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IS–ORGANIZATION COEVOLUTION: THE FUTURE OF INFORMATION SYSTEMS

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Abstract

How information systems (IS) affect organizations and enable radical organizational change has been explored from a variety of perspectives. Through a case study in the investment banking industry, we will examine the changing nature of IS–organization relationships focusing on the crucial role that IS play and will continue to play as organizations strive for competitive advantage in a global economy. By expanding on the organizational emergence theoretical framework of Truex et al. (1999) and drawing on the technology evolution literature, we aim to gain a deeper understanding of the coevolution between an IS and an investment banking company.

Keywords: IS–organization interaction, emergent IS, IS–organization coevolution, technology evolution.

INTRODUCTION

This story began a few years ago when we chatted with the manager of an information system (IS) group in an investment banking company. He talked enthusiastically about a new IS that captured their analysts' financial models, producing market reports for clients faster and on-demand. The excitement, though, was mixed with frustration caused by analysts' ignorance of the project and their refusal to even know what the IS was all about. "They are," he said, "not only too busy to talk to us, but too busy to use the IS designed to assist them and save *their* time." The analysts did not know what they needed, did not want to participate in the IS requirements specification, in fact did not want the system at all, they just "wanted to be left alone." Yet the company management supported the project, expecting increased client satisfaction and market advantages. The story looked familiar and we started a research project. Our task was to assist in the IS implementation and monitor its impact on the company's performance. What was originally a half year research project turned into a long term research partnership. And from then on, we found ourselves witnessing the frustration and excitement of highly professional groups of people embarking, not fully consciously, on an uncertain journey of organizational transformation through its IS with unprecedented consequences.

As we followed them on this journey, we aimed to understand the emergence of the company's business models and how they coupled with the on-going development and implementation of their core business IS, and explain the shifting nature of the company's competitive advantage. This exploration led us to unexpected insights into the complexity and dynamics of IS–organization coevolution, a process by which the company and its IS changed together, each influencing the other. Moreover, as the IS was integrated into the company's operations, becoming indispensable in the provision of services to its clients, we became concerned with the future of this coevolution, especially so, as one of the most highly appreciated consequences of IS development was an increase in the company's competitive advantage. We needed, therefore, not only to provide meaningful explanations of past situations and events in the development and deployment of the IS in the company, but also to derive more general conclusions about the interrelationships and coevolutionary processes involved and potential risks for the future.

The issues we faced are not totally new to IS researchers. How IS affect and transform organizations has occupied researchers' interest ever since their origination in the 1950s (Robey and Boudreau 1999). Perceived as enablers, drivers, or agents of change, IS are believed to cause radical changes in organizations (Leavitt and Whisler 1958; Scott Morton 1991). Models, deploying

simple cause-effect deterministic logic, however, failed to explain the complex mutual influences between IS and organizations, and especially contradictory empirical research results (Galliers and Baets 1998; Marcus and Benjamin 1997). Viewing an IS as a component of a complex process of social change "in which forces of transformation are frequently offset by forces of persistence," Robey and Boudreau (1999, pg. 182) suggest instead the use of theories employing a *logic of opposition*. As explained using theories such as organizational politics, organizational culture, institutional theory, and organizational learning, IS may support either transformation or persistence, or both at the same time. We found these theories extremely useful in understanding many specific and critical issues involved in the IS–organization relationship; however, they provided little help in comprehending its emergent nature.

In this paper, therefore, we explore the organizational emergence perspective suggested by Truex et al. (1999). We found the term *emergent* organization they use to refer to "the state of being in continual process, never arriving, but always in transition" applicable to our case company. Following their lead, in this paper we aim to develop a deeper, more grounded understanding of a perceived coevolution between the IS and its host investment banking company, and explore how it affects the company's current, and possibly future, competitive advantage. By drawing from this case study, we also aim to develop a new theoretical perspective on IS–organization coevolutionary processes.

In the next two sections, we will briefly present the research method and a description of the field study conducted in the investment banking company during the 1999-2001 period. First locally and gradually more globally, we describe the continuing development and implementation of the company's core IS, a research information system, with both its intended and unintended impacts. In the fourth section, we interpret these findings and provide an explanation of a shift in the composition of the firm's competitive advantage. We also present a model of the IS–organization coevolution process that explains its dynamics and sources of the risks involved. In the concluding section, we summarize potential contributions of the proposed IS–organization coevolution framework and suggest how it might develop further.

