

Open source software solutions:
A study on customer value propositions
by
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Abstract

The extant literature examines individuals' and suppliers' perspectives of the value of open source software, not the value that enterprise users perceive of open source software. This research uses the results of nine interviews with managers to develop a model of enterprise users' value of open source, ten propositions anchored around this model, and five managerial guidelines. Results suggest that customers value their relationship with suppliers when the open source software product is less mature and the supplier can provide a reliable support model; customers perceive the reputation of the software and supplier as more important than the brand of the open source software; customers perceive open source switching costs to be high due to the size, complexity or dependencies of open source software; and customers value differentiating functionality and cost savings.

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1. Introduction

1.1 Research objective and outcomes

The objective of this research is to identify how enterprise users perceive value from open source software (OSS). The extant literature pool on customer value perception with respect to OSS has focused primarily on individuals' and suppliers' perspectives of open source (Feller and Fitzgerald, 2002; Lerner and Tirole, 2005; Dahlander and Magnusson, 2008). The focus of this research is a qualitative study on enterprise users, using the marketing literature on customer value as a basis to identify the various types of value customers perceive. The scope of this research is restricted to OSS that is used in operational projects and OSS that is not custom made for a particular enterprise.

The research questions are two:

1. What are the various types of value that can be created for customers of an OSS solution?
2. How do customers perceive value of an OSS solution?

This research delivers:

1. Value points that matter to customers of OSS solutions
2. A model that identifies points of value that matter to enterprise customers
3. A set of propositions anchored around the model developed
4. Managerial guidelines for OSS suppliers

1.2 Definitions

For the purpose of this research, the following definitions apply:

OSS: software that is free to use and free to modify as per the Free Software Foundation (FSF) definition (<http://www.gnu.org/philosophy/free-sw.html>) and the Open Source Initiative (OSI) definition (<http://www.opensource.org/docs/osd>).

OSS is inherently free software, but the main difference between OSS and free software is that the source code itself is distributed along with the binaries, making it possible for any user to make changes to the software and (depending on the licenses) distribute their modified version and produce it on demand if required. It should be noted that this is different from free software where there is no obligation to distribute the source code itself.

Open source solution: refers to a service such as customizing, controlling, managing and/or supporting a software solution that is based primarily on OSS.

Customer value: “a customer perceived preference for and evaluation of those products attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer’s goals and purposes in use situations” (Woodruff, 1997).

Customer value proposition: a firm’s pre-emptive value offering that proposes to create value for customers.

1.3 Relevance

This research is relevant for at least three reasons. First, this research is relevant to entrepreneurs and top management teams of small and large companies that supply open source solutions because it identifies the differentiating points for which customers pay. A firm's valuable resources and capabilities can be focused on these differentiated points. This reduces time spent on activities that do not generate revenue and increases efficiency (i.e., allows the firm to do more with less).

Second, suppliers can identify the dimensions along which customers perceive value; to provide products and services that increase customer satisfaction and enable suppliers to gain a competitive advantage.

Third, this research is relevant to academics because it uses the concept of customer value perception from the marketing literature and identifies points of value that apply to OSS customers. The analysis of customer value perception in open source software is still very new. The extant literature examines mainly individuals' and suppliers' perspectives of the value of OSS.

1.4 Contribution

This research makes at least four contributions. First, investors, entrepreneurs and top management teams can use the identified points that provide value to customers to develop products and services that better meet customer's needs and increase competitive advantage.

Second, managers can increase customer satisfaction by using the guidelines to meet points that matter the most to customers.

Third, suppliers of OSS can save time and money by focusing their resources and capabilities on areas that customers are willing to pay for.

Fourth, researchers can test the developed propositions and refine the proposed model.

1.5 Organization

The thesis is organized into six chapters. The first chapter provides the introduction. Chapter 2 provides a review of the literature. Chapter 3 describes the research design and includes the data collection methodology. Chapter 4 provides the results of the research. Chapter 5 provides a discussion of the results. Chapter 6 provides the conclusions, identifies the limitations of this research and suggests recommendations for future research.

2. Literature review

This chapter is organized into four sections. Section 2.1 identifies why and how firms participate in open source projects. Section 2.2 reviews the literature on business models, business model components and business models associated with open source. Section 2.3 reviews the marketing literature on customer value and customer value creation in business models associated with OSS. Section 2.4 discusses the lessons learned from the literature review.

