EVALUATING INTEGRATED ELECTRONIC COMMERCE SYSTEMS

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INTRODUCTION

Until recently establishing an electronic distribution channel necessitated a major financial effort for a company as it involved costly and know-how intensive development of custom applications. By now, however, a considerable number of Integrated Electronic Commerce Systems (IECS) have become commercially available from a variety of vendors. Such systems promise to support within an integrated software system all aspects of electronic commerce from the stage of product identification-through the agreement phase all the way to the settlement of a deal and customer support services. A closer look at such products, though, reveals considerable differences in the amount of functionality supported and the suitability for different types of applications. What most IECS have in common today is their focus on retailing operations. Solutions tailored to the characteristics of the business-to-business sector or the specific needs of certain vertical markets are only slowly starting to appear. Thus, a certain amount of custom development is usually unavoidable.

CATALOG OF EVALUATION CRITERIA

The following catalog of evaluation criteria is meant to provide practitioners with a framework for analyzing the market for IECS and be of help in reaching sound purchase decisions taking into account the specific characteristics of a business. It has already been applied in an extensive study of the IECS market (see Lincke et al. 1997). Besides essential technical aspects the main emphasis is put on the degree to which the different phases of an electronic market transaction are supported.

COMPANY PROFILE

Establishing a corporate presence in the electronic market space and setting up the necessary services and organizational processes to ensure electronic handling of business relations in their entirety requires considerable investments. Depending on the IECS product chosen and the kinds of services planned implementation costs can range from US$ 60'000 up to beyond US$ 1 Mio. After initial setup additional human and financial resources need to be allocated to ensure professional maintenance of the platform and content. Thus, investments in this area are of a long-term nature.

As no standards have evolved yet in the market for IECS, solutions from different vendors are generally incompatible with each other. Once a decision for a certain product has been made there is a certain

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dependence on the manufacturer that should not be underestimated considering the high investments a change of platform would require. Therefore, the market potential and economic prospect of the manufacturer should definitely be taken into account when evaluating an IECS. Especially since the market for internet commerce software is still very short-lived and many promising startup companies vanish again within just a few months.

Furthermore, aspects of achieving synergies and integration with established information systems should be taken into account when deciding on a vendor. To exploit the full potential of an electronic distribution channel, tight integration with order and inventory management systems etc. is essential. For companies that are running their operations on standard software (e.g. SAP R/3, Peoplesoft etc.) web extension modules offered by those vendors (e.g. SAP's Internet Transaction Server) might be an option worth considering.

PLATFORM SUPPORT

IECS available today differ considerably in their technical architecture. However, concerning their logical architecture and the partitioning of functionality usually similar structures can be observed. Typically a three-tier architecture is employed which divides the system into presentation services jointly provided by a web server and a browser residing on the client, an application server on which business logic is executed and a database backend for data storage (see Fig. 1).
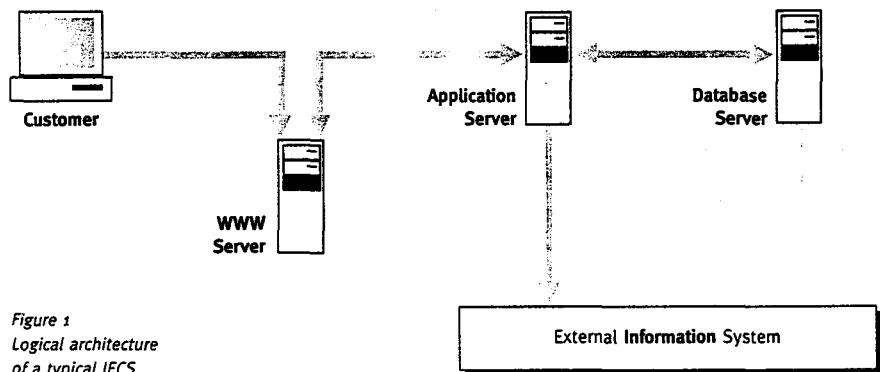

Figure 1
Logical architecture
of a typical IECS

Concerning their openness and support for heterogeneous environments notable differences exist between the solutions available today. While affordable solutions at the low end often are only available for the Windows NT operating system most high-end solutions feature a modular structure, which allows for the distribution of components on different operating system platforms and database systems.

