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Evolutionary patterns in e-business strategy

by

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EVOLUTIONARY PATTERNS IN E-BUSINESS STRATEGY

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ABSTRACT

In 2003 we investigated the level of adoption of e-business by manufacturing firms in Europe, identifying four strategies and analyzing them in terms of contingent factors and supply chain integration mechanisms. In this paper we replicate those analyses using the new release of the International Manufacturing Strategy Survey (IMSS IV), comparing new results with old ones. Data collected in Europe within IMSS III and IMSS IV are used. In particular, we cluster companies according to e-business practices adopted in supply chain management and compare the degree of adoption of e-business in the two samples. A longitudinal analysis using data from companies participating to both editions of the survey is also conducted. We show that the main underlying constructs remain valid, with a higher average level of adoption of e-business tools, but the four cluster model is no more valid, while three clusters emerge, characterized by different levels of adoption of e-business, but balanced between *e-commerce* and *e-procurement.* The paper shows that also small and medium firms in various industries today are starting adopting e-business. Results show that a balanced, cautious approach is preferred to radical adoptions, since some firms have even reduced their initial efforts.

Keywords: Supply Chain Strategy, Internet, Supply Chain Integration, Research Paper

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1. INTRODUCTION

Within the vast debate about supply chain management in the last decade of literature on Operations Management, many authors dealt with the topic of supply chain integration. The term, generally speaking, refers to the efforts put in place by firms in a broad variety of industries to improve their performance and those of the entire network they belong to, by mean of a closer interaction and even collaboration with customers, suppliers, partners and third parties in general.

The last decades have shown a rising interest towards the topic both in literature and in managerial practices and particular attention has been placed to the integration of the supply chain, the impact of this complex relationship and the mean by which it can be adopted. Relevant interest has been given to the role of ICT in supply chain management. Since the seminal works on this topic (i.e. Malone *et al.*, 1987), its importance has been proved significant and several contributions have discussed their impact on managerial practices and operational performances. In the last 10 years the Internet phenomenon has shown up and a vast amount of publications and studies has been developed to claim and prove the importance of this technology on Supply Chain Management practices. Even if several works have been published and several success cases have been provided, there is a lack of extensive contributions regarding the development of the Internet phenomenon in Supply Chain Management.

Cagliano *et al.* (2003) analysed the adoption of Internet technologies in supply chain processes by a large sample of European manufacturing firms participating in the third edition of the International Manufacturing Strategy Survey (IMSS III). Two years later, basing on new trends and economical scenarios, this article was updated (Cagliano *et al.*, 2005); the main elements seemed to remain valid, but no new data were available.

Today the fourth edition of the IMSS is available: the present paper aims to understand if the original modelling is still valid and which are the significant patterns that emerge from the comparison of the two editions of the survey.

The remainder of the paper is structured as follows: the next section will provide a review of contributions of current literature on supply chain integration and ICT; then research goals and methodology will be presented and findings from the empirical research will be provided. In the end a discussion of these results will be detailed and conclusions and future developments will be presented.

2. LITERATURE REVIEW

Supply chain integration

Supply chain integration can be seen as the natural evolution of approaches such as customer-supplier partnership (e.g. Lamming, 1993), i.e. the process of moving from an adversarial and arm's-length relationship to a more collaborative one. Typically the goal is to create and coordinate manufacturing processes seamlessly across the supply chain in a manner that most competitors cannot very easily match (Anderson and Katz, 1998; Lummus *et al.*, 1998 in Frohlich and Westbrook, 2001), thus shifting attention towards a supply chain based competition (Ronchi, 2003). Moreover, the general trend of decentralizing value-adding activities by outsourcing and developing virtual enterprises has strengthened the need of integration especially from the ICT point of view (Gunasekaran and Ngai, 2004).

Many contributions (e.g. Frohlich and Westbrook, 2001, Cagliano *et al.*, 2003; Devaraj *et al.*, 2007; Sanders, 2007; Harland *et al.*, 2007, Zhou and Benton, 2007) show that a higher level of integration provides better operational performance, thus suggesting that all firms should invest in this direction. Anyway, the effort in integrating with customers and suppliers should be always supported by a strategic and holistic view of the supply chain and of the systemic nature of interactions among participants (Power, 2005).

The topic is particularly challenging since it takes into account several issues; for example an extensively debated form of supply chain coordination is represented by contracts, which are considered a tool to align the objectives of the various actors (Cachon, 2003). However, adopting coordination contracts alone can hardly be considered as a form of integration; instead, it is a necessary tool to develop a deeper collaboration involving information, physical logistics and collaboration rights aspects (Power, 2005). Competences should be taken into account too (Rosenzweig and Roth, 2007) and organizational changes should be developed accordingly (Stank *et al.*, 2001; Vickery *et al.*, 2003; Sanders, 2007). The functions where deep collaboration generally takes place are research & development and production & logistics (e.g. De Toni and Nassimbeni, 1999). Great attention has been lately devoted to the integration also within production & logistics.

In this area, researchers have identified two complementary ways in which supply chain integration can be applied (Frohlich and Westbrook, 2001; Cagliano *et al.*, 2006): *information sharing* and *system coupling*. The former concerns exchanging information on market demand, inventories, production plans, delivery dates, etc. Lee *et al.* (1997) provide many

examples of information sharing as an effective instrument to face the bullwhip effect (Forrester, 1961).

The second type of integration, *system coupling*, is represented by coordinating physical activities, through mechanisms such as VMI, CPFR or JIT-Kanban to obtain a smooth material flow and a seamless supply chain (see for examples Childerhouse and Towill, 2003; Disney and Towill, 2003). From this point of view, an integrated supply chain offers the opportunity for firms to compete on the basis of speed and flexibility, while at the same time holding minimum levels of inventory in the chain (Power, 2005; Devaraj *et al.*, 2007).

The Internet in Supply chain management

Inside the supply chain integration sphere, great importance has been given to the subject of information integration by means of electronic tools. The adoption of electronic communication means between firms has been a relevant issue for several years (e.g., Malone *et al.*, 1987) and literature has provided several contributions on the role of ICT in SCM on different perspectives (see Gunasekaran and Ngai, 2004 and Power and Singh, 2007 for a review of contributions). Attention has been paid, from one side, to the objectives that force companies to invest in these technologies (e.g., Webster, 1995; Ho, 1996; Williams, 1997; Maloni and Benton, 1997). Other authors have focused on the possibility to build "virtual supply chains", thus having companies capable of changing the network structure and the echelons of the chains (e.g., Webster, 1995; Voss, 1996). Other contributions have also considered the problems that arise in ICT implementation in SCM both from a technological (e.g., Pawar and Driva, 2000) and organizational point of view (e.g., Ho, 1996).

