How Business Models Influence the Development of E-Business Applications

October 2000

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Abstract

Currently, we are in the midst of the digital equivalent of the Industrial Revolution. Internet technologies fundamentally change the way business is done. Besides offering new possibilities for existing business models, they also enable totally new ones. This paper presents *a methodology for the development of e-business applications* which considers in particular the (strategic) business model level. The explicit representation of the business model supports the design of the e-business application according to the business needs. Additionally, a classification schema for business models is explained and application architectures and development technologies for e-business applications are described. The *three-level modeling language* of the proposed methodology has been realized within the (meta) business process management tool ADONIS.

1. Introduction

Currently, we are in the midst of the digital equivalent of the Industrial Revolution. Internet technologies fundamentally change the way business is done [28]. Besides offering new possibilities for existing business models, they also enable totally new ones. Additionally, Internet technologies themselves rapidly evolve, e.g. WAP enables mobile commerce, XML replaces HTML, etc. A lot of work has been done investigating the influence of *e-business applications*, i.e. IT applications based on Internet technologies, on different price building mechanisms such as fixed price sales, various forms of auctions, and brokerages [19, 26, 29]. On the other hand, there is also a lot of research concerning the development of e-business applications [7, 8, 22]. However, the majority of proposed development methodologies is IT-driven, because they neither take the underlying business model nor the related business processes into account. This paper extends the concepts presented in [3]. It introduces a methodology for the development of e-business applications which considers in particular the (strategic) business model level. The modeling language of this methodology has been realized within the (meta) business process management tool ADONIS[*] [5, 13, 17].

   The paper is structured as follows: In section 2 the term "business model" is defined and classification criteria for business models are explained. Afterwards, section 3 discusses characteristics of e-business applications, presents a generic application architecture, and investigates the usage of different technologies for its implementation. Section 4 explains the modeling part of the methodology and its realization within ADONIS. Additionally, aspects of the IT implementation are dealt with. The paper concludes with some project experiences and an outlook to further work.

2. Business Models for E-Business

According to [27], a *business model* consists of three parts:

a) *Dynamic part:* A (usually high-level) architecture for the product, service, and information flows, including a description of the various business actors and their roles.
b) *Business Benefits part:* A description of the potential benefits for the various business actors.
c) *Revenues part:* A description of the sources of revenues.

   For a further classification of specific business models different criteria can be used. Table 1 shows some of these criteria. Detailed explanations can be found for example in [14, 20, 23, 27].

Table 1: Classification criteria for business models

Involved Parties	B2C (business-to-consumer)	B2B (business-to-business)	B2A (business-to-administration)	C2A (consumer-to-administration)	C2C (consumer-to-consumer)
Buyer/Seller Relation	1-to-1		1-to-many	many-to-1	many-to-many
Product Source	Non-Intermediary-Based			Intermediary-Based	
Evolution Level	Publishing		Triggering	Interactive Execution	Transparent Processing
Functional Integration	Single Function, no integration		Multiple, partially integrated functions		Multiple, fully integrated functions

In [27] eleven business models are distinguished, ranging from electronic versions of traditional business (e.g. e-shops) to totally new business models (e.g. virtual communities), see also [14]. It should be noted, that business models in particular for B2B e-business are often branch- or even company-specific.

Obviously, business models and e-business applications strongly influence each other. On the one hand IT - in particular the Internet - enables new ways of doing business and on the other hand it restricts it. Such restrictions could be security problems, performance issues, and the integration of ERP and legacy systems.

