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A Multi-Level Approach for Devising Effective B2B E-Commerce Development Strategies with an Application to the Case of China

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Abstract

This paper introduces a framework for devising effective business-to-business (B2B) electronic commerce development strategies which is used for organizing some first data on the case of China and for drawing tentative policy conclusions. The framework is based on the assumption that B2B electronic commerce is a dynamic phenomenon involving increasing degrees of information systems externalization and thus needs to be analyzed on the level of the individual company as well as on the level of the whole industry. The aim of the framework is to identify which level forms the main bottleneck for further development at a given point in time. Albeit the framework is based on a set of established theories, notably Nolan's Stages Theory and the Industry Life Cycle theory, it needs further refinement and verification.

Keywords: business-to-business electronic commerce, IT development strategies, China, electronic data interchange

Introduction

The formulation of B2B electronic commerce development strategies has so far been mainly addressed from either one of two perspectives: the perspective of the individual firm (cf. [Fowler, Parker, and Swatman, 16; Chan and Swatman, 8; Boddy, 5]) or the perspective of a whole industry (cf. [Mansell and Jenkins, 25; Klein and Schad, 19; Cathomen and Klein, 7; Salmi and Tuunainen, 34; Barrett, 4; Damsgaard and Lyytinen, 10; Damsgaard and Lyytinen, 11; Christiaanse, Been, and van Diepen, 9]). Few studies have addressed both levels (see for example [Hempel and Kwong, 18]). This seems to be a serious shortcoming as benefits from electronic commerce mostly stem from integrating information systems across company borders [Markus et al., 26] which implies that companies have the required information systems in place as well as access to adequate external infrastructures for linking them. For this reason, an effective B2B e-commerce development strategy must consider both levels simultaneously. This seems to be especially important when considering the situation in developing countries as the status of development on these two levels might be more uneven here than in developed countries.

In this paper, we want to explore the idea that the development of electronic commerce results from the interaction between the development of information systems on the com-

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pany level and the development of electronic commerce infrastructures on the industry level. In addition, we distinguish between the user and the provider industry as there might be large differences between their respective stages of development. The overall development process is then characterized by simultaneous relationships of promoting and restraining use of information technology between the two levels of analysis: the level of IT use in companies can become a constraining factor regarding the development of e-commerce infrastructures on the industry level but it may also promote these and vice versa. Effective B2B e-commerce development strategies should be based on a recognition of bottlenecks and promoters among the three interlocking fields.

The paper will first motivate the distinction between the three fields of IT development and propose ways how to analyze the development of IT in each of them as well as their interactions. We will then provide some first data for the situation in China to illustrate the approach and also to draw some tentative policy conclusions. Finally, we will outline our further theoretical and empirical approach.

1. Describing and distinguishing EC development levels

Electronic commerce in the business area can rely on two principal approaches, the use of inter-organizational systems or the linking of two or more intra-organizational systems, recently called 'external systems integration' by Markus et al. [26]. According to Cash, an inter-organizational system is defined as "an automated information system used by two or more separate companies" [Cash, 6, p. 200]. An inter-organizational system might be provided by one of the user companies or by a specialized services company. An example of the first case is a retailer who uses the website of a wholesaler to place a purchase order, check availability of goods, or track past purchase orders. An example of the second case is an airline reservation system used by travel agents to check availability of seats, make reservations, or issue tickets. In both cases the communication along the supply chain or supply network occurs over an inter-organizational information system.

External systems integration, in contrast, involves at least two information systems which are linked together via Electronic Data Interchange (EDI, cf. [Swatman and Swatman, 36]). EDI refers to the exchange of structured data so that the receiving information system can directly, i.e. without further human input, process the data. This, however, requires agreements on other levels too, not just the level of the structure of data, as the *meaning* of the data need to be intelligible to the receiving information system as well as the required *action* expected to be taken [Kubicek, 21]. These agreements can be either bilateral or multilateral.

Finally, it has been proposed that a next step of external systems integration could consist of disposing of internal systems altogether [Markus, Petrie, and Axline, 27]. Such systems do not yet exist but seem at least plausible as responsiveness of whole supply chains, rather than of individual companies, becomes a competitive necessity. These systems would offer the same range of functionality as do advanced intra-organizational systems (such as ERP systems, cf. [Davenport, 12]) implying that both data and functions are externally 'hosted' as is the case in the so-called ASP model (Application Service Provider, cf. [Yao and

Murphy, 39]). The difference between the ASP model and the External Systems model, however, is that whereas in the ASP model only the software functionality is shared among several users (expected to result in benefits from economies of scale and increased bargaining power), in the External Systems model data common across users are shared as well thus facilitating information exchange between supply chain members (cf. [Markus, Petrie, and Axline, 27]).

Considering these distinctions and descriptions, it seems that they could be ordered in a series of types of systems displaying increasing levels of external infrastructures sophistication:

- Inter-organizational systems;
- Bilateral EDI;
- Multilateral EDI;
- External systems.

Whereas inter-organizational systems only require an external telecommunication infrastructure, bilateral EDI, in addition, requires agreements with another company about the structure, meaning, and legal implications of electronic messages. Multilateral EDI systems imply a degree of standardization of these agreements and their enforcement. Standardization and enforcement is typically done by some 'meso-level' organizations such as industry associations [Monse and Reimers, 29]. Finally, external systems need an even more sophisticated and dedicated governance structure in order to provide a level of control over these functions and data similar to that generally achieved with regard to intra-organizational systems.

The development of electronic commerce in the realm of business therefore not only requires that companies know how to use information technology internally but also that a supporting e-commerce infrastructure evolves on the industry level enabling the 'externalization' of information systems. This supporting e-commerce infrastructure consists of technical IT and data communication services as well as an institutional structure for developing and maintaining standards. For this reason, we are going to analyze the process of electronic commerce in three fields: the company, the user industry, and the IT services industry. We will first outline theoretical approaches towards analyzing IT use and services on these two levels and then try to provide an integrated view.

