Predicting web services performance from internet performance: an empirical study of resources and capabilities in e-business SMEs

Brian R. Webb and Frank Schlemmer

Brian R. Webb is based at the School of Management, Queen's University Belfast, Belfast, UK. Frank Schlemmer is Managing Director of Schlemmer Optik, Nürnberg, Germany.

Abstract

Purpose – *Web services promise a step change in business-to-business application models and practices. But how do we measure web services' performance? Because web services are so new, and implementations so few, the purpose of this paper is to take internet performance as a proxy for web services performance.*

Design/methodology/approach – *The authors surveyed 106 e-business SMEs to identify key drivers for internet performance, and then predicted web services performance.*

Findings – *Surprisingly, it was found that while business resources and IT resources positively impact internet performance, dynamic capabilities do not. Also, there appear to be significant firm size effects.*

Originality/value – *The implications of these findings for the strategic management of web services are discussed, and in particular, managers' need to balance resources and capabilities in volatile business environments.*

Keywords *Worldwide web, Internet, Small to medium-sized enterprises, Company performance*

Paper type *Research paper*

Introduction

> . . . the Semantic Web will enable the accessing of Web resources by semantic content rather than just by keywords. Resources (in this case Web Services) are defined in such a way that they can be automatically ''understood'' and processed by machine. This will enable the realisation of Semantic Web Services, involving the automation of service discovery, acquisition, composition and monitoring. Software agents will be able to automatically create new services from already published services, with potentially huge implications for models of eBusiness (Davies *et al.*, 2004, p. 118).

In this scenario, we may suppose that, as the utility value of technology declines, the capability value in building and maintaining web services will increase. if information technology is increasingly seen as a ''general purpose technology'' then web services (along with virtualisation and grid computing) represent its transformation into a ''centralised utility'' (Carr, 2005). With increased ''commoditisation'' of IT (McAfee, 2005) in the form of web services, superior firm performance will be determined by the ability of the firm to manage IT through a unique set of capabilities. As more and more service or functional capabilities become embedded in web services software (for example, the capability to perform credit checks or to process payments will be codified in web services software and available across the internet) then firms must compete on other distinct competencies. It is clear that management capabilities will be important to the success of web services implementations; but what sort of capabilities, how will these combine with other strategic assets and what is the likely impact upon performance?

Unfortunately we cannot easily go out and measure such capabilities in small firms. web services technology is too new, and implementations too few, to make cross-sectional or longitudinal studies possible. Case studies of web services success stories offer important initial direction, but these cannot substitute for a body of empirical data, and are anyway mostly confined to large firms. In the absence of significant implementations of web services technology, we are left to study ''intermediate'' web services adoption, predicated on the internet where ''the web services initiative effectively adds computational objects to the static information of yesterday's Web and as such offers distributed services capability over a network'' (Davies *et al.*, 2004).

We take internet performance as a proxy for web services performance. We acknowledge the limitations of this approach but believe that the commonalities between internet adoption and web services adoption yield important insights into the role of business resources and management capabilities in web services performance. The commonalities go beyond merely technical considerations (where the internet is the ''carrier technology'' for web services) to include managerial and organisational considerations (where that same carrier technology facilitates enhanced knowledge management and organisational learning). Whereas the impact of the internet on competency development and organisational learning has already been studied in the small firm environment (e.g. Chaston *et al.*, 2001; Pollard, 2003; Martin and Matlay, 2003; Ellis and Wagner, 2005) we seek to extend this line of inquiry to web services.

Web services are variously described in the literature as technology (Gottschalk *et al.*, 2002; Lim and Wen, 2003; Joshi *et al.*, 2004), standards (McAfee, 2005), services (Jobber, 1998; Elfatatry and Layzell, 2004) or some combination thereof (Hagel and Brown, 2001). The polymorphous nature of web services is reflected in the following definition:

> Web Services [are] modular internet based business functions that perform specific business tasks to facilitate business interactions within and beyond the organisation. By this definition Web services reflect and refer to loosely coupled reusable software components that are able to semantically encapsulate discrete functionality and are programmatically accessible over standard internet protocols (Ratnasingham, 2004, p. 382).

Although sometimes viewed as an extension of EDI and the internet (Ratnasingham, 2004), web services differ from previous technologies because of the absence of human intervention in key processes (McAfee, 2005). Whereas both EDI and internet technologies rely on human-application and human-human interaction to work (for example when placing and fulfilling an order on the web), web services require – and indeed are predicated upon – no human involvement. That is, a process running on Machine A will communicate with a process running on Machine B in order to complete a certain task. This task itself will also be a process (for example performing a customer credit check) and may itself be called by another process. Machine A and Machine B, the process which calls them, and the process which in turns calls that process, may be located within the same firm or located across two or more different firms.

Whilst it is true that web services are uniquely defined by their ability to enact ''programmatic interaction'' (Murtaza and Shah, 2004), nevertheless ''because Web Services are essentially described using semi-structured natural language mechanisms, considerable human intervention is needed to find and combine Web Services into an end application'' (Davies *et al.*, 2004). This suggests that individual and organisational capability in the development and management of web services will remain important, as the utility value of the technology declines.