In the last ten years, however, great attention has been paid to the role of Internet based tools for the increase of information sharing in the supply chain context. Several authors have debated on the importance of these tools in business to business transactions (e.g. Evans and Wurster, 1999; Skjoett-Larsen, 2000; Kehoe and Boughton, 2001; Ronchi, 2003, Croom, 2005; Kouvelis *et al.*, 2006, Cagliano *et al.* 2003; Devaraj *et al.*, 2007; Sanders, 2007; Harland *et al.* 2007, Zhou and Benton, 2007), aiming to understand the particular e-business phenomenon specifically within supply chain management.

Several authors claim and provide evidence that the Internet allows to better manage supply chain activities. Transaction costs are reduced thus allowing to develop new relationships between companies (Croom, 2001; Ronchi, 2003; Barratt and Oke, 2007); the bullwhip effect can be reduced or at least controlled better (Elliman and Orange, 2000; Emiliani, 2000;

Olhager and Sellin, 2003); purchasing performances can be improved (McIvor *et al.*, 2000); the flow of information along the supply chain can be easily transferred thus helping in being more responsive (Naylor *et al.* ,1999; Feeny, 2001; Murillo, 2001; Aviv, 2001, Kulp *et al.*, 2004; Devaraj *et al.*, 2007)

Other authors have focused on the different processes that can be improved by the use of the Internet; thus we have *e-commerce* when the Internet supports sales and distribution (Brynjolfsson and Smith, 2000; Lancioni *et al.*, 2000; Frohlich and Westbrook, 2002; Zhu and Kramer, 2002; Zhu *et al.*, 2004; Barua *et al.*, 2004; Johnson *et al.*, 2007; Devaraj et al, 2007), *e-procurement* and *e-sourcing*, when we consider procurement, order fulfilment and sourcing activities (De Boer *et al.*, 2002; Zhu and Kramer, 2002; Poirier and Quinn, 2003; Barua *et al.*, 2004; Devaraj et al, 2007); *e-collaboration* when we consider capacity planning, demand forecasting, inventory management (Lee and Whang, 2001; Frohlich and Westbrook, 2002; Hill and Scudder, 2002; Poirier and Quinn, 2003; Barua *et al.*, 2004; Devaraj et al, 2007). Several tools have been developed in order to support these new processes (e.g., auctions, marketplaces, catalogues, etc.), thus allowing to cope with different needs and objectives.

E-business strategy has been conceptualized to highlight the important role that the Internet plays in defining the competitive advantage of companies. From a Supply Chain Management point of view the definition of an e-business strategy refers to how Internet tools are used according to the specific integration a company seeks to introduce. Literature has devoted significant attention to the impact of e-business strategy in terms of operational performances and organizational structure (e.g., Croom, 2001; Sampler, 1998; Ronchi, 2003; Bagchi and Skjoett-Larsen, 2003; Power, 2005). Research on this issue has resulted in inconsistent results, claiming that as Sanders (2007) suggests: "...a productivity paradox exists (Lim er al. 2004; Sriram and Stump, 2004)". Several explanations have been proposed for this phenomenon. Some contributions claim that the impact of ICT technologies is not directly related to performances, since they only enable particular forms of cooperation along the supply chain which have a positive effect on operations (Sanders, 2007; Devaraj *et al.*, 2007). Companies may not be able to promptly evaluate benefits of Internet technologies, since their competences and organizational structures need time to adapt to the new tools and new processes (Power and Singh, 2007) and since there is a time lag between IT investments and their impact on performances (Devaraj and Kohli, 2003). Some authors have also considered that the impact of ICT technologies changes according to the presence of specific enablers such as cross-functional teams (Robey *et al.*, 2002) and purchasing teams (Ellram and

Pearson, 1993; Giunipero and Vogt, 1997; Johnson *et al.*, 2007). Also management's failure to exploit full potential of IT has been considered (Dos Santos and Sussman, 2000) and ineffective implementation may be another reason too (Stratopoulos and Dehing, 2000). These may be some of the reasons why some companies may decide to change the degree of adoption of these tools over time.

The diffusion of the Internet as a SC integration mean

Even if literature has significantly contributed to the debate on the role of the Internet in SCM, fewer contributions can be found regarding the diffusion of internet based tools in supply chain management and supply chain integration practices (Bagchi *et al.*, 2005). According to Cagliano *et al.* (2005), the literature seems to focus mainly on specific Internet-based tools (auctions, catalogues, e-commerce, etc.) in specific contexts.

Looking at some recent industry outlooks (Bertelè *et al.*, 2005; Forrester Research, 1999; Lee and Barua, 1999; Boyer and Olson, 2002; Zhu and Kraemer, 2002; Barua *et al.*, 2004), it emerges that exchanges through these instruments are having today a positive rate of growth. More specifically, Internet based exchanges seem to have a faster growth than traditional electronic systems. Some contributions try then to provide some evidence regarding what companies are doing and highlight the existence of relevant gaps between scientific literature and companies practices (Fawcett and Magnan, 2002). McAdam and McCormark (2001) claim that frequently integration in the supply chain is limited to dyadic relationships (i.e. customer-supplier interface). Kemppaien and Vepsalainen (2003) show that within Finnish companies there is a limited adoption of information sharing tools. Olhager and Selldin (2003) provide evidence on Swedish companies of a focused use of IT tools on specific supply chain activities. Matapoulos *et al.* (2007) show that the impact of internet based tools on supply chains changes significantly among different industrial sectors.

Among all these contributions, Cagliano *et al.* (2003) provide important evidence based on the IMSS III questionnaire, collected in 2001, regarding how companies are shaping their supply chain through the internet. In this work the pattern of adoption of e-business tools was taken into account in order to identify which strategies where adopted and their impact of supply chain collaboration. However this work was based on data collected during 2001, right when the Internet phenomenon reached the "peak of inflated expectations" of the well-known Gartner's hype cycle (www.gartner.com). Immediately afterwards, the fall of the Nasdaq and of many Internet based firms lead to the "trough of disillusionment" (Cagliano *et al.*, 2005).