It seems to us that two theories hold the biggest potential for performing this analysis: Nolan's Stages theory and industry life cycle theory.

1.1. Nolan's Stages Theory

Based on longitudinal data of three companies' IT budgets, Nolan [30] developed his 'Stages Theory.' For two companies, he was able to collect IT budget data for 13 consecutive years while the third company's data covered a period of eight years. The common pattern among the development of all three companies' IT budget was that of an S-curve which has been observed in other fields of technological innovation as well (cf. [Rogers, 33]). The S-shaped diffusion pattern in larger populations (such as a country's consumer

population) is alternatively explained by individual learning and an epidemic process. According to the first explanation, use of a new technology must be learned by individuals. As learning is cumulative, initial advances are slow but will gather momentum as more and more of the technology's features and uses are known to the users explaining the accelerating part of the S-curve. However, beyond a certain point most features and uses are known and additional unknown features and uses are discovered at ever lower rates explaining the decelerating part of the S-curve [Rogers, 33, p. 244]. The epidemic or 'statistical' explanation, in contrast, is located on the collective rather than the individual level. Similar to the spread of an epidemic disease, early users will 'infect' non-users thus transforming them into users as well. The process of 'infection' is basically one of communication in which users educate others about a new technology's features and potential uses. As new members of a population are 'infected,' i.e. become users, the number of 'infections' initially increases similar to a bandwagon or a snowball. However, once 50% of the population have been 'infected,' encounters involving a user and a non-user are becoming less frequent again leading to a decelerating diffusion rate [Rogers, 33, p. 245].

Nolan has put forward an explanation for the phenomenon of an S-shaped development of IT spending in companies which combines both of these explanations. These are summarized under the concept of 'organizational learning' and involve mainly two components, management control and user awareness. These two components are two of four so-called growth processes described in a later revision of the Stages Theory [Nolan, Croson, and Seger, 31] with the other two growth processes being purely descriptive (the application portfolio and the resources needed for applying IT in the business, [Nolan, Croson, and Seger, 31, p. 3]). User awareness accounts for the accelerating part of the S-curve as organization members are increasingly 'infected' by early users. Accordingly, this stage is called 'Contagion' and follows on the 'Initiation' stage. During the first two stages, management encourages an experimental approach towards use of the new technology. In contrast, as growth of the new technology outpaces revenue growth, managers become concerned with profitability and impose strict financial controls leading to a decline in internal IT growth rates. Therefore, this stage is called 'Control.' The final stage, 'Integration,' is characterized by a balance between the imposition of financial controls and the allowance of organizational slack which, however, in itself does not explain the leveling-off of the internal IT diffusion-curve. Rather, it seems that a sort of saturation effect accounts for this phenomenon which, however, is not explicitly addressed by Nolan. The Stages Theory is summarized in Figure 1.

In their revision of the Stages Theory Nolan et al. also extended it in order to incorporate developments which had taken place since Nolan first published it by introducing the concept of 'eras' reminiscent of the notion of 'technological waves' in the field of innovation studies. These are marked by technological discontinuities through the introduction of micro-computers and the deregulation of the telecommunication industry (leading to the widespread creation of internal and external networks linking computers). In each era, companies have to go through all four stages of organizational learning and learning is cumulative over all eras as depicted in Figure 2.

Nolan has also attempted to link stages of organizational learning to the development of the IT industry by proposing that internal and external developments parallel one an-

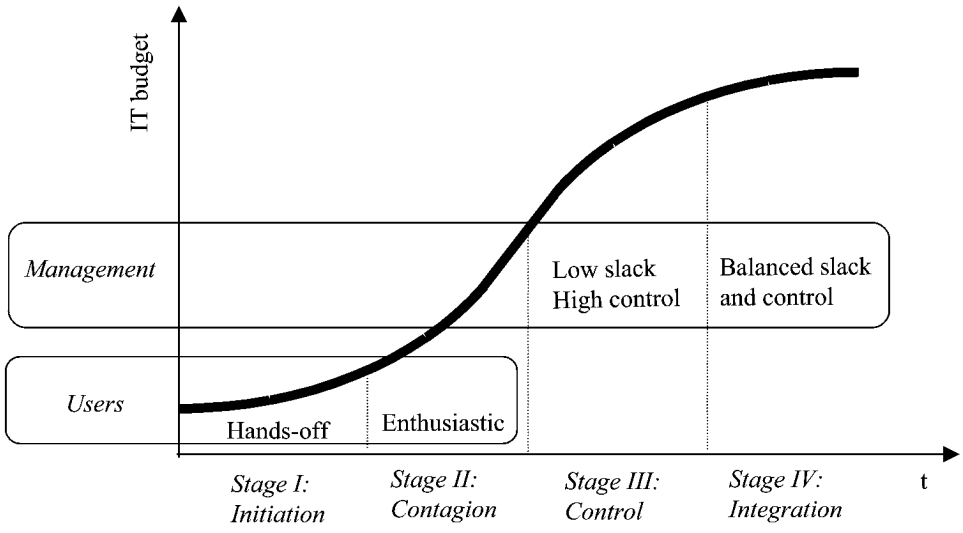

Figure 1. Stages of organizational learning (simplified from [Nolan, Croson, and Seger, 31, p. 3].