In moderately dynamic markets, evidence for successful small firm adoption of web services is mostly found when small firms are invited or mandated as suppliers to large firms to join supply chain management systems (Ulfelder, 2003). Murtaza and Shah (2004) suggest that such developments have become a strategic necessity for small firms because ''real time collaboration is a key element of agile manufacturing strategies as it can lead to significant strategic and operational benefits for all business partners'' (p. 50). In high-velocity markets,

> **"As more and more service or functional capabilities become embedded in web services software, then firms must compete on other distinct competencies."**

examples of successful implementations are rarer. The way in which small firms collaborated and co-evolved in the creation and development of the ASP industry is one example but even here the industry soon came to be dominated by fewer larger firms, with the result that routines became more established, outcomes more predictable and capabilities less dynamic (Austin, 2002).

Similar to the internet, because web services are built using open and freely available standards they are relatively inexpensive, simple and quick to develop, certainly in comparison with proprietary based solutions. Rooney (2002) claims that it requires two thirds less time to build a web service than to develop a typical client/server application. Gillmor (2002) claims a two-thirds cost reduction in a major implementation project when web services were used in preference to a traditional proprietary-based approach. Stal (2002) has noted reduced complexity, time and cost and Fletcher and Waterhouse (2002) have noted that users of web services face fewer maintenance costs than for competing integration technologies.

A key development in web services (and suggested in the definition given above, Ratnasingham, 2004, p. 382) is the move to semantic web technology. This allows the accessing of web resources by semantic content rather than just keywords, so that resources (web services) can be defined in a way that they are automatically understood and processed by machine (Davies *et al.*, 2004). This ''step change in capability'' will require a development away from the XML-based standards that currently underpin the semantic web (and which underpin web services and internet technologies) to a new language, capable of expressing semantic metadata. Whilst the technological development of web services and the semantic web are beyond the scope of this paper, it is interesting to note the extent to which such developments are being applied in different fields. For example, Heiwy (2006) re-uses existing resources and applies new resources to build a learning object repository, based upon standard metadata or ontology. Other researchers are concerned that knowledge management ontologies are ''properly integrated into existing ontological bases, for the practical purpose of providing the required support for the development of intelligent applications'' (Sicilia *et al.*, 2005, p. 1).

In this paper we examine empirically the contribution of resources and capabilities to internet performance. From this analysis we predict their likely impact on web services performance. The emphasis is on small firms in general and e-business SMEs in particular. Our results suggest that, contrary to expectations, dynamic capabilities may not be significant to web services performance, whereas firm size does appear to be significant. These outcomes have important implications for managers and these are discussed at the end of the paper. Firstly the research method is introduced and the results are presented, then these are discussed in terms of some of the web services literature.

Research method

We defined small firms as a firm employing less than 250 employees (European Union definition of an SME). Such firms comprise 98 per cent of all companies in the USA and Europe and create about 80 per cent of economic growth (Jutla *et al.*, 2000). We concentrated on e-business SMEs defined as a firm that derives revenues from transactions over the internet.

A database of 7,600 companies held in Belfast, Northern Ireland, was analysed; 2,377 companies had an internet address. After deleting the non-profit organizations and excluding 50 companies used for a pilot study, questionnaires were sent to the remaining 1,913 firms. Forty-four questionnaires were returned because the companies had gone away or closed, and 11 answered that they would not complete the questionnaire because it was not appropriate for their organization. Thus the final sample consisted of 1,858 companies. Two hundred and twenty-eight questionnaires were returned, giving a response rate of 12.3 per cent. After sorting out the remaining non-profit organizations, non-independent organizations, companies that were too large, and companies without online sales, 106 companies remained[1].

The questionnaire was a modification of Powell and Dent-Micaleff's (1997) questionnaire which they used to study the impact of business resources, human resources and IT resources on financial performance, and which itself was based on the work of Walton (1989) and Keen (1993). We made a number of modifications to the Powell and Dent-Micaleff questionnaire to make it more appropriate to the purposes of our study, including, for example, replacing human resources with dynamic capabilities and focusing on internet performance rather than financial performance (the full set of changes is given in Appendix 1).

Respondents (usually the owner manager or managing director) were asked to assess their company's internet performance across five questions related to impact on productivity, competitive position, sales, profitability and overall performance. They were also asked to account for the contributions of business resources, dynamic capabilities and IT resources respectively (see Appendix 2).

It is broadly accepted that objective performance measures are highly correlated with subjective ones, and can be used if subjective data is not available (Dess, 1987; Dess and Robinson, 1984). By using subjective measures it is assumed that, given the senior executives involved, that respondents had sufficient perspective and information to assess their performance relative to competitors. Some researchers even prefer subjective measures, because it avoids the problems of varying accounting conventions in areas such as inventory valuation, depreciation and officer's salaries (Powell and Dent-Micallef, 1997).

