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AGILITY—THE KEY TO SURVIVAL OF THE FITTEST IN THE SOFTWARE MARKET

THE IDEAS OF
DARWINIAN EVOLUTION
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The software industry and IT departments are facing extreme pressures to provide new applications that add value in today's competitive environment. Whereas in the 1990s companies concentrated on implementing systems that reautomated functions to provide specific benefits, such as Y2K processing, today's market demands new applications, and better integration within and between organizations. This has sparked the formation of many new software companies, and well-established application providers are looking for new features and business models to improve their revenue streams.

Concurrently, we have seen a significant increase in small, interconnected organizations working to provide emerging services and products to today's customers. These firms have simpler information needs than large firms, since they often provide a limited number of products or services. But they often work in concert with multiple firms to complete projects, so they need to communicate seamlessly within this web of firms to share information about each project. In response to traditional and emerging markets, software vendors are realizing they must satisfy the needs of a wide range of companies and to develop

applications tailored to each niche.

Facing these changes involves the daunting task of understanding key differences among software packages and identifying the major players within each market segment. To facilitate such analysis, we have developed a framework that organizes software applications similarly to the evolutionary categorization of animals. As with animals, each category of enterprise system can be divided and subdivided, and each species of system can be studied to identify the characteristics that ensure its continued existence, and the niches in which it can flourish. This framework can help software buyers identify key differences among currently available systems, and can also help software vendors and customers highlight today's trends, with an eye toward guiding organizations toward future software choices. We have successfully used this framework in a graduate course introducing students to a wide range of software applications—where it helped prepare them to enter a market in which agility is the key to survival.

The Evolution Analogy

The ideas of Darwinian evolution can be used to describe the tumultuous IT environment in which enterprises compete. As illustrated in Figure 1 for animals, a first pass at natural classification produces the three categories of invertebrates, vertebrates, and a speculative category of how animals interact as communities. In Figure 2, a comparable first pass categorizes enterprise systems into those with no overall organizing rationale, or backbone; those with inward organization, which can be likened to vertebrates; and those with outward organization, or the ability to communicate and interact as communities. Each category is explained in more detail as follows and can be further subdivided, as illustrated in Figure 2.

Systems with no organizing rationale. Invertebrate animals such as insects are not as advanced biologically as their vertebrate counterparts, but they sur-

vive well in a multitude of environments. Likewise, single entry enterprise systems do not provide robust classification principles to guide the recognition of transactions, but they can be successful in guiding a multitude of

Figure 1. Animal evolution.