RESEARCH SETTING AND METHOD

The field study has been going on in the Australian branch of the equities division of a global investment banking company since 1999. The study focused initially on the research department, which provides market and company analysis to clients for the purposes of investment decision making. The design of a research IS (that we will call Omega) was initiated in 1995 to improve company performance and make its services more easily accessible for clients. Our task was to investigate and improve Omega's use, its impact on both the department and the company's performance, and the satisfaction of clients' needs.

The research department consists of approximately 50 people, including directors, analysts, research assistants, and clerical staff, grouped by industry sectors. It also includes an IS support team composed by one director, two technical support staff who have both IT and financial knowledge, four programmers, and one computer trainer. The role of the IS support team involves system development, technical support for the analysts when they experience difficulties, training of new recruits on how to use the system, and gaining analysts' "buy-in" to the system.

Our research was neither preplanned nor designed in advance. Instead, it came out of the opportunity to observe the development and implementation of Omega in order to explain how it impacted on the company's performance. As we tried to achieve this by gaining understanding from the actors, their meanings, and interpretations of events and situations, our research can be classified as an *interpretive field study* (Klein and Myers 1999; Myers 1997; Walsham 1993). Being outsiders to an organization in which members experience extreme time pressures, we could only use non-participant observation techniques. Throughout the study, we maintained weekly informal communication and semi-formal discussions with members. We also participated in some formal meetings with analysts and the company management. In addition, we collected and analyzed documents and e-mails related to Omega's development and use. So far, we have also conducted one survey and 12 semi-structured interviews focusing on specific users' and developers' problems.

We analyzed and interpreted field data continuously as the study evolved. In fact, visiting the company, collecting data, and interpreting them were all blended in an extraordinary research experience. As witnesses, we could hardly keep pace with the fast development and deployment of Omega and its dramatic impacts on the company's operations and performance. We realized that our journey challenged our preconceptions about IS and that we faced some fundamental issues regarding IS–organization relationships. As our understanding kept changing, we searched for concepts and models that could help us understand these issues better and provide a more meaningful and profound explanation of events. This lead us to develop a model of IS–organization coevolutionary processes that reveals a deeper layer of organizational dynamics. The journey continues, giving us further opportunities for checking our interpretations and testing our explanations.

FIELD STUDY: THE EVOLUTION OF THE OMEGA INFORMATION SYSTEM

Omega's development was and continues to be ongoing. The system's evolution may best be conceptualized in terms of three broad phases, each distinguishable by functional and technological characteristics (see Figure 1) and each also indicating an increase in the complexity of IS–organization interaction.