The independent variables are shown in Table I. They consist of business resources (a modification from Powell and Dent-Micallef, 1997), dynamic capabilities (a modification from Sher and Lee, 2004), and IT resources (a modification from Tippins and Sohi, 2003).

Business resources

Business resources were divided into five sub-resources:

1. relationships with customers and suppliers;
2. external-driven e-business;
3. benchmarking;
4. strategic use of the internet; and
5. financial resources.

Supplier relationships are becoming increasingly critical (Cousins and Spekman, 2003), especially for integrating processes via the internet (Porter, 2001). Also, *customer relationships* are a critical success factor in e-business (Schroder and Madeja, 2004). Keller Johnson (2002) believed that if companies create competitive advantage with their customer relationships, they seem well equipped to leverage them on the internet. In contrast a lack of trading partner readiness to deploy the internet is a significant e-business adoption inhibitor (Zhu *et al.*, 2002). *Supplier driven e-business* is a resource for e-SMEs, and consumer readiness can be an internet adoption driver (Zhu *et al.*, 2002), and like the above described supplier-driven e-business *customer-driven e-business* can be seen as a

Table I The independent variables

Business resources	
Relationships	Open and trusting relationships with customers and key suppliers
External-driven e-business	Encouragement and support by suppliers and customers to adopt the internet, which may create inter-organisational efficiencies
Benchmarking	Actively researching and observing best practices of other firms in activities or processes that need improvement
Strategic use of the internet	The e-business strategy supports and enhances the overall competitive strategy
Financial resources	The necessary financial resources are available
Dynamic capabilities	
Integration	Capability to coordinate internal and external activities
Learning/gain	Capability to improve task fulfilment
Reconfiguration	Capability for internal and external transformation
IT resources	
IT knowledge	The extent to which a firm possesses a body of technical knowledge about objects such as computer-based systems
IT operations	The extent to which a firm utilises IT to manage market and customer information
IT objects	Computer-based hardware, software, and support personnel

resource for e-business companies. *Benchmarking* can enhance the development of IT systems (Whitley, 1992).

Teo and Choo (2001) suggested that using the internet can have a positive impact on competitive intelligence information. Furthermore they suggested that the quality of competitive intelligence drives firm performance. Strategies that integrate the internet and traditional competitive advantages are very effective (Porter, 2001). Thus *strategic use of the internet* leads to competitive advantage, because production and procurement can be more effective and buyers will value a combination of on- and off-line services. However, small companies are often at a disadvantage because they usually have fewer *financial resources* than their larger competitors (Caldeira and Ward, 2003; Chow *et al.*, 1997).

Dynamic capabilities

Dynamic capabilities can be divided into the following three subcategories (Teece *et al.*, 1997). First, *coordination* or *integration* of resources drives firm performance. Second, *learning* is the process by which repetition and experimentation enable tasks to be performed better and quicker. Third, fast changing markets require the ability to *reconfigure* the firm's asset structure, and to accomplish the necessary internal and external transformation. Rindova and Kotha's (2001) studied Yahoo! and Excite and suggested that the fast changing virtual markets require dynamic capabilities. In the same vein, Zhu *et al.* (2002) suggested a positive relationship between e-commerce capability and financial performance. Zhu (2004) then showed complementarity between e-commerce capability and IT infrastructure and a positive relationship to financial performance.

IT resources

According to Tippins and Sohi (2003, p. 748) IT resources are defined as ''the extent to which a firm is knowledgeable about and effectively utilizes IT to manage information within the firm''. Tippins and Sohi's (2003) model is divided into the sub categories *IT knowledge* (the extent to which a firm possesses a body of technical knowledge about objects such as

computer-based systems), *IT operations* (the extent to which a firm utilises IT to manage market and customer information), and *IT objects* (computer-based hardware, software and support personnel). Research on the impact of IT resources on financial performance frequently suggests no direct link between IT and firm performance (for a review, see Wade and Hulland, 2004). Clemons and Row (1991) suggested that IT *per se* cannot create sustainable competitive advantage; however, it can be used to leverage other resources.

Figure 1 sets out the relationships between the independent variables and the dependent variable. *A priori*, from previous studies found in the strategic management literature, we expected business resources, IT resources and dynamic capabilities to be positively correlated with internet performance.

These relationships are expressed in the following hypotheses

H1. Dynamic capabilities explain significant internet performance variance among e-SMEs.

H2. Business resources explain significant internet performance variance among e-SMEs.

H3. IT resources explain significant internet performance variance among e-SMEs.