3. Application Architectures and Development Technologies

3.1 Characteristics of E-Business Applications

When comparing e-business applications and its development methodologies with traditional IT applications, the following characteristics can be found:

a) *Speed of development:* "Speed" is one of the key characteristics of e-business. Business models are adapted rapidly to gain competitive advantage. Therefore, e-business applications have to be developed and adapted very quickly, resulting in prototyping approaches and application changes while being already in production.

b) *System heterogeneity and complexity:* Traditional applications are often based on one "main technology", for example workflow, CASE or standard software (ERP systems). At lot of work has been done on methodologies using these technologies. Most of these methodologies take business process modeling as a basis [1, 4, 6, 15, 16, 18]. In e-business applications there is usually not one "main technology". Here, a number of different technologies and systems have to be integrated (see also figure 1). It is helpful to design the integration already on the modeling level, because this reduces the complexity (compared to the technical level).

c) *Application and data security:* The main platform for e-business is the Internet. Due to the (current) insecurity of the Internet, e-business applications have to provide sophisticated security mechanisms.

d) *Application performance:* The worldwide availability of e-business services within the Internet enables access to a large, potentially unlimited, customer base. Additionally, the volume of the customer base can grow rapidly. Therefore, e-business applications have to be extremely scalable.

3.2 A Generic Application Architecture

Figure 1 shows a generic architecture for e-business applications. Through the concurrent development and maintenance of the architectural elements, the development speed can be improved. Because of the potential heterogeneity of the architectural elements, security aspects have to be handled at every point of interaction within the architecture. The generic architecture can be implemented using 2-tier, 3-tier or 4-tier technologies, depending on performance and scalability requirements [24]. For an "instantiation" of this architecture for B2C e-business applications see [3].
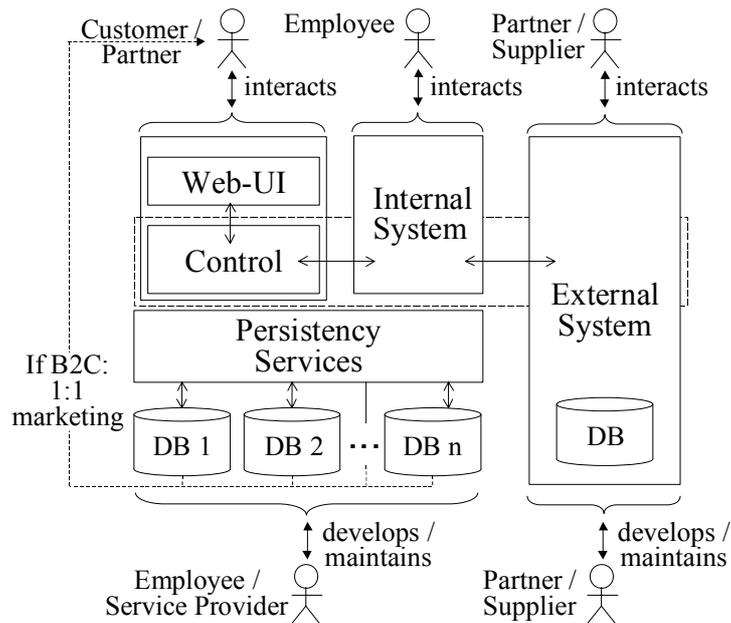

Figure 1: A Generic Application Architecture

3.3 Technologies for E-Business Application Development

For the realization of e-business applications *packaged e-business platforms* and/or *individually developed applications* can be used. Packaged e-business platforms are often used for B2C e-business, for an overview see for example [23]. Such systems provide IT services such as security, payment, and product catalogs. These services can be integrated with existing systems, but most of them are largely proprietary. Additionally, they usually implement a fixed business model, which cannot be changed.

For the development of both, packaged platforms and individual applications, different technologies can be used. Table 2 shows some of them [23]. Of course, these technologies do not have to be used, their functionality can also be realized by using "lower level technologies".

Table 2: Technologies for E-Business Applications

Task Management	Workflow Management Systems		Groupware Systems		. . .
Frameworks	San Francisco	Java Wallets	Network Comput. Architecture		. . .
Middleware	CORBA	DBMS	Java Packages		. . .
Base Technologies & Standards	TCP/IP / HTTP	GSM / UMTS	Smart Cards	HTML / XML	Cryptographic Algorithms	. . .

