needed for making timely decisions.

Vis-à-vis CI data exchange for collaboration with parties outside the organization, CI data can also be disseminated to external parties so as to lead to a firm's greater overall competitiveness. For example, businesses may deem certain intelligence to be of strategic use to their business partners and pass it on. Thus, CI data can often be disseminated to a firm's external customers and suppliers so that these stakeholders are able to take the necessary actions for mutual benefit. This external use of the Internet for collaboration and dissemination of CI data is expected to improve the quality of CI information available for decision making. This leads to the following hypothesis.

Hypothesis 3. External use of the Internet is positively related to quality of CI information.

3.1.4. Strategic benefits

The strategic benefits of using improved CI information is indicated by revenue generation, cost reduction and managerial effectiveness [55]. These strategic benefits improve the overall performance of an organization.

Intelligence gives a company a competitive advantage [23] through *revenue generation*. Better firm performance is expected through new product introduction success and new market development [42]. Subramanian and Ishak's [50] study revealed that firms having advanced systems to monitor their competitors' activities exhibited greater profitability. Internet communication technology makes it possible for smaller firms to take advantage of the cost-effectiveness of streamlining the supply chain to maximize competitive gain. Capturing new business is also enhanced when the ease of making the transaction is provided in the Internet site. Feher and Towell's [22] study showed that businesses expect to develop new markets and increase their current market share by using the Internet.

The use of improved intelligence can also lead to *cost reduction* in business processes. Using the Internet allows manufacturing to improve supplier selection through better supplier information. On-line sales information can facilitate continuous forecast of sales, resulting in better production planning and less inventory stockpiles. Improved cost control is not the only benefit to be gained through improved access to vendor options and bypassing intermediaries. Shortened lead times, as well as faster, and more accurate order-processing capabilities may also be enhanced from Internet usage [8].

A particularly valuable tool is the value-added capability of including responses to frequently asked questions (FAQs) in a Web site. This provides a less labor intensive, lower cost means of communicating information. Canter and Siegel [11] have compared the costs of advertising via television and the Internet and found that Internet advertising and promotions cost far less on a cost/performance ratio. The Internet provides a means of achieving the desired degree of interconnectivity without an investment in a complex and expensive dedicated EDI system [45].

Managerial effectiveness is enhanced through the use of improved CI information, which is positively related to firm performance. Improved CI information allows better business planning and improved decision-making accuracy. Customer relationships can be built or strengthened through the improved

convenience of on-demand access to key information. Feher and Towell [22] found that firms using the Internet expected to enhance communication with employees and improve relationships with vendors. Thirty-eight percent of the respondents in that survey also expected their business processes to be accelerated.

Since the use of the Internet overcomes geographical barriers and reduces time lag in information transmission, there should be a corresponding improvement in managerial effectiveness. Consequently, it is expected that better CI information would enhance organizational flexibility, responsiveness to customer needs and production operations, decision making speed and accuracy, and improving forecasting accuracy. Coordination activities and market trend spotting should also improve. Therefore, the following hypothesis is proposed.

Hypothesis 4. Quality of CI information through the Internet is positively related to strategic benefits.

4. Method

4.1. Sample and procedures

The goal of this study is to investigate the impact of using the Internet for CI activities. Therefore, the companies chosen were those that would most likely have access to the Internet and a formal CI system in place. With this in mind, the sample was drawn from the ''Singapore 1000'' directory. The top 600 companies, with sales revenues in excess of US$ 100 million were selected. They were expected to have the resources to invest in organized CI collection and be users of the Internet. The companies included multinational companies and local enterprises.

A questionnaire survey was used to collect data for this study. The questionnaire was first pre-tested with five undergraduate and two post-graduate students. Modifications were made and the revised questionnaire was pilot-tested with five senior executives in local companies. Since there were no major comments, the questionnaire was deemed ready for data collection. Copies of the questionnaire were sent to the CEOs/Managing Directors of 600 firms. A follow-up mailing was made 3 weeks later to non-responding firms.

