Organizational forms for the development of new broadband services: a dynamic model for the degree of integration between collaborating firms

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Abstract

The development of new applications and services for broadband systems is characterized by a high degree of uncertainty related to the investments in broadband infrastructures, gateways, service platforms and content. These elements of the broadband system are tightly interconnected. The question is which organizational forms are most appropriate for the development of new services in broadband: internal within one firm, or in different forms of collaboration between different firms. In this paper we hypothesize a relationship between market maturity of the service and the level of integration of new service development projects. We test the model on a small sample of exploratory case studies in different phases of the life cycle of broadband services.

Keywords: ownership integration, task integration, systemic innovation, new service development, broadband services

Introduction

In the literature, there are two conflicting views on the intensity of collaboration necessary for the development of systemic innovations. In the first view, it is argued that a loose constellation of parties is preferred when technological uncertainty is high and the capabilities needed for the innovation are not known exactly (Dittrich et al., 2004; Nooteboom, 2000; Robertson and Langlois, 1995; Sadowski et al., 2003). In the second view, it is argued that loose partnership produce more conflicts of interest than centrally managed organizations, and those conflicts can hamper the development of systemic innovations (Chesbrough and Teece, 2002; Teece, 1996).

This exploratory paper addresses the question which governance modes are appropriate for the development of new broadband services. We consider this type of innovation to be systemic, since it involves an innovation on elements of the system that have to be aligned to varying degrees with other elements of the system. Central issue in this paper is the intensity of collaboration between parties working on different components of functional layers of the new service. The service can be developed by a party responsible for the broadband system as a whole, by a party responsible for a specific component, or in some form of collaborative setting. More in particular, we address the influence of the newness of the service on the degree of integration.

In this paper we build on a previous model (Van den Ende, 2003; Van den Ende and Jaspers, 2003) by developing and testing a model for component innovation in which we take the life cycle of the subsystem into account. Our model is based on two types of considerations: the need to integrate different functional layers (components) included in the new service, and the need to appropriate the returns of the innovation from the market. For this latter purpose often the creation of sufficient installed base and responding flexibly to market feedback is required. The question is which degree of integration is required under different degrees of market maturity.

The life-cycle of (sub)systems

We distinguish four phases of market maturity for the analysis of broadband services. The product life cycle model distinguishes three phases of maturity for a product: fluid, transitional and specific (Abernathy, 1978; Utterback, 1994). The emergence of a dominant design for the product separates the fluid phase from the transitional and specific phases. The dominant design results from the choices of producers and customers. It has a technical and a functional aspect. The technical aspect specifies the dominant architecture and technical character of product elements, whereas the functional aspect relates to the preferences of users regarding product features (Cusumano et al., 1992: p. 56). In this paper we will distinguish a fourth, preparatory phase of the life cycle: the experimental phase, which takes place before the introductory phase, and in which development activities and trials take place. In this phase firms perform research, build early prototypes and test these prototypes in the experimental phase. This phase includes the first two phases in the model that Suarez (2004) has developed for standards battles (R&D build up and Technical Feasibility phases). The other three phases in our model are the ones mentioned above. The introductory phase, which is the second phase in our model, starts when the market introduction of the product begins.

The life cycle model can be applied to technological systems, such as broadband systems. Technological systems consist of a number of components united in a common architecture (Henderson and Clark, 1990). The interfaces between components are an important part of the system. Baldwin and Clark (1997) call these interfaces ‘visible design rules’ versus hidden design rules within the components. Architectural innovation means that the architecture or the interfaces between the components change. Component innovation means that one or more of the components change, which may involve that also the interfaces between that specific component and other components change. If clear interfaces are defined between the components of a system, so that component innovation does not affect the interfaces, component innovation is largely autonomous (Chesbrough and Teece, 1996).

The life cycle of the system as a whole can be defined based on the common architecture and the interfaces with the components. Often in the beginning of the life of the system, different architectures, defining different interfaces, compete in the market, one of which becomes dominant after some time. For instance, in many countries in the beginning of the railroad system different track width competed, one of which became dominant. Different life cycles can also be defined with respect to components.

These do not necessarily concur with the life cycle of the system. For instance, a completely new system can include established components on other systems that are united by a new architecture and interfaces. In that case the system is new, not the component(s). On the other hand, a completely new component can be included in an established system. For instance an electrical switch can be included in an existing railway system without creating a completely new system. Sometimes the interfaces between the component and the system may have to be redesigned.