4. Integrated Management of Business Models, Business Processes and IT Systems

4.1 Methodology: Overview

As already mentioned, business model(s) and e-business applications are strongly interdependent. Therefore, we propose to model both explicitly. But, a business model focuses on high-level details such as goals, strategies, and the interaction of entities (customer, partners, etc.), whereas an e-business application implies a low-level, technology-based perspective [14]. We consider business processes as the "missing link" between a business model and the corresponding e-business application. The business model describes the "what", the business processes the "how" and "who", and the IT system "which" technologies are used to implement the business processes. The main characteristics of the proposed methodology are (see figure 2):

- Integrated modeling of business models, business processes and IT systems within one tool. This allows to discover interdependencies between these elements as early as possible [9, 10].
- Transformation/linkage interfaces to the different implementation platforms (compare section 3.3).
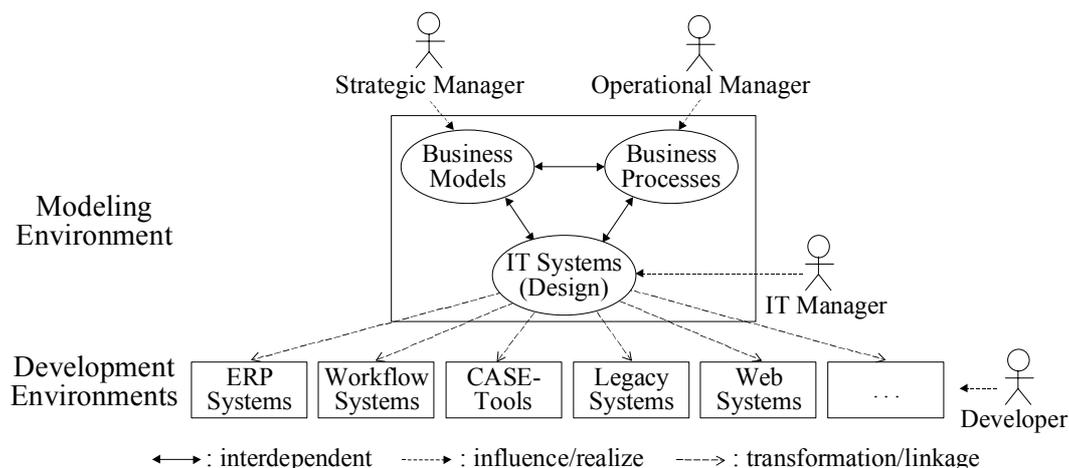
Figure 2: Developing E-Business Applications

We use the (meta) business process management tool ADONIS as modeling environment, because it provides powerful customizing capabilities [5, 13]. In particular, it allows the definition of arbitrary modeling languages without requiring any programming effort [17].

4.2 A Modeling Language for E-Business Application Development

Figure 3 shows the metamodel of the proposed modeling language in UML. The three levels of abstraction - business models, business processes, and IT systems - are represented by different model types. Each model type contains modeling classes and relationships to build the models. The models are connected via inter-model relationships. Figure 4 shows an example.
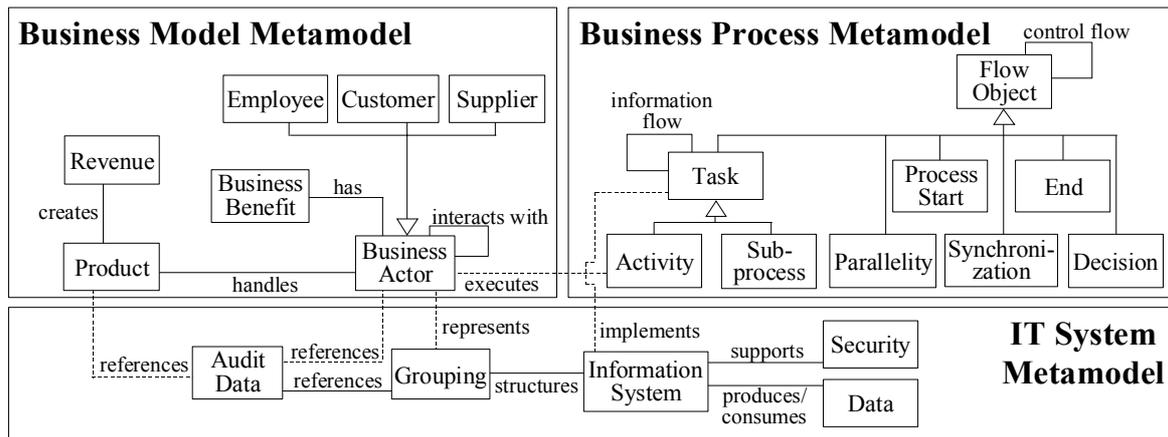
Figure 3: A Modeling Language for E-Business Applications