4.2. Instrument

The items used to measure the various constructs were derived from an extensive review of articles on the Internet and CI-related periodicals, journals, books, Web sites, and newspapers. Based on the literature review, three generic uses of the Internet for CI activities were identified. These are (1) research, (2) internal use and (3) external use. Each generic use could be further categorized into primary research and secondary research, internal collaboration and internal dissemination, external collaboration and external dissemination, respectively.

4.2.1. Usage dimensions

The usage dimensions were derived from research examining the different functions of CI. The indicators were developed from the common activities performed by CI professionals. For each category, organizations were asked to indicate the extent of usage on a five-point Likert-type scale ranging from (1) not at all, (2) little extent, (3) moderate extent, (4) high extent, to (5) great extent.

4.2.2. Research

Primary research was measured using six indicators that CI professionals would perform while using the Internet to collect primary data. This included patent search, new product and service identification, and newsgroups monitoring. Customer feedback on competitor's, own firm's, and future products and services were also covered.

Eleven indicators were used to measure the extensiveness of Internet usage for the purposes of *secondary research*. This included reviews or analyses of competitors' financial reports, business processes, Web sites, job postings, product/price lists, product/service specification data, and advertising strategy. Reviewing articles in industry/trade Web sites, monitoring government information, accessing Internet-based CI sites and commercial databases were other secondary research uses of the Internet identified and measured. Table 1(a) shows a summary of the sources of the adapted research measures.

4.2.3. Internal use

Analyzing, exchanging, and sharing CI data with other departments were three indicators of using the

Table 1
Operationalization of variables

Measure	Source
Please indicate the extent that the Internet is used to perform the following CI tasks in your organization: (scale: (1) not at all to (5) great extent)	
(a) Research	
Primary research	
Patent search	[14,30,38,47,48,56]
Identify new products and services	
Monitor discussion groups/newsgroups on competitors	
Receive customer feedback on competitors' products/services	
Receive customer feedback on own firms' products/services	
Receive customer feedback on enhancements for future products/services	
Secondary research	
Review articles in industry/trade Web sites	[14,30,38,48,56]
Review competitors' financial reports	
Analyze competitors' business processes	
Access Internet-based CI sites	
Access Internet-based commercial databases	
Analyze competitors' Web sites	
Review competitors' job postings	
Check competitors' product/service price lists	
Monitor government information	
Review competitors' advertising strategy, execution and targeting	
Check competitors' product/service specification data	
(b) Internal use	
Internal collaboration	
Analyze CI data jointly with other departments	[29,30]
Exchange CI data with other departments	
Share CI data with other departments	
Improve the management of or access to internal CI data	
Internal dissemination	
Distribute CI data to company employees	[22,29,30,50]
Distribute CI data to top management	
(c) External use	
External collaboration	
Exchange CI data with external consultants	[29,30,34]
Exchange CI data with suppliers	
Exchange CI data with customers	
Locate experts	
External dissemination	
Distribute CI data to customers	[29,30]
Distribute CI data to suppliers	
Please indicate the extent that you agree or disagree that using the Internet has enhanced the following quality traits of your organization's competitive intelligence (CI) (scale: (1) strongly disagree to (5) strongly agree)	
(d) Quality of CI information	
Accuracy	[4,25,39]
Content	
Completeness	
Currency	
Importance	
Relevance	
Reliability	

Table 1 (*Continued*)

Measure	Source
Timeliness	
Understandability	
Usefulness	
Please indicate the extent to which you agree or disagree with each of the following statements on how using the Internet for CI activities has contributed to your organization (scale: (1) strongly disagree to (5) strongly agree)	
(e) Strategic benefits	
Revenue generation	
Increase market share	[17,22,55]
Improve competitive advantage	
Improve product/service differentiation	
Facilitate new market development	
Facilitate new product/service generation	
Increase profit margin	
Improve return on assets (ROA)	
Improve return on investment (ROI)	
Cost reduction	
Reduce costs of material procurement	[17,22,48,55]
Reduce costs Of product distribution	
Reduce overall manpower needs	
Reduce costs of goods production	
Reduce costs of customer service and support	
Reduce costs of new product/service development	
Reduce costs of advertising and promotion	
Managerial effectiveness	
Enhance organizational flexibility	[14,17,22,48,55]
Focus R&D efforts	
Improve decision making speed	
Improve decision making accuracy	
Enhance responsiveness to customer needs	
Enhance responsiveness to production operations	
Improve coordination with suppliers	
Improve coordination with customers	
Improve coordination with business partners	
Improve coordination between internal functions	
Identify market trends	
Improve forecasting accuracy	

Internet for *internal collaboration*. Using the Internet for improving the management of or access to internal CI data was another indicator.

