

The role of design in the development of technology-based services

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The goal of this paper is to examine the role of design in the development of technology-based services and reports on case research undertaken in new firms. Design was found to be applied to a broad range of service aspects in the case firms, namely user interfaces, tangible artifacts, documents, usability, service processes, revenue models, communication processes, community building, customer experiences and marketing materials. The application of design in the case firms was found to be motivated in part by the desire to either counteract or exploit one or more of the distinguishing characteristics of services, which are intangibility, inseparability, heterogeneity and perishability.

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'One of the interesting things about the iPod, one of the things that people love most about it is not the technology; it's the box it comes in. That's because Apple really understood that the iPod was not about the iPod; it was about the entire range of experience: the way they design their stores, the box it comes in, the iTunes website, the ease of getting the user back and forth.' (Donald A. Norman, in Zachry, 2005)

The story of the phenomenal success of the design of the Apple iPod has reached almost paradigmatic status. The predominant focus of this story is the design of the tangible object, the iPod itself, but as expressed by Donald Norman above, the object may not be the only important player in the story. Indeed, the design of the services enfolding the iPod emerges as being as important as the design of the object itself. Despite the increasing importance of services (Coombs and Miles, 2000; Normann, 2001; Von Stamm, 2003), research on innovation has been characterized by a prevailing emphasis on the development of new tangible products (Gallouj and Weinstein, 1997).

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Following from the increasing importance of services and the importance of technological innovation, technology-based services (TBSs) play an



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important role in innovation and economic growth, and their development constitutes the focus of this paper.

There is increasing recognition that differentiation based on technology alone is not sufficient to insure success. Instead, design has been recognized as being an important contributor to new product development and commercial success based on differentiation, e.g. Gemser and Leenders (2001), Hertenstein et al. (2005), Walsh et al. (1992), Black and Baker (1987), Rothwell and Gardiner (1984). Despite its importance, design is commonly neglected in social science research (Walsh, 1996) and the role of design in innovation is under-investigated (Trueman and Jobber, 1998; Perks et al., 2005). Only two of the studies listed above specifically target technology-based firms, and all focus on tangible product design rather than service design. Therefore, research on design as an element of TBS development is needed.

This paper reports on a multiple case study of TBS development projects in new firms. New firms were selected as a suitable context for the research for two reasons. New firms can be expected to be engaged in innovation, and they can be expected to base their strategy on differentiation (Carter et al., 1994; Bryson et al., 1997) rather than factors such as economies of scale. If design is indeed a fruitful means to achieve differentiation, new firms should constitute a class of firms particularly sensitive to the use of design as a means to achieve success when developing new offerings.

The goal of this research is to examine the role of design in the development of TBSs in new firms to approach a characterization of design in this context and how the service context constrains or motivates design. The research goal motivates the following research questions:

- Question 1: To which aspects of technology-based service development is design applied in new firms?
- Question 2: What is the role of design as an element of technology-based service development in new firms, in terms of addressing the characteristics of services that distinguish them from products?

The contributions of this paper are, in the first place, a suggested framework for empirical research on design in the development of TBSs in new firms, and in the second place, managerial implications for successful development of TBSs. The research findings are that the case firms were found to apply design to a broad range of aspects of TBSs. The application of design in the case firms was found to be motivated in part by the desire to either counteract or exploit one or more of the characteristics distinguishing services from products. Of the two motivating forces, the desire to counteract the characteristics of services was more commonly observed than the desire

to exploit these characteristics. In view of the importance of services and service innovation, this is an important conclusion which points to potentially untapped opportunities for achieving success in the development of new services through design that exploits the distinguishing characteristics of services.

1 Framework

The case research on which this paper is based follows a pre-structured design (Miles and Huberman, 1994) which calls for the development of an initial conceptual framework. In this section a framework for design applied to services is developed and the distinguishing characteristics of services are described.

1.1 Design applied to services

The term design is quite broad and has diverse meanings (Stacey et al., 2002) and is frequently equated with engineering (Veryzer, 2005). The innovation process is sometimes described as a not entirely harmonious integration of technology and commercialization (Marsh and Stock, 2003). The commercial element, which encompasses design and marketing, is concerned with providing a bridge from technical functionalities to value in a finished product or service (Walsh, 1996).

Thus, for the purposes of this paper, design is defined as follows: *In the context of technology-based service development, design encompasses those elements of the development process which enhance and communicate the value of services* (Yamamoto and Lambert, 1994; Hertenstein et al., 2005).

Roy and Riedel (1997) argue that a multi-dimensional approach to design is more successful than a narrow approach. In their discussion of design education, Broadbent and Cross (2003) call for a holistic approach to design, which goes beyond the prevailing emphasis on mechanical systems. This supports taking a broad view when studying design as an element of innovation. In a study of the prevalence of design emphasis in technology-based firms, Candi (2006) develops a three-dimensional taxonomy of design consisting of the visceral, the functional and the experiential dimensions.