4.3 Implementation of E-Business Applications

The conceptual models described in the last section serve as input for IT implementation. This means, that these models have to be "mapped" to the application architecture described in section 3.2 in accordance to their development environments. In general three types of interfaces can be distinguished:

1. *Organizational interface*: This (simple) interface consists of using the business models or documents generated out of these models as specification for the implementation.
2. *Transformation interface*: Among other formats, model data can be exported from ADONIS using ADL (ADONIS Definition Language), SGML, XML, and WPDL (Workflow Process Definition Language) [12, 13]. The generated files can - if necessary - be converted and then imported into the application development environments.
3. *Online linkage interface:* For implementing online interfaces, ADONIS provides the scripting language AdoScript and APIs which support access and manipulation of model data and the integration of external programs and functions from DLLs [4].

An additional advantage when using a modeling tool based on metamodeling concepts (such as ADONIS), is, that the IT modeling can also be adapted to the selected "IT target platforms" by using exactly their modeling languages. In figure 4 for example, on the lower right side a workflow model is shown, which is modeled in the language of MQSeries Workflow (IBM) [11, 21]. For further explanations of this approach please refer to [13].

5. Conclusions

We applied the presented methodology in several projects. Often the involved managers of an organization do not have a consensus about the business model to be deployed. Here, an explicit representation reduces discussions considerably, because it forces everybody involved to clearly state his opinion. As feedback from operational and IT managers shows, the integration of business models, business process models, and IT system models helps to discover the consequences more easily when a model is changed. In some projects we found it helpful to extend the business models with branch-specific modeling elements.

Therefore, we are currently working on branch-specific business model metamodels for insurances, banks, and the public sector. Additionally, we see deficits concerning methodologies for the model-based development of e-business applications using object-oriented application frameworks.
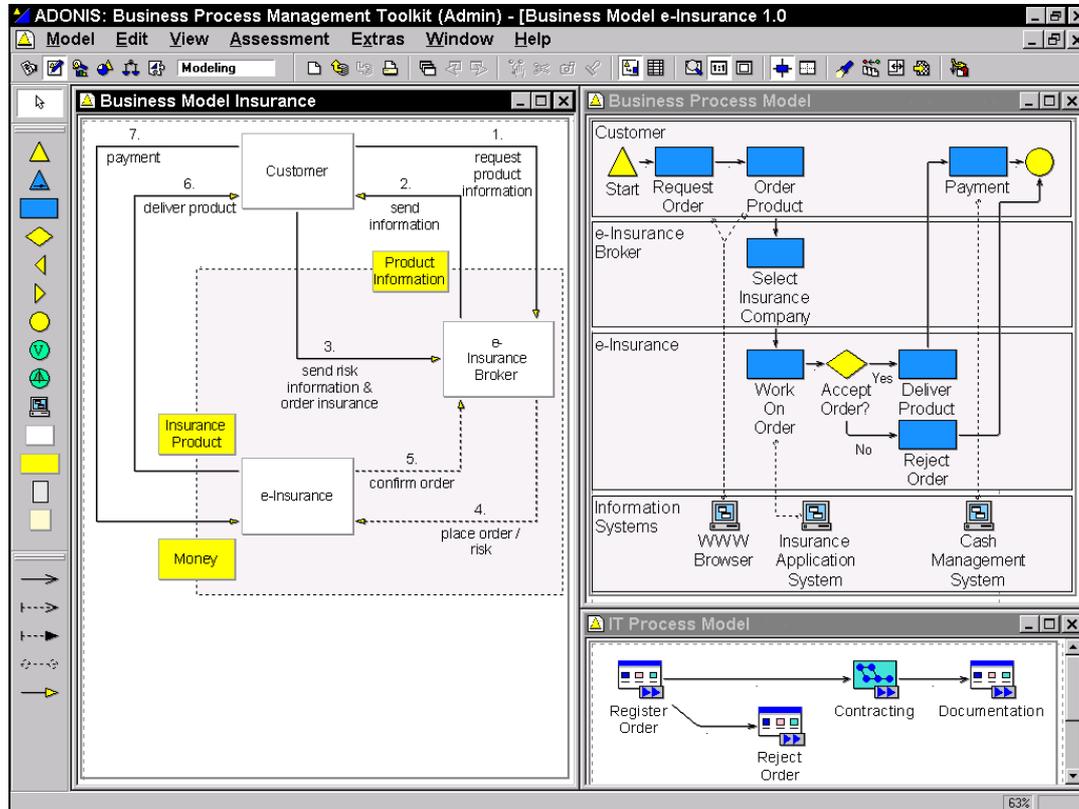