Results

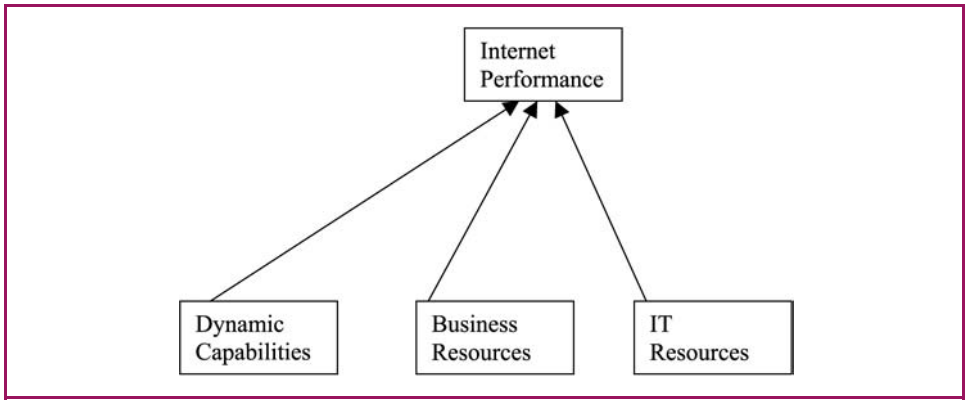
The vast majority of quantitative resource-based research deploys linear regression models (e.g. Wang and Ang, 2004; Klassen and Whybark, 1999; Robins and Wiersma, 1995). Following Powell and Dent-Micallef (1997), who studied financial performance, we used this linear regression model to study internet performance:

$$Z_Y = \alpha + \beta_B Z_B + \beta_D Z_D + \beta_1 Z_1 + \varepsilon.$$

Z_Y stands for internet performance (and not financial performance), α for the intercept, B for the variable set of business resources, D for dynamic capabilities, and I for IT resources. β_X are the standardized partial regression coefficients. It is assumed that β_B and β_D will be positive and significant and β_I (IT resources) is also expected to be positive and significant (and not about zero, as in Powell and Dent-Micallef, 1997). ε is the residual term that captures the net effect of all unspecified factors.

The correlations of all variables are presented in Appendix 3. As can be seen (highlighted values in the final columns of the final row), all three independent variables correlate statistically significant to internet performance – business resources ($r = 0.707$***), dynamic capabilities ($r = 0.425$***), and IT resources ($r = 0.507$***). However, further

Figure 1 The relationship between the independent variables and the dependent variable



exploration of these relationships using regression analysis shows that dynamic capabilities are not significant in explaining internet performance.

Table II presents the results from the multiple regressions for the independent variable sets (business resources, dynamic capabilities, and IT resources), the control variable (firm size, ''ln emp'' measured as the natural logarithm of employees), and for the dependent variable (internet performance).

The variables combined explain 52.1 per cent of internet performance variance, and an estimated 50.2 per cent of variance in population (using adjusted R^2, which estimates population effects based on sample degrees of freedom). It is interesting to note that the firm size (measured by the natural logarithm of employees) is *negatively* related to internet performance. This implies that smaller companies are more successful in deploying the internet[2].

Expected relationships between business resources and internet performance and between IT resources and internet performance were supported (*H2* and *H3* were confirmed). But, surprisingly, dynamic capabilities did not have the expected relationship with internet performance (*H1* was not confirmed). This is similar to the findings of Saban and Rau (2005) which showed that the usage of websites of SMEs is mainly driven by resource constraints and not by their limited capabilities. A possible explanation for this could be that flexibility is a strategic necessity for small companies, and can therefore not be a source of competitive advantage in volatile or virtual markets.

Discussion

Virtual markets are high-velocity markets which are defined as markets in which market boundaries are blurred, successful business models are unclear, and market players are ambiguous and shifting (Eisenhardt and Martin, 2000). In low velocity markets dynamic capabilities are complicated, analytic, and linear processes; in high-velocity markets they are simple (not complicated), experiential (not analytic), and iterative (not linear) processes (Eisenhardt and Martin, 2000). This means that the requirements of virtual markets are ideal for SMEs, because they usually have simple structures (Hannan and Freeman, 1984) and perform activities less analytically than larger companies (Verhees and Meulenberg, 2004). Furthermore SMEs often have strengths, for example speed and flexibility (Dean *et al.*, 1998). Managers of SMEs often react in a fire-fighting mode (Hudson *et al.*, 2001). Thus the typical behaviour of SMEs equals the necessary dynamic capabilities for virtual markets. When the majority of SMEs already have the required dynamic capabilities, they cannot be a

Table II Strategic assets and internet performance

Construct (single variable)	*Internet performance*
Business resources	0.574***
(External driven)	(0.245**)
(Strategic internet)	(0.397***)
Dynamic capabilities	0.007
IT resources	0.192*
(IT operations)	(0.255**)
ln emp	−0.172*
	(−0.106)
R	0.722***
	(0.711***)
R^2	0.521
	(0.506)
Adjusted R^2	0.502
	(0.487)

Notes: *Correlation is significant at the 0.05 level (two-tailed); **correlation is significant at the 0.01 level (two-tailed); ***correlation is significant at the 0.001 level (two-tailed)

"Companies controlling strong business and IT resources should seriously consider adopting web services."

source of competitive advantage in virtual markets, but they may be a source of competitive advantage *vis-à-vis* large firms.