The two indicators used to measure *internal dissemination* were distribution of CI data to company employees and to top management. It is critical that CI is disseminated to the relevant parties so that actions may be taken to improve a company's competitiveness. CI data is often disseminated with the use of e-mail within the organization. Table 1(b) shows a summary of the sources of the adapted internal use measures.

4.2.4. External use

The exchange of CI data with external consultants, suppliers, and customers were used as indicators of

using the Internet for *external collaboration*. In addition, the Internet could be utilized for external collaboration in locating experts.

The Internet could be used to distribute CI data externally through the corporate Web site, e-mail, FTP or newsgroups to customers or suppliers. This *external dissemination* is a usage of the Internet for CI purposes. Table 1(c) shows a summary of the sources of the adapted external use measures.

4.2.5. Impact on quality of CI information

The impact of Internet usage on quality of CI information was measured using 10 information *quality* dimensions. The empirical measures of information quality are derived from the summary of MIS success measures collated by DeLone and McLean [17]. They include empirical measures used by Bailey and Pearson, [4] and Gallagher [25]. The 10 indicators used were accuracy, content, completeness, currency, importance, relevance, reliability, timeliness, understandability, and usefulness. The organizations were asked to indicate the response which best described their perception of the Internet's impact. A five-point Likert-type scale, ranging from (1) strongly disagree to (5) strongly disagree was used. Table 1(d) shows a summary of the sources of the adapted quality measures.

4.2.6. Organizational impact

The three dimensions used to measure strategic benefits that make up organizational impact were (1) revenue generation, (2) cost reduction, and (3) managerial effectiveness. The organizations were asked to indicate the extent to which they agree or disagree with the statements concerning the above mentioned dimensions. A five-point Likert-type scale, ranging from (1) strongly disagree to (5) strongly agree was used.

Eight indicators were used to measure *revenue generation* as a result of using the Internet for CI activities. This included increase in market share and profits margins, an improvement in return on assets (ROA), return on investment (ROI), competitive advantage, product/service differentiation, and facilitation of new market development and new product or service generation.

Seven indicators were used to measure the *cost reduction* effects for the organization when using the Internet for CI activities. This included reducing the costs of material procurement, product distribution, overall manpower needs, goods production, customer service and support, new product or service development, and advertising and promotion.

Managerial effectiveness was measured using a total of 12 indicators. Organizations were asked how using the Internet for CI activities had contributed in enhancing organizational flexibility, responsiveness to customer needs and production operations, improving decision making speed and accuracy, forecasting accuracy market trend identification, co-ordination with customers, suppliers, business partners, and between internal functions. Table 1(e) shows a summary of the sources of the adapted strategic benefits measures.

5. Results

This section reports the findings of the data analyses and it is organized into the following subsections. First, the response rate of the questionnaire survey is presented. Next, the company profiles of the respondents are presented. Thereafter, the research instrument was assessed for reliability and validity. Subsequently, the research model was tested using structured equation modeling methodology. The research hypotheses were empirically validated and discussed. All statistical procedures were conducted using SPSS for Windows Release 8.0 and AMOS Graphics 3.6.1.

Of the 600 questionnaires sent out, 138 responses were received. Nine of them were rejected due to incompleteness. Usable responses totaled 129 companies that had access to the Internet, giving a response rate of 21.5%. This sample size is considered appropriate for use of maximum likelihood estimation (MLE) where the minimum sample size is 100. The recommended sample size ranges from 100 to 200 [41].