2.1 Firm participation in open source projects

Feller and Fitzgerald (2002) identify the economic, social and political motivations for firms to participate in open source projects. The economic motivation of open source is that it allows small to medium enterprises (SMEs) to compete independently from the pricing and licensing policies of large software companies. Moreover, participation in open source projects provides a recruitment ground for firms to find qualified future employees.

The social motivation for a firm's participation in OSS projects is sharing the ideology of OSS. Technological motivations include the advantages of leveraging the intelligence of collectives, obtaining code that is not available in proprietary software and the quality and reliability of OSS. In addition, firms participate in OSS projects to gain legitimacy, amplify knowledge, transfer external knowledge into internal operations and improve their reputation (Lerner and Tirole, 2002).

Morgan and Finnegan (2008) identify the factors that motivate firms to use an OSS strategy. The key factors are lowered costs with regard to licensing and

software upgrades, the scalability and reliability of OSS, consumer or management demands for OSS, the ability to invest more resources in staff training and development, a new way of collaboration with other companies and reduced risk of vendor lock-in.

Firm participation in OSS projects can include code contributions, collaboration in code development, providing an OSS product or integrating OSS components into a software system (Hauge, Ayala and Conradi, 2010). Dahlander and Magnusson (2008) identify three ways in which a firm can participate in OSS projects.

1. Firms *assess* software either by establishing new communities or using existing communities of software developers.
2. Firms can *align* their interests with a community and use the community to help improve a product.
3. A firm can *assimilate* a product that is already developed by an OSS development community.

In the case of firms that *assess* the community, the benefit of releasing source code is that it enables a wider install base and contributor pool (West, 2007). In return, firms can benefit from the ideas generated by an OSS community (Dahlander, 2007).

When firms *assimilate* OSS or *align* their interests with an open source community, they also need to attract and retain developers' interests. Firms employ various tactics such as donating code to the community and using adaptive governance structures to attract and retain talented developers (Spaeth,

Stuermer and von Krogh, 2010; Lerner and Tirole, 2005). The concept of modularity to enable open innovation models is also emphasized by Weiss (2011).

An adaptive governance structure (e.g., non-profit foundations like the Eclipse foundation) also attracts developers and helps control the direction an open source code base will take (Spaeth, Stuermer and von Krogh, 2010).

Another advantage of the adaptive governance structure such as a non-profit foundation is that it allows commercial companies to gain some credibility about their commitment to OSS and the community (Lerner and Tirole, 2005).

2.2 Business models

A business model tells a story about how a company works. It explains how a company makes money and the economic logic behind it (Magretta, 2002). Every successful company satisfies a customer need with an effective business model, whether or not they realize it explicitly (Magretta, 2002; Johnson, Christiansen and Kagermann, 2008; Chesbrough and Rosenbloom, 2002).

Teece (2010) defines a business model as an entity that “articulates the logic, the data, and other evidence that support a value proposition for the customer and a viable structure of revenues and costs for the enterprise delivering that value”. Business models seek to explain both value creation and value capture, they explain how firms “do business” (Zott, Amiti and Massa, 2011).

2.2.1 Business model components

Johnson, Christiansen and Kagermann (2008) conceptualize a business model as comprised of four elements: customer value proposition (CVP), profit formula,

key resources, and key processes. The CVP identifies a solution to a fundamental problem in a given situation and defines how a company will create value for customers. The profit formula identifies how a company will create value for itself while delivering value to its customers. The key resources are the assets such as people and technology that are required to deliver value. The key processes are the operational and managerial processes that allow companies to deliver value. Managerial cognition could also be considered as an element of a business model (Tikkanen, Lamberg, Parvinen and Kallunki, 2005).

Chesbrough and Rosenbloom (2002) offer a detailed definition of a business model by identifying the six functions of a business model. The six functions are: articulating a value proposition, identifying the market segments, defining the structure of the value chain within the firm, estimating the cost structure and profit potential, describing the position of the firm within the value network and formulating a competitive strategy.

A commonly used multi-item definition of a business model is the business model canvas proposed by Osterwalder and Pigneur, 2010. The business model canvas identifies the nine building blocks of a business model as: key activities, key resources, key partners, customer relationship, customer segments, channels, value proposition, revenue streams and cost structure.

2.2.2 Open source business models

In a proprietary software business model, value is created by producing software that fulfills a customer's need to get a job done or solve a problem. Value is appropriated by methods such as patents and licenses to use the software.

When a firm uses open source assets to satisfy a customer's needs, value is captured in different ways as the supplier cannot charge for the OSS. Therefore, it can be said that OSS represents the "antithesis" of proprietary software technology business models (West, 2003).