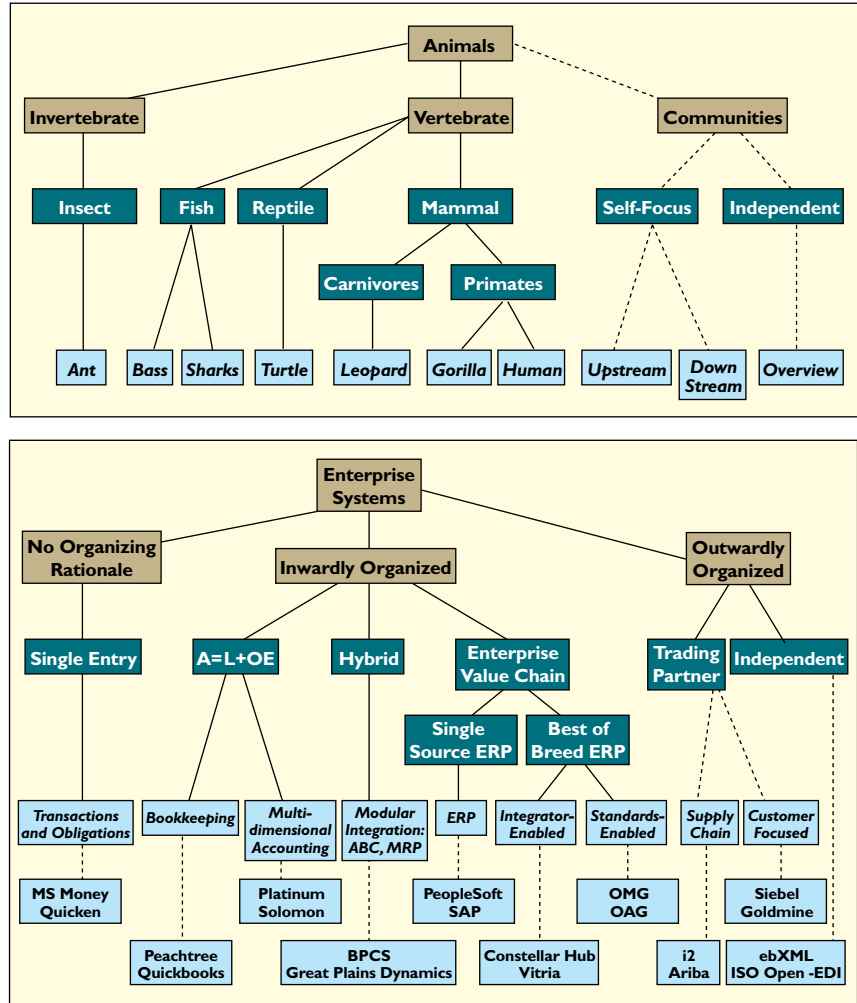


Figure 2. The evolution of enterprise systems.

small organizations. Intuit's Quicken is an excellent example of such a system flourishing within a niche of individual users and small businesses, in which the owner is the key participant and decision maker. Such systems work well when the owner or manager participates in all key business events, but face survival problems if the organization has significant transaction volumes, reporting requirements, or outside information users. For example, it is difficult to provide substantial nonfinancial information using these systems.

Systems with inward organization. More advanced enterprise systems incorporate an organizing principle to bolster their categorization and processing capabilities. These systems adhere in some fashion to one of two major organizing principles: the clas-

sic double-entry accounting equation of assets = liabilities + owners equity ($A=L+OE$) from Pacioli's 1494 treatise [5], or Porter's enterprise value chain concept [7]. The first organizing principle, $A=L+OE$, has successfully guided enterprise information needs for over 500 years. Using this principle, information is focused on the financial implications of economic events, much as it is with single entry systems, but users have a framework to help insure information completeness and to enforce rules about how and when transactions are recognized.

As technology advanced and managers recognized weaknesses in systems that summarize data to fit the categorization of general ledgers and account charts, materials requirements planning (MRP) systems were created to better support manufacturing processes and to assist with production schedules and materials lead-time requirements. Also, activity-based costing (ABC) systems were developed to identify activities resulting in cost expenditures, rather than relying on allocations based on direct labor and materials usage. These MRP and ABC systems are examples of hybrids that have evolved beyond traditional $A=L+OE$ systems, but many products in this category retain some fundamental bookkeeping flavor.

More recently created enterprise resource planning (ERP) systems are better understood using Porter's enterprisewide value chains concepts as their foundation. Their goal is to capture a wide range of information about all key business events. These systems recognize that customer demand pulls resources into the organization to be consumed in pursuit of customer value. When implemented correctly, ERP systems offer firms many advantages beyond generating financial statements and working in an integrated fashion with general ledgers. They help standardize procedures across global divisions, consolidate

detailed transaction data from different functions, and provide methods to access data throughout the entire range of organizational activities. By reducing internal processing costs and enhancing organizational communication, these systems have facilitated the growth of multinational firms, but these systems also impose many constraints on adopting organizations. Many of these packages are inflexible, and firms implementing them must adapt their business rules to meet software specifications rather than the other way around. As a result, some organizations are struggling to implement best-of-breed solutions for a better functional fit, but integration using this approach may be difficult and costly. However, if Web services become widely adopted, with well-established standards to enable easy integration, best-of-breed will likely become the status quo for software selection.

Systems with outward organization. Outwardly organized software systems, such as customer relationship management (CRM) and supply chain execution (SCE) systems, support not only a single enterprise's set of business processes, but work among organizations to provide data to other participants in predictable formats. For example, e-Procurement software can enhance interorganizational communication by focusing on a standard set of document definitions based on EDI or XML, allowing uniform integration of data elements.