5.1. Company profiles of respondents

As shown in Table 2, the respondents were mainly from the manufacturing industry (30.4%), followed by the banking and finance sector (12.8%) and the trading sector (10.4%). More than 80% of respondents are

Table 2
Respondents' profile ($N = 129$)

Respondents' profile	Percentage (%)
Industry sectors	
Manufacturing	29.5
Banking/finance	12.4
Trading	10.1
Services	8.5
Engineering/construction	6.2
Logistics/transportation	6.2
Retail	5.4
Oil/power	4.7
Computer/information technology	4.7
Property	3.9
Travel/hospitality	3.1
Consumer electronics	2.3
Others	3.1
Hierarchical level	
CEO/managing directors/senior management	56.6
Managers	25.6
Assistant managers/others	17.8
Number of employees	
<250	43.4
251–500	16.3
501–750	8.5
751–1000	3.9
101–2000	10.9
>2000	17.1
Organization structure	
Decentralized	16.3
Centralized	57.4
Hybrid	26.4
Management attitude towards the Internet	
Negative	0.8
Apprehensive	3.1
Indifferent	10.1
Interested	61.2
Enthusiastic	24.8

managers or senior management. The high hierarchical level of respondents enhances the validity of our results since they are more likely to be familiar with the organization's CI activities and its impact.

Due to the relatively low response rate, a non-respondent bias test was performed using the Chi-square (χ^2) statistic to compare the industry profile of respondents and non-respondents ($\chi^2 = 15.1$, d.f. $= 12$, $P > 0.05$). No bias was detected.

The average number of years of access to the Internet is 2.5 years. Respondents' average number of years spent in the current company and industry was 7.1 and 11.1 years, respectively. About 57% of the companies had a centralized structure, and 86% of the respondents reported that management was interested or enthusiastic about the Internet.

5.2. Structural equation modeling (SEM)

The hypothesized model was analyzed using SEM [37]. Specifically, a *confirmatory modeling strategy* was pursued to empirically assess the significance of the research model.

Analysis of moment structures (AMOS) Graphics 3.6.1 was used because it allows easy specification, view and modification to the research model with simple drawing tools, while allowing assessment of model fit, adjustment, and test reruns.

Before running AMOS, the various constructs were tested for validity using principal component analyses with varimax rotation. All constructs loaded onto a single factor with the exception of secondary research and revenue generation which loaded onto two factors. The items were forced loaded into a single factor. Only one item pertaining to commercial databases in secondary research was removed as the loading was <0.50. In addition, reliability analysis was carried out using Cronbach alpha which is a measure of internal consistency. The results show that all constructs are valid and reliable (Table 3).

As the number of indicators relative to sample size is large, we computed the mean of the composite indicators, e.g. primary research is made up of the mean of six items, secondary research is made up of the mean of 10 items, etc. The mean value of each

Table 3
Reliability analysis

Constructs	No. of items	Loadings	α-Value
Primary research	6	0.50–0.88	0.8328
Secondary research	10	0.57–0.86	0.9003
Internal collaboration	4	0.90–0.94	0.9360
Internal dissemination	2	0.90–0.90	0.7727
External collaboration	4	0.82–0.87	0.8660
External dissemination	2	0.96–0.96	0.9068
CI quality	10	0.60–0.82	0.9222
Revenue generation	8	0.80–0.85	0.9327
Cost reduction	7	0.72–0.85	0.9216
Managerial effectiveness	12	0.68–0.86	0.9474

composite indicator is then used when testing the measurement and structural model. This is a valid approach as the composite indicators have been shown to be valid and reliable. Further, reducing the number of indicators by using the mean helps to increase the stability of the parameter estimates and is often necessary when the ratio of indicators to sample size is large.

5.2.1. Measurement model

A confirmatory factor analysis (CFA) of the measurement model was made to ensure that the indicators were reliable. The Chi-square statistic of the CFA model was 3.38 with d.f. = 6 ($P = 0.76$). The goodness-of-fit index (GFI) and adjusted goodness-of-fit index (AGFI) was 0.97 and 0.99, respectively. The factor loadings of the indicators for the latent constructs are shown on Fig. 2. All the indicators had loadings above the 0.8 recommended level for reliability. Thus, none of the indicators had to be dropped. The results show that the measurement model was a good fit. Fig. 2 also shows the AMOS path diagram for the CFA.