Our results suggested the importance of business resources to internet performance, and (by inference) to web services performance. This is also suggested in the literature. Anderson *et al.* (2005) expanded upon the findings of Dembla *et al.* (2004) and examined ''the significance of technological, methodological and business factors in contributing to the success of initial Web Services projects'' (p. 66). They used four case studies from the financial services sector. Each case study was evaluated against 36 success factors, derived from the ''industry experiences of several of the authors and a synopsis of practitioner studies'' (p. 67).

Their factors included business client contribution, customer demand and financial rate of return. They rank business factors ahead of technological factors (which broadly equate to our IT knowledge, operations and objects) and methodological factors (which include aspects of dynamic capabilities such as learning, integration and re-configuration). Anderson *et al.* (2005) also find that their ''[case] studies indicate importance in the collateral and incremental benefits of the existing or introduced technological factors in the success of the [Web Services] projects'' (p. 73).

While both the Dembla *et al.* (2004) and Anderson *et al.* (2005) studies were of larger more complex firms and industries, and neither focused specifically upon e-businesses, we argue that their results lend support to the general findings of this study by highlighting the importance of business factors over technological factors in web services adoption and success. Moreover, where disaggregated data is available on individual firm performance, this remains consistent with our analysis. For example, Case Study 1 in the Anderson *et al.* study was a smaller and less sophisticated firm than the other three case studies but still ranked business factors ahead of technological and methodological factors (although not so strongly).

Elsewhere Hagel and Brown (2001) emphasise the importance of capabilities over technology, and McAfee (2005, p. 84) makes a distinction between the ''raw materials of IT'' such as hardware and commercially available software (which are widely available and therefore not a source of competitive advantage), and the ''finished goods of IT'' (which are technologies adding value through the application of capabilities) and therefore more likely to be a source of sustainable competitive advantage.

Overall our results suggest that effective knowledge management is best achieved when Web Services are managed as strategic assets. Although the middle layer of the web services architecture (see Ratnasingham, 2004, p. 385; adapted from Hagel and Brown, 2001) provides specific utilities for resource knowledge management (including directories, brokers, registries, repositories and data transformation) and these utilities can be used (*inter alia*) at the operational level to integrate existing systems within an organisation's web service application, to create intranets/extranets that provide the right information in an appropriate format and to enable business partners to interact seamlessly (Ratnasingham, 2004, p. 384), it is unlikely that this is where the greatest benefit will be realised. Similar to the internet, web services are key enablers of other firm resources and capabilities and are themselves subject to the management of these resources and capabilities. Our results suggest that (as with the internet) effective knowledge management may depend upon understanding web services as bundles of firm specific assets that both reflect and contribute towards the management of firm performance in other areas. Indeed (as with the

internet) much may be gained from studying the interaction effects or complementarity of web services on other firm resources and capabilities.

Conclusions

In this paper we predicted web services performance by examining internet performance. We suggest that both business resources and IT resources are important predictors of web services performance, but dynamic capabilities are not (we further suggest because, in highly competitive and volatile markets, such capability is already a strategic necessity amongst small firms). This has two managerial implications. First, companies controlling strong business and IT resources should seriously consider adopting web services. Second, it may be that dynamic capabilities will be less important to this adoption than previously thought. Whereas dynamic capabilities appear to be critical to financial performance in the ''off-line world'', small companies may not be able to leverage them strategically in highly volatile markets.

We also note that firm size negatively impacts internet performance. That is, the larger the firm is, the worse is its internet performance. This conclusion appears at odds with our earlier conclusion that control of resources and capabilities is important to internet performance. One would expect larger firms to have access to more and better resources and to have more and better control over them, resulting in better performance (financial and non-financial). However, the conclusion is consistent with our earlier hypothesis that, although small firms cannot achieve a competitive advantage over other small firms using dynamic capabilities (since they are commonly held amongst small firms) they may use dynamic capabilities to achieve a competitive advantage over large firms. That is, smaller firms with fewer resources rely more on flexibility and speed, or on dynamic capabilities. On the other hand, larger and more mature firms have developed routine capabilities, which although important, are less flexible and therefore less strategic in volatile markets. Our conclusion from this sample is that smaller firms' advantage in dynamic capabilities outweighs their disadvantage (*vis-à-vis* larger firms) in business resources.

Another interpretation of our results is that they anticipate the commoditisation of technology *and* capabilities under web services. With the internet/worldwide web human-human interactions have been replaced by human-application interactions in the majority of B2B transactions. Web services will in turn replace many human-application interactions with program-program or application-application interactions. Because a web service is essentially a process that runs on the web, technology and capability are bundled and made freely available. In this scenario competitive advantage will not come from low level, operational or functional capabilities that are embedded in web services but from higher level, strategic or organisational capabilities that are developed and retained by the firm. Our results suggest that business and IT resources will be important to building such capabilities and that the mere possession of dynamic capabilities will be insufficient to create competitive advantage from web services (although it may – as we have seen – yield some short-term benefits).