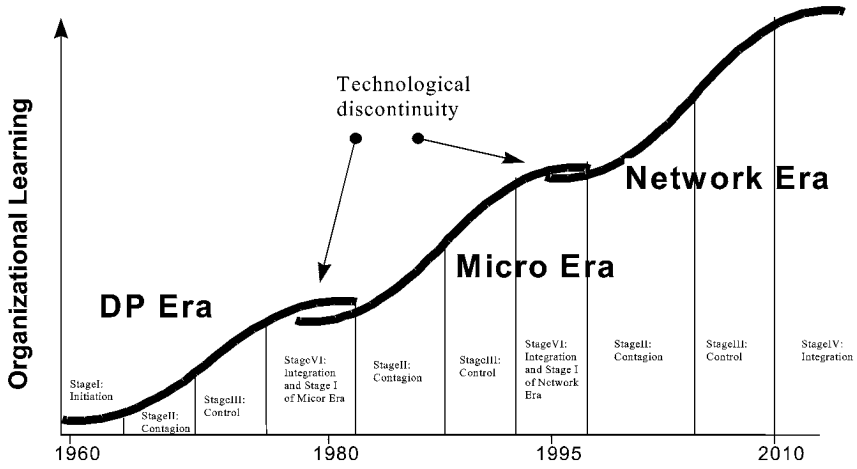

Figure 2. Eras of organizational learning [Nolan, Croson, and Seger, 31, p. 5].

other. For example, the development of a 'decentralized' and innovative micro-computer industry (epitomized by the Silicon Valley-phenomenon) seems to parallel the decentralization of IT in companies as departments or even individual employees buy their own PCs and put them to new uses. In the same vein, centralized IT departments resist this type of change as, initially, established computer firms did with regard to the sprouting PC phenomenon.

However, as recognized by Nolan et al., these similarities only go so far. For example, the Network Era seems to be characterized by development patterns which are entirely

unrelated on the two levels (IT industry and company level; [Nolan, Croson, and Seger, 31, p. 7]). Thus, the similarities between the two levels could be accidental. Also, the development on the industry level is not based on a theoretical concept matching that of the Stages Theory. Therefore, it is necessary to look for a more systematic approach towards describing IT development on the industry level before these two levels can be linked again.

1.2. Industry life cycle theory

The concept of the industry life cycle has been originally introduced by Utterback and Abernathy (cf. [Utterback and Abernathy, 37] and [Abernathy and Utterback, 2]) based on the notion of 'dominant designs.' According to this hypothesis, a dominant design emerges in the course of industry evolution and marks a fundamental shift in the way firms compete and cooperate including innovation strategies. Before a dominant design emerges, product design is 'fluid' meaning that designs are frequently changed as well as the existence of a large number of alternative designs. Competition is therefore mostly based on product innovation and design modifications are aimed at closely meeting specific customers' needs. Anyone who has a new design concept can easily enter the industry so that the number of firms during this period is usually high. However, once different designs are consolidated into one, competition policies shift away from product to process innovation as companies seek to lower costs. As this usually involves a replacement of machines for labor, economies of scale emerge which, on the one hand, erect a barrier to entry for prospective competitors and, on the other hand, lead to a consolidation among firms via exits and mergers. Thus, the number of firms tends to decline after a dominant design has emerged. The emergence of a dominant design is therein seen as a "result of a fortunate combination of technological, economic, and organizational factors" (Suárez and Utterback [35, pp. 416–417]). This pattern of increasing and decreasing total number of firms before and after the emergence of a dominant design has been verified for a large number of industries [Klepperer and Graddy, 20; Anderson and Tushman, 3; Utterback and Suàrez, 38; Filson, 14].

While the characteristic pattern of the industry life cycle has been broadly verified, there is less consensus on its internal structuring or patterning. Authors that point to the emergence of a dominant design and technological discontinuities as major events in an industry life cycle tend to distinguish just two phases, the fluid period of design competition, the 'era of ferment,' and the period of competition based on economies of scale and process innovation ('era of incremental change;' cf. [Anderson and Tushman, 3]). Klepperer and Graddy [20] have distinguished between three phases, growth, shake-out, and stabilization. De Jong [13] and Gemser, Leenders, and Wijnberg [17] differentiate the growth stage into the stages 'emergence' and 'growth' and add a 'decline' stage. Figure 3 illustrates the different models.

It should be noted that the concept of the industry life cycle does not imply a deterministic course of events. Abernathy and Clark [1] have warned that the life cycle metaphor could be misleading as industries might be able to renew themselves. In addition, it seems to us necessary to extend the concept of the industry life cycle to allow for the possibility

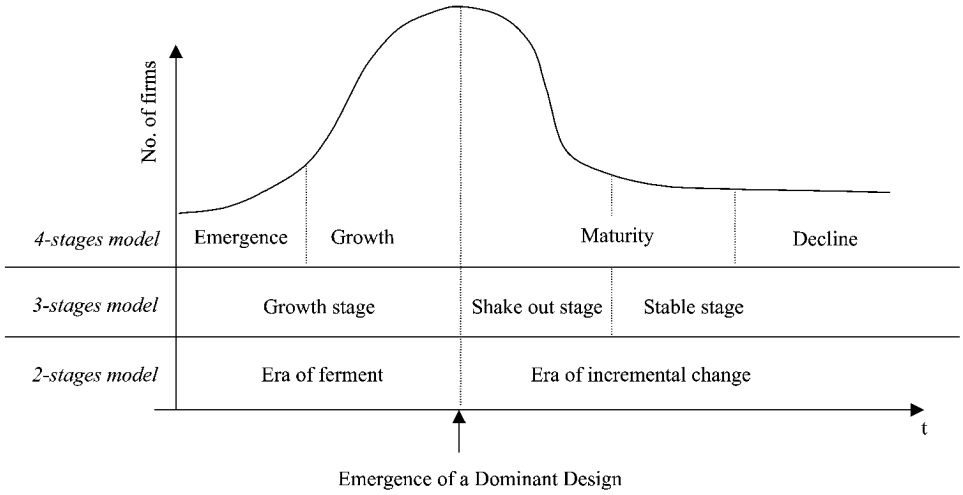

Figure 3. Industry life cycle models.