The principal approach used to assess the measurement model is the composite reliability and variance-extracted measures for each construct. The *composite reliability* test is performed to measure the internal consistency of the construct indicators. Another measure of reliability used in this study is the *variance-extracted* measure. This measure reflects the overall amount of variance in the indicators accounted for by the latent construct. The variance-extracted measure is a complementary measure to the construct reliability value. Recommendations typically suggest that the variance extracted value for a construct should exceed 0.50 [33].

All exogenous construct composite reliabilities exceed the suggested level of 0.70. The average variances extracted in constructs were all over 0.50, which is indicative of convergent validity. Table 4 shows the computations of estimates for the constructs.

5.2.2. Structural model

Goodness-of-fit is a measure of the correspondence of the actual or observed input (covariance or correlation) matrix with that predicted from the proposed model. The goodness-of-fit measures fall into three types: (1) absolute fit measures; (2) incremental fit measures or (3) parsimonious fit measures. The absolute fit measures assess only the overall model fit, with no adjustment for the degree of 'overfitting' that might occur. The incremental fit allows comparison between the proposed model and competing models. However, it is used only to assess the incremental fit of the model compared to a null model and thus not used here. Lastly, the parsimonious fit measures 'adjust' the

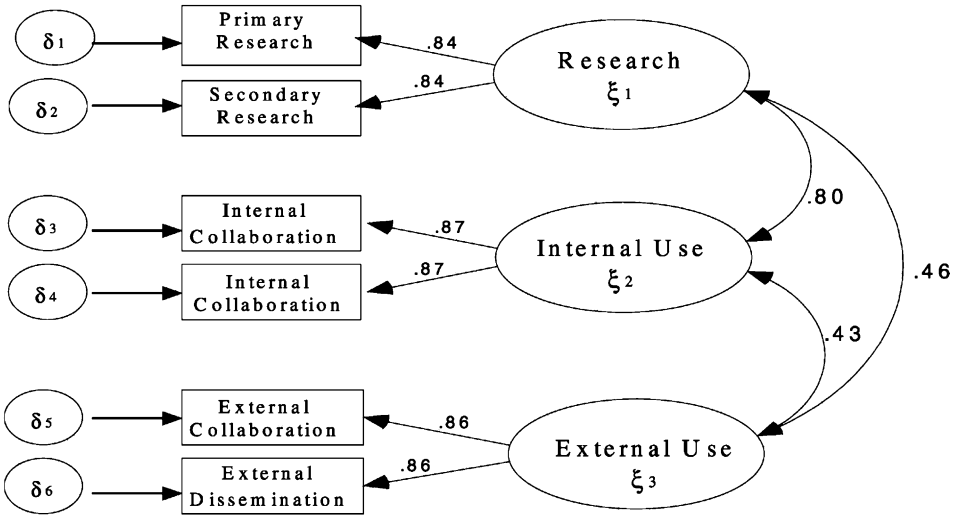

Fig. 2. AMOS path diagram for confirmatory factor analysis ($\chi^2 = 3.38$, d.f. = 6, $P = 0.76$, AGFI = 0.97, GFI = 0.99).

Table 4
Computation of reliability estimates for the constructs

Variables	Composite reliability[a]	Variance extracted[b]
Research	0.828	1.411
Internal use	0.860	1.510
External use	0.855	1.495

[a] $$\text{Composite reliability} = \frac{(\sum \text{standardized loadings})^2}{(\sum \text{standardized loadings})^2 + (\sum \text{indicator measurement error})}.$$

[b] $$\text{Variance extracted} = \frac{(\sum \text{standardized loadings})^2}{(\sum \text{standardized loadings})^2 + (\sum \text{indicator measurement error})}.$$

measures of fit to compare between models with differing numbers of estimated coefficients so that the amount of fit achieved by each estimated coefficient can be determined.