Finally, we have studied the impact of three independent variables (business resources, IT resources and dynamic capabilities) on (the dependent variable) of web services performance. We have not studied the impact of web services as an independent variable

"Precisely because web services are built using open and freely available standards they are relatively inexpensive, simple and quick to develop, certainly in comparison with proprietary based solutions."

impacting financial performance. In particular, the value of web services as an enabler of other resources and competencies, as well as a driver for financial performance remains unknown. Whilst we may (again) use the internet as a proxy to predict outcomes, we must consider the full interaction effects or ''complementarity'' of web services, and the level of analysis required is unlikely to be yielded from surrogate data. In particular, research into actual web services implementations is needed in order to understand the commoditisation effects on technology and capabilities, and its impact of firm performance.

Notes

1. Because it was not always possible to definitively classify firms on the basis of the information given in the database alone, some corrections were necessary once firms had returned the questionnaires.
2. In addition a single regression with ln emp as an independent variable and internet performance as dependent variable was conducted. The results supported the negative relationship between the dependent and independent variables (adjusted $R^2 = 0.039$*; standardized $\beta = -0.219$).

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Appendix 1. Modifications to the questionnaire

Business resources (Powell and Dent-Micallef, 1997):

- Supplier relationships: was changed to relationships because the measure customer relationships was also used.
- Supplier driven IT: was changed to external driven e-business; the measure customer driven e-business was also used.
- IT training: was discussed in the IT competence section.
- Process redesign: business processes were discussed in the dynamic capabilities section.
- Teams: this is about cross-departmental teams, considering the simple structures of SMEs that may not have clearly divided departments, this measure was not applied.
- Benchmarking: was used without modification.
- IT planning: was changed to strategic use of the internet.
- The measure ''financial resources'' was included because SMEs often lack them. The question was: ''The necessary financial resources are available'' (Chow *et al.*, 1997; Caldeira and Ward, 2003).

IT competence for SMEs engaging in e-business (Tippins and Sohi, 2003):

- Our company has a formal MIS department: was not used.
- Our firm employs a manager whose main duties include the management of our information technology: was not used because at SMEs the majority of management decision is often done by the owner-manager. And the question ''CEO commitment to e-business'' in the human resources section of this research already considers the importance of e-business by the management.

Dynamic capabilities for SMEs engaging in e-business:

- Measures for customer relationships and trust with vendors were not used because they were already used in the business resources section.

The following questions were added to increase validity:

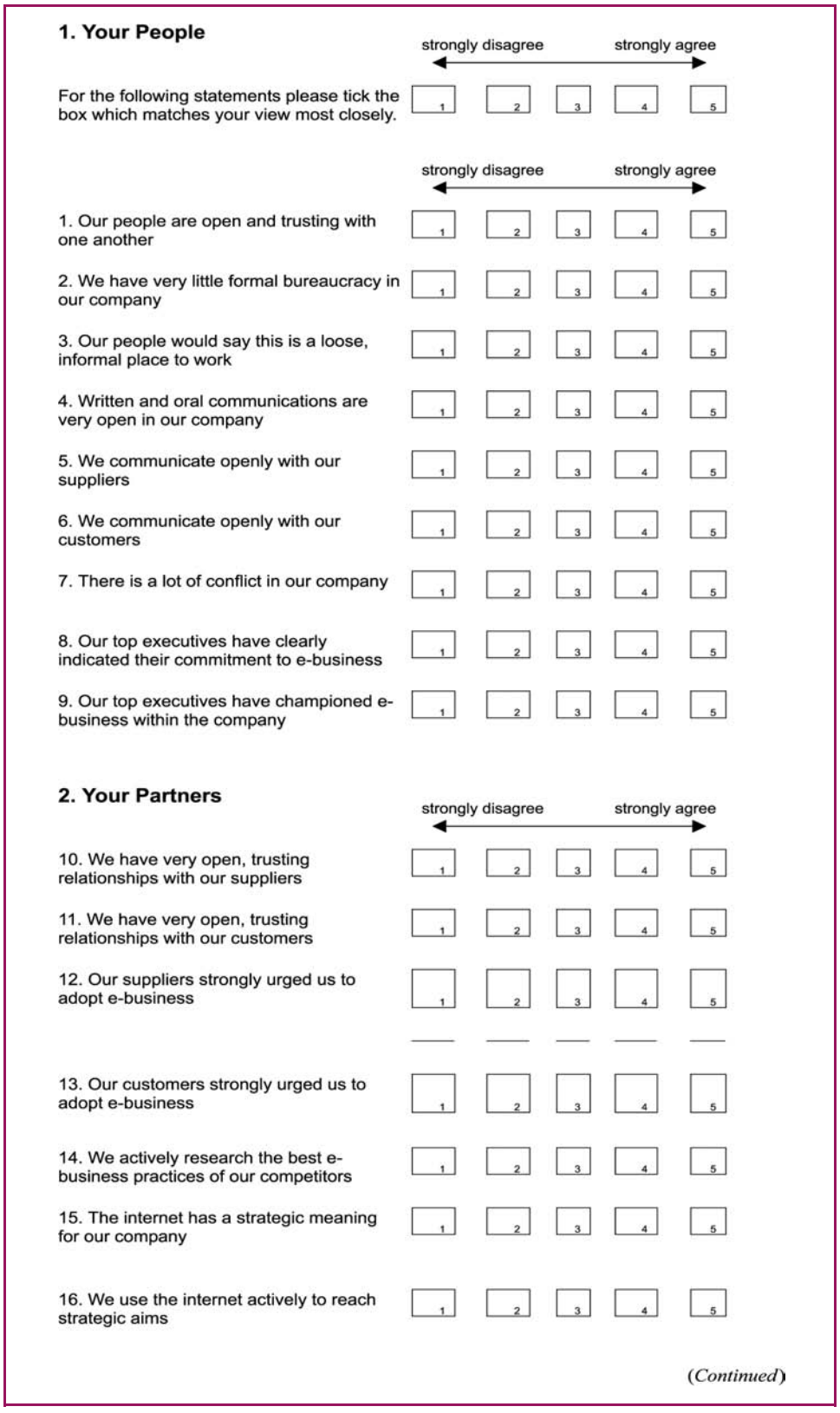
- Capabilities of coordination (Caloghirou *et al.*, 2004).
- Recognizing how customers can benefit from new technologies (Daniel and Wilson, 2003).
- Continuous adoption to shifting customer needs (Caloghirou *et al.*, 2004).
- Timely response to competitive strategic moves (Caloghirou *et al.*, 2004).
- Jettison of assets that create no more value (Eisenhardt and Martin, 2000).