Since then, the "slope of enlightment" started, making the adoption of internet based tools proceed more slowly but more firmly. Thus the implementation of internet technologies may have changed in the last few years, and the distribution of e-business strategies may differ substantially. Moreover, as some authors claim, some companies are dissatisfied with the performances of business technologies (Poirier and Quinn, 2003; Zhu and Kraemer, 2002) .This is due to the lack of competences companies had when they first invested in Internet technologies and to specific process improvement programs needed to adapt the organization to the new tools. These elements both reduce the positive impact of internet technologies on processes and need also some time in order to provide results (Stank *et al.*, 2001). This has forced companies to change their approach towards e-business as soon as the cost and benefits trade-off of internet applications has been clearly understood (Sanders, 2007; Devaraj *et al.*, 2007). From this point of view, only limited contributions can be found regarding whether companies have changed their e-business strategy over time (e.g., Harland *et al.*, 2007) and there is a complete lack of extensive researches on this issue.

3. RESEARCH GOALS AND HYPOTHESIS

The goal of this paper is to analyse the diffusion of the Internet over time so to evaluate how companies are investing in Internet-based tools to manage their supply chain. Specifically, we aim to replicate the analysis performed on the IMSS III data collected in 2001 (Cagliano *et al.*, 2003), in order to investigate whether the pattern of adoption of e-business tools has changed in the last four years. Replication is a fundamental part of the scientific process (see Frohlich and Dixon, 2001, for a review): theory building must be followed by rounds of verification and elaboration (Flynn *et al.*, 1990). In particular, a new and fast evolving issue, such as e-business, needs to be frequently monitored both to test the robustness of initial findings and to identify evolutionary trends.

Several authors claim that exchanges and supply chain integration by means of internet based tools is increasing (Bertelè *et al.*, 2005; Forrester Research, 1999; Lee and Barua, 1999; Boyer and Olson, 2002; Zhu and Kraemer, 2002; Barua *et al.*, 2004). Literature assumes that after the "peak of inflated expectation" was reached, the adoption of information technologies proceeds firmly (Cagliano *et al.*, 2005) even if it may change between different countries (Kemppaien and Vepsalainen, 2003; Olhager and Selldin,2003) and different industrial

sectors (Matapoulos *et al.*, 2007). Given the previous contributions we formulate the following proposition:

P1: *The level of adoption of internet based tools within supply chain relationships has increased over time*

Literature suggests that the impact of the different tools depend from several contingent factors such as the existence of specific kinds of teams (Giunipero and Vogt, 1997; Robey *et al.*, 2002; Johnson *et al.*, 2007), the possibility of developing specific forms of cooperation along the supply chain (Sanders, 2007; Devaraj *et al.*, 2007), companies competences and organizational structures (Power and Singh, 2007). This claims that different companies will invest differently in the use of Internet technologies within the supply chain.
In Cagliano *et al.* (2003) it was provided evidence that companies had invested differently in e-business tools. Based on IMSS III data, four e-business strategies were identified; these were named *Traditionals* (i.e. no use of e-business), *e-Sellers* (use of *e-commerce* only), *e-Purchasers* (use of *e-procurement* only), and *e-Integrators* (joint use of *e-commerce*, *e-procurement* and *e-operations*). Two years later, basing on new trends and economical scenarios, this article was updated (Cagliano *et al.*, 2005); the main elements seemed to remain valid, but no new data were available. Thus we formulate the following proposition:

P2: *The four e-business strategies, namely Traditionals, e-Sellers, e-Purchasers and e-Integrators are confirmed.*

Even if alternative strategies remain stable over time some companies may have changed their own e-business strategy, i.e. moving from one cluster to another. However, Cagliano *et al.* (2003) showed that firms, at that time, were planning to increase their efforts towards e-business, but without changing their strategy. This means that *e-Sellers* declared that they were going to adopt Internet tools mainly with customers (*e-commerce*); *e-Purchasers* were continuing to use *e-procurement* more than anything else; *e-Integrators*, finally, were going to use intensively e-business with both customers and suppliers. For these reasons we formulate the following proposition:

P3: *Firms are adopting the same e-business strategy over time*.

4. METHODOLOGY

Sample

In order to investigate the above research questions, data have been collected within the fourth edition of the International Manufacturing Strategy Survey, a research project carried out in 2005 by a global network (IMSS IV), and compared with those collected in 2001 (IMSS III). This project, originally launched by London Business School and Chalmers University of Technology, studies manufacturing and supply chain strategies within the assembly industry (ISIC 28-35 classification), through a detailed questionnaire that is administered simultaneously in many countries by local research groups; responses are gathered in a unique global database (Lindberg *et al.*, 1998). In order to gain a longitudinal perspective, we compare data collected within two subsequent releases of the same research project, which are very similar, despite single respondents may not be the same. We consider this choice suitable, since our main goal is not to study individual firms, but rather to compare two similar samples, in the same industry and economic areas. Besides, a sub-set of firms participated to both editions of the research, thus allowing us also to investigate the same companies over time (strict longitudinality). Coherently with Cagliano *et al.*, 2003, research propositions have been tested on the basis of the IMSS III and IV European sub-samples, which consist respectively of 338 and 423 firms from 8 and 13 countries, with an average response rate of 34% and 14%. The usable sample included respectively 276 and 357 firms, which provided enough information for the purpose of this study. The distribution of the sample in terms of country ("a" tables), industry ("b" tables) and size ("c" tables) is shown in the next tables. Table I (a,b,c) refers to the IMSS III (2001) sample; table II (a, b, c) uses the new IMSS IV (2005) data. The industry type is identified through the ISIC code (Table III). Because the ISIC code has been lately reviewed, we had to recode the new sample (encoded with the old ISIC classification rev. 2) with the new coding (ISIC classification rev. 3.1) to make the two samples comparable.

The longitudinal sub-sample consists of 47 firms belonging to both IMSS III and IV samples. They are described in terms of country, industry and size in table IV.