Generally, in this respect products can be differentiated according to the operating systems and database management systems they support and the (industry) standards they comply with:

Operating Systems
Unlike low-end solutions which tend to be available solely on the Microsoft family of operating systems most high-end systems tend to be available on a whole range of operating systems including the major UNIX derivatives.

Database Management Systems (DBMS)
Most IECS don't depend on a certain database product to be used in conjunction with it and usually a database server is not or only optionally included in the package. When deciding on a DBMS, easy integration with established information systems should be of foremost concern in order to ensure fast and reliable data exchange. If possible it is advisable to use the same database product with an IECS that other corporate applications are based on. Otherwise it is important to ensure that appropriate middleware is available that will allow data exchange to take place through replication or batch loading.

Most IECS running on Microsoft operating systems support ODBC as a database interface, thereby enabling any ODBC-compliant database to be used as the storage backend. UNIX-based solutions, on the other hand, tend to only support a limited selection of databases via their faster native interfaces.

Standards Compliance
While high-end products tend to provide a whole range of programming interfaces, low-end solutions are usually severely limited in their degree of end-user customizability and often don't provide any programming interfaces at all. In order to cut down on the development effort when developing custom extensions an important buying criterion should be the degree to which open (industry) standards are supported. Besides Internet standards like CGI and several important vendor specific APIs (e.g. Microsoft DCOM, ActiveX etc.) the Object Management Group's CORBA standard is increasingly taking on the role of a universal middleware standard for distributed applications.

SCALABILITY
Planning in advance for the right degree of scalability of an electronic commerce platform ist just as important as ensuring the quality and usability of such a platform on the content side. Only appropriate sizing and scalability of hardware and software components can guarantee smooth operation even under substantial transactional growth conditions. Thus, before committing to a specific product it is crucial to carry out an in-depth analysis of the kind of usage patterns and the transaction load that are to be expected in daily operation.

Mall Support
In addition to enabling a single organization to establish an electronic many of the high-end IECS offer the option of accommodating a whole range of separate businesses in the form of an electronic mall. Considering the substantial costs involved in creating an independent presence on the Internet a presence within an electronic mall can prove to be a worthwhile alternative especially for small and medium size enterprises. In such an environment services of the agreement and settlement phase can be centrally provided by the mall operator without a need for each single company to replicate those services.

Transaction Load
Besides organizational considerations, a precise estimate of the transaction load that is to be expected and its future growth path is essential. In addition to affecting the choice of IECS software product this also has a direct impact on the kind and size of hardware infrastructure needed and operating and database management systems.

On the side of the IECS modularity and the ability to distribute the components throughout a network is critical. Especially CORBA-based solutions tend to be highly scalable as they allow single components of the overall system to be distributed to different size servers and operating systems according to load handling requirements. Frequently, however, the actual bottleneck is the database backend. While single-user databases (e.g. Microsoft Access) are inappropriate for most small installations, even low-end database server products offer an affordable and viable solution for most small to medium size installations. Large implementations with very high transaction rates should opt for enterprise level solutions from vendors like Oracle, IBM, Informix etc.

SUPPORT FOR SPECIFIC MARKET SEGMENTS
While some IECS take a generic approach and feature a modular structure that offers a high degree of freedom in assembling a system that accommodates specific business requirements, other products focus on optimally supporting the needs of a certain market segment. Generally, a differentiation into two distinct types of segments can be made:

- Business to consumer / retail operations
- Business to business

Each of these sectors can be characterized along the dimensions of *content* (characterization of the kind of content and content-related services offered), *transaction* (types of transactions being carried out) and *personalization* (use of supporting personalization services).