Table 1. Nolan's 'Eras' according to the industry life cycle model (two-stages version)

Era	Discontinuity	Dominant design	Source
DP	Solid-state transistor	IBM System 360	Fisher, McKie, and Mancke [15]
Micro	Integrated circuit	IBM PC	Langlois [22]
Network	Telecom deregulation	TCP/IP	Leiner et al. [23]

of 'regulatory discontinuities' since this seems to be the pattern behind the emergence of Nolan's Network Era. This has been triggered by the deregulation of the telecommunication industry rather than the 'invention' of the browser. With this modification, it is possible to use the concept of the industry life cycle as a description of the three eras described by Nolan as delineated in the following way (see Table 1).

Gemser, Leenders, and Wijnberg [17] have attempted to use the four phase industry life cycle model of de Jong to derive hypotheses regarding the nature and extent of horizontal and vertical linkages for each stage. However, these depend upon specific assumptions regarding companies' policies about vertical and horizontal integration which, it seems to us, cannot be generalized. Also, the authors do not clearly indicate how the three stages 'emergence,' 'growth' and 'maturity' can be distinguished. Therefore, we will use the three-stages classification scheme of Klepperer and Graddy. This scheme reflects empirical regularities more accurately and the implications for horizontal and vertical relationships are more intuitively plausible. These two schemes are shown in Tables 2 and 3, respectively.

The overall implication of this hypothesis is that B2B electronic commerce (i.e. the establishment of electronic linkages between vertically related companies) provides the biggest potential benefits in the stable stage while in this stage companies are also able to cooperate horizontally to build an external electronic commerce infrastructure. However,

Table 2. Horizontal and vertical relationships in the four-stages model

	Horizontal relationships [de Jong, 13, pp. 85-86]	Vertical relationships [Gemser, Leenders, and Wijnberg, 17, p. 442]
Emergence	Monopolistic competition*	Forging linkages to create the necessary infrastructure
Growth	Fierce competition	Increase of linkages because of specialization
Maturity	Oligopolistic ('friendly') competition	Decrease of linkages because firms integrate vertically
Decline	Ruinous competition	Increase of linkages because firms focus on 'core capabilities' and/or enhance innovative capability

*Not specified in de Jong [13].

Table 3. Horizontal and vertical relationships in the three-stages model

	Horizontal relationships	Vertical relationships
Growth stage	Competition based on product innovation; cooperation on joint standards	Depends upon the type of companies dominating the industry (start-ups vs. established)
Shake-out stage	Hostile and desperate, struggle for survival; cooperation in order to join forces (Bertrand competition)	Competition for total value added; pressure on supply chain partners to cut costs
Stable stage	Oligopolistic competition based on process innovation	Forging of linkages to create integrated supply chains

it should be pointed out that this conclusion rests on assumptions which have not yet been tested, albeit being consistent with assumptions about the nature of vertical relationships across life cycle stages tentatively supported by industry case studies in Gemser, Leenders, and Wijnberg [17].

1.3. An integrated view

Considering the development of electronic commerce among firms, we think it necessary to distinguish between the 'user' and the 'provider' industry. This distinction is sometimes absent in studies of technological innovation (cf., for example, [Anderson and Tushman, 3]) as the interaction between the user and the provider industry is normally not considered. Innovations are classified either as product innovations (then the provider industry becomes the unit of analysis) or process innovations in which case the user industry is considered the unit of analysis. In contrast, using information technology to create electronic commerce links between firms requires that users and providers jointly engage in the building of these systems.

The overall idea for providing an integrated view then is that the three development processes located on our two levels of analysis should match. For example, if companies have not yet completed the 'DP learning cycle' offering sophisticated electronic commerce systems would not be of much help. Similarly, companies on a sophisticated level of IT use (i.e. companies which have gone through the learning cycles of all three eras) might still find it difficult to create external linkages if the whole industry is in an early stage of its development (note that it is possible that established companies dominate the early stages