In this paper we are primarily interested in life cycles of subsystems. Subsystems are at an intermediate level between system and component, combining a number of components and interfaces. For instance, electric engines may be included in an existing coal supplied railway system. It requires the combined change of a number of components and interfaces of the system, such as components for electricity provision and overhead wires as interfaces, whereas the overall architecture (stations, tracks) remain the same. Such a subsystem may define a product or service class. Hypothetically, in the case that the electrical trains have the option to stop more often on a track than traditional coal-fueled trains, this subsystem may create the new service class stopping train services. Such product or service classes have a life cycle of their own: in the initial stage different designs (for instance of stopping train services) may compete in the market, after some time one becomes dominant initiating the growth phase of the product or service class. In case of broadband applications at home, we consider, for example, Gaming, Video on Demand and Voice over IP as service classes based on subsystems of the larger broadband system.

Governance modes and integration

We propose that the life cycle of product or service classes affect the most appropriate governance mode for their development. We address two dimensions of integration: ownership integration and task integration (Robertson and Langlois, 1995).[1] Ownership integration refers to the degree that the different components of the product or service are developed under common ownership. Task integration refers to the degree that the governance mode facilitates coordination between activities on different components.

We hypothesize that the life cycle of a product or service class affects the two types of integration, for two reasons: the effect on the degree of uncertainty and the need for appropriation. Traditional organization theory has already asserted that higher degrees of uncertainty require higher degrees of task coordination (Lawrence and Lorsch, 1967; Thompson, 1967). In our case two types of uncertainty can be distinguished: technological and market uncertainty (Kamien and Schwartz, 1982: pp. 109 ff). Technological uncertainty concerns technological knowledge that is required and the interfaces between the components. Market uncertainty relates to the behavior of competitors, to the type and number of prospective users and their preferences, and to substitutes that may appear. We presume that high levels of uncertainty require high intensity of information processing and task integration in the development process.

Both ownership and task integration may facilitate appropriation. Appropriation refers to the need to acquire the returns from an innovation from the market. One of the ways to facilitate appropriation of returns of an innovation is to acquire the dominant design in the market. For that purpose installed base and flexible reacting to user feedback is important (Schilling, 2002; Teece, 1996). We assume that ownership integration facilitates appropriation, particularly under uncertainty, since integrated ownership facilitates responding flexibly to the market (Gulati and Singh, 1998). Moreover, under integrated ownership the returns of the innovation will usually stay with the party that has developed the innovation. Task integration facilitates appropriation since it also facilitates flexible reactions to user feedback.

In the experimental phase of the life cycle of the product or service class both technological and market uncertainty are high. For that reason we assume that task uncertainty has to be high. Appropriation concerns are still low, since the product or service still has to be put into the market, and thus ownership integration can be low. In that situation, close collaboration between different parties is an appropriate organizational form. We hypothesize:

[1] Our definition of task integration is what Robertson and Langlois (1995) would call ‘coordination integration’.

H1. In the experimental phase of a product or service class a low degree of ownership integration and a high degree of task integration between the development activities on the components of the product or service have a positive effect on its performance.

In the introductory phase technological uncertainty will decrease to medium levels, market uncertainty remains high, whereas appropriation concerns are increasing. A high degree of ownership integration and a high degree of task integration are required. An internal organizational form or a joint venture appears to be the most appropriate. Therefore we hypothesize:

H2. In the introductory phase of a product or service class high degrees of ownership and task integration between the development activities on the components of the product or service have a positive effect on its performance.

In the transitional and mature phases, the levels of uncertainty and appropriation concerns are decreasing, and so is the need for integration:

H3. In the growth and mature phases of the product or service class, low degrees of ownership and task integration between the development activities on the components of product or service have a positive effect on its performance .

These hypotheses are visualized in figure 1.