In a weak appropriability regime (such as open source) where firms do not enjoy strong intellectual property rights, the sale of complementary assets can be used to profit from innovation (Teece, 1986). A complementary asset is a specialized service such as marketing, after sale support or in the case of technological innovation it could be specialized software. Most open source business models rely on selling complementary goods and services and leveraging other intangible sources such as tacit knowledge over rivals to capture value (West, 2007).

Some of the literature on business models focuses on revenue generation strategies (Hecker, 1999; Fitzgerald, 2006). Recently, the focus has shifted to examine business models that create and retain value in the open source value network of developers and suppliers. Table 1 identifies examples of OSS business models that focus on revenue generation.

Table 1: OSS Business Strategies (revenue generation focus)

Author	Business Strategy	Details
Hecker, 1999	Support seller	Generate revenue by selling support and services for an open source product
	Loss leader	Open source used as a loss leader for commercial OSS
	Widget frosting	Open source model used for enabling software for a company whose primary business is hardware
	Accessorizing	Selling accessories such as books for OSS

	Enabler	OSS is created to enable the generation of revenue for online services
	Brand licensing	Charging companies to use a brand name
	Software franchising	A combination of Brand Licensing and Support where a company can authorize others to use its name. Supply franchises with support/training services for a fee.
	Selling it, freeing it	Companies release previously proprietary source code to the community when appropriate
	Distributor	Providing software on a CD, services, support and upgrades
Krishnamurthy, 2005	Software producer	Incorporate source code in existing products or bundle with existing products
	Third party service provider	Service based revenue stream
	Value-added service enabling	Bootstrapping – a company bootstraps its own value added services to an OSS offering
Fitzgerald, 2006	Market creating	Dual-licensing, cost reduction and accessorizing.
	Leveraging open source brand	Companies use OSS as a brand. For example, Oracle promotes “unbreakable Linux”
	Leveraging community development	Increase development productivity by harnessing the expertise of the OSS development community
	Hybrid business Models	Firms combine proprietary and open source assets to profit from open source.
Bonaccorsi, Giannangeli and Rossi, 2006	Hybrid business models	Mix open source and proprietary software, types of licenses and revenue sources.

Hecker (1999) organizes open source business models into eight groups based on how revenue can be captured by a firm. The business strategy in each group is to profit from open source without charging customers for the software itself.

Krishnamurthy (2005) identifies OSS as a means for software companies to create business models that help reduce costs and generate revenue.

Krishnamurthy's three groups of business models are: software distributors, software producers and third party service providers. For each of these three groups, revenue generation strategies are identified. Software distributors generate revenue by distributing software and charging for services such as upgrades and support. Software producers benefit by using OSS or its derivatives in their software offerings. Third party service providers generate revenue by providing services associated with an open source offering.

Fitzgerald (2006) proposes that OSS has now transformed into OSS 2.0; a new production model where companies realize the strategic potential of open source to grow market share or undermine competition. In OSS 2.0, customers want to leverage the open source brand. They are willing to pay for professional services and seek a "whole-product" solution that delivers a complete solution in terms of products and services. Fitzgerald (2006) identifies two overarching families of revenue models: value-added services and loss-leader market creating.

Bonaccorsi, Giannangeli and Rossi (2006) describe hybrid business models where firms mix open source and proprietary software, types of licenses and revenue sources. They found that hybrid business models are not a transient state that are continuously changing but a persistent state. Hybrid business models allow firms to maximize learning benefits by participation in an OSS community while at the same time meeting customer requirements using open source or proprietary software and solutions.

Two dominant strategies have emerged in this field of hybrid business models: the first being a strategy to waive control of the commodity layers of a platform while retaining control of other layers and the second is a strategy to disclose technology under restrictions that add value for customers but make it difficult for competitors to imitate (West, 2003). The former strategy speeds up adoption and the latter strategy makes a technology available to competitors, increasing the number of products that are interoperable with a vendor's products. Dual licensing schemes employed by companies (e.g., MySQL) are an example of a hybrid business model where firms can have an OSS version that is free and released to the community as well as a closed source version that has proprietary add-ons for which customers pay (Dahlander, 2007; Hecker, 1999).

Table 2 shows open source business strategies that identify aspects of value captured, value creation and the open source value network.