Extant research in the areas of new product and service development is used to provide an initial framework for the case research. The following three sections discuss research findings falling under each of the three design dimensions. This is followed by a summary of the kinds of things to be inquired about in the empirical setting based on extant research.

1.1.1 Visceral design

Visceral design is concerned with appealing to the human senses (Norman, 2004), and thus provides a measure of tangibility to services.

Crilly et al. (2004), in their study of consumer response to product visual form found that consumers tend to judge products' elegance, functionality and social significance based mostly on visual information. Yamamoto and Lambert (1994) show that appearance has an influence on customer preference even in the industrial market. Turning to technology-based services, Van der Heijden (2003) found that the perceived visual attractiveness of websites influences usefulness, enjoyment and ease-of-use, and Lavie and Tractinsky (2004) show that the visual aesthetics of computer interfaces are a strong determinant of user satisfaction.

In examining success factors in the development of new services, de Brentani (2001) found that the success of radical new services can be improved by creating a clear product identity and offering tangible clues to help customers visualize and evaluate services.

1.1.2 Functional design

Functional design encompasses usability and performance. According to Utterback (1994) success in continuous improvement requires equal emphasis on product and process design. This is relevant to both the development of products and services. Just as the processes for creating a tangible product can be designed, so can the processes for delivering a service that fulfills user expectations be designed.

Veryzer and de Mozota (2005) argue that a key characteristic of a successful service is that it relieves users of the frustration, confusion, and sense of helplessness which commonly plague service users, particularly users of complex technical services.

1.1.3 Experiential design

Experiential design is concerned with message, culture, meaning, and emotional and sociological aspects of a service.

Stuart and Tax (2004) and Pine and Gilmore (1998) define service design as the design of customer experiences. Rayport and Jaworski (2005) argue that firms should work backward from the customer experiences they wish to deliver when developing new services. They further argue that a company's service interfaces can be an important means by which to manage customer experience.

In their study of business-to-business professional services Woo and Ennew (2005) examined the interaction dimension of service quality and found that when what is provided in a service becomes more and more similar among competitive offerings, how the service is provided, or the social exchange involved, is what can create a competitive edge.

Pullman and Gross (2004), in their research on experience design, found that one of the key elements for success is creating opportunities for customers to interact with each other, to gain entry into a community. Community building has been successfully employed by product manufacturers such as General Motors, who have created and support clubs for Saturn owners (Peters, 1997).

Whyte et al. (2003) report on design activities and new product development in a set of small manufacturing companies. The design activities examined are those that go beyond traditional engineering design and include branding, marketing and interactive websites which can all be classified as being essentially concerned with marketing. In their research on branding in services Berry and Lampo (2004) emphasize the importance of developing a strong brand which can be aided by using clues, connecting emotionally and internalizing the brand. The branding of services is very much about creating and fostering a specific customer experience (Norman, 2004).

1.1.4 Summary of framework for application of design to services

Based on the research outlined in the sections above, the starting point for the empirical study is that the role of design in the development of TBSs could include application to the following aspects of services: User interfaces, tangible artifacts integrated with services, service processes, usability, definition of desired customer experiences, processes for communicating with customers, community building and marketing materials.

1.2 Distinguishing characteristics of services

The commonly accepted characteristics of services, which distinguish them from products, are well documented (for a summary see Fitzsimmons and Fitzsimmons, 2006) and are *intangibility*, *inseparability*, *heterogeneity* and *perishability*.

Services are intangible in the sense that they need not include any palpable objects, although they may. Production and consumption of services are concurrent and thus services are said to be inseparable. Each time a service is delivered there will be variability in the service, making the service heterogeneous. Services cannot be produced and stored for delivery when requested and, hence, are said to be perishable. This perishability of services means that services tend to be manpower-dependent.

The four characteristics described above are used as a framework for analyzing the case data to answer research question 2 about how design is used to address these characteristics of services.

2 *Research methodology*

Research has shown that service innovation tends to be an *ad hoc* process (Sundbo, 1997; Dolfsma, 2004) which contraindicates inquiring about this process solely in an open-ended manner. Gorb and Dumas (1987) in their paper entitled *Silent Design* found that some kind of design activity was found in almost all firms. Gorb and Dumas define silent design as the process by which employees are engaged in design as an adjunct to their primary roles, basically non-designers doing design. This phenomenon can be expected to be prevalent in new firms due to the resource constraints which characterize such firms (Garnsey, 1995; Murray and Lott, 1995). If design is 'silent' it may also be unacknowledged which, in turn, supports taking a pre-structured approach to the case study (Miles and Huberman, 1994). This approach requires the definition of a conceptual framework prior to data collection (see the previous chapter), with the possibility of expansion or modification as data collection and analysis progress.

The research strategy is based on studying multiple cases to provide rich results and a basis for qualitative comparison. The empirical focus is TBS development projects and the unit of analysis is the firm.