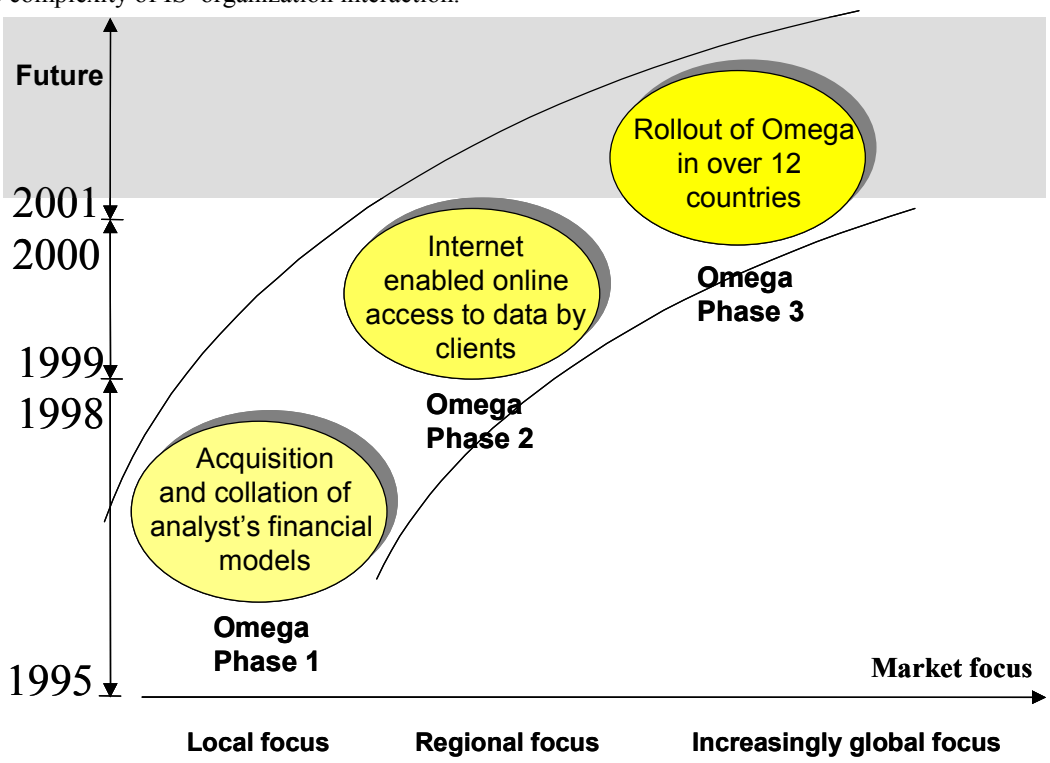

Figure 1. Evolution of Omega

Phase 1: Collection of Analysts' Models and Semi-Automated Report Production

Following an initial proposal and approval by the company's management, the IS team developed the first version of Omega in 1996. During Phase 1, Omega consisted of the collection of data sets and projections from financial models, individually created and maintained by analysts as spreadsheets on their own PCs. Before an analyst's data were uploaded into Omega's database, their consistency and accuracy were automatically checked to ensure high quality. Having checked and consolidated data from most analysts' models in a single database, the computer–based production of financial reports for clients (printed in a newsletter style) became feasible. During Omega's early development, the purpose of the system was primarily to service clients. Extensive market research was undertaken by Omega's support team to ascertain the breadth and depth of information required by clients. Consequently, its impact/output was clearly assessable in terms of timeliness, accuracy of reports, client satisfaction, numbers of new clients, and increased profit.

Throughout Phase 1, various additions were made to Omega's functionality, including online market information (some purchased from external information providers) that the analysts could use as a resource. An in-house built workflow, that enabled the coordinated and semi-automated production of reports, also formed part of Omega's functionality.

From the beginning, analysts displayed considerable resistance to the system. Although their input and the input of research assistants was sought during the system's design, they were not prepared to spend time working on (what they considered) an unknown and, in terms of their own work, "unnecessary" system. During Phase 1, the production of reports essentially added no value to their work but required their time and input to maintain. So despite their choice not to contribute to the system's development, many analysts complained about Omega's complexity and the structure of the database, arguing that designers didn't understand the meaning of their financial models.

Yet despite this environment of resistance, Omega evolved into a highly complex IS, capable of producing over 150 different reports for clients, some on a daily basis. Omega also provided the research department with an information resource through which directors and analysts could access various financial data online. Omega was considered to be the state of the art among similar proprietary systems developed by competitors.

At the time, we could not fully understand how Omega succeeded in spite of the resistance of its users. It seemed from our interviews to be the result of the efforts of the IS director, who actively built working relationships with the analysts. However, this did not fully explain its success.

Phase 2: On-line Access by Clients via the Internet

Phase 2 of Omega's development was characterized by the addition of on-line client access to its information resources over the Internet. Key clients could also make special requests for information, not normally included in the analyst's reports, via Omega's support team. These requests required analysts to feed further data into the system and were often associated with strong resistance from analysts who were forced to spend considerable time updating their spreadsheets such that the additional information could be fed into the system. Omega, under normal circumstances, only draws selected data from the analysts' financial models. Analysts, in order to gain a comprehensive understanding of the company's financial status, would use a broader set of data that would allow them to undertake more sophisticated analyses than those presented in Omega's reports. The analysts felt that the information being requested ad hoc should already have been collected by Omega and that they were in many ways victims of a "poorly designed system."