Figure 4: Modeling an E-Insurance Order in ADONIS

Acknowledgment

References

[1]   M. Amberg. The Benefits of Business Process Modeling for Workflow Systems. In P. Lawrence (Ed.), Workflow Handbook 1997. John Wiley & Sons Ltd, Chichester et al. 1997, pp. 61-68.

[2]   U. Baake, R. Zobel, and M. Al-Akaidi (Eds.). Proceedings of the 7th European Concurrent Engineering Conference (ECEC'2000), Leicester, UK, 17-19 April 2000, Society for Computer Simulation.

[3]   F. Bayer, S. Junginger, and H. Kühn. A Business Process-Oriented Methodology for Developing E-Business Applications. In [2], pp. 32-40.

[4]   BOC and microTOOL. The ADONIS - case/4/0 Interface. Product Information. Berlin/Vienna, September 1997. (in German).

[5]   BOC GmbH. ADONIS Version 3.0 - Users Guide. Vienna 1999.

[6]   M. Böhm. Entwicklung von Workflow-Typen. Springer, Berlin et al. 1999. (in German).

[7]   S. Boll, A. Grüner, A. Haaf, and W. Klas. EMP - A Database-Driven Electronic Market Place for Business-to-Business Commerce on the Internet. *Journal of Distributed and Parallel Databases*, Special Issue on Internet Electronic Commerce, 7 (1999) 2, pp. 149-177.
      http://www.informatik.uni-ulm.de/dbis/persons/boll/papers/DAPDEMP.ps.gz (2000-01-31).

[8]   J. Conallen. Modeling Web Application Architectures with UML. *Communications of the ACM* 42 (1999) 10, pp. 63-70.

[9] J. Gordijn and H. van Vliet. On the Interaction Between Business Models and Software Architecture in Electronic Commerce. In Addendum to the Proceedings of ESEC/FSE'99. http://www.cs.vu.nl/~hans/publications/ESEC99.pdf (2000-05-05).

[10] J. Gordijn, H. Akkermans, and H. van Vliet. Value Based Requirements Creation for Electronic Commerce Applications. In Proceedings HICSS-33, IEEE (CD-ROM). http://www.cs.vu.nl/~hans/publication/HICSS33.pdf (2000-05-05).

[11] IBM Corp. MQSeries Workflow V.3.1 - Product information and documentation. 1998.

[12] S. Junginger. The Workflow Management Coalition Standard WPDL: First Steps towards Formalization. In [2], pp. 163-168.

[13] S. Junginger, H. Kühn, R. Strobl, and D. Karagiannis. Ein Geschäftsprozessmanagement-Werkzeug der nächsten Generation - ADONIS: Konzeption und Anwendungen. BPMS-Report, University of Vienna, April 2000. (in German).

[14] D. Jutla, P. Bodorik, C. Hajnal, and C. Davis. Making Business Sense of Electronic Commerce, *Computer* 32 (1999) 3, March 1999, pp. 67-75. http://dlib.computer.org/co/books/co1999/pdf/r3067.pdf (2000-05-05, registration required).