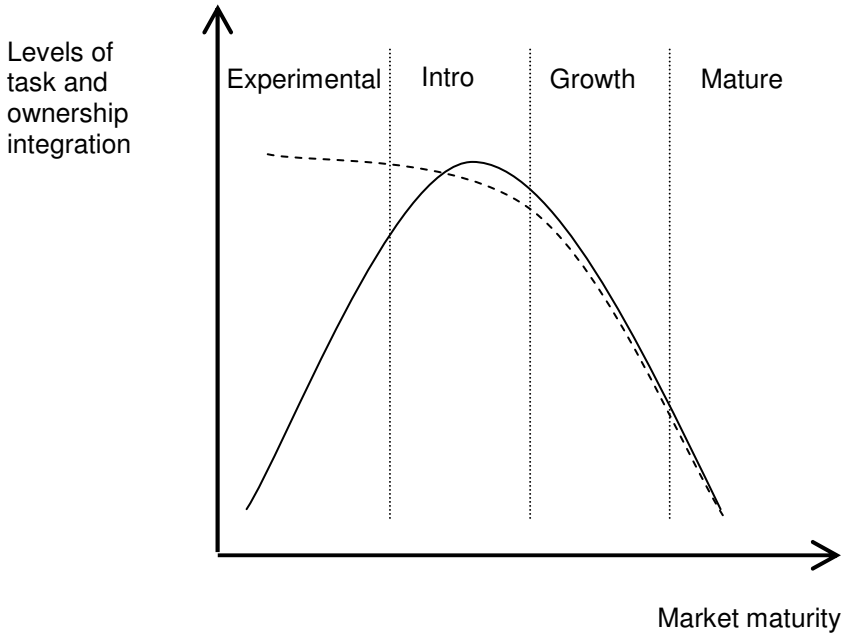

Figure 1: The relation between market maturity and level of ownership integration.
___ Ownership integration ---- Task integration

Methodology

For the empirical testing and further development of our initial hypotheses we use a small sample of exploratory case studies in the development of broadband services. We selected cases from the experimental, market introduction and mature phases of the service life cycle. Because the selected cases consider services in the beginning of their life cycles, performance of each of the cases is difficult to measure. The purpose of these exploratory cases is mainly to establish whether our hypothesized conditions for good performance are present.

Variables

A class of services is a type of service that is distinct from earlier services with respect to its attributes for customers, and that embodies one or more new components or interfaces of the system.
The newness of a class of services is determined based on the maturity of the market for this class of services. The development of a new service class usually implies the incremental or radical change of several but not all components of the system. The components of system of broadband services are categorized in six functional layers:

- Device. The device that is necessary to consume a class of services, e.g. a PC or television set for video on demand;
- Gateway. The gateway that establishes the connection to the broadband Internet infrastructures, e.g. a modem.
- Content. The content that is delivered by a class of services, e.g. videos for the class of services video on demand.
- Service. The particular software needed to create the service.
- Service platform. The basic software including middleware, necessary for service provision, e.g. the software on a central server in the network for storing and access to videos, Real Player for video on demand and PayPal for payment.
- Access infrastructure. The broadband Internet infrastructure, like a fiber optic cable network.

We distinguish three levels of newness of each layer: existing, modified and radically new layers. Existing layers have been developed for other services and need no modification for the provision of the new service class.

We determine ownership integration based on the degree that the development of the different functional layers needed for this class of services takes place under common ownership. The strongest form of ownership integration between two or more independent parties is a single firm. Joint development activities have different degrees of ownership integration. We adapt the ranking of Hagedoorn (1990) and Hagedoorn and Duysters (2000) of joint development agreements to (starting with the highest form of ownership integration):

- Joint ventures and research corporations;
- Joint development agreements;
- R&D contracts and buyer-supplier relationships;
- Informal agreements.

We will also take the degree that development activities on the components and interfaces are under unified control as measure of the degree of ownership integration.

We determine task integration based on the degree that the organizational form facilitates information exchange between people working on different components (functional layers). Tasks can be integrated within a single firm or between different firms.

Procedure

In our cases we evaluate which functional layers have to be modified to deliver that specific class of services. For each service development project we investigate which party supplies the different functional layers needed for that class of service, and the degrees of integration between those parties. The reference for the rating of integration is thus the set of functional layers needed for the specific class of services.

For each case we furthermore determine the degree that ownership integration and task integration have facilitated alignment of different functional layers under the specific degree of uncertainty in that case and thereby performance. We also determine the degree that ownership integration and task integration have facilitated appropriation of returns from the market.