Omega's increasing complexity (with new functions added on a weekly basis) was a real issue even for the most technically competent analysts. According to analysts with experience of competitors' proprietary information systems, Omega was a more comprehensive and complex IS. As one of the analysts commented, "*The systems of other firms are like a regular family car, they're easy to drive but limited in terms of their capabilities. Our system is more like a Ferrari, a bit harder to drive, but in the hands of a skilled individual capable of much higher performance.*"

Despite continuing complaints from analysts, a survey we conducted in 2000 showed 71% of directors, analysts and research assistants felt that Omega contributed considerable value to their overall performance (less than 5% claimed no value for their individual performance) (Kay and Cecez-Kecmanovic, 2000). Interviews with analysts also confirmed Omega positively influenced the research department's performance. Furthermore, Omega was now considered an important dimension of the company's product portfolio, even drawing its own income stream from report subscriptions.

Phase 2 also brought a shift in Omega's focus from the local market, essentially Sydney and Melbourne, to the region, i.e., Australia and New Zealand. Both shifts in complexity and in focus required expansion of Omega's support team, with the addition of an extra programmer and trainer.

Phase 3: Globalization

Phase 3 of Omega's development is under way, with the system being rolled out in 12 other countries. To this point in Omega's history, its development and use had been limited to Australia and New Zealand. Globally, different branches of the company had been given autonomy with regard to the IS they used or developed, resulting in a number of competing and incompatible systems. In late 2000, the head office (of the parent company) determined that all branches of the company should implement a single IS (one to be developed in the head office).[1] In the period before the launch of the head office IS, however, a number of countries chose to adopt Omega instead, practically creating a race between the two systems.[2] While the impact of these decisions on the global organization are yet to be seen, significant implications for Omega's operation and its support team are already evident.

[1]How the decision was made and why Omega was not even considered is beyond the scope of this paper.

[2]It was widely accepted throughout the company that Omega was superior to the official system that was under development.

Up to now, the roll of Omega's support team had largely been limited to Omega's development and implementation. Their tasks included gaining analysts' buy-in to the system, training, and technical support. The lack of buy-in from analysts has made many of these tasks difficult. For example, various training seminars were organized by Omega's support team, in response to calls from analysts for better training, only to have analysts not attend. The process of gaining analyst buy-in to the system was laborious enough in the local setting; now the analysts' buy-in must be sought globally as well.

Gradually, through experience and one-to-one conversations with analysts, Omega's team director developed a process, he termed *hooking* for gaining the analysts' buy-in. This process of one-to-one selling provided an opportunity for the analysts and the director to share their knowledge regarding the opportunities and requirements for Omega on a regular basis. However, the director openly acknowledged that the process of gaining buy-in or hooking one-to- one was not sustainable, particularly when Omega was being rolled out in 12 countries and has thousands of users.

While the director's concerns focus on Omega's future operations, we anticipate significant risks relating to the increased complexity, not only of Omega, but more importantly of the Omega–company relationship on a global scale. How will the ongoing IS development take place when the opportunity for one-to-one conversations is no longer viable? In order to examine these risks, it is necessary to discuss the organizational implications emerging from Omega's development.

INTERPRETING FIELD DATA: OMEGA–COMPANY COEVOLUTION

There were both intended and unintended consequences emerging from Omega's continuing development. The intended outcomes of increased accuracy and timeliness of information, increased speed of delivery to clients, greater interactivity with the information sources (Omega database), and enlarged client numbers were all achieved. Less obvious were a number of other implications. In this section, we examine how the nature of the firm's competitive advantage changed as a function of its co-emergence with Omega's development.

Shifts in Competitive Advantage

Historically, clients had held direct relationships with the company's analysts, with client loyalty directly dependent upon the caliber of analysts the firm employed. Whenever an analyst left, they were likely to take their key clients with them; there was little to no brand loyalty. The competitive advantage of the brokerage house lay firmly in the hands of the analysts and the relationships they maintained with their clients. However, following Phase 2 of Omega's development, it was possible for clients to receive market information without ever speaking to an analyst. While analysts remained a key source of knowledge, the increasingly prominent role of Omega in mediating client–analyst interaction was gradually changing the company's competitive advantage.