Table I a,b,c – Distribution of the IMSS III sample in terms of country, industry, size

(a)

Country	n	Percent
Denmark	34	6.9%
Germany	28	5.7%
Hungary	53	10.8%
Ireland	27	5.5%
Italy	55	11.2%
Norway	20	4.1%
Spain	17	3.5%
UK	42	8.6%
Total	276	100.0%

(b)

ISIC	N	Percent
28	77	27.9%
29-30	75	27.2%
31-32	73	26.4%
33	21	7.6%
34-35	30	10.9%
Total	276	100.0%

(c)

Size*	n	Percent
Small	135	48.9%
Medium	56	20.3%
Large	85	30.8%
Total	276	100.0%

* Small: less than 250 employees
Medium: 251-500 employees
Large: over 501 employees

Table II a,b,c – Distribution of the IMSS IV sample in terms of country, industry, size

(a)

Country	n	Percent
Belgium	28	7.8%
Denmark	29	8.1%
Estonia	18	5.0%
Germany	14	3.9%
Greece	7	2.0%
Hungary	53	14.8%
Ireland	12	3.4%
Italy	38	10.6%
Norway	16	4.5%
Portugal	9	2.5%
Sweden	66	18.5%
Netherlands	54	15.1%
UK	13	3.6%
Total	357	100.0%

(b)

ISIC	N	Percent
28	131	36.8%
29-30	81	22.8%
31-32	79	22.2%
33	19	5.3%
34-35	46	12.9%
Missing	1	
Total	357	100%

(c)

Size*	n	Percent
Small	197	55.2%
Medium	90	25.2%
Large	70	19.6%
Total	357	100.0%

* Small: less than 250 employees
Medium: 251-500 employees
Large: over 501 employees

Table III – Table of correspondence between ISIC code Rev 3.1 and industry description

ISIC Code	Industry description
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment not elsewhere classified
30	Manufacture of office, accounting and computing machinery
31	Manufacture of electrical machinery and apparatus not elsewhere classified
32	Manufacture of radio, television and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semi-trailers
35	Manufacture of other transport equipment

Table IV – Distribution of the longitudinal IMSS III and IV sample in terms of country (a), industry (b), size (c)

(a)

Country	n	Percent
Denmark	4	8.51%
Germany	7	14.89%
Hungary	9	19.15%
Ireland	8	17.02%
Italy	11	23.40%
Norway	1	2.13%
UK	7	14.89%
Total	47	100.00%

(b)

ISIC	N	Percent
28	12	25.53%
29-30	12	25.53%
31-32	17	36.17%
33	5	10.64%
34-35	1	2.13%
Total	47	100%

(c)

Size*	n	Percent
Small	15	31,91%
Medium	6	12,77%
Large	26	55,32%
Total	47	100,00%

* Small: less than 250 employees
Medium: 251-500 employees
Large: over 501 employees

Measures

In order to replicate the analysis of the previous work, we had to build the same constructs with the new data, checking their validity and reliability. We used principal component analysis with *varimax rotation* to obtain the measures for e-business adoption.

We used again exploratory factor analysis because the questions related to e-business were not identical to those used in the previous release, due to the evolution of the concept in recent years. In particular, the questions related to the use of the Internet in supporting internal operations of the company (i.e. production planning and scheduling, inventory management) were no more included, since today they are no more considered part of the e-business concept, while they are often included in ERP suites. Questions related to the different Internet-based tools used to interact with customers and suppliers were available (answers which were measured on 1-5 likert-like scale). The factor analysis highlighted the existence of a single construct referring to each side of supply chain relationships, which have been coherently named *e-commerce* and *e-procurement* (Table V). In the *e-commerce* factor, the item "collaboration support services" had a low value of the factor loading, therefore it has been eliminated from subsequent analysis. The high values of Cronbach's Alpha confirm the reliability of these constructs (DeVellis,1991; Nunnally, 1994).

Cluster building

The original clusters of e-business strategy were identified through a two-step cluster analysis, in order to identify the most appropriate number of clusters first, and then assign each firm to the closest one (Cagliano *et al.*, 2003). The four clusters (*Traditionals, e-Sellers, e-Purchasers and e-Integrators*) were originally based on three variables (*e-procurement, e-operations, and e-commerce).* Since we no more have a *e-operations* construct, we will use

only the *e-procurement* and *e-commerce* ones. We performed the same two-step cluster analysis on the IMSS III sample using only the *e-procurement* and *e-operations* and we obtained the same four clusters also without the *e-operations* variable. As done in the past, we used first a hierarchical cluster analysis with the Ward Method and Squared Euclidean Distance to identify the natural number of clusters, subsequently we assigned each firm to a cluster using the K-means algorithm.

We used the same method to cluster the IMSS IV sample, on the base of the two *e-procurement* and *e-operations* constructs.

In Cagliano *et al.* (2003) the relationship between e-business strategy and contingent factors (industry, size and position in the supply chain) was also tested, showing that only industry had a significant relationship with the distribution of the sample among the four clusters. We tested this relationship also with IMSS IV data, but no significant effect was found, meaning that there is no impact of contingent factors such as industry, size and position in the supply chain on the choice of the e-business strategy adopted by the firm. Detailed data on this issue are not presented for briefness sake.

Table V – Factor analysis of the e-business practices with suppliers and customers

	e-business with suppliers		e-business with customers	
Item Name	e-procurement	Mean	e-commerce	Mean
Scouting/ pre-qualify	**0.699**	2.610	**0.569**	1.720
Auctions	**0.535**	1.604	**0.755**	2.862
RFx	**0.739**	2.847	**0.850**	2.488
Data analysis	**0.772**	2.527	**0.594**	2.680
Access to catalogues	**0.664**	3.017	**0.749**	2.883
Order management and tracking	**0.714**	2.827	**0.827**	2.402
Content and knowledge management	**0.749**	2.317	**0.810**	2.465
Collaboration support services	**0.771**	2.325	0.300	2.767
Eigenvalue	4.022		3.960	
Total Variance explained (%)	50.276		49.503	
Cronbach's alpha	0.856		0.859*	
Factor Mean	2.511		2.506*	

* Calculated without "Collaboration support service" item

Longitudinal analysis

We tested our findings on a sub-set of firms participated to both editions of the research, thus allowing us also to verify if common emerging trends and strategies are really put in practice by single firms.