Business to Consumer

At the heart of online retail operations is the electronically supported selling of goods and services by vendors to end consumers.

Content:

Products are presented to customers by way of electronic product catalogs. Easily navigable, browsing-oriented user interfaces, multimedia enhanced content design and support for marketing promotions are some of the key aspects in this context.

Transaction:

The subject of transactions can be either physical goods and services or digital goods, where an option of electronic fulfillment can be offered. Key aspects include electronic shopping cart systems, credit card based electronic payment, order status tracking and notification systems etc.

Personalization:

Personalization is an especially interesting feature in the retail sector as it can give a store operator fine grained control over what content is presented to specific types of customers. By implementing a target marketing concept each single customer can be provided with his personal store featuring promotions with a high likelihood to fall within his interests. Profile information is derived from personal data given out by customers, but in advanced solutions can also be derived from implicit user feedback.

Business to Business

The business-to-business sector is characterized on one hand by traditional long-term business relationships but on the other hand also by new kinds of ad-hoc deals facilitated by the increased transparency in electronic markets.

Content:

Corporate customers are not that interested in fancy graphics as their main interest is in accessing relevant information fast and efficiently. Thus, clearly structured content enabling efficient navigation and search for relevant product information is of foremost concern. Ease of use can be further increased by offering value added retrieval services, e.g. full text search mechanisms and product attribute based search interfaces.

Transaction:

While basic properties of transactions remain the same as in retail operations, fully accommodating business requirements will usually demand support for EDI and the tight integration of external applications and processes.
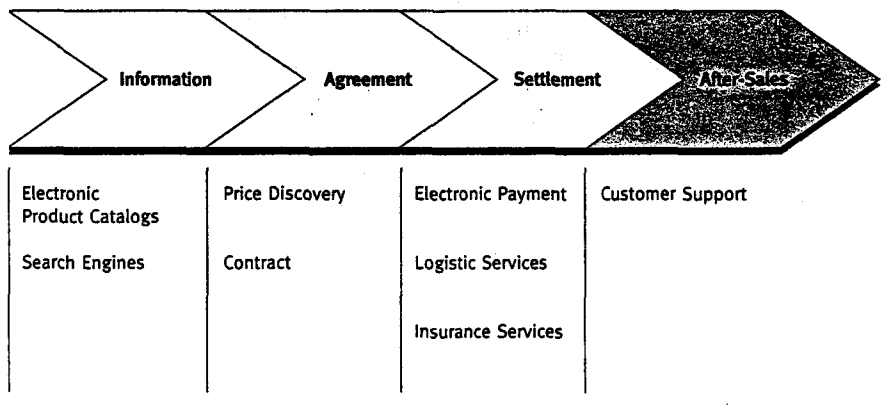
Personalization:

In the business sector, the ability to customize content presentation for individual customers can be useful in adding value to customer support offerings. E.g. a software or hardware vendor can offer tailored support services, so that a customer will only be presented with bug fixes, update options or spare parts that match his specific configuration.

END-TO-END SUPPORT FOR BUSINESS PROCESSES

Ideally, an IECS should provide end-to-end support for carrying out business transactions (Lindemann/Runge 1997). This means that every single step in the transaction process is to be electronically supported by some system component – starting with the selection of goods and services from an electronic product catalog, followed by reaching a contractual agreement between buyer and seller on the purchase conditions to be applied and settlement of the deal through payment and shipping of goods all the way to customer support services throughout the lifetime of a purchased product. End-to-end support is a core criterion in the assessment of electronic commerce applications and forms a basic requirement in reference models for electronic markets (Schmid/Lindemann 1998).