Consequently, through Omega–company coevolution, the nature of the client–company relationship was gradually shifting from the personal relationship with the analyst alone, to an Omega-mediated relationship between the client and the company, including the client's familiarity with the system. As other brokerage houses also began to take their systems to clients online, the choice of firm for receiving brokerage services was increasingly influenced by the quality of a company's IS and to a lesser degree the perceived caliber of the analysts. Moreover, as clients' loyalty to a company (and its IS) was increasing, their loyalty to analysts was decreasing. It is not surprising that Omega was viewed, by some analysts, as a threat to the sovereignty of their knowledge and their market position.

Additionally, a high quality IS has the effect of attracting higher caliber analysts to work for a brokerage house. The reason for this may be found in the structure of the investment banking industry. The esteem with which an analyst is viewed relates to their ranking. An analyst's ranking is a function of a number of factors, including the strength of their relationships with their subject companies and the associated quality of information to which they have access. This in turn relates to the quality of services that a client may expect to receive. The quality of research an analyst is able to provide to the clients is affected in no small part by the systems the firm makes available to them. As such, not only do clients rely on the IS for the provision of timely, accurate, and comprehensive industry data, but so too do the analysts themselves, in order to maintain or improve their ranking.

In summary, as Omega has increasingly become an integral part of both the analysts' work processes and the process by which clients are serviced, it increasingly plays a key role in the company's competitive advantage. Competitive advantage has shifted toward a more complex combination of analyst expertise, the quality of the IS and its embeddedness in the company's processes,

as well as the level of clients' access to, familiarity with, and benefits from the IS. Consequently issues, such as analysts' resistance, that previously may only have affected Omega and its team, now present significant risks to the research department as a whole and the company's ongoing competitive advantage.

Observing Coevolutionary Processes

Omega's evolution through the phases (Figure 1) was easily identifiable from the empirical evidence and observations. The ensuing impacts on the company's competitive advantage, described above, were understood by examining the broader context of market information, brokerage firms, analysts' roles and rankings, as well as clients' behavior. However, to understand how all this happened, how technological innovations introduced by Omega eventually brought about such significant and profound changes, we needed to dig much deeper into the dynamics of Omega–company interrelationships and carry out a more detailed analysis of the coevolution process.

By examining a sequence of events, from the initial idea to develop a prototype database (DB) that would capture and store analysts' financial models, to the development of Omega by the IS team, to company decisions to implement Omega and change the way they provided services to their clients, we identified patterns that revealed dynamics not visible at the macro view of evolutionary phases in Figure 1. What we found is that technological innovations introduced by Omega went through sequences of *variation-selection-retention* processes, well known in the technology evolution literature (Anderson and Tushman 1990; Campbell 1965; Rosenkopf and Nerkar 1999; Van de Ven and Garud 1994). For instance, by introducing technological discontinuity, development of Omega produced a *variation* in the work practices of analysts. Through training and collaboration with the IS team, analysts were exposed to novel ways of performing their tasks. Each analyst chose a *variation* most appropriate to his/her needs and working style. This meant choosing one among alternative ways of performing a task via Omega or choosing not to use Omega. A selected variant is further re-informed through a *retention* process that includes repeated use and incremental improvements.

While we identified numerous sequences of such variation-selection-retention processes, they did not emerge as a neat and linear progression. Instead, we witnessed a messy succession of individual moments of technological innovation, innovation of work practices, changes to institutional norms and policies, and changes in the nature of services provided to clients. In fact, we identified cumulative progression of numerous micro events of variation, selection and retention in which many actors—analysts, IS team members, company management, global company management—made their individual contributions. What became apparent, though, was that some of these events took place at the level of Omega's development and implementation (including changes in analysts' work practices), others at the level of production of services to clients, and yet others at the global level of the parent company. By classifying them according to the level at which variation, selection, and retention processes occur, namely, *component*, *service* and *system* level,[3] we created a detailed model of the Omega–company coevolution process, part of which is presented in Figure 2.

In this model, it is important to note that a component may be either social or technological in nature. For instance, analysts' financial models (spreadsheets) and Omega's database are technological components; a methodology for valuing intellectual property or analysts' working procedures represent examples of social components. Individual *variations* of components may take a range of forms. These may be manifest in the creation of new technologies (such as the development of a prototype database) or work practices (collecting new data to meet specific client needs). Variation of components may also be manifest in changes to existing technologies or work practices. When a component variation is accepted or rejected, we talk of a *selection* event (e.g. individual analysts refuse/accept Omega). Acceptance of a component variation gradually leads to *retention* and further reinforcement. Rejection, on the other hand, may trigger another modification (e.g., IS team improves Omega interface), which means further variation. In any case, each component has its own observable developmental path. Moreover, the development path of a component involves actors (with particular roles in variation, selection, or retention) who together create a *component-specific community*.