New firms were identified as a desirable laboratory in which to perform this research. As was discussed in the introduction to this paper, the reasons are twofold. In the first place, new firms can be expected to be engaged in innovation. In the second place, new firms can be expected to base their strategies on differentiation, which means they should be particularly sensitive to the use of design.

This paper is based on case research covering eight TBS projects in four new firms, two projects in each firm. Studying two separate TBS projects in the same firm provides a richer picture of design application in each firm and provides a basis for examining the level of consistency in design across TBS projects within the same firm.

Semi-structured interviews were conducted with at least two persons knowledgeable about each TBS project. Each interview was divided into two parts. First, respondents were asked to describe how their firms develop new services and to elaborate on the services offered by their firms or under development. This part of the interview was guided by open-ended questions. The second half of each interview focused on a specific TBS project and the questions, although still allowing for free respondent elaboration, were more specific than in the first part of the interview. The questions followed the framework developed prior to data collection, with extensions as appropriate. The interviews were typically about 90 min in duration. Interviews were recorded and transcribed.

To increase the reliability of the data, the requirement was made that TBS projects included in the study must have been recently completed or be well into development. This restriction was imposed in the interest of avoiding the problems of both extreme hindsight and wishful thinking on the part of respondents.

To further increase reliability, a summary was prepared following each interview and submitted to the respondent. Follow-up phone interviews were used to collect additional information where needed and solicit comments about the summaries. Secondary sources, such as industry reports and websites, were examined as available to gain more information about specific TBS projects and case firms. Using more than one source of information about each project allows triangulation of data, which is important to counteract the tendency toward subjectivity inherent in case research (Eisenhardt, 1989).

Data analysis was modeled on the methodology outlined in Eisenhardt (1989). The interview texts were coded in several passes. Additional data were collected for each case firm and cases were added until the point of saturation was deemed to be passed, namely the point where each additional interview or case added little in terms of new concepts and ideas.

3 Results

This chapter consists of two parts. First, the results of within-case analysis are presented in the form of brief overviews of each of the case firms and descriptions of the role of design in each firm. Second, the results of cross-case analysis are presented. The cross-case analysis deals with how design is applied to each of the aspects of services identified by the framework as well as two additional aspects which emerged in the course of the case study, namely documents and revenue models. The cross-case analysis also examines how design was used in the case firms to address the distinguishing characteristics of services. A summary of the case analysis is included in the [Appendix](#).

3.1 Results of within-case analysis

In the following sections a brief overview of each of the case firms is provided and the application of design in the firms' TBS development projects is described. The firm names are real, but pseudonyms¹ are used for the TBS projects. The use of pseudonyms for the projects was necessary because some of them were still under development at the time of data collection and in some cases had only working titles.

3.1.1 CellStory

CellStory was founded in Silicon Valley but at the time of data collection its headquarters were in New York City. The firm was 2 years old and employed

10–12 people, with part of its development work done in Rumania and Russia. The innovativeness of CellStory's services is based on a technology that makes it easy to use mobile phones to create customizable Internet content in real time. The customizability consists of the ability to pre-define a series of question-and-answer scripts that run on mobile phones and require only simple data entry at the time of content creation.

CS1 is CellStory's initial service, which is a hosted service allowing customers to take photos or videos using mobile phones and post them to a website along with rich information entered on the mobile phones at the time of posting. The initial target market for CS1 was realtors. CS2 is a simplified version of CS1 targeted at teenagers and was under development at the time of data collection. This service allows customers to create blogs by selecting from a gallery of available templates and post photos or videos taken using mobile phones to these blogs.

Design was viewed as an important means to make CellStory's services attractive to customers, to foster ease-of-use and make the service experience enjoyable. From the outset CellStory had employed a designer who was involved in the initial concept development and continued to participate in ongoing development.

Some differences were observed between the application of design to CS1 and CS2. The most important of these was that CellStory had used an informal and personal approach to communication with customers for CS1 but when moving to the consumer market with CS2 it became necessary to design an automated model for communicating with customers.

3.1.2 Lucidoc

Lucidoc was founded in the Seattle area and was 5 years old at the time of data collection. Although many of the firm's 11 employees had artistic backgrounds, including photography and music, Lucidoc had made some use of outside designers for visual design of user interfaces. The development team viewed design primarily as a means to hide complexity and elicit customer feedback in an iterative prototyping process.

Indeed, this approach was employed from the beginning. The firm was founded during a consulting project undertaken by its founder for a single customer. The project developed from the backs of napkins to mock-ups of user interfaces. Since then, the firm has been increasingly packaging and standardizing its services to make them available to a growing number of customers. Lucidoc's services are innovative in that they use a multi-cataloging system, which is an uncommon approach to document management. Also, by viewing policies and procedures within organizations as a set of protocols, Lucidoc's

method is essentially analogous to the version control systems commonly used for software development.

Lucidoc's initial service, LU1, which is a compliance management solution for documents, was targeted for the health care market. The service is provided as a hosted service with considerable customization to fulfill the requirements of each customer. LU2 is an add-on to LU1, which provides the ability to customize and create reports based on documents.