Most IECS available today claim to fulfill this criterion. However, while their support in certain areas like electronic product catalogs tends to be very comprehensive they often fall short of their promises in other areas, especially in their support for the agreement and after-sales phases. To facilitate a systematic analysis of the strengths and weaknesses of IECS in this context a separation of the market transaction into several distinct phases can be helpful. In chronological order these are the information phase, the agreement phase, the settlement phase and the after-sales phase (see Fig. 2):

Figure 2
Phase model of an electric market transaction

Information	Agreement	Settlement	After-Sales
Electronic Product Catalogs	Price Discovery	Electronic Payment	Customer Support
Search Engines	Contract	Logistic Services	
		Insurance Services	

INFORMATION PHASE

In the information phase potential customers acquire an overview of the market by gathering information on suppliers and products which seem to be suited to satisfy their specific needs. On the system side these activities are supported by directory services and electronic product catalogs (Schmid 1996, Lincke 1997). While early proponents of electronic product catalogs mainly consisted of not much more than a set of static pages, practically all IECS available today support dynamic generation of catalog pages from product data stored in relational databases. This also enables the construction of powerful search interfaces allowing the search for products based on attribute values.

Concerning the flexibility with which product information can be rearranged, however, considerable differences exist between the available IECS. The most advanced systems are able to combine user profile information with catalog data thereby allowing content to be tailored to the preferences and needs of each individual user.

With specialized products of a high complexity (e.g. tool machines), where often a plethora of model specific options is available, the support of online configuration management applications can be of tremendous value to customers. Such applications allow users to safely put together an integrated solution without the danger of ending up with a misconfigured product. However, due to the their high specificity such services are beyond the scope of today's IECS.

Agreement Phase

Within the agreement phase conditions of the transaction are negotiated which allow for an agreement to be reached. The result is a legally binding contract between the market partners. While in general only a price policy according to the "take it or leave it" principle is supported, some IECS allow special purchase conditions, rebates etc. to be applied for individual customers based on user profile information.

For the calculation of taxes which tend to differ according to geographic location and type of product sold most IECS provide interfaces for the integration of third-party products or custom developed modules.

Settlement Phase

In the settlement phase the agreed-upon terms of the contract are fulfilled. Depending on the type of good or service to be exchanged the settlement phase can have varying sub-functions. The terms for e.g. physical goods may include packaging, transport, storage and insurance. Besides a range of electronic payment methods (for an in-depth analysis of electronic payment systems available in IECS see Himmelspach et al. 1996) a service should be provided that allows for the tracking of the delivery status of orders. For the case of digital goods mechanisms for online delivery are another important aspect.

The level of support for these functions is very uneven among the available IECS. Many of them are only prepared to handle physical goods. Among the different kinds of payment methods supported credit card based systems are clearly dominating and SET seems to be slowly evolving into the dominant payment technology employed. Some IECS targeting specifically the business-to-business seg-ment also offer EDI interfaces for the exchange of order and payment in-formation.

In order to enable the provision of order status tracking and inventory checking services many products provide programming interfaces that allow links to external order and inventory management systems to be created.

After-Sales Phase

After a deal has been closed it is important to maintain continuous contact with a customer in order to forge close ties and encourage repeat visits and purchases, e.g. by offering help with any product-related problems, regularly sending him updated product information, notifying him about special promotions etc.

Basically, customer support applications can be divided into two different types:

♦ Synchronous applications
These kinds of applications cover the typical helpdesk scenario where a customer and a support representative confer with each other in real time. Unlike a traditional call center application, however, communication takes place within chat rooms or through internet-based video or audio conferencing. In addition chat rooms can also be used by vendors to facilitate contact and exchange of experiences within their customer base. Also hybrid technologies marrying call center applications with web content are slowly starting to appear.

♦ Asynchronous applications
A classical application of this type are electronic discussion groups like the USENET newsgroups that have been available for many years. Such discussion groups enable the exchange of information not only between customers and manufacturers but also among customers. Other customer support services that fall in this category are mailing lists and product knowledge and problem solving databases that can be queried by customers.

The support for this kind of functionality in IECS is minimal to non-existent today. With few exceptions services like discussion groups or chat rooms require the installation and integration of additional specialized application servers.