[3]Inspiration for the three-level model came from Rosenkopf and Nerkar's (1999) product hierarchies, which relate specifically to the evolution of technology, rather than socio-technical systems, like the one in this study.

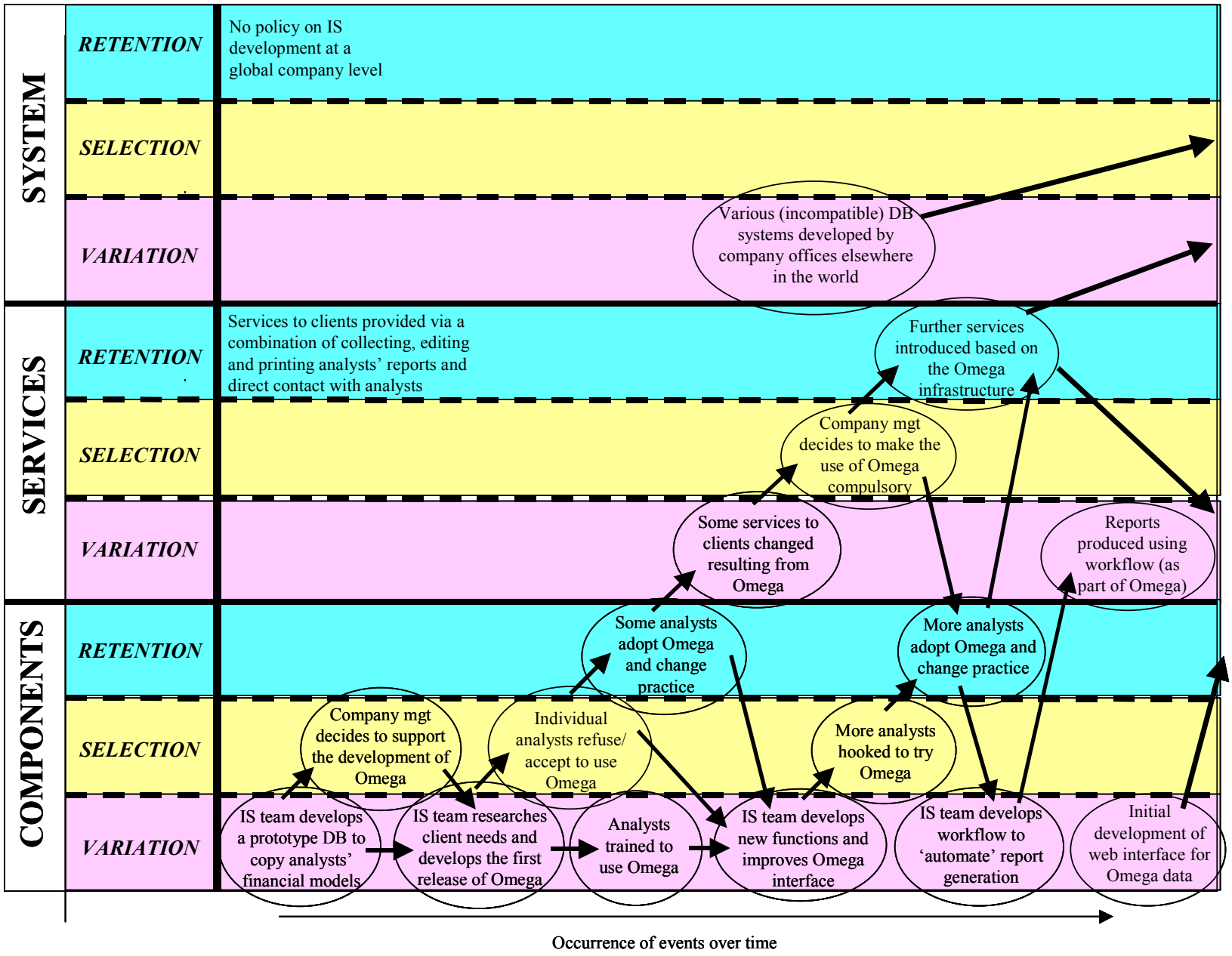

Figure 2. Micro Events during Phase 1 of the Omega–Company Coevolution

Any number of components may be brought together in order to produce services to clients. Before Omega was developed, the company provided printed market reports to its clients[4] (by collecting, editing, and printing analysts' reports) and in some cases enabled direct consultation with analysts. Innovation and evolutionary processes at the components level triggered changes at the *services* level. For instance, due to the use of Omega, the content of reports and the ways in which they were provided changed, which created *variations in services* to clients. After assessing these variations, company management had to change rules and policies regarding the production of services to clients. They made the use of Omega compulsory (a *selection of services*). This lead to the production of full range of services via Omega (including 150 types of reports), indicating *retention* processes at the services level. In shifting perspective from the *components* to the *services* (Figure 2), we observe another level of evolutionary processes with a distinct developmental path and multiple service-related communities.

This evolutionary path has resulted in the current situation where a number of similar services have been offered, based upon different component-level and service-level evolutions in different branches in various countries. The evolutionary pressures observed at the *component* and *service* levels are now forcing *system level* evolution, in the form of standardization of products and technologies across the firm's global operations.

System level evolution is characterized by the setting of policies and standards for the organization's products and services. The pattern of variation-selection-retention is observable at this level as well, but slower-paced and in a somewhat diffused form. This is manifested, for example, in the way Omega has challenged the dominant position of the head office sponsored IS. Since Omega's rollout across 12 countries in Phase 3 (*variation* at the system level), the parent company management has been compelled to recognize its existence and legitimize its operations (a kind of *selection* process). Political pressures and face saving, which played an important role in these processes, are beyond the scope of this paper. What can be concluded from this investigation, however, is that innovations of services (in various branches where Omega was implemented) and in the maintenance of the company's competitive advantage are at risk of being stifled by the system level evolution processes. The highly political nature of the evolutionary path at the system level and the increasing complexity of service-related communities (including a proposed virtual IS team structure) introduce high uncertainty for the future of Omega–company coevolution and consequently challenge the maintenance of the company's competitive advantage.