The absolute fit measure, Chi-square test results are 37.62 for 28 degrees of freedom ($P = 0.106$). The GFI has a value of 0.944. The root mean square residual (RMSR) is 0.03, which is within the acceptable range of 0.08 or less. Another measure that attempts to correct for the tendency of the Chi-square statistic with a sufficiently large model is the root mean square error of approximation (RMSEA), where values ranging from 0.05 to 0.08 are deemed acceptable. The proposed model's RMSEA is 0.052 and falls within that range.

However, the parsimonious measure of AGFI is 0.890, which is close to the recommended level of 0.90 [33]. The second parsimonious measure is the normed Chi-square (χ^2/d.f.), which has a value of 1.344 (37.623/28). This falls within the recommended levels of 1.0–2.0.

Modification indices are calculated for each non-estimated relationship. The modification indices recommended by the AMOS program lacked theoretical backing and thus were not considered for revising the model for an improved fit. Hence, no further revisions were made to the model.

Having assessed the structural model, the estimated coefficients can now be examined for both practical and theoretical reasons. As a measure of the entire structural equation, an overall coefficient of determination (R^2) is calculated. It provides a relative measure of fit for each structural equation.

Another means of evaluation is the standardized estimation coefficients. The coefficients closely approximate effect sizes shown by beta weights in regression. Coefficients near zero have little, if any, substantive effect, whereas an increase in values corresponds to increased importance in the causal relationships. Since a positive relationship is expected in the hypotheses, a one-tailed test of significance is employed.

The structural equation fit of the endogenous constructs is as follows.

- R^2 of the quality of CI information ($\eta_1 = 0.578$) shows that 57.8% of the variance in quality of CI information was accounted for by research, internal use and external use of the Internet.
- R^2 of the strategic benefits ($\eta_2 = 0.694$) reveals that 69.4% of its variance was explained by the quality of CI information.

The results of the SEM are shown in Fig. 3.

5.2.2.1. Research construct. The primary and secondary indicators measure the research construct. Supportive findings for Hypothesis 1 ($\gamma_{11} = 0.773$, $P < 0.05$) suggest that there is a positive relationship between the use of the Internet for research and the quality of CI information. Hence, the large amounts of information found on the Internet do have their merits and add value as a resource for improving CI.

5.2.2.2. Internal use construct. The findings for Hypothesis 2 ($\gamma_{12} = -0.152$, $P > 0.05$) indicate that internal use of the Internet for collaboration and dissemination fails to influence the quality of CI information. The rejection of Hypothesis 2 may not be too surprising, as the effectiveness of teleconferencing meetings, briefings, or e-mail may vary from company to company. Thus, the issue of internal collaboration and dissemination may not be

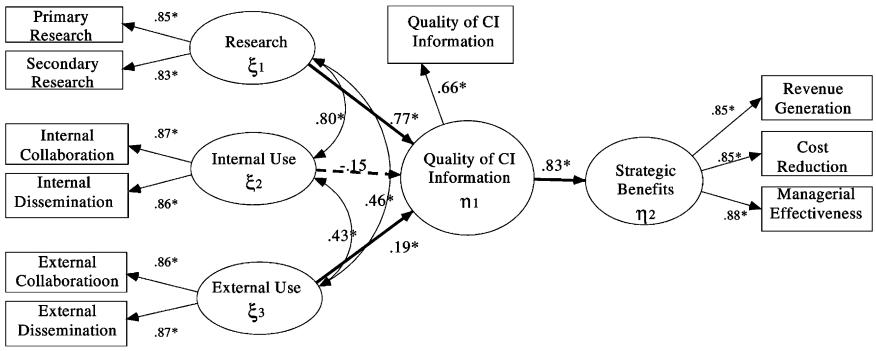

Fig. 3. Final fitted model ($\chi^2 = 37.62$, d.f. $= 28$, $P = 0.11$, AGFI $= 0.89$, GFI $= 0.94$; *: significant at $P \leq 0.05$).

as crucial as how the information is used to produce better CI.