The following questions were be divided into sub-questions:

- Capabilities of communication and coordination is divided into two questions because a company could have good communication and bad coordination skills or *vice versa*.
- Integration in new product development will be divided into customer integration and integration of the internet into business processes.

Appendix 2. The questionnaire

Figure A1



1. Your People

For the following statements please tick the box which matches your view most closely.

strongly disagree — strongly agree

	1	2	3	4	5
1. Our people are open and trusting with one another	☐	☐	☐	☐	☐
2. We have very little formal bureaucracy in our company	☐	☐	☐	☐	☐
3. Our people would say this is a loose, informal place to work	☐	☐	☐	☐	☐
4. Written and oral communications are very open in our company	☐	☐	☐	☐	☐
5. We communicate openly with our suppliers	☐	☐	☐	☐	☐
6. We communicate openly with our customers	☐	☐	☐	☐	☐
7. There is a lot of conflict in our company	☐	☐	☐	☐	☐
8. Our top executives have clearly indicated their commitment to e-business	☐	☐	☐	☐	☐
9. Our top executives have championed e-business within the company	☐	☐	☐	☐	☐

2. Your Partners

strongly disagree — strongly agree

	1	2	3	4	5
10. We have very open, trusting relationships with our suppliers	☐	☐	☐	☐	☐
11. We have very open, trusting relationships with our customers	☐	☐	☐	☐	☐
12. Our suppliers strongly urged us to adopt e-business	☐	☐	☐	☐	☐
13. Our customers strongly urged us to adopt e-business	☐	☐	☐	☐	☐
14. We actively research the best e-business practices of our competitors	☐	☐	☐	☐	☐
15. The internet has a strategic meaning for our company	☐	☐	☐	☐	☐
16. We use the internet actively to reach strategic aims	☐	☐	☐	☐	☐

(Continued)

Figure A1

	1	2	3	4	5
17. Overall, we have enough financial resources	☐	☐	☐	☐	☐

3. Your IT

	strongly disagree ◄				► strongly agree
18. Overall, our technical support staff is knowledgeable, when it comes to computer-based systems	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
19. Our firm possesses a high degree of computer-based technical expertise	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
20. We are very knowledgeable about new computer-based innovations	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
21. We have the knowledge to develop and maintain computer-based communication links with our customers	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
22. Our firm is skilled at collecting and analyzing market information about our customers via computer-based systems	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
23. We routinely utilize computer-based systems to access market information from outside databases	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
24. We have set procedures for collecting customer information from online sources	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
25. We use computer-based systems to analyze customer and market information	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
26. We utilize decision-support systems frequently when it comes to managing customer information	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
27. We rely on computer-based systems to acquire, store, and process information about our customers	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
28. Every year we budget a significant amount of funds for new information technology hardware and software	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
29. Our firm creates customized software applications when the need arises	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
30. Our firm's members are linked by a computer network	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

4. Inside Your Company

	strongly disagree ◄				► strongly agree
31. Overall, our management has expertise to conduct the major strategic moves	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
32. Overall, our employees have very good communication skills	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
33. Our management has expertise in coordinating internal processes and operations	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

(Continued)

Figure A1

34. The feedback of our customers helps us to improve our products and/or services	1	2	3	4	5
35. The internet has changed our processes significantly	1	2	3	4	5
36. Overall, our company acquires new knowledge effectively	1	2	3	4	5
37. Overall, our company reacts quickly to market changes	1	2	3	4	5
38. Overall, our company accumulates knowledge effectively	1	2	3	4	5
39. Our company recognizes how customers can benefit from new technologies	1	2	3	4	5
40. We have had problems integrating e-business applications in previous IT	1	2	3	4	5
41. Our strategic assets are hard to copy for our competitors	1	2	3	4	5
42. We continuously adapt to customers shifting needs.	1	2	3	4	5
43. We quickly respond to competitive strategic moves	1	2	3	4	5
44. We easily get rid of assets that have no more value	1	2	3	4	5