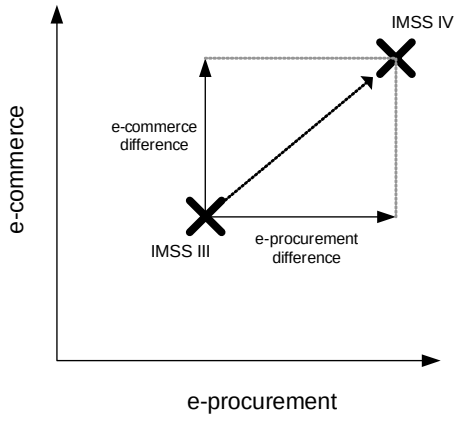
First of all we tried to understand if the sub-sample could be representative of the entire population. We assessed this by comparing the sub-sample *e-procurement* and *e-commerce*

levels of adoptions and trends with those of the overall sample. Results show aligned values in e-business adoption and a similar trend in increasing of e-business use compared with the entire population, claiming that the sub-sample seems to be representative of the entire population.

Next we highlighted general patterns and strategies observing the firms movements from old (IMSS III) to new (IMSS IV) clusters.

To evaluate the robustness of these trends, we considered *e-commerce* and *e-procurement* adoption as the two axes of a Cartesian plan. In this plan, a strategy can be defined as the path between the starting and the ending point of a firm. In our case, for each firm in the sub-sample we had only a starting point (IMSS III coordinates) and an ending point (IMSS IV coordinates). In this way we can break down every strategy in the two components: the *e-commerce* difference and *e-procurement* difference (Figure 1). The principal axes arrows show the sign of these differences (e.g. a horizontal right movement express a positive difference in *e-procurement* and, by consequence, an increase in its adoption). After calculating the *e-procurement* and *e-commerce* differences for each case, we finally evaluate the statistical significance of firms movements (i.e. strategies) according to the starting (IMSS III) cluster they belonged to.

Figure 1- Example of e-business strategy with positive differences in e-procurement and e-commerce adoption.



5. RESULTS

E-business adoption

By comparing the means of the e-business constructs (factors) between IMSS III and IV releases, we can notice a slight increase: *e-commerce* has moved from 1.94 to 2.51, and *e-procurement* from 1.90 to 2.51. The ANOVA in Table VI shows that these differences are significant at $p<0.001$ level. Therefore we can conclude that proposition P1 is confirmed by the data.

Table VI – ANOVA of the adoption of e-business constructs between IMSS III and IV

Cluster*	IMSS III	IMSS IV	ANOVA Sig.
E-commerce	1,903	2,509	0.000
E-procurement	1,944	2,506	0.000

In absolute terms, the average adoption of e-business in general (i.e. both *e-commerce* and *e-procurement*) is still low, confirming what has already been highlighted by industry outlooks. After the initial enthusiasm of the new-economy boom, the subsequent "trough of disillusionment" (Gartner Group) has cooled down both expectations and investments. This can be related also to the difficulty in perceiving the benefits of such investments. Literature argues that benefits of Internet technologies may not be identified promptly for different reasons: there is a time lag after which ICT investments have an impact on performance (Devaraj and Kohli, 2003), competences and organizational structures need time to adapt to the e-business strategy (Power and Singh, 2007), some enabling elements have to be developed, such as cross-functional teams (Robey *et al.*, 2002) and purchasing teams (Ellram and Pearson, 1993; Giunipero and Vogt, 1997; Johnson *et al.*, 2007).

However, our data show that a slight increase in adoption has actually taken place, confirming what recent researches also showed (Bertelè *et al.*, 2005; Forrester Research, 2007). Adopting again the Gartner's terminology, firms are now slowly climbing the "slope of enlightenment", i.e. adopting e-business solutions with gradual and focused investments, without radical innovations in their business processes, but rather opting for an incremental approach. Clearly these are average values, i.e. they are the result of the combination of firms with very different levels of adoption, ranging from no use of any internet based tool at all, to intensive and pervasive adoption of all available tools. While considering the average values provides a snapshot of the sample as a whole, which is an interesting picture of the general situation, it is

much too aggregate to investigate different patterns and strategies within the e-business domain. In particular, the average values are almost identical for both *e-commerce* and *e-procurement*, but this is not enough to conclude that they are adopted together. Previous studies (Cagliano *et al.*, 2003) showed that firms often adopted internet base tools with only customers or suppliers, although average values were very similar.

E-business strategies

Table VII shows the distribution of the IMSS III and IV samples in the clusters, and the related cluster centres.

Table VII - Distribution of the IMSS III and IV samples in the various clusters (Cluster numbering: 1 = Traditionals; 2 = e-Sellers; 3 = e-Purchasers; 4 = e-Integrators; A = low adopters; B = partial adopters; C = full adopters) Number in brackets show significantly different clusters at p<0.05 with Scheffè method.

	IMSS III					IMSS IV			
Cluster	1	2	3	4	ANOVA Sig.	A	B	C	ANOVA Sig.
E-commerce	1.33	3.10	1.73	4.25	0.000	1.70	2.71	3.37	0.000
Pairwise difference	(2;3;4)	(1;3;4)	(1;2;4)	(1;2;3)		(B;C)	(A;C)	(A;B)	
E-procurement	1.32	1.85	3.42	4.14	0.000	1.55	2.64	3.71	0.000
Pairwise difference	(2;3;4)	(1;3;4)	(1;2;4)	(1;2;3)		(B;C)	(A;C)	(A;B)	
Number	153	64	39	20		124	150	182	
Percent	55.43%	23.19%	14.13%	7.25%		27.19%	32.89%	39.91%	