Future systems solutions may go further by utilizing common and independently viewed definitions. For example, a system that captures shipping information could give the originating company data for sales calculations, while the destination company could use the same data as their receiving records. These integration systems provide trade facilitation advantages because they increase efficiency with consistent and nonredundant storage. However, the standards for supporting this type of processing are in infancy. Firms located in countries that dictate adher-

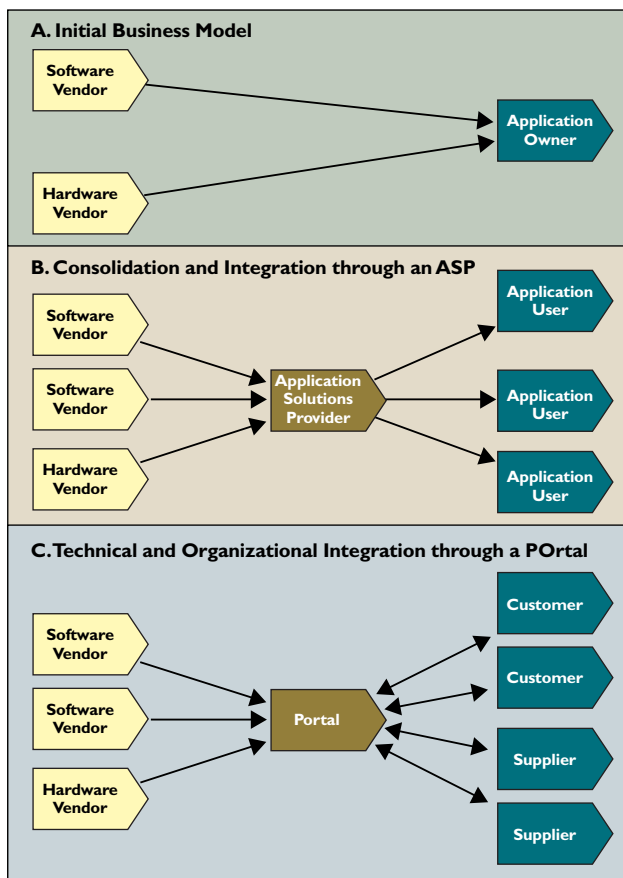


Figure 3. Business models for application solutions.

ence to account standardization may choose to standardize their interorganizational data transfers at the bookkeeping level (that is, use A=L+OE as the transfer protocol), with common data being reduced to account entries. But we believe it is much more likely that these common systems will evolve from ones that capture more detailed semantics about business resources and events, such as envisioned in the Semantic Web [2] and Web services. These higher-order systems will allow users to store, access, and format their information in a manner suited to their own goals. Additionally, these systems may enable new organizational structures. By reducing the cost of interorganizational coordination, small, nimble firms that focus on one activity in the value chain can flourish, relying on the communication capabilities of firms providing complementary services.

Using the Framework

This framework has several uses, the most obvious being to explain the range of software available. Having shared it with a wide range of students as well as members of the international business community, we have seen it can minimize the complexity of today's market, especially for software non-experts. However, we believe it also has value for those who purchase software and those in the software industry. The following examples share insights that become apparent when you extend the framework by applying the additional evolutionary concepts of species classification, adaptation, and mutation.

Species Classification. As evolutionary structures have helped biologists categorize individual species according to their similarities and differences and illustrate the evolutionary relationships among organisms [4], our framework can help categorize software applications. Organizations that need to purchase software are often overwhelmed with the range of application solutions and amount of information available about them. If corporate managers understand the enterprise evolution structure, they can quickly narrow their search to a category that supports their business needs.

Adaptation. As in the animal world, where species that adapt to different environments survive [4], flexible software vendors that successfully adapt their applications to a range of market niches are more likely to flourish in today's economy. An obvious route to increased revenues is for vendors to identify closely related market niches and modify their existing system to move into this new market. In terms of the software hierarchy, this means that vendors may attempt to expand to their left or right, especially within an organizational family. In the

inwardly organized group, we see several of the smaller ERP systems moving right on the evolutionary tree by marketing to larger markets. Consider J.D. Edwards' successful move from the hybrid category to become a single-source ERP vendor, for example. Also, larger systems that have nearly saturated the Fortune 500 market have begun to streamline offerings for smaller firms. SAP states its product, mySAP, can work in companies of all sizes, for example. While many vendors have aggressive adaptation goals, we believe slow and methodical movement to nearby categories can prove more successful than attempting to simultaneously adapt to every environment.