SECURITY

As the Internet represents an open public network special attention has to be paid to security concerns when establishing an electronic distribution channel. In the context of IECS two kinds of security aspects can be differentiated each requiring specific measures:

♦ System security
System security needs to ensure that an IECS platform and other information systems linked to it can not be maliciously compromised. Besides the use and proper configuration of a secure operating system platform this calls for the implementation of a firewall which screens and prevents unauthorized external accesses to the internal network and only exposes specific network services. As firewalls are complex systems consisting of hard- and software components they need to be evaluated separately from an IECS solution.

♦ Data and application security
Measures of data and application security are concerned with protecting data from being tampered with that is exchanged between customers and an IECS. Besides guaranteeing the authenticity of the communicating parties involved, maintaining confidentiality, integrity and non-repudiation of exchanged data is critical. Over the last few years the SSL protocol has evolved into a standard solution for these kinds of requirements. SSL as well as most electronic payment mechanisms are based on public key cryptography.

PROGRAMMING INTERFACES AND THIRD-PARTY COMPONENTS

Frequently, the standard functionality of an IECS cannot satisfy specific business requirements. Provided the product offers a set of application programming interfaces (API) custom extension modules can be developed to provide the missing functionality. Besides the extent to which

REFERENCES

Himmelspach, A., Runge, A., Schubert, P., and Zimmermann, H.-D. "Analyse und Bewertung von Zahlungssystemen", Working Paper BusinessMedia/52, Institute for Information Management, University of St. Gallen, 1996.

Lincke, D.-M. "Ein Ansatz für verteilte Architekturen intelligenter elektronischer Produktkataloge", Working Paper BusinessMedia/54, Institute for Information Management, University of St. Gallen, 1997.

Lincke, D.-M., Haertsch, P., Hoffmann, C. A., and Lindemann, M. A. "Integrierte Electronic Commerce Systeme – Auswahlkriterien und Evaluation aktueller Produktangebote", Working Paper BusinessMedia/58, Institute for Information Management, University of St. Gallen, 1997.

Lindemann, M. A., and Runge, A. "Permanent IT-Support in Electronic Commerce Transactions", in International Journal of Electronic Markets, Vol. 7, No. 1, 1997, URL: http://www.electronicmarkets.org.

Schmid, B., and Lindemann, M. A. "Elements of a Reference Model for Electronic Markets", in Proceedings of the 31st HICSS Conference, Hawaii, 1998.

Schmid, B. "Zur Konstruktion Elektronischer Märkte", in: Informatik/Informatique, Zeitschrift der schweizerischen Informatikorganisationen, No. 6 1996.

standard functionality can be customized and extended through APIs, the range of programming languages and development environments supported should be taken into account when evaluating an IECS. Some vendors of IECS also maintain partnerships programs through which business partners offer extension modules to their IECS solutions, which often can obviate the need for expensive in-house custom development.

CONCLUSIONS

The evaluation criteria for IECS discussed above have been used in an extensive evaluation of IECS solutions for companies in the tool machinery industry in Switzerland (for the full study see Lincke et al. 1997). Unfortunately, none of the solutions that were examined fulfilled the requirements of a comprehensive electronic commerce application. Besides in properties of a technical nature (e.g. operating system and database support) products differed mainly in their orientation towards specific business sectors (retail or business-to-business) and the extent to which they achieved end-to-end support for business transactions. The majority of solutions available today are tailored to the requirements of retail operations. Basically, the amount of functionality supporting the different phases of a market transaction is steadily decreasing from the information up to the after-sales phase. While rich electronic product catalogs and search mechanisms are a feature of almost any IECS offering, hardly any of them offer any support for the after-sales phase today.

For most companies, especially those in the business-to-business sector, this means that no suitable shrink wrapped software solutions are available today. Therefore, the aspect of extensibility of IECS products is of special importance to them as a comprehensive set of programming interfaces can allow them to take advantage of suitable components of an IECS while not being restricted by its limitations.