[15] D. Karagiannis, S. Junginger, and R. Strobl. Introduction to Business Process Management Systems Concepts. In B. Scholz-Reiter and E. Stickel (Eds.), Business Process Modelling, Springer, 1996, pp. 81-106.

[16] M. Kirchmer. Business Process Oriented Implementation of Standard Software. 2nd Edition. Springer, Berlin et al. 1999.

[17] H. Kühn, S. Junginger, D. Karagiannis, and C. Petersen. Metamodellierung im Geschäftsprozeßmanagement: Konzepte, Erfahrungen und Potentiale. In J. Desel, K. Pohl, and A. Schürr (Eds.), Modellierung'99, Teubner Verlag, pp. 75-90. (in German).

[18] H. Kühn and S. Junginger. An Approach to use UML for Business Process Modeling and Simulation in ADONIS. In H. Szczerbicka (Ed.), Proceedings of the 13th European Simulation Multiconference (ESM'99), Society for Computer Simulation, Warsaw 1999, pp. 634-639.

[19] M. Kumar and S. Feldman. Business negotiations on the Internet. Technical Report, IBM Institute for Advanced Commerce. March 1998. http://www.ibm.com/iac/reports-technical/inet98.pdf (2000-05-05).

[20] K. Kurbel. Internet-Nutzung im Business-to-Business Bereich: Stand der Entwicklung, Typologie und Anwendungsbeispiele. In H. Krallmann (Ed.), Wirtschaftsinformatik'97, Physica-Verlag, Heidelberg 1997, pp. 23-34. (in German).

[21] F. Leymann and D. Roller. Production Workflow. Concepts and Techniques. Prentice Hall, Upper Saddle River 2000.

[22] H. Ludwig. Analysis Framework of Complex Service Performance for Electronic Commerce. In A. M. Tjoa and R. R. Wagner (Eds.), Proceedings of DEXA'98. IEEE Computer Society, pp. 638-643. http://www.zurich.ibm.com/~hlu/publications/dexa98.ps (2000-01-28).

[23] M. Merz. Electronic Commerce. dpunkt Verlag, Heidelberg 1999. (in German).

[24] J. Noack, H. Mehmanesh, H. Mehmaneche, and A. Zendler. Architekturen für Network Computing. In *Wirtschaftsinformatik* 42 (2000) 1, pp. 5-14. Accesible in the members area of the Wirtschaftsinformatik hompage: http://www.wirtschaftsinformatik.de (2000-05-08). (in German).

[25] R. Strobl, D. Karagiannis, and M. Heidenfeld. How an SME can spin-off from a university with support from Esprit. EMMSEC'98. 28-30 September 1998. Bordeaux.

[26] M. Ströbel. Effects of Electronic Markets on Negotiation Processes. Appears in: Proceedings of the ECIS 2000 Conference, Vienna Austria. http://www.zurich.ibm.com/~mis/SilkRoad/ECIS_2000.pdf (2000-05-05).

[27] P. Timmers. Business Models for Electronic Markets. In Y. Gadient, B. F. Schmid, and D. Selz (Eds.), *EM - Electronic Markets* 8 (1998) 2, July 1998, pp. 3-8. http://www.electronicmarkets.org/netacademy/publications.nsf/all_pk/949 (2000-05-05).

[28] P. Timmers, B. Stanford Smith, and P. T. Kidd. Electronic Commerce: Opening Up New Opportunities for Business. 1998.

[29] Y. Vakrat and A. Seidmann. Implications of the Bidders' Arrival Process on the Design of Online Auctions. Proceedings HICSS-33, IEEE (CD-ROM). http://dlib.computer.org/conferen/hicss/0493/pdf/04936015.pdf (2000-05-08, registration required).

Endnote

* ADONIS is a registered trademark of BOC GmbH (http://www.boc-eu.com). ADONIS was successfully applied and extended in the ESPRIT EU-projects REFINE No.20.588 [15] and ADVISOR No.28706 [25]. Additionally, ADONIS is used in the IST EU-project PROMOTE No. IST-11658.