Vendors are also adapting their applications by reaching across organizational categories to integrate new product functionality previously available only through standalone packages such as advanced planning and scheduling (APS) and CRM systems. Because APS and CRM can provide significant value to potentially any organization, the market is attempting to determine the best way to integrate these features into other systems. In the ERP market, several vendors have entered into partnerships to quickly build preconfigured integration between their systems. J.D. Edwards, for example, initially added CRM functionality to its ERP system by partnering with Siebel Systems. Another approach to adding functionality is for firms to purchase standalone products to tightly integrate into their systems. More recently J.D. Edwards has taken this approach through acquisition of advanced planning system Numetrix in 1999, and CRM system YOUcentric in 2001 (and severing its relationship with Siebel to focus on providing a single, integrated ERP/CRM solution). Finally, some vendors have chosen to create their own application modules. SAP has released its own supply chain modules to be sold with its R/3 product, for example. While this approach eliminates integration concerns as the products have been designed to work together, ERP vendors that take this approach may find themselves playing catch-up to match the functionality of older products [7], since standalone vendors often have a long history of successful implementations and years of refining their systems.

Mutation. As in the biological realm, where gene mutations result in new inheritable characteristics [4], adaptive mutations introduced by new vendors are altering the software market. Application service providers (ASPs) are responsible for recent mutations to the traditional model, in which companies buy both software and hardware, accepting responsibilities for ownership and operation of these systems. ASPs, which host an organization's systems on cen-

tralized hardware, have found a market in companies recognizing systems operation is not their core competency, and that maintaining internal IT departments in an increasingly competitive economy is inefficient.

ASPs, which are capable of processing organizational transactions as well as integrating modules and customizing code, pose two threats to software vendors. First, if ASPs consolidate processing resources more efficiently than individual companies, then software sales will shrink. Additionally, if ASPs provide value-added services such as consulting and customization, software vendors will lose additional revenues. The impact of these threats can be significant. For example, BP America outsourced virtually all of its HR functionality—with a \$600 million service agreement with Exult, an ASP and outsourcing firm [3]. Currently, hardware and software vendors, consulting firms, and public accounting firms are all vying to become prominent ASPs [6]. The key to their success lies in their ability to offer high levels of reliable service and to efficiently integrate separate software products.

The new portal providers are taking ASP mutations a step further, issuing more challenges to traditional notions of how software should be delivered. By creating Web-based software and operating it through their portals, portal providers operate similarly to ASPs. But whereas ASPs have largely hosted client/server applications, portal providers can also provide additional site services such as coordinating relationships among related sites and organizations. Taken to the extreme, this model could result in componentized Web-based applications for all functions, and a community of users working together, streamlining the supply chain. Portal providers can earn revenues from individual users, from advertisers, and from transactions occurring between community members. Software customers get the same advantages they get from ASPs, plus reduced software implementation costs since software runs over the Web, and reduced training costs since any employee familiar with browser software is likely to need minimal additional training. Finally, by providing firms with the ability to interact seamlessly with their customers and suppliers, overall efficiencies should be improved, thus helping all organizations in the supply chain remain competitive.

These types of environments are new, and considerable uncertainty exists about how they will evolve. Similar to the single-source versus best-of-breed tension in the ERP market, software-providing portals may debate over whether to develop complete information solutions or focus on core competencies. If the

latter occurs, the need for interportal communication standards will be critical to the success of these niches.

Portal providers could also develop radically different data structures for their systems—as different as the break between systems with no organizing rationale and those that are inwardly organized. If the portals focus on streamlining interorganizational communication, they will need to capture detailed information about each customer–supplier interaction, similar to current CRM products. The difference, however, will be that the data could be stored once and then made available to both parties in the transaction. In this environment, the records could be used by customers to perform vendor analysis and supply chain execution, while suppliers could use the records to perform customer analysis and demand planning.

Conclusion

We have developed an evolutionary framework to categorize today's enterprise software market. The value of this framework lies in its ability to explain the market and to help identify potential evolutionary changes. Today's market is complex, and the changes business firms face are dramatic. Our framework highlights that any application's ability to survive in such an environment relies on its producer's ability to remain flexible. Producers must be able to identify important market mutations that challenge the status quo and to adapt with either incremental or wholesale changes in product components. ■

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