Some differences were observed between the application of design to LU1 and LU2. The target users for LU1 were health care workers, predominantly with limited technical expertise, so simplification was a top priority goal for this service. The target users for LU2 were 'power users' requiring more advanced functionality and so although shielding from complexity was emphasized, providing rich functionality was the guiding motivation.

3.1.3 Quantum3D

Quantum3D was founded in Silicon Valley and at the time of data collection it was 8 years old and employed about 100 employees who were primarily based in the firm's headquarters in San Jose or Huntsville, Alabama. Quantum3D specializes in providing custom visualization and training support services targeted at a variety of users including the military.

QU1 is an image generation service for visual and sensor simulation training. The service tends to be highly customized for each customer and delivery to end users occurs either in a customer's facility or within training or simulation equipment, such as military vehicles. QU2 is one of a newer generation of services developed by Quantum3D, which provides the ability to develop graphical user interfaces for embedded systems and simulation. Like QU1, this service tends to be highly customized for each customer.

Design was observed to take a backseat to functionality and technical concerns at Quantum3D. However, compared to QU1 an increased design emphasis was observed in the more recent project QU2. Quantum3D did not employ designers at the time of data collection.

3.1.4 Red Condor

Red Condor was founded in Santa Rosa, California and at the time of data collection was 3 years old and employed about 20 people. Red Condor offers a range of security services for e-mail and Internet browsing. Red Condor's target market is primarily small and medium-sized businesses, schools and municipalities.

RC1 is Red Condor's initial service, a hosted spam-protection service for e-mail. The service is innovative in that spam-detection is based not only on the Bayesian methods commonly used to detect spam but also on human evaluation of suspected spam senders. RC2 is a suite of bundled security services including anti-spam, anti-virus, anti-spyware, URL content filtering and asset management. All of these services are available from a number of other providers but RC2's innovation consists in bringing them together and providing integrated management of all the services.

Design was observed to take a backseat to functionality and technical concerns for the RC1 project, but design was emphasized for RC2 and recognized as an area of opportunity. At the time of data collection, Red Condor had recently hired a designer to be responsible for visual user interface design for RC2.

3.2 Results of cross-case analysis

The results of cross-case analysis are organized according to the aspects of services to which design was found to be applied in the case firms. The application of design was observed for all the service aspects identified in the framework, and additionally, evidence was found for the application of design to documents and revenue models.

The observations suggest relationships between design application and the characteristics which distinguish services from products. These relationships fall into two categories: relationships where design is applied to counteract distinguishing characteristics of services, and relationships where design is applied to exploit these characteristics.

3.2.1 Design applied to user interfaces

Design of user interfaces was something that all respondents could relate to, but the deliberateness of these design efforts varied. At one end of the spectrum user interface design happened incidentally and was driven by the desired functionality of the services, and at the other end user interface design was seen as a key aspect of the services.

'You can just see that it is supposed to look bright and modern, bright happy future. The technology is not scary, it's childish, it's so easy a child could do it.' [CellStory]

There was also evidence of user interface design used as a tool to elicit customer feedback to guide development.

'The only way that we know that we are actually solving the problem is to be able to simulate with the software, so visual design goes right up front most of the time.' [Lucidoc]

User interface design in the case firms was found to be primarily about designing visual interfaces for software. Manufactured products, if they are intended for direct human use, also have user interfaces, but these interfaces can be three-dimensional and include tactile aspects whereas the design of user interfaces for services observed in the case firms was two-dimensional and mostly non-tactile.

Where user interface design was emphasized it can be characterized as being done with the purpose of counteracting the intangibility, heterogeneity and perishability of the services. User interfaces become the persistent 'face' of a service thus counteracting intangibility and perishability. Additionally, one of the goals observed in user interface design was to maintain consistency, which counteracts heterogeneity.

The simultaneous production and consumption of services (the inseparability characteristic) offers opportunities for customizing services to best serve the needs of individual customers (Berry, 1980). In QU2, where 'widget' design is provided as a custom service, interface design can be characterized as being done to exploit the inseparability of the service, as is the case in LU1 where prototyping is used to elicit customer input.

3.2.2 Design applied to tangible artifacts

QU1 includes a tangible object, which is a piece of computer hardware required for service delivery. The hardware was designed in a cooperative effort between engineers inside the firm and an outside mechanical engineer. The primary considerations in designing the object were the environmental requirements imposed by the laboratories and training facilities where the service would be used. Some emphasis was also placed on making the object visually attractive.

A respondent at Red Condor explained that through the firm's experience with its initial service RC1, the firm realized that customers may prefer to have a piece of hardware on site to lend an element of tangibility to what is otherwise an almost invisible service, as tends to be the nature of security-related services. So RC2 incorporated a piece of hardware, both for technical reasons and because the very fact of the tangible artifact was viewed as important. This resonates with the conclusions reached by de Brentani (2001) about the value of making services more tangible by incorporating tangible artifacts.