Table 2: OSS Business Strategies (value creation and capture focus)

Authors	Business Strategy	Description
West and Gallagher, 2006	Pooled R& D	Firms pool their R&D resources and collaborate to support competing interests
	Spinouts	Firms extract value from technologies by situating them outside the boundaries of the firms such as IBM's spinout of eclipse
	Selling complements	Firms sell complementary assets that rely on OSS that they contribute to and support
	Donated complements	Relying on external complements that are valuable but donated and making money off the core offering
West, 2007	Value creation	Buyer perceptions of value creation such as lower prices and less vendor lock-in. Attracting a large pool of adopters Market segmentation – combining

		priced and un-priced complementary assets Commoditization of previously proprietary technology
	Value capture	Ongoing ownership to retain copyright and control others Surrendering ownership to fuel adoption External ownership to create new technologies based on OSS Selling complements
	Value network	User contributors, third party complementors Competitors to build legitimacy and spur adoption of shared technology
Morgan and Finnegan, 2008	Value creation	Quality, reliability, security, performance, cost
	Value capture	Freedom of choice and customization, less lock-in, superior technical knowledge, more opportunities of innovation/creativity
	Value network	Cooperation and collaboration with companies, communities, customers Joint ventures with companies

West and Gallagher (2006) identify four strategies that firms can use to invest in open source and benefit from their investment in open source, given the fact that the investments firms make in OSS can be shared by their rivals. Therefore, the business strategies identified by West and Gallagher (2006) do identify how firms create and capture value with OSS as a key resource and they do not focus on a pure revenue generation model as the strategies identified in Table 1. The strategies proposed focus on either collaborative development of technology or the shared rights to use a technology.

West (2007) presents the three dimensions of a business model as value creation, sustainable value capture and the value network. Value creation requires identifying customer segments, the value proposition for each of these segments

and how the business will provide this value. Value capture identifies a revenue model and includes a strategy on what will be priced and how much will be charged. Since the value created and captured by a firm is determined by a firm's position in a value chain, a business model must define a firm's position in this network of suppliers, buyers, complementors and other allies. Morgan and Finnegan (2008) use the same three business model dimensions as West (2007) and identify components used to create and capture value; they identify the value network as an integral part of OSS business models.

2.3 Customer value

The creation of customer value is considered to be a driver for customer loyalty and satisfaction and a means to develop a competitive advantage in business markets (Woodruff, 1997). The term customer value may mean low price, receiving what is desired, receiving quality for what is paid, or receiving something in return for what is given (Zeithaml, 1988). Woodruff (1997) defines customer value as "a customer perceived preference for and evaluation of those products attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations".

Customer value perceptions vary depending on the time that the value assessment is made (Woodruff, 1997; Zeithaml, 1999; Sánchez-Fernández and Iniesta-Bonillo, 2007). There are two aspects to customer value: desired value and perceived value (Flint, Woodruff and Gardial, 2002). Desired value refers to what customers want in a product or service. Perceived value is the benefit that a

customer believes he or she will receive from a product after it has been purchased.

Woodruff (1997) proposes a customer value hierarchy as comprising of three levels: attributes, attribute consequences and goals (Figure 1). The lowest level of the customer value hierarchy defines customer value perceptions as an assessment of the attributes of the product itself. At the next level customers determine what the use value or possession value is. At the top most level of the customer value hierarchy, customers perceive value in achieving desired goals and they seek consequences that help them achieve these goals.