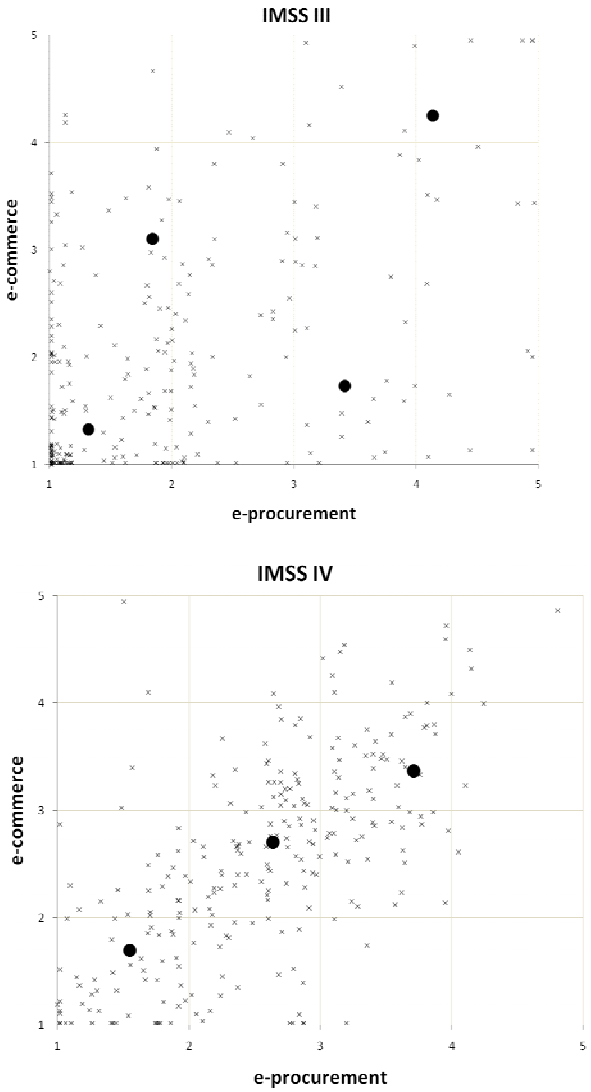
First of all it can be noted that the new sample does not cluster into four groups as the old one, but into three groups only. More precisely, there are no more mono-directional strategies, i.e. *e-Purchasers and e-Sellers* no more exist. On the contrary, the three clusters emerging from IMSS IV data are characterized by the adoption of both *e-commerce* and *e-procurement*, at three different levels. We also verified that if 4 clusters are imposed results are significantly different compare to the clusters emerging from IMSS III: the four cluster identified are still characterized by the adoption of both strategies at different levels of adoption.

The *low adopters* cluster is very similar to the old *Traditionals* group, being formed by companies with very low values of both *e-commerce* and *e-procurement*. This group accounts for the 27% of the whole sample. The *partial adopters* cluster is formed by firms with intermediate levels of adoption of both *e-commerce* and *e-procurement*, which is a strategy that we did not find in the previous release of the survey. This group accounts for 33% of the whole sample. Finally, the *high adopters* cluster is formed by firms with quite high values of e-business adoption with both customers and suppliers, similarly to the *e-Integrators* group of

the previous release. It should be noted however that this cluster accounts for 40% of the total sample, while in the past it was only the 7%. This explains also why cluster centres have slightly lower values in the new release, since this group includes a quite broad range of firms, not only "extreme" adopters.

The first result that emerges from the clustering is that the four strategies identified four years ago are not confirmed by new data, thus leading to reject proposition P2. This result emerges also from the observation of the dispersion of firms in the two samples (figure 2). It can be seen clearly that firms have moved towards similar values of *e-commerce* and *e-procurement*.

Figure 2 - Distribution of firms according to e-commerce and e-procurement in both IMSS III (left) and IMSS IV (right) samples (larger dots represent cluster centres)



At the same time, the number of firms that do not adopt any form of e-business (score 1 on both dimensions) is highly diminished from the old to the new sample, although a high

number of low adopters remain. At the same time, the number of firms with extremely high levels of adoption (score 5 on both dimensions) is very limited in both samples. It is clear that the highest concentration of firms has moved from the bottom left corner of the table to the centre, meaning a diffused low to medium adoption of e-business, as previously inferred by observing the average values. This result confirms again proposition P1.

This result is definitely interesting, since it casts new light on the average increase in e-business adoption that we discussed so far. Despite firms in the last years have increased only marginally their use of internet based tools to manage supply chain relationships, they definitely changed their e-business strategies, in particular those who initially opted for a mono-directional one. This result suggests that firms have evolved their strategies towards more balanced ones, in order to exploit e-business benefits in all their supply chain relationships. This change in strategies seems to be related in particular to the maturity of both firms and internet based solutions, since today almost no firm adopts either *e-commerce* or *e-procurement* alone. Indeed, when companies at first invest in new technologies, they may not be completely aware of what they need to fully exploit these technologies and they need to adapt their strategy to the contingencies of their particular situation. This may also be influenced by the inexperience of management in IT investments (Dos Santos and Sussman, 2000; Stratopoulos and Dehning, 2000) and poor performance measures (Bharadwaj *et al.*, 1999). Moreover, bidirectional strategies may be more effective than "pure" ones.

From a research perspective, we can conclude that the modelling proposed by Cagliano *et al.* in 2003 is no more valid, confirming the perception that e-business is still a rather new and evolving concept, not yet consolidated.

Evolution of e-business strategies

The 47 strictly longitudinal firms have been analyzed singularly to investigate the evolution in their e-business strategies. Table VIII shows the distribution of the sub-sample in the IMSS III and IV clusters. Figure 3 shows the distribution of the sub-sample in the two editions of the research.

Although the subsample accounts for a limited portion of the overall sample, it can be noticed that the distribution is similar: in IMSS III there was a predominance of *Traditionals* as in the overall sample, while in IMSS IV firms have grouped along the diagonal and moved towards the centre of the graph (*partial adopters*). To confirm again that the sub-sample is

representative, we can observe that it shows aligned values in e-business adoption and a similar trend in increasing of e-business use compared with the entire population (Table IX).

Table VIII - Distribution of the longitudinal subsample in the IMSS III and IV clusters

	Cluster IMSS IV			
Cluster IMSS III	Low adopters	Partial adopters	Full adopters	Total
Traditionals	10	16	2	28
e-Purchasers	5	3	4	12
e-Sellers	3	1	2	6
e-Integrators	0	1	0	1
Total	18	21	8	47

Figure 3- Distribution of longitudinal firms according to e-commerce and e-procurement in both IMSS III (left) and IMSS IV (right) samples