Where incorporated, tangible artifact design can be characterized as having been applied in the interest of counteracting the intangibility of the services as well as their perishability, since a tangible artifact persists even while the associated service is not being delivered.

3.2.3 *Design applied to documents*

When asked about tangible objects, many respondents mentioned documents such as manuals and contracts. This is an arena for design not predicted by the research framework, but which was added to the framework early in the data collection process.

A kind of document which is commonly part of TBSs is online help. Manufactured products often come with manuals and increasingly this documentation is made available in electronic form on the Internet. However, TBSs delivered in an electronic environment present a unique opportunity to provide context sensitive user assistance through electronic or online help when and where needed. Therefore, this constitutes an arena for design which could be said to distinguish TBSs from products.

CellStory's services incorporated online help conforming to the overall aesthetic of the service-delivery platforms, which were websites. The online help included animations and other visual elements to help users make the most of the services.

In the case firms, documents were viewed as necessary adjuncts to services and were authored by technical persons. In some instances documents were designed by designers; in others they were subject to review for layout and consistency by non-technical persons; and in some their design was incidental.

'It's just PDF. There's nothing fancy here.' [Quantum3D]

For RC2 documents were seen as having strategic importance in communicating the simplicity of the service and had been designed by outside designers.

'Our objective is that all documentation is step 1, step 2, step 3, you're done. Whether it's a contract for our reseller, whether it's a contract for a sale, whether it's a sign-up sheet for a customer to sign up to our service.' [Red Condor]

Visual design of documents, where observed, focused on layout and typeface issues and, in some cases, the design of visual objects (graphic design).

In each of the TBS projects which included documents, the design of documents can be characterized as having been applied in the interest of counteracting one or more of the distinguishing characteristics of services. Manuals and online help lend a measure of separability between the case firms and their customers since these documents can help make customers more self-sufficient. This also helps counteract perishability and intangibility since manuals, particularly printed manuals, and online help can be said to persist after their creation. Manuals and online help can also make services less heterogeneous since all customers can have access to the same information and directions at all times.

3.2.4 Design for usability

Because TBSs may be based on advanced technology, usability can be an important concern. In fact, the creators of TBSs may have to deal with the hurdle of customers' fear of technology. This can, of course, also be the case for manufactured products (Norman, 2002) as is so eloquently expressed in the oft-repeated anecdote about the difficulty of programming video recording equipment.

The key importance of usability design was emphasized by all respondents and in the TBS projects studied, usability design was found to be focused on simplification and/or complexity hiding. In fact, some of the respondents named ergonomic features as one of the primary selling points for their services as evidenced by the emphasis observed in some of the projects on communicating the message of simplicity.

'Very early on the requirements were that this needs to be a close to zero administration, no tweaking, it never gets in your way service. And so, we try to minimize the number of knobs that customers have to deal with.' [Red Condor]

Since QU2 is targeted at training/simulation developers, it needs to include relatively complicated options, so efficiency was seen as more important than complexity hiding. Conversely, a strong simplification goal was observed for LU1, whose users are health care workers, not necessarily having a technical background. CellStory took all possible measures to make CS1 easy to use but there were some technical hindrances. CS2 is a simplified version of CS1 and a greater level of simplification was achieved in the latter service.

A respondent for Lucidoc expressed the desire to do more formal usability testing to improve usability of the firm's services.

'We would like to do more fully-blinded usability testing. And would tie that much closer into the development process. Because we don't have that, we tend to do more site visits, looking over peoples' shoulders, which is not quite as objective as I'd like to have it.' [Lucidoc]

Usability design deals with the interaction between the customer and the service. In each of the TBS projects, usability design can be characterized as having been applied in the interest of counteracting one or more of the distinguishing characteristics of services. Improved usability empowers customers to be more self-sufficient and thus counteracts inseparability and the manpower requirements for customer service that follow from perishability. Where the goal of services was for them to be transparent to customers, usability design can also be said to counteract heterogeneity.

3.2.5 Design applied to service processes

Of the aspects developed in the framework, service processes constitute the only aspect which is specific to services. However, product manufacture can rely heavily on processes, so even here there could be overlap in design activities between service and product development.

Service process design was described by several respondents as a collaborative effort by small teams of managers and developers around a whiteboard. The descriptions were of rather informal, but very graphical, approaches to service process design.

In QU1 the service processes emerged incidentally to development and QU2 is based on an established tradition for visual simulation and training and so there was no new service process design involved. For RC1 the service processes followed the technical architecture:

'Basically we have these capabilities that we need to expose somehow in the user interface, and so we come up with some organization that's very close to the organization that we have in the code.' [Red Condor]

Defining service processes counteracts the heterogeneity of services by making service delivery more consistent. Defining service processes can be the first step on the road to service automation and thereby counteracts perishability by making service delivery less manpower-dependent. Lucidoc includes prototyping in its service process development and thereby engages customers in the process, which can be seen as a way to exploit the inseparability characteristic.