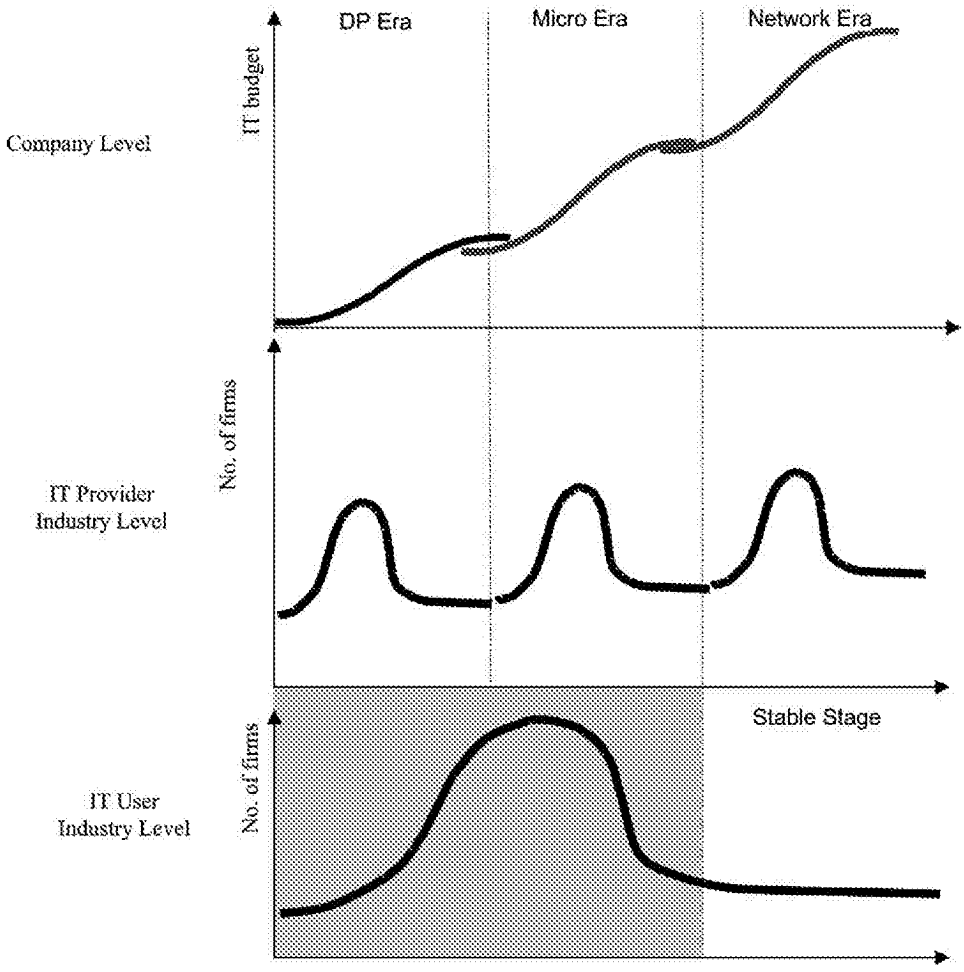

Figure 4. Fit relationship between the three development processes (shaded area not included in the matching procedure).

of an industry life cycle). The hypothesized fit relationships are summarized in Figure 4. Regarding the user industry development, only the final, stable stage is considered for this matching procedure as there are no clear implications for IT use in the other three stages which could be derived from the discussion so far. Nor is such a matching necessary for the purposes of this study which focuses on B2B electronic commerce. In short, we hypothesize that effective e-commerce development strategies should address all three levels and, more specifically, assess whether on each level the final life cycle stage has emerged. Otherwise, that level will create a constraint for the development of B2B e-commerce systems. This also implies that effective B2B e-commerce development strategies have to be located on the industry level.

2. First empirical results for China

In order to asses the current situation in China in view of possible e-commerce development strategies, we draw on the results of four separate studies we have conducted so far. These comprise (1) a study of the longitudinal development of IT spending in Chinese companies, (2) a study of ERP implementation processes in China, (3) a study of the diffusion of information technology on the level of the Chinese economy, and (4) a study aimed at developing sustainable B2B e-commerce scenarios for a selected number of industries in China. These studies have been conducted for different purposes and employed different research designs. Also, they represent early results of ongoing research projects implying that their nature is exploratory rather than confirmatory. However, we think that they provide some first clues on the question of how to devise effective e-commerce development strategies for a developing country and also provide insights regarding further research requirements.

The aim of the first study was to assess the applicability of Nolan's Stages Theory in Chinese companies. This study proceeded in two stages. The first stage involved a survey of 27 Chinese companies. Data were collected by on-site interviews, questionnaires, and follow-up telephone interviews. In the second stage, a questionnaire survey was used which yielded answers from 94 companies. Companies had been selected with a view of collecting information about IT spending over an extended period of time implying that the companies should have existed over the whole period of analysis (1980 to 2001) and thus are not representative of the current population of Chinese companies. However, these companies can be seen as representing the recent history of Chinese companies with regard to their IT experiences.

The aim of the second study was to explore conditions for successful and less successful ERP implementation projects in both Chinese and foreign-invested companies in China. It involved six in-depth case studies and a questionnaire survey of all R/3 users (about 120) at the time of the survey (March to May 2000). This study was supported by SAP Greater China which, apart from financial support, helped most by providing their customer list. However, aims, methods, and analysis have been completely independent without any influence from SAP. Using SAP's customer list and limiting the study to one brand of ERP implies that the sample is not representative of Chinese companies. It is heavily dominated by foreign-invested companies and also heavily tilted towards manufacturing companies. However, these companies can be seen to represent the vanguard of Chinese companies regarding IT use; for this reason, study results can be taken to indicate the current frontier of IT use in China.

The aim of the IT diffusion study is to assess the current state of China's IT industry as well as the use of IT in the whole economy in view of several policy issues such as labor market implications, industrial policy, and regional inequalities. In this study, secondary data were collected from a wide range of publicly available international and Chinese sources.

Finally, the study on developing sustainable B2B e-commerce scenarios for selected industries explores the possibility of developing centralized inter-organizational systems

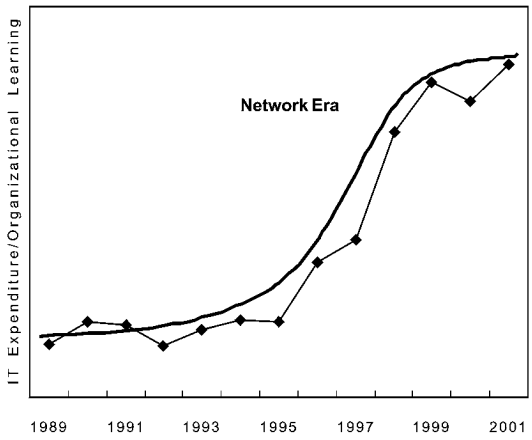

Figure 5. Stages of IT expenditure growth in China (sum of average IT spending of 94 companies).

for supply chain management. It is the most recent of all four projects and has, so far, produced first data on a set of four industries to be studied in more detail in the future.

The main insight from the first study on the longitudinal development of organizational learning/IT spending is that, indeed, the pattern observable in China resembles the pattern observed by Nolan, namely an S-shaped or logistical curve (as it is known in diffusion studies). This pattern was observed for both of the periods 1980 to 1990 and 1990 to 2000. While the pattern could be constructed only in qualitative terms for the earlier period due to the small sample size and missing values in the first stage of the study, it was possible to derive a curve consisting of average IT spending for the set of 94 companies in the second stage of the study which closely resembled the prediction of Nolan's Stages Theory (see Figure 5).