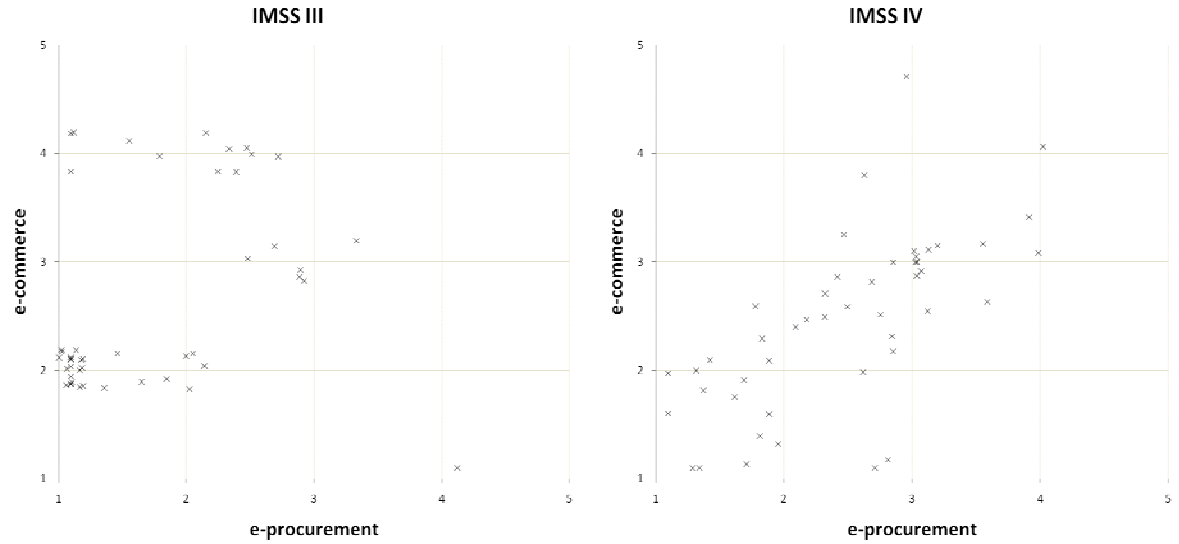


Table IX – ANOVA of the adoption of e-business constructs between IMSS III and IV in the longitudinal sample and in the overall population.

Longitudinal sample	IMSS III	IMSS IV	ANOVA Sig.
E-commerce	1,689	2,434	0.000
E-procurement	1,950	2,497	0.003
Population			
E-commerce	1,903	2,509	0.000
E-procurement	1,944	2,506	0.000

Moving back to table VIII, we can observe that the large group of *Traditionals* has been characterized by different evolutionary paths: one-third remained *low adopters*, while more than half has moved to *partial adopters*, and only 2 firms have become *full adopters*.

Although we cannot generalize this result, it seems to confirm the hypothesis that many non adopters or low adopters of IMSS III have evolved towards an intermediate adoption of e-business with both customers and suppliers.

Instead, firms that were adopting mono-directional strategies (*e-Purchasers* and *e-Sellers*) in IMSS III have evolved towards a bi-directional adoption of e-business, but with different paths. Almost half of them are now *low adopters*, meaning that they have reduced their efforts towards e-business, apparently unsatisfied by the results obtained. A few of them have become *partial-adopters*¸ thus balancing their efforts in both directions, while one-third of them have extended their investments becoming *full adopters*. Finally, we have only one firm that in IMSS III was an *e-Integrator*, which in IMSS IV has moved back to *partial adopters*.

To evaluate more analytically these findings, we analyzed for each case the differences between IMSS III and IMSS IV levels of *e-commerce* and *e-procurement* adoption. Next we compared these values between groups of cases defined according to the original cluster they belonged to. Because of the single item in the *e-integrators* cluster we cannot perform statistical analyses on it. Results in table X confirm the trends previously emerged.

Table X - Distribution of the e-commerce and e-procurement differences according to IMSS III clusters. Number in brackets show significantly different clusters at p<0.05 with Scheffè method.

Cluster	Traditionals (1)	e-Sellers (2)	e-Purchasers (3)	e-Integrators (4)	ANOVA Sig.
E-commerce diff.	1.069	-0.347	0.753	NA	0.006
Pairwise difference	(2)	(1)		NA	
E-procurement diff.	1.011	1.062	-0.726	NA	0.000
Pairwise difference	(3)	(3)	(1;2)	NA	
Number	28	6	12	1	
Percent	59.57%	12.77%	25.53%	2.13%	

First of all the ANOVA significance with $p<0.05$ demonstrates that clusters have moved differently on each dimension (i.e. *e-commerce* and *e-procurement*). Looking at the means, *Traditionals* have increased of about 1 point (on 5) both the adoption of *e-commerce* and *e-procurement*. *E-Sellers* followed this trend on *e-procurement* (1.06), but at the same time have decreased their investments in *e-commerce* (-0.35). Vice versa, *e-Purchasers* have increased a little bit less (0.75) their *e-commerce* capability, but reducing consistently the *e-procurement* one (-0.72).

We can conclude that also proposition P3 is rejected, since single firms are significantly changing their e-business strategies, by moving out from mono-directional strategies towards bi-directional ones, and also changing their level of adoption, generally towards a higher level, but sometimes even towards a lower one.

This result further supports previous ones, by showing that differences among the two complete samples are not related much to their different composition, but rather to actual changes in e-business adoption strategies, since also the strictly longitudinal sub-sample shows similar patterns. Firms are indeed modifying their decisions regarding e-business, confirming that differences among them are related to the level of adoption, which is much more wide spread than in the past, rather than to the direction of adoption, which is instead almost always symmetrical.

In order to further investigate the evolution of e-business strategies in terms of both *e-commerce* and *e-procurement*, we have mapped in table XI the longitudinal sub-sample according to whether the efforts have decreased, increased or remained stable (differences lower than 0.5 in absolute value). This last analysis allows us to investigate how firms have modified their strategies by considering both *e-commerce* and *e-procurement* at the same time. Almost half of the sample has increased the efforts in both directions, has seen in the overall distribution, while only 2 firms have decreased their efforts with both customers and suppliers. However, it is interesting to notice that several firms adopted asymmetric policies, by increasing efforts in one direction while remaining stable or even decreasing in the other. This fact explains how the firms balanced their strategies, without necessarily increasing their total investments. This result suggests that firms in the last years have adopted a pragmatic and cautious approach to e-business, avoiding extreme investments but trying to exploit benefits along the whole supply chain.