Cases

Kersnet

As part of a larger scale urban development project near the city of Utrecht in the Netherlands, a group of enthusiastic people have been working on a development plan for 94 sustainable houses. The plan consists of a mix of family houses with gardens and apartments, either for sale from the developer or for rent through the local housing corporation Portaal. Together they comprise a small neighbourhood with some common facilities, such as a neighbourhood café and meeting rooms. This initiative also led

to the development of Kersnet, a network in which all the houses in the project were connected through fibre optic cable with a central room, which, in turn, would hook up to an Internet backbone.

Service. Kersnet provides the following services to the residents on the network:
- Fast internet access with a speed of 1 Mbps
- Telephony services through Kersentuin.net, based on Voice over IP
- Intranet, to be used for communication within "De Kersentuin" and for access to local applications.
- Local applications. The residents voiced their preference for the following services, which will be the first ones to be implemented: Kersentuin e-mail, a reservation system (for the car and the communal rooms), an electronic archive, joint purchasing tools and file sharing.

The available bandwidth opens possibilities for a whole new array of services, like video communication and Triple Play for multiple users.[2]

Functional layer	Description	Developed by	Newness
Device	PC, IP telephones	NA	Existing
Gateway	Network terminator	InTouch	Modified
Content	Internet, Voice over IP	NA	Existing
Service	Software for Intranet services	InTouch	New
Service platform	Software for mailserver and Intranet server	InTouch	New
Access infra	Fiber optic cable network	Draka Comteq	New

Table 1: Developers and newness of functional layers of Kersnet

Functional layers. The functional layers of this broadband service are the following (see table 1):
- Gateway. The gateway is a network terminator with intelligent functionality. The network terminator is modified from existing terminators by InTouch Metro.
- Service. InTouch has developed new software for car rental, intranet, and a common electronic agenda.
- Service platform. InTouch also delivers and manages and developed new software for the main mail and application servers.
- Access infrastructure. Draka Comteq provided a new fiber optic Super Broadband Internet connection to the homes in Kersentuin.

The other functional layers, like devices and content, have not been exclusively developed for Kersnet.
Actors. The foundation Kersentuin.net, which carries out further realization and exploitation of the network, consists of local residents. Other members of the consortium are the housing corporation Portaal, the municipality of Utrecht and the Ministry of Economic Affairs for financial support, a consultancy agency (M&I/Partners) for project management support, a passive infrastructure developer (Draka Comteq), an active infrastructure developer/maintainer (InTouch), and end users.
Life cycle. The Kersnet service belongs to the service class Super Broadband Internet services. This class of services is in the experimental phase of the technology life cycle, since the broadband services are only provided in small submarkets. In the Kersnet case it has no commercial pricing, and which is made possible by subsidies from the local community (see figure 2). The functional layers needed for this service class are largely the same as the ones created for Kersnet, as indicated in the last column of table 1.
Task integration. Task integration is high for the content, service, service platform provisioning and access infrastructure, since these components were created with intense communication between the parties involved, coordinated by a steering committee of users and providers.
Ownership integration. Ownership integration is low, since the foundation coordinates activities, but does not exert control. Actors like Draka and InTouch, are independent parties delivering access infrastructure. These companies are part of the consortium, but deliver the passive and active infrastructure partly on their own expense.
Validation. Although we cannot evaluate the success of Kersnet yet, so far the case seems to confirm hypothesis 1, since task integration is high and ownership integration is low (see figure 2).

[2] Triple Play is the simultaneous provision and use of Internet access, telephony services and television or video services.

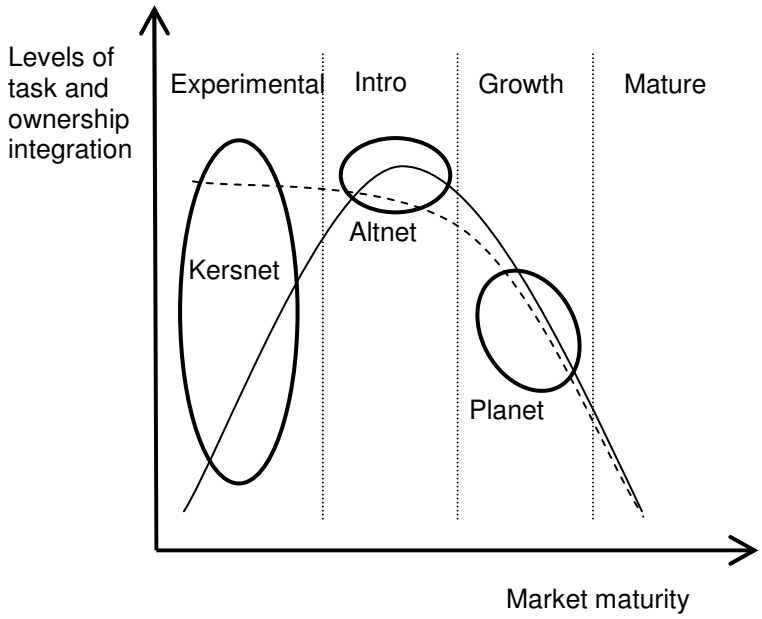

Figure 2: The relation between market maturity and level of ownership integration for each of the three cases