These findings could be explained mainly by regulatory factor. In 1978, China began a fundamental economic reform which tentatively released industrial organizations into the realm of autonomous planning and management. These emerging organizational units then began to experiment with information technology in order to explore possible uses and its value to support management decisions. However, funds were limited and administrative involvement by the government still noticeable in these early days of the reform. Only after it became clear that the reform was going to be successful, the extent of management autonomy was increased substantially enabling the emerging firms to invest more freely in information technology. A boom period, characterized by enthusiasm and sometimes purely symbolic IT investment, ensued leading to a steep increase in firms' IT budgets.

As the beginning of the reform process coincided with the commencement of the Micro Era in the US, Chinese companies could almost immediately draw on Micro Era technology, namely the microcomputer. Also, the Internet has hit China with almost no delay relative to the US so that Network Era technology became available to Chinese companies at about the same time as in the US and in Europe (albeit there is still a huge gap in the availability of the Internet across regions). However, Chinese companies started employing Micro Era systems, in most cases, in a situation characterized by paper-based control

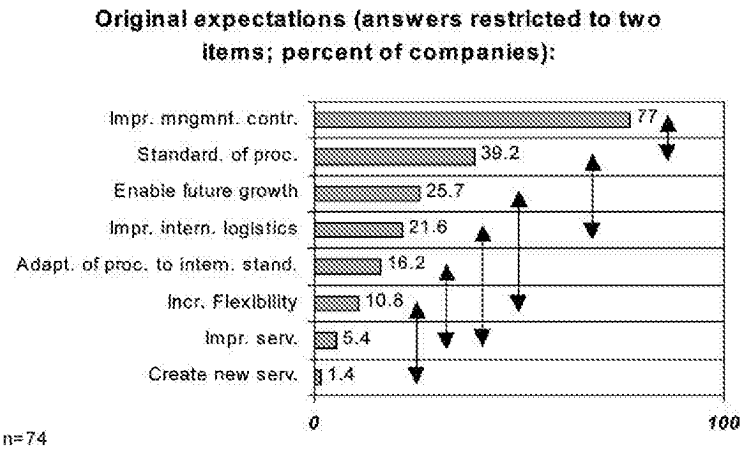

Figure 6. Motives for implementing ERP systems in Chinese companies (arrows indicate statistically discernible differences).

systems whereas US and European companies had automated back-office systems based on DP Era technology. Thus, although Chinese companies were living through the same eras in terms of information technology, they were doing so with a different organizational history. Therefore, the question arises if companies have used IT for Micro Era applications or rather for catching up on DP Era applications during the 1980s and used Micro and Network Era technologies to develop internal control systems characteristic of the Micro Era in developed countries.

We draw on the survey of ERP implementation projects in order to provide an answer to this question. All ERP systems involved in this study have been implemented after 1995 as SAP has entered the China market in that year (as one of the first ERP vendors in China). Thus, the implementation of ERP systems coincides with a period of resurgent growth in IT spending after management had clamped down on the initial wave of dramatically increased IT spending in the second half of the 1980s and with the beginning of the Network Era according to Nolan's extended Stages Theory. ERP systems in the US and in Europe are mainly used to replace so-called legacy systems which have evolved over the years as companies have integrated separate functional information systems into one integrated system which, however, was difficult to maintain. Thus, replacing legacy systems and simplifying and standardizing systems emerged as the most frequently cited motivation for implementing ERP systems in a broad study of ERP implementation projects in the US (cf. [Mabert, Soni, and Venkataramanan, 24]). This is in sharp contrast with the motivation of companies in China as represented in our sample (see Figure 6). According to our findings, the overall motive is to improve management control and to standardize processes. From our in-depth case studies we know that management is often struggling to obtain the most basic data on company operations. Also, most organizational processes display a high degree of variation according to ad-hoc requirements and managerial discretion. Thus, management often uses an ERP implementation project to reduce the degree of managerial discretion and process variability and thus increase the extent of direct control top man-

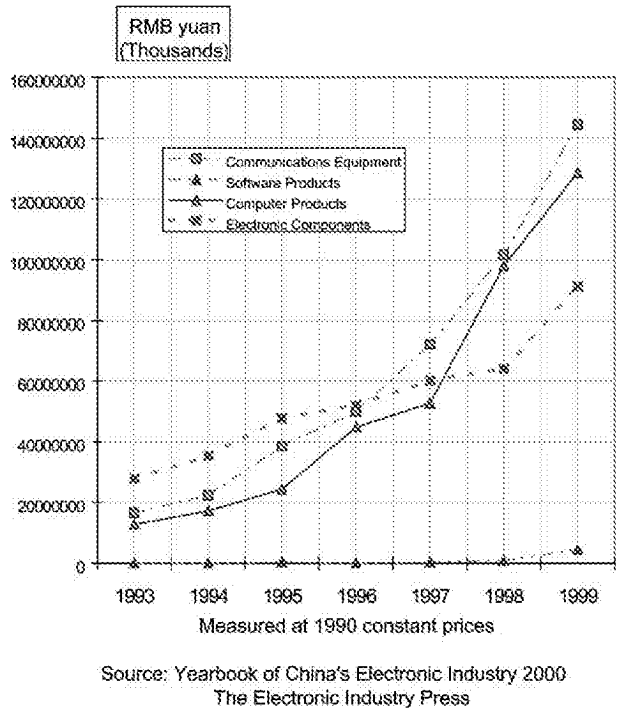

Figure 7. Composition of electronics production in China.

agement has over company operations. Somewhat paradoxically, ERP systems in Chinese companies seem to be used for enabling more centralized decision making whereas in the west the underlying rationale of an ERP system is to enable more decentralized decision making by bringing information required for decision making to the operational level.

From these findings, we conclude that, indeed, Chinese companies are using Micro Era technology to catch up on DP Era applications. Only the most advanced companies are beginning to build inter-organizational systems on the back of successful ERP implementation projects (cf. [McFarlan, Chen, and Reimers, 28]).