CONCLUSION

In this paper we presented results from the field study of an investment bank and the ongoing development of its research information system, Omega. These results are significant for both the company and, we would argue, the IS researchers and practitioners. First, we explained how the ongoing IS–organization coevolution produced a situation where the company's competitive advantage is inextricably linked to the quality of its IS. As such, maintenance of its competitive advantage is increasingly a function of the way in which the IS coevolves over time with the organization. Historically this process has been a function of a relatively simple set of interactions between two groups of people: analysts and the IS support team in a local setting. As coevolutionary processes advance at the more global scale, the complexity of underlying events and interactions among the key actors increase, with potentially harmful consequences to the company's competitive advantage.

Second, in order to explain the results from the study, we developed a model of IS–organization coevolution by adapting ideas from technology evolution (variation-selection-retention) and integrating them with the notion of systemic levels (component-service-system) at which micro-evolutionary processes simultaneously occur. The model, we would argue, is applicable to other contexts. This model enables us to explain how numerous single events of technological and organizational innovation by many actors, at different levels, created discontinuities that, over time, accumulated and became recognized as macro stages of coevolution. These individual events and their micro and macro effects are made possible by complex social networks of actors. Our further research focuses on the social networks and how groups of actors interrelate to enact micro events which will add another layer to the IS–organization coevolution model.

Third, the rising complexity and uncertainty of IS–organization coevolution poses new challenges to both IS practitioners and researchers. As we have demonstrated in this paper, the analysis of macro to micro events suggests a promising direction for investigating the nature of IS–organization coevolution. Moreover, it opens a pathway to deeper analysis of actors, their networks

[4]The Australian branch, like other branches around the world, has its own clients, its own services, and to date has operated with relative autonomy in regard to its head office in the U.S. and the setting of policies and standards.

and relationships that create the micro events. This might, we believe, lead to a more comprehensive theory of IS–organization coevolution.

Acknowledgments

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