___ Ownership integration ---- Task integration

Altnet

Altnet is an online distributor of licensed digital entertainment, selling its content mainly via the KazAa peer-to-peer (P2P) file sharing network.

Service. Altnet offers a relatively cheap and easy to locate alternative for illegal downloaded music, movies games via the KazAa network. The service provided by Altnet is labeling and certification of legal MP3 music tracks and sales, billing and payment of these MP3s. Altnet claims their content, as opposed to shared illegal content, is legal, virus free and high quality. Altnet does not distribute its files from one central server, but from the distributed servers of Altnet clients. Clients can download the content via the KazAa network or from the Altnet website. Altnet file owners are not obliged to share their files. To stimulate clients to open up their file stocks, Altnet uses the Peerpoint Program, that rewards users who share their content with prizes and free downloads.

Functional layer	Description	Developed by	Newness
Device	PC	NA	Existing
Gateway	Modem	NA	Existing
Content	Digital music tracks	Altnet	Modified
Service	B3D client, PeerPoint program and PeerPay payment software	Altnet	New
Service platform	KazAa software	Altnet, KazAa	Modified
Access infra	Broadband Internet	NA	Existing

Table 2: Developers and newness of functional layers of Altnet

Functional layers. The functional layers of the class of services are the following (see table 2):

- Content. The content is legal, high quality and labeled music tracks. Altnet modifies existing music tracks for use on KazAa so that they appear with a golden label on screen.
- Service. Altnet has developed the so called. B3D client, which is the piece of software developed by Altnet that every user who downloads KazAa gets installed on his computer. Furthermore Altnet

has developed software for the Peerpoint progam for monitoring and awarding file sharing and a micro payment system called PeerPay, which is integrated in the KazAa software.
- Service platform. Altnet uses the KazAa software as the service platform.

The other functional layers, like devices and content, have not been exclusively developed for Altnet.
Actors. Altnet is a subsidiary of the U.S.-based company Brilliant Digital Entertainment Inc. Brilliant formed Altnet together with Sweden-based Company Joltid Inc., which licensed their PeerEnabler software in return of a 49 percent stake in Altnet. Altnet can therefore be considered a joint venture. The Australia-based company Sharman Networks, which owns and runs KazAa, has a license agreement with Altnet to distribute the B3D client. Altnet serves as an intermediary, who offers content producers and providers a marketing, distribution and selling gateway with KazAa. Content producers include recording, gaming and software companies. No major labels have yet been signed. Clients provide the platform by hosting the content. Altnet only distributes content in case of absence with fallback servers.
Life cycle. The class of services that Altnet provides is the legal selling of digital music tracks (MP3), to which also Apple's iTunes belongs. This service is rather new and in the introductory phase of the life cycle (see figure 2). The content and service provided is new compared to traditional music stores and also new relative to (illegal) sharing of music files like KazAa, Napster and WinMX. At this moment, iTunes is growing in popularity but it has not established a dominant design yet. The components that have to be changed for this class of service are the same ones as modified by Altnet, and indicated in table 2, last column.
Task integration. Since Altnet modifies and develops the three functional layers (content, service and service platform) itself. Task integration can be considered high (see figure 2).
Ownership integration. Ownership integration is high since the modification and the development of two functional layers is done under common ownership of one company, Altnet. The ownership integration of the service platform is established through a licensing agreement between Altnet and KazAa. This is a low level of ownership integration. Overall ownership integration can be considered high.
Validation. Task integration is and ownership integration can be considered high. Although we cannot evaluate the success of Altnet yet, this case seems to confirm hypothesis 2 (see figure 2).