3.2.6 Application of design to revenue models

The application of design to revenue models was one of the aspects not predicted by the initial framework for the case study, but emerged as a strategic element of service development, particularly at Red Condor.

'Our revenue model was one of the very early decisions that we made. We wanted to have a hosted service; we were not in the business of selling widgets and having one-time revenue.' [Red Condor]

Red Condor's motivation for designing their revenue model may partly be characterized as one of insuring consistent and continuous service delivery, or counteracting heterogeneity.

Some of the services studied used a standard revenue model, that is a revenue model that is commonly used for specific kinds of services, such as subscription plans for Internet access services and metered plans for telephone services. In these TBS projects there was no revenue model design. LU1 and QU2 used a revenue model constituting a customization from a standard one, such as LU1's revenue model which used a measure specific to its target market as a counter on which to base fees.

3.2.7 Application of design to communication with customers

The characteristics of services all contribute to the need for communication between firms and customers in the course of service delivery. So, whereas many product manufacturers need to consider communication processes with customers, this requirement is more acute for firms selling services.

Some of the respondents indicated that communication processes with customers were designed deliberately, whereas some described very informal and personal models where customers expected to be able to call their individual contact within the firm at almost any time. The newness of the firms studied and their relatively small number of customers came through in the descriptions of informal personal communication. However, there was a consistent tone that designing and implementing automated processes for communicating with customers becomes necessary when the number of customers increases and employees' tolerance for increasingly frequent interruptions diminishes. CellStory had used an informal and personal model for CS1 but when moving to the consumer market with CS2 it became necessary to design and adopt a more automated system for communicating with customers.

Where communication with customers was informal and personal, the firms could be said to be exploiting their ongoing relationships with customers, which are attributable to the inseparability of the services, as well as the heterogeneity of the services, which creates the opportunity to provide customized and personal service to individual customers. When firms design formal communication processes this is closely related to, and even overlaps, service process design and therefore, as for service process design, can be characterized as a means to counteract the heterogeneity and inseparability of services.

3.2.8 Application of design to community building

Quantum3D, Red Condor and Lucidoc all aspired to support and foster community building between their customers through means such as user groups and blogs although these aspirations had not been realized at the time of data collection.

'That's an area that I think we have fallen down woefully on. We should have an active user group.' [Lucidoc]

CellStory's services, particularly CS2, incorporate elements of community building between customers, since the services provide ways for customers to communicate through the Internet, particularly through the blog environment supported by CS2.

Community building can be said to exploit the inseparability and heterogeneity of services. Services are delivered simultaneously with consumption and therefore service providers have the opportunity to influence customers' direct interaction with the service as well as their interaction with other customers. Where community building is implemented, part of what makes it interesting and attractive to customers is the heterogeneity among customers and the uncertainty inherent in a heterogeneous service. A community, once established and if successful, can be said to get a life of its own and can be viewed as a means to counteract the intangibility and perishability of services.

3.2.9 *Application of design to customer experiences*

Most of the respondents were able to describe the desired customer experience for their TBSs. The experiences described can be classified as fun, simple or invisible. These experiences are supported by other aspects such as user interfaces and usability.

'Our real goal in terms of our design is to be so invisible that all we do is support the user's need for information. One of the strongest, most positive, comments that we have when we asked one of our users for a recommendation, is "I'm not sure I can actually recommend you because I never notice that I'm using you." Which means that we have emulated his knowledge acquisition need sufficiently clearly and cleanly that he doesn't see the interface of the service as being separate from himself.' [Lucidoc]

In the case of CellStory, the defined experience was fun.

'The experience should be happy, happy, fun, fun.' [CellStory]

Since the 'fun' in CellStory's services is closely tied in with their community building and user interface design, the motivation for defining the customer experience as fun is to counteract intangibility and perishability, like community building and user interface design, and to exploit inseparability and heterogeneity like community building.

In those instances where firms defined their customer experience as simple the motivation resonates with the motivation for design for improved usability. Simplicity, like improved usability, empowers customers to be more self-sufficient and thus counteracts inseparability and perishability. Where the firms defined their customer experience as invisible, design can also be said to counteract heterogeneity since what is invisible is homogenous.

The emphasis in QU2 is to exactly mirror user requirements while at the same time striving for simplicity. In this case, the service's inseparability is exploited through the firm's close interaction with customers in the interest of discerning and meeting requirements.

3.2.10 *Application of design to marketing materials*

Information about all the TBS projects was found on the Internet, except for LU2 and RC2 which were still in mid-development. These websites varied widely in their comprehensiveness and level of design.

In addition to websites, some of the case firms' marketing strategies centered on demos. Quantum3D particularly emphasized demos and put considerable effort into staging demonstrations at trade shows and similar venues. Lucidoc also used demos extensively, both to market existing services and to create and/or gauge interest in potential new services.