China's IT industry has expanded accordingly and made significant headway in comparison to the global IT output. According to the Elsevier Yearbook of World Electronics Data, total electronics production has grown at an annual rate of 17.9% between 1987 and 1996 in China compared to an annual growth rate of 7.6% for world electronic production leading to an increase of China's share in world electronics production from 1.4% to 3.1% over the same period.

When considering the composition of China's IT output (see Figure 7), it becomes apparent that China has simultaneously entered the Micro and the Network eras with the output of computer products and communication equipment closely tracking one another. However, this graph also illustrates that China's IT industry is heavily oriented towards hardware products with China's software output being almost negligible (1% in 1999).

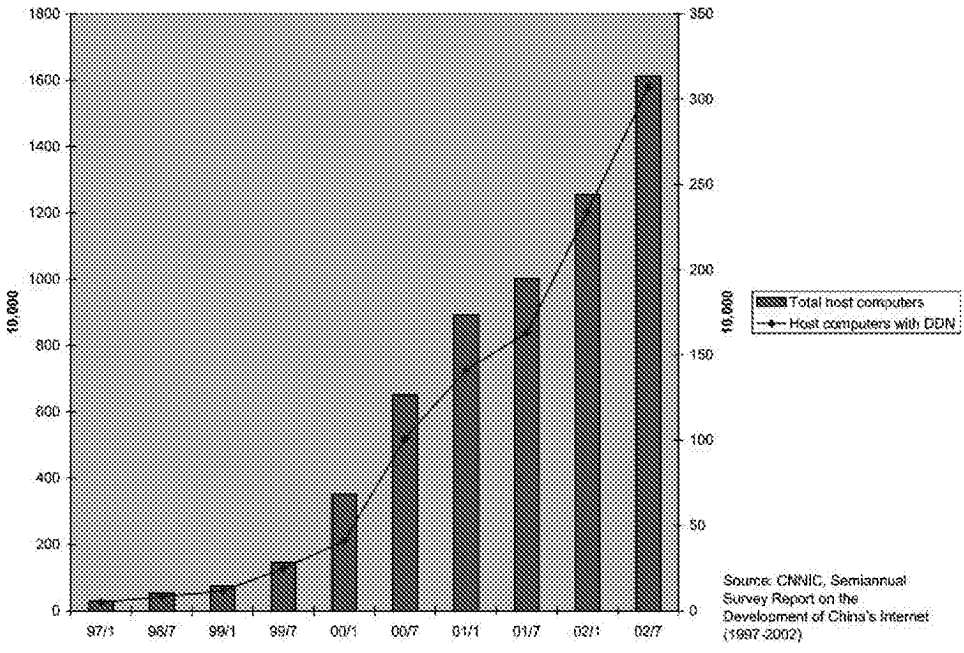

Figure 8. Number of host computers with Internet connection.

Regarding the level of Internet use, Figure 8 indicates that China displays a pattern similar to that in developed countries when measured in terms of the number of host computers. In addition, the rate at which host computers connected via leased lines (DDN) to the Internet keeps pace or outpaces the overall growth rate indicating that the structure of Internet access diversifies and matures, according to the CNNIC semiannual report (1997–2002).

The overall impression from these data is that China's IT industry might be moving ahead of companies ability to absorb IT products in their operational processes. Most companies still have to complete the learning cycle related to the DP and the Micro eras before they can begin to exploit Network Era technology.

The assessment of the current stage of the industry life cycle of IT users obviously depends upon which industry one chooses to look at. We have started to select some industries for more in-depth study of this question and collected data on key variables such as number of companies, output and profit level and value added in order to assess in which stage these industries are. Our initial set of industries comprises the textile, the garment, the automotive and the IT (electronic components) industries as we assumed that these industries should be in different life cycle stages according to the age of the involved technologies. However, the somewhat surprising finding is that the life cycle stages of all four industries, as evaluated from the number of firms, seem to closely track each other (see Figure 9).

From this coincidence of developments in the four industries we tentatively conclude that the shake-out stage has been initiated by government action rather than by compa-

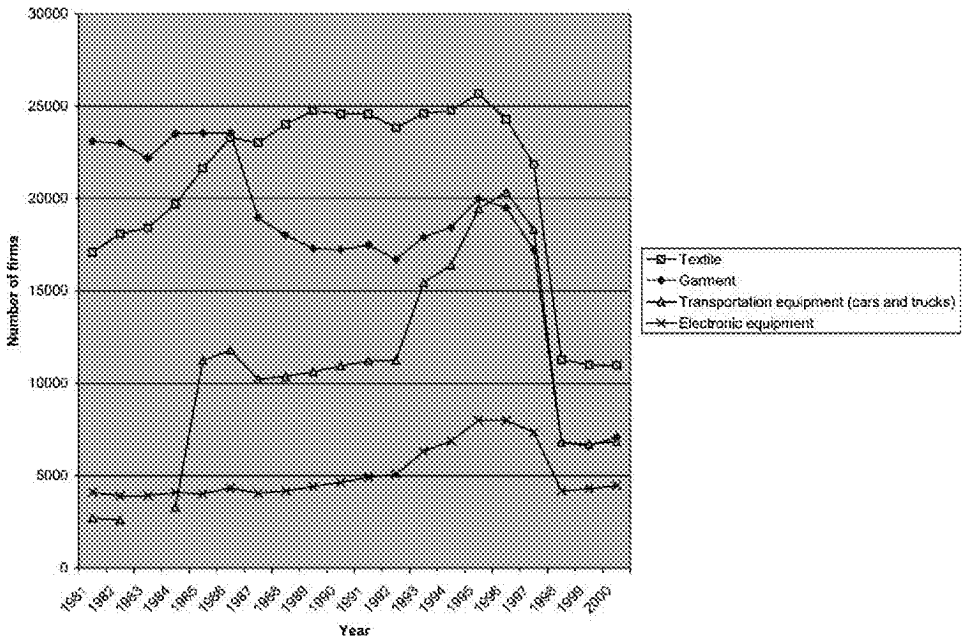

Figure 9. Industry life cycle of four selected industries.