5.2.2.3. External use construct. Significant findings for Hypothesis 3 ($\gamma_{13} = 0.187$, $P < 0.05$) suggest that greater use of the Internet for external collaboration and dissemination leads to higher quality of CI information. This augments the theoretical benefits of being able to overcome geographical barriers to communicate with external parties for the advantage of the company.

5.2.2.4. The strategic benefits construct. Similarly, supportive findings for Hypothesis 4 ($\beta_{21} = 0.833$, $P < 0.05$) suggest that higher quality of CI information improves an organization's strategic benefits. As was anticipated, the strategic benefits of companies improve as they raise the quality of CI information through the Internet.

5.2.3. Summary of findings

A CFA indicated that the measurement model fit the sample data adequately ($\chi^2 = 3.38$, d.f. $= 6$, $P = 0.76$, GFI $= 0.99$). The goodness-of-fit measures for the overall model were also adequate ($\chi^2 = 37.62$, d.f. $= 28$, $P = 0.106$, GFI $= 0.94$). Thus, the proposed model is accepted. Evidence of internal consistency is provided by the composite reliabilities and variance extracted measures. The R^2 of the endogenous constructs also exhibited statistical significance ($\eta_1 = 0.578$, $\eta_2 = 0.694$) for the structural model.

6. Limitations

There are three main limitations of this study. First, the companies chosen for this study were mainly large corporations with sales in excess of US$ 100 million. Thus, the results may not be generalizable to smaller companies. However, since it is an assumption that large companies are more likely to engage actively in CI activities, it is an inevitable trade-off that has been taken into consideration.

Second, the relatively low response rate of 21.5% may make generalisability difficult. However, due to the sensitive nature of the topic of CI coupled with respondents being mainly senior management or managers, the response rate is acceptable. Furthermore, a Chi-square test to examine the differences in industry types between respondents and non-respondents revealed the lack of non-response bias ($\chi^2 = 15.1$, d.f. $= 12$, $P = 0.237$).

Third, the use of one respondent per firm may result in common source bias. This is mitigated by targeting the questionnaires at senior management who are more likely to have knowledge about the organization's CI activities.

7. Implications

The results of this study indicate that using the Internet has a positive impact on the quality of CI information. The findings further augment previous studies on the positive relationship between usage of

CI information and organizational performance [16,40]. It shows that the improved quality of CI information through Internet usage has a positive impact on the organization.

In other words, the results suggest that there is a direct positive link between usage of the Internet and the quality of CI information, and a positive downstream impact on the organizations' strategic benefits. Hence, this research has also given support for the usefulness of applying the usage construct as an independent variable.

The positive relationship between research and quality of CI information indicates the importance of the Internet as an information-gathering tool. It suggests the underlying reason for the Internet's popularity as a research tool. Although there may be some concerns about the reliability and timeliness of information published on the Internet, there is little doubt that it is one of the most cost-effective means of obtaining information.

The results suggest that mining the Internet for CI data helps to produce useful intelligence. The growing number of CI services and databases found on the Internet allows firms to have access to reliable sources of CI data. The companies' accessibility to the Internet for research has elevated demand for portals to more sophisticated intelligence. The popularity of the Internet as a low-cost research tool implies that CI professionals have to provide more than just collated data. Bates [7] noted that data must be transformed into knowledge and order has to be created from the chaos of the Internet. Thus, actionable and focussed intelligence must be produced to add value to clients.

At the same time, companies should *not* be misled into thinking that 'everything can be found on the Net'. Although there is breadth of CI data available on the Internet, in-depth data on specific topics are not always available. It is likely that firms may increasingly need to employ 'boutique information services' that serve niche industries for specific needs.

The information overload from the Internet also makes focussed research difficult. However, as more companies take to the Internet for CI data, 'intelligent agents' have to be developed to automate and alleviate the CI professional's information gathering workload. Then, the CI professional can invest more time in analyzing data and producing actionable intelligence.