'Since we had several "power users" with particular requests from our customer base, we announced to them that we were working on improved functionality. As soon as things were sufficiently stable to be able to demonstrate, we did a web demo and teleconference to show the new

features and solicit comments, which we then incorporated into the design, or scheduled for later implementation.' [Lucidoc]

Outside designers were employed by Lucidoc and Red Condor to create marketing materials, CellStory relied on its internal designer and Quantum3D had an internal marketing function. Red Condor hired an outside designer to create a Flash presentation for RC1. This presentation was available on Red Condor's website and is used for trade shows. Red Condor had also hired an outside designer to create a sales kit for its services.

Red Condor's marketing materials had a tangible element to them, particularly the sales kit, which is a physical prop, and therefore Red Condor's motivation seems to be, in part, to counteract intangibility.

Demos, since they are commonly presented in an interaction setting, can be said to exploit inseparability, the opportunity created by the fact that service delivery is simultaneous with service consumption. This is particularly true when demos are deliberately used to solicit input from customers.

4 Conclusions, discussion and implications

The goal of this paper was to examine the role of design in the development of technology-based services (TBSs) in new firms to approach a characterization of design in this context and how design specifically addresses the distinguishing characteristics of services. Existing research suggesting the importance of design as a means for achieving differentiation, leading to competitive advantage and improved performance, motivates this research.

Two research questions dealing with the role of design in the development of TBSs in new firms were posed and answers were sought through a pre-structured multiple case study. Evidence of the role of design in exploiting technological innovations to create attractive and competitive services and to facilitate the management of positive relationships with customers was observed in the case firms. Emphasis, effort spent and methods used differed between firms, and even between TBS projects in the same firm.

The first research question is about the aspects of TBSs to which design is applied. An initial framework was developed based on extant research and evidence of design application to the aspects suggested by this framework was found in the case firms, namely user interfaces, tangible artifacts integrated with services, service processes, usability, definition of desired customer experiences, processes for communicating with customers, community building and marketing materials. Additionally, evidence of the application of design

to revenue models and documents, which were aspects not included in the initial framework, was found in the case firms.

Differences in design application between TBS projects within the same firm were observed in all the case firms. Interestingly, it seems that in the case firms studied, there was more emphasis on design, or more intense application of design, in more recent TBS projects. This may support the notion of strategy adaptation (Andries and Debackere, 2006) or indicate that once new firms have introduced their initial services they become increasingly aware of the value of design and therefore are more likely to apply design in subsequent TBS projects.

The second research question is about the application of design to address the distinguishing characteristics of services, which are intangibility, inseparability, heterogeneity and perishability. The observations in the case firms suggest that design is, in part, applied with the purpose of either counteracting or exploiting these characteristics.

The role of design in the case firms was found to be more commonly that of counteracting the distinguishing characteristics of services and less commonly of exploiting these characteristics. This could be a reflection of the perceived notion that the characteristics of services make them vulnerable, particularly in terms of establishing their value (Von Stamm, 2003).

Technology provides the means to standardize service delivery and increase efficiency and quality (Dolfsma, 2004) as well as support delivery to mass markets through automation. The evolution from personal service delivery to automated delivery was specifically observed in CellStory, which was moving from the business-to-business market to the consumer market. Standardizing a service makes it less heterogeneous and automating it counteracts its perishability and inseparability since automation constitutes a means to create service processes which can be accessed by customers as needed.

The contributions of this paper are: 1) A suggested framework for empirical research on design in the development of TBSs in new firms; and 2) Managerial implications for successful development of TBSs.

The framework for empirical research on design suggested by this research views design in the development of TBSs along three dimensions: 1) The aspects of TBSs to which design is applied; 2) The emphasis on or, intensity of, design applied to each aspect; and 3) How the design applied addresses the distinguishing characteristics of services. The first two dimensions deal with what firms do as far as service design is concerned, and the third dimension deals with the motivation for service

design. This framework is reflected in the structure of the table in the [Appendix](#).

The conclusions of this research also suggest managerial implications for successful development of TBSs. Comparison of extant research with the research findings suggests a number of possibly untapped opportunities for applying design for differentiation of TBSs such as deliberate design of user interfaces for attractiveness and ease-of-use (Norman, 2004), the inclusion of tangible artifacts in services (de Brentani, 2001), the exploitation of the various documents which constitute part of the services as vehicles for differentiation through design (Norman, 2004), the use of community building as a means to foster customer emotional investment (Pullman and Gross, 2004), and the design of marketing materials in addition to information websites (Berry and Lampo, 2004). A further implication is that design can be used to standardize TBSs making them deliverable to a larger and more distributed customer base and making them less manpower-intensive. Finally, the observed emphasis on using design to counteract the very service-ness of TBSs rather than exploiting the distinguishing characteristics of services, suggests possibly untapped opportunities for using design to exploit the characteristics of services when developing new TBSs.