6. Your Performance

Strategic e-Business Performance

	strongly disagree ◄				► strongly agree
45. The internet has dramatically increased our productivity	1	2	3	4	5
46. The internet has improved our competitive position	1	2	3	4	5
47. The internet has dramatically increased our sales	1	2	3	4	5
48. The internet has dramatically increased our profitability	1	2	3	4	5
49. The internet has dramatically improved our overall performance	1	2	3	4	5

Financial Performance

	strongly disagree ◄				► strongly agree
50. Over the past 3 years, our revenues have been outstanding	1	2	3	4	5
51. Over the past 3 years, our revenues have exceeded our competitors	1	2	3	4	5
52. Over the past 3 years, our sales growth has been outstanding	1	2	3	4	5

(Continued)

Figure A1

53. Over the past 3 years, our sales growth has exceeded our competitors ☐1 ☐2 ☐3 ☐4 ☐5

54. Over the past three years, our return on assets has been outstanding ☐1 ☐2 ☐3 ☐4 ☐5

55. Over the past 3 years, our return on assets has exceeded our competitors ☐1 ☐2 ☐3 ☐4 ☐5

General Questions

56. How many full-time employees work in your company? ☐

57. What percentage of your revenue is created by e-commerce? ☐

58. What percentage of the goods and services you buy are ordered via the internet? ☐

59. What is your SIC-code? ☐

60. Are you a for-profit or a non-profit organization? For-profit ☐ Non-profit ☐

61. Is your company independent? (This means you have e.g. no parent company or you are not part of a franchising system). If no please also answer the following questions: Yes ☐ No ☐

strongly disagree ◄——► strongly agree

62. Our branch's human resource management is independent ☐1 ☐2 ☐3 ☐4 ☐5

63. Our branch manages the relationships to our stakeholders like e.g. customers, suppliers and business partners independent ☐1 ☐2 ☐3 ☐4 ☐5

64. Our branch's IT is independent ☐1 ☐2 ☐3 ☐4 ☐5

65. Our branch's strategic and operations management is independent ☐1 ☐2 ☐3 ☐4 ☐5

Appendix 3. Correlations

Table AI

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Relation	1															
2. Extedr	0.244*	1														
3. Benchma	0.065	0.464**	1													
4. Stratint	0.153	0.404**	0.508**	1												
5. Finre	0.147	0.345**	0.155	0.023	1											
6. Integr	0.366**	0.296**	0.260**	0.469**	0.292**	1										
7. Learning	0.395**	0.345**	0.327**	0.439**	0.291**	0.787**	1									
8. Reconfig	0.448**	0.276**	0.157	0.213*	0.451**	0.515**	0.540**	1								
9. ITknow	0.103	0.379**	0.374**	0.475**	0.192*	0.555**	0.555**	0.281**	1							
10. ITOPER	0.064	0.337**	0.563**	0.397**	0.221*	0.435**	0.481**	0.297**	0.561**	1						
11. ITobject	−0.041	0.225*	0.310**	0.334**	0.215*	0.395**	0.266**	0.235*	0.624**	0.591**	1					
12. MeanBR	0.382**	0.719**	0.734**	0.804**	0.320**	0.526**	0.553**	0.361**	0.500**	0.541**	0.335**	1				
13. MeanDC	0.462**	0.355**	0.287**	0.437**	0.397**	0.884**	0.891**	0.786**	0.557**	0.461**	0.355**	0.554**	1			
14. MeanIT	0.063	0.380**	0.522**	0.477**	0.251**	0.543**	0.533**	0.322**	0.831**	0.896**	0.816**	0.563**	0.547**	1		
15. SumIP	0.099	0.499**	0.555**	0.617**	0.130	0.431**	0.473**	0.198*	0.461**	0.479**	0.299**	0.707**	0.425**	0.507**	1	

About the authors

Brian Webb is a Senior Lecturer in Information Systems, School of Management and Economics, Queen's University of Belfast, Northern Ireland. He is a former Distinguished Erskine Fellow in the Department of Accounting, Finance, and Information Systems, Faculty of Commerce, University of Canterbury, New Zealand. He holds a Bachelor's degree from Queen's, an MBA from the University of Ulster and a PhD from University College London. In 1999 he was Visiting Scholar in the Department of Computer Science, University of British Columbia, Canada. Prior to becoming an academic he worked as a systems analyst in both the UK and the USA. Brian Webb is the corresponding author and can be contacted at: b.webb@qub.ac.uk

Frank Schlemmer is the owner-manager of a small independent retailer based in Nürnberg, Germany. He is also currently in the final stages of completing his doctoral studies at the Queen's University of Belfast. He has written a number of papers on the impact of IT and small firms and has previously published a book on performance management.