The relationship between using the Internet in the area of internal collaboration and dissemination and quality of CI information was not supported. This implies that internal collaboration of CI data in the local context may not be centered on the Internet but may depend on more traditional approaches such as meetings, memos, telephone calls or faxes.

However, with the growing acceptance of intranets and client-server networks in local enterprises, local firms are becoming more comfortable with the Internet as a medium for communication. Thus, internal collaboration and dissemination is likely to become more prevalent in the future.

The use of the Internet for external collaboration and dissemination is of significant importance. This is expected, as the Internet is able to overcome geographical restrictions for research, collaboration and dissemination of CI data. As noted by Graef [30], the Internet is another way for primary researchers and analysts to locate experts.

The study has also provided empirical evidence for 'collaborative intelligence', which is an advanced stage of CI development. The findings show that collaborative effort facilitated by the Internet does contribute effectively to the quality of CI information produced.

This suggests that CI professionals can team up with other members outside the organization to leverage intellectual capital. They can develop 'knowledge centers' to help inter-organizational information sharing and collaboration. Customized CI information services can be developed for specific client groups. CI professionals need to adapt to an intelligence climate in which the Internet is used both to compete and to collaborate. Companies also need to adjust to an environment in which a company can simultaneously be both a competitor and a strategic partner.

Hence, the external use of the Internet suggests that there is a wide scope for companies to collaborate through a 'virtual link'. The ability to set up a 'virtual link' would allow organizations to access expertise or resources previously not considered. DuPont's 'virtual' tie-up of its Delaware research laboratories with the National University of Singapore for chemical and biotechnology research is a case in point [53]. It is expected to help produce commercially viable technologies and products. Such 'virtual links' would be of

critical value to small companies, which have resource constraints.

In summary, the findings indicate that using the Internet for research has a stronger impact on the quality of CI information than external or internal use. One likely reason is that the availability of a wide variety of databases, Web sites and discussion groups on-line provide the resources necessary for most forms of research. It also corresponds with previous studies which show that research is the most important use of the Internet [22,48].

Similarly, it is not surprising that the results reveal that external use of the Internet has a positive impact on quality of CI information while the internal use of the Internet does not. The principal advantages of the Internet as a communications tool are its capabilities of asymmetric response and marginal-cost, instantaneous global messaging. These capabilities help companies to engage in CI activities with external parties at greater efficiency and lower cost than conventional communications means. However, conventional means such as facsimile transmissions, telephone calls, memos, or meetings may be more practical for internal CI activities.

The empirical support for the hypothesis that improved quality of CI information leads to higher strategic benefits, suggests that companies should redesign CI strategies in planning for competitive advantage. CI activities should take advantage of the Internet's capabilities, thereby reducing wasted resources. By incorporating the Internet in their CI and overall business strategies, firms are in a better position to generate higher revenue, reduce business costs and improve managerial effectiveness.

The positive organizational impact of using the Internet for CI brings the importance of organized CI activities to attention. This study has demonstrated that there is value in using the Internet for CI activities. As global competition heightens, a firm's intellectual capital could be the key weapon for future survival. Consequently, developing a streamlined CI system would enable an organization to cope effectively with information overload from the Internet, and ensure its own ability to protect its proprietary knowledge.

Firms need to analyze the organizational impact of using the Internet for CI activities and formulate suitable counterintelligence strategies so as to protect themselves against their competitors. More importantly, firms need to understand how the Internet has transformed the intelligence landscape in the knowledge-based economy. They could then take the necessary steps to leverage the Internet to complement their CI strategy.

There are several avenues where future research may be conducted. Firstly, research may be specifically conducted on how CI from the Internet differs from the traditional sources of CI. Due to its unregulated nature, there are concerns among firms on the reliability of information from the Internet. How does management's perception of data from the Internet affect the way information is sieved or used?

There may also be more in-depth research into the significant differences in the way the Internet is used for CI activities between local and foreign enterprises, and how it affects the performance of firms. In addition, in-depth case studies may be conducted to reveal key push and pull factors surrounding the use of the Internet for CI activities. Such studies may also provide insights into the detailed processes used to collect and disseminate CI data.

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