Planet Game Stream

Planet Media Group is the largest Dutch Internet Service Provider. Planet Media Group has developed several web portals in the past, for delivery of different services and file sharing. The latest portal they developed is Planet Game Stream, a portal for downloading and playing on-line video games.

Service. Planet Media Group has introduced a gaming on demand service for its broadband clients. The service was initially called 'Planet Game Club' and is now renamed in Game Stream. Planet's ADSL subscribers can play games unlimitedly for a fixed monthly fee. In 2003 this service also became available for broadband subscribers of other ISPs. For a fixed monthly fee of 10 euros, subscribers can get unlimited use of a wide range of PC-games in various genres. Amongst the offering are action games, flight simulators and racing games, but also board games. Recently, Playful Learning ('Spelend Leren') was added to the game portal, also labeled as Game Stream Kids.

Functional layer	Description	Developed by	Newness
Device	PC	NA	Existing
Gateway	Modem	NA	Existing
Content	Games	Game publishers	Existing
Service	Software for downloading games	Planet, Extent, GX	New
Service platform	Game portal	Planet	Modified
Access infra	Broadband Internet	NA	Existing

Table 3: Developers and newness of functional layers of Game Stream

Functional layers. The functional layers of the service provided by Planet are (see table 3):
- Content. The content that is delivered is existing video games modified for playing in on-line environment. Established (game) publishers, like Eidos and Ubi Soft, provide the video games.

- Service. The service developed provided by Planet is software for access to on-line gaming and billing and payment of the use of the games. The access software is provided through a contract with Extent Technologies. GX is contracted for web page and Java development.
- Service platform. The service platform for access to on-line game is a modification of a general web portal, which Planet will also use for providing other content, such as News items.
- The other functional layers, like devices and content, have not been exclusively developed for Planet Game Stream.

Actors. Planet Media Group is fully owned by KPN, the largest (and incumbent) telecom operator. For Game Stream, Planet teamed up with game publishers Atari, Eidos, Infogrames and UbiSoft. The new content service is based on access software and technology of Extent Technologies. GX is a partner in web page and Java development. Games for children are offered through this portal in conjunction with publishers AW Bruna , Karakter, Lannoo, OWG, Standaard, Transposia, Zwijssen.
Life cycle. The class of services to which Planet Game Stream belongs is the market for on-line video games. The newness of this class of services lies in the intelligence that is added to the on-line environment. Users can stop and continue playing games without loosing information, which is in stored on-line. The market for video games has reached maturity, and the market for on-line games is growing. Therefore, Planet is in the growth phase of the technological life cycle (see figure 2). The functional layers that have been changed for this class of services are the ones indicated in the last column of table 3. In addition, the games have been adapted for on-line use. This functional layer has not been modified by Planet, since they use the games already modified for other on-line game providers.
Task integration. Task integration between content and service/service platform provisioning is relatively low. Task integration mainly takes place between service and service platform provision in terms of network security and game storage, which is orchestrated by Plant. Overall task integration can be considered medium.
Ownership integration. Ownership integration is high for service and service platform provisioning, since these are internally developed by Planet. However, parts of the software development have been outsourced by regular buyer-supplier contract with Extent and GX. Planet has also contracted independent publishers for the provisioning of games, but has a licensing agreement. Overall ownership integration can be considered medium (figure 2).
Validation. As expected, both task and ownership integration are low. Although the number of Game Stream subscribers is increasing, it is unclear yet to what extent it has been a success. Despite the lack of financial data on Game Stream use or revenues, the case seems to confirm hypothesis 3.

Conclusions

In this paper, we investigated the governance modes that are appropriate for the development of new broadband services. We developed a model for the degree of integration between the development of different components that are part of a new broadband service, depending on the degree of novelty of the service. The model moderates the two visions on organization of systemic innovation mentioned in the introduction of this paper, in the sense that loose constellations of actors are assumed to be most appropriate in the experimental and mature phases of the life cycle of a new service class, and that centrally managed organizational forms are more appropriate during the introductory phase.

The selected cases follow our hypotheses with respect the relation between market maturity and levels of task and ownership integration The two models of integration, loose constellation of partners and full integration for the development of new services, are both applicable in the three cases in accordance to the different phases of the life cycle. Problematic, however, is that success has not been measured in these cases.

In future research the model has to be refined and tested more rigorously. We tested the model on only three cases in which performance data were largely lacking. More rigorous testing requires a higher number of cases and data on the outcome of the cases.

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