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Appendix. Observed application of design in case firms

Table 1 Observed application of design in the development of technology-based services in the case firms

TBS	Characterization of project observed design	Application relative to service characteristics
		Intangibility Inseparability Heterogeneity Perishability
<i>Design applied to user interfaces</i>		
LU2	Incidental	
QU1		
RC1		

(continued on next page)

Table 1 (continued)

TBS project	Characterization of observed design	Application relative to service characteristics			
		Intangibility	Inseparability	Heterogeneity	Perishability
QU2	Provided as a custom service, but low emphasis on aesthetics		Exploit		
LU1	Used as a tool for prototyping		Exploit		
CS1 RC2	Relatively important	Counteract Counteract		Counteract Counteract	Counteract Counteract
CS2	High priority	Counteract		Counteract	Counteract
<i>Design applied to tangible artifacts</i>					
CS1 CS2 LU1 LU2 QU2 RC1	no tangible artifacts				
RC2	The fact that there is a tangible artifact is important	Counteract			Counteract
QU1	Design of tangibles is important	Counteract			Counteract
<i>Design applied to documents</i>					
RC1	Few documents, low priority				
QU1	Authored by technical people, no design		Counteract	Counteract	Counteract
LU1	Authored by technical people, layout reviewed by non-technical		Counteract	Counteract	Counteract
LU2 QU2		Counteract Counteract	Counteract Counteract	Counteract Counteract	Counteract Counteract
CS1	Online help integrated with user interface		Counteract	Counteract	Counteract
CS2			Counteract	Counteract	Counteract
RC2	Documents strategically important	Counteract	Counteract	Counteract	
<i>Design applied to usability</i>					
LU2	Shielding from complexity		Counteract		Counteract

Table 1 (continued)

TBS	Characterization of project observed design	Application relative to service characteristics			
		Intangibility	Inseparability	Heterogeneity	Perishability
QU1		Counteract		Counteract	
RC1	Interaction elements or number of user steps minimized	Counteract	Counteract	Counteract	
RC2		Counteract		Counteract	
CS1	All possible measures to simplify, but some technical hindrances	Counteract		Counteract	
CS2	Simplicity is a key characteristic	Counteract		Counteract	
LU1		Counteract	Counteract	Counteract	
<i>Design applied to service processes</i>					
QU1	Incidental				
RC1	Service processes follow technical architecture			Counteract	Counteract
QU2	Standard process used				
CS1	Service process designed deliberately			Counteract	Counteract
CS2				Counteract	Counteract
LU1		Exploit		Counteract	Counteract
LU2		Exploit		Counteract	Counteract
RC2				Counteract	Counteract
<i>Design applied to revenue models</i>					
CS1	Using standard revenue model				
CS2					
LU2					
QU1					
LU1	Some adjustment to standard model				
QU2					
RC1	Custom revenue model designed			Counteract	
RC2				Counteract	
<i>Design applied to communication with customers</i>					
CS2	Communication channels are impersonal	Counteract	Counteract		

(continued on next page)

Table 1 (continued)

TBS project	Characterization of observed design	Application relative to service characteristics			
		Intangibility	Inseparability	Heterogeneity	Perishability
CS1	Communication is informal and personal, but moving to an automated customer service model		Counteract	Counteract	
QU1	Customer support is automated but customers are able to contact individuals in the firm		Counteract	Counteract	
QU2			Counteract	Counteract	
LU1	Communication is informal and personal		Exploit	Exploit	
LU2			Exploit	Exploit	
RC1			Exploit	Exploit	
RC2			Exploit	Exploit	
<i>Design applied to community building</i>					
QU1	No communication between users supported				
RC1					
LU1	Aspirations to initiate and foster user community		Exploit		
LU2			Exploit		
QU2			Exploit		
RC2			Exploit		
CS1	Communication between users is a by-product of the service	Counteract	Exploit	Exploit	Counteract
CS2	Community building designed into the service	Counteract	Exploit	Exploit	Counteract
<i>Design applied to customer experiences</i>					
LU2	Defined experience: simple				
QU1			Counteract		Counteract
QU2			Exploit		
RC1	Defined experience: simple and invisible		Counteract	Counteract	Counteract

Table 1 (continued)

TBS	Characterization of project observed design	Application relative to service characteristics			
		Intangibility	Inseparability	Heterogeneity	Perishability
LU1	Defined experience: invisibility		Counteract	Counteract	Counteract
RC2			Counteract	Counteract	Counteract
CS1	Defined experience: fun	Counteract	Exploit	Exploit	Counteract
CS2		Counteract	Exploit	Exploit	Counteract
<i>Design applied to marketing materials</i>					
CS1	Service information on website only				
CS2					
QU1	Emphasis on demos		Exploit		
QU2			Exploit		
LU1	Marketing materials and demos		Exploit		
LU2			Exploit		
RC1		Counteract	Exploit		
RC2		Counteract	Exploit		

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1. The pseudonyms are three-character abbreviations which are based on the firms' names and the number 1 or 2, where, for each firm, the project with the number 1 in its pseudonym was started earlier than the other.