Table XI – Evolution of e-business adoption in the longitudinal sub-sample (firms whose values changed no more than +/- 0.5 are considered stable)

	E-commerce		
E-procurement	Decrease	Stable	Increase
Decrease	2	3	3
Stable	4	4	5
Increase	1	4	21

This is a further confirmation that firms have indeed changed their e-business strategies, thus again leading to reject proposition P3. Besides, despite the overall average increase in the

level of adoption which is emerging also from this sub-sample, some counter-tendency shifts can be clearly observed. They can be related to unsatisfying results obtained from initial efforts, but also to the increased maturity achieved through usage, which allows to identify the areas where benefits are greater and thus to focus adoption only where it is worthwhile.

6. DISCUSSION

In this paper we have replicated the analysis on e-business strategy performed in 2003 with IMSS III data, using similar data from the new release of the same research project (IMSS IV – 2005).

First of all results confirmed our first proposition, i.e. that the level of e-business adoption has increased on average, as other sources also have shown. This claims for a growing relevance of the e-business phenomenon, beyond short-term fashion and hype: Internet based tools are now, slowly but steadily, spreading across firms in different industries and contexts, reshaping supply chain management strategies and practices.

However, results have not confirmed the modelling proposed four years ago: although the main constructs of e-business (i.e. *e-commerce* and *e-procurement*) are still valid, the four e-business strategies (*Traditionals, e-Purchasers, e-Sellers, e-Integrators*) are no more adopted by manufacturing firms in Europe. Instead, three clusters emerged from the new data, namely *low adopters, partial adopters* and *full adopters.* Despite the different level of adoption, all three groups are characterized by a balanced use of e-business with both customers and suppliers (i.e. *e-commerce* and *e-procurement*). These results suggested an evolutionary trend in the process of e-business adoption, which shows two distinct features: on the one hand, a reduction in the number of low adopters, which are still a relevant portion of the sample, but smaller compared to four years ago. On the other hand, today the integrated adoption of e-business both up- and down-stream has taken the place of partial adoption, reversing the results observed four years ago.

This unexpected result claims that firms are becoming more mature and conscious about e-business, which in turn is becoming a more consolidated concept compared to the past. The fact that most companies have chosen a partial, but more pervasive (i.e. both up- and down-stream) adoption supports this conclusion. This is contrasting with the alternative hypothesis that could be inferred by the results of four years ago. At that time one could argue that mono-directional strategies (*e-Purchasers* and *e-Sellers*) were the first step of an evolutionary path

towards *e-integration*. But if this was the case, today we should still have some firms adopting such strategies, in particular those that four years ago were still *Traditionals*. Instead today no firm declares such a strategy, while instead we can observe many different degrees of adoption of both *e-commerce* and *e-procurement* at the same time. This leads us to the conclusion that today the evolutionary path, if it exists, runs along the balance of the two strategies.

Finally, we investigated the strictly longitudinal sub-sample, i.e. those firms that participated to both editions of the project, thus allowing us to understand the evolution of e-business strategies of each single firm. Results first of all confirm the overall trend towards a slight increase in adoption and a rebalancing of *e-commerce* and *e-procurement*. The firms that participated to both editions of the research showed a similar evolutionary trend of the entire sample, thus confirming results obtained for the whole sample. This means that the difference among the two editions are not to be ascribed to a different composition of the sample. Besides, we observed that some firms even decreased previous investments (either up- or down-stream), in order to balance their efforts in the use of Internet technologies. This claims for a more conscious and cautious adoption of e-business, aiming at exploiting the real benefits wherever they are easily accessible, without over-investing in one direction.

This last result is contrasting with what the same firms declared at the time of IMSS III, when they planned an increase use of e-business in the following years, but without changing the underlying strategy. It is not really surprising that in the last years firms changed their mind, if we consider how immature they were at the time and how much different reality has been compared to the original claims of the new economy era. Companies have also been able to verify the efficacy of their investments only recently. However these shifts in strategy, and also the reduction in the use of Internet based tools in some cases, further support the claim that e-business is becoming a consolidated concept, adjusting itself in order to become no more an innovative strategy adopted only by the most advanced firms, but more and more the way business is conducted every day.

7. CONCLUSIONS

We claim these results to be relevant for research, since very few authors so far investigated the level and the pattern of adoption of e-business strategies on large, longitudinal samples.

Moreover, the emerging results also provide new light on the evolution of such a new and fast-evolving topic.

We claim these results to be relevant also for practitioners, who can better understand what is the current level of diffusion of e-business and its implications with supply chain strategy in general. In particular, our results are interesting also for small and traditional companies, since they show that the world is actually changing, and also small firms are now slowly adopting e-business, thus tracing the way to keep up with industry long-term trends.

Many interesting questions emerge from this research, providing suggestions for further research. First of all it would be important to relate the various strategies to performance, in order to evaluate their actual contribution to company's results. This would also help in better understanding why companies may have changed their approach towards Internet technologies. Future studies should analyze in deeper detail the different patterns that this work highlights in e-business strategy, especially those situations in which disinvestments occurred. A detailed analysis of the elements that explain this behaviour would help companies in better understanding how to successfully introduce e-business in their supply chains.

On a second perspective, *e-commerce* and *e-procurement* are today two very broad concepts: it is definitely relevant to investigate further into each of them, to understand the different applications adopted, for what purpose they are used, and the results achieved.

In the end, since the IMSS project is global, comparison with different geographical areas is also possible and useful to understand whether different patterns exists and which elements characterize investments in Internet technologies.

The findings of the paper lead us to possible hypotheses on future trends in this issue. Data have provided evidence that companies are taking e-business as a relevant topic, even if only some of them are really investing significantly in these applications. Previous literature has claimed that this behaviour may be due to enabling elements that may enforce the impact of e-business technologies on companies performances. This result is consistent with core competence theories that argue that companies compete and thus develop those competencies that prove to be more significant to achieve their goals (e.g., Hamel and Prahalad, 1990; Peteraf, 1993; Barratt and Oke, 2007). This claims that companies that are now investing in e-business technologies will develop better competencies and will probably be able in the future to invest more and more effectively on them. This will make them able to improve performances through the use of e-business technologies while those companies that are now

limiting their investments in these technologies will not be able to gain significant benefits from them and will probably reduce their investments over time. Thus, we argue that in future studies, even if a continuum in the e-business adoption will be found, the distance between the low adopters and the full adopters will increase over time and that partial adopters will move towards one of the two extreme strategies. This will lead to a "digital divide" paradigm: companies will have to choose if e-business is a critical element of their strategy or not and then invest accordingly.

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