nies' strategies. Thus, it could be that companies have been forced to merge or to exit the industry because government feels that companies have to do so in order to withstand expected fierce competition by international companies in the wake of China's WTO accession. However, these 'administrative mergers' do not guarantee that the intended effects, namely the realization of economies of scale and a focus on process innovations, have ensued. Rather, companies could manage the new entities as they would manage a conglomerate, i.e. as a collection of independent companies which would be more in line with the traditional management approach in China but forego the benefits which are usually associated with size. This would also imply that horizontal and vertical relationships do not comply with the pattern predicted above for the stable third stage (see Table 3). Specifically, horizontal relationships might still be based on Bertrand competition aimed at driving out competitors and vertical relationships by tough bargaining for total valued added . These characteristics would represent a rather difficult environment for developing B2B e-commerce systems.

Thus, we conclude that although the overall image indicates that (1) companies have participated in the learning cycle associated with the Network Era; (2) the IT industry provides the equipment characteristic of Network Era applications; and (3) a range of selected manufacturing industries seem to have reached the stable stage of their life cycle, significant doubts remain which would advise a rather cautious assessment. A more in-depth look into companies' current way of IT use shows that companies are still struggling to implement applications characteristic of the DP and Micro eras and that the stable stage of

those manufacturing industries which we had looked at was enforced by government rather than the result of a 'natural' process of competition and cooperation. Both of these conclusions imply that companies and industries are not yet prepared for B2B e-commerce. Thus, any policy which would promote the development of an external infrastructure for B2B e-commerce (from extending the physical network to developing B2B e-commerce standards) might be premature. This is not to say that these efforts would not have beneficial effects for other policy areas (such as promoting the development of the IT industry). However, we do not, based on our preliminary empirical assessment, expect significant increases of B2B e-commerce activity as a result of policies aimed at improving the external e-commerce infrastructure.

3. Outline of further empirical and theoretical approach

These conclusions, however, are only made tentatively and we are currently looking deeper into the state of 'e-commerce' readiness of several industries. Specifically, we want to identify whether the observed parallelism in the life cycle of the industries we looked at is accidental or systematic, e.g., induced by government. In the latter case, there might still be significant differences between industries obscured by the 'enforced' life cycle patterns. In addition, different industry structures may call for different approaches towards developing B2B e-commerce systems. To address this issue, we are developing a classification scheme for industry structures so that different e-commerce strategies can be mapped on to different industry structures. For example, electronic commerce based on centralized inter-organizational systems might be more appropriate for an industrial structure dominated by a focal company so that other supply chain members can link into this company's information system in order to exchange information. In contrast, an industry structure characterized by several large firms probably requires a bilateral or multilateral EDI approach. Also, the institutional structure of an industry matters since, for example, multilateral EDI requires that EDI messages are standardized and these standards are enforced along the supply chain as well as across members on the same production stage. In some industries, institutional structures might exist facilitating such standardization processes, in others they might be lacking. Another intriguing possibility is that the existing institutional structure might actually prevent such an approach as it reinforces lines of conflict along the supply chain rather than providing a mechanism for creating integrated supply chains as has been observed in several European industries in the early phases of EDI development (cf. [Monse and Reimers, 29]).

Finally, an interesting and possibly very relevant issue is whether those companies which are still in the early stages of their learning cycle could directly move into the next learning cycle concerning the Network Era in a similar vein to the way many companies in China have combined the learning processes related to the DP and the Micro Era in one learning cycle as we argued above. Specifically, do companies have to follow the example of western companies by first integrating internal operations via an ERP system and only then being able to move on to external forms of integration (via bilateral or multilateral EDI) or could they directly move to a model of external systems integration? As many Chinese

companies have not yet invested in internal systems integration, they would not have to consider the problem of sunk costs when moving to such a model. On the other hand, internal systems integration is related to a process of organizational learning which cannot simply be skipped when aspiring for the next stage of development. This, in essence, in the theoretical core of the Stages Theory, namely that individual stages of learning cycles must follow in the given order. However, several technological cycles (eras in Nolan's terminology) might be combined in one learning cycle, albeit learning might then take longer.

Our ongoing research also addresses this issue, again on an industry-by-industry basis as this question might have to be answered differently for each industry (see [Reimers, 32] for a more detailed description of this project). In addition, we hope to be able to conduct an international comparative study in order to isolate the factor of national institutions which might play an important role in this regard. Specifically, national institutions might favor or disfavor a centralized solution implicit in the external systems integration approach to B2B electronic commerce.

4. Summary

In this paper, we have developed a framework for devising effective B2B e-commerce development strategies with a view of applying it to the case of developing countries. This framework is based on the assumption that developing B2B electronic commerce involves increasing levels of information systems externalization and thus necessitates a multi-level approach including the company level and the industry level. In addition, we argued that the industry level has to be investigated from the IT provider as well as the IT user side as developing electronic commerce involves the interaction between IT providers and users.

We have then provided some first data to apply this framework to one specific developing country, namely China, and tentatively concluded that, currently, the bottleneck for developing e-commerce in China lies in the companies' stage of learning to use IT products and the development stage of IT user industry structures rather than in the stage of the development of the IT industry.

However, these conclusions are tentative and more empirical work is required before this and related conclusions can be recommended to policy makers. We have also indicated how we plan to build on and extend our studies in order to explore novel ways of devising e-commerce development strategies which take into account the variables of industrial structure and national institutions.

The final point regards the possibility of leapfrogging western companies as companies in developing countries might combine the learning processes associated with IT use of several technological cycles and thus avoid the development of 'legacy systems' hampering a more direct approach towards IT enabled supply chain integration.

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