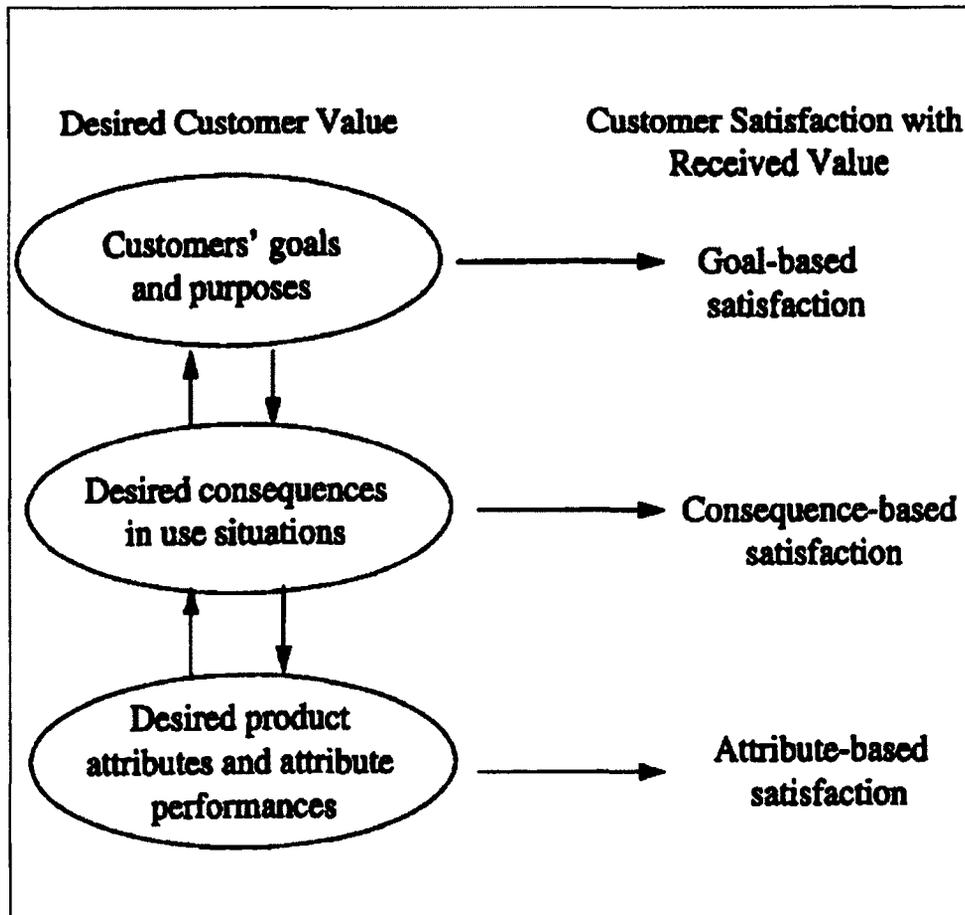


Figure 1: Customer Value Hierarchy (Woodruff, 1997)

Perceived value is a trade-off between give and get components or a cost/sacrifice exchange. Zeithaml (1998) proposes that the benefit component includes intrinsic and extrinsic attributes; the sacrifice component includes both monetary and non-monetary price.

Table 3 lists the various dimensions of value identified in the extant literature pool. It should be noted that value is context-specific; therefore table 3 also identifies the context to which each set of identified value dimensions is applicable.

Table 3: Value dimensions identified in literature pool

Authors	Value dimension	Context
Ulaga, 2003	Product quality Service support Delivery performance Supplier know-how Time-to-market Personal interaction Price and process costs	Dimensions of value that apply to manufacturer-supplier relationships'
Smith and Colgate, 2007	Functional/instrumental value Experiential/hedonic value Symbolic/expressive value Cost/sacrifice value	Marketing managers perspective that identifies types of value and how an organization can create these types of value
O'Cass and Ngo, 2011	Performance value Pricing value Relationship value Co-creation value	Value offerings from a firm's view; interpretation of what customers are looking for in the marketplace and what firms provide in response

There is no widely accepted framework or methodology for customer value creation and researchers have adopted divergent views on this construct (Sánchez-Fernández and Iniesta-Bonillo, 2007). At the same time, researchers also

acknowledge that understanding the customer value creation strategies applicable to various contexts is central to marketing strategy (Smith and Colgate, 2007).

Ulag (2003) identifies eight dimensions of value creation in a business-to-business context: product quality, service support, delivery performance, supplier know-how, time-to-market, personal interaction, price and process costs. While Ulag focused on relationship value (manufacturer-supplier relationships), the eight dimensions are applicable to OSS businesses as most consumers or end-customers for commercial open source are businesses.

Smith and Colgate (2007) extend and integrate previous works on customer value creation and propose a customer value creation framework that focuses on identifying the categories of value that could differentiate offerings, instead of identifying all the individual benefits and sacrifices perceived by customers. The framework identifies the four major types of value that can be created by organizations as follows:

1. **Functional/instrumental value** - the attributes of the product itself. It is the extent to which a product is useful and fulfills a customer's desired goals.
2. **Experiential/hedonic value** - the extent to which a product creates appropriate experiences, feelings, and emotions for the customer
3. **Symbolic/expressive value** – the extent to which customers attach or associate psychological meaning to a product
4. **Cost/sacrifice value** – consumers and customers try to minimize the cost or sacrifice that would be associated to the use of the product.

Smith and Colgate (2007) propose their framework as a tool for identifying marketing strategy, enhancing product concepts, identifying value creation opportunities and evaluating customer value.

O'Cass and Ngo (2011) assert that a firm's pre-emptive value-creation strategy is comprised of:

1. **Performance value:** this component is associated with the product attributes and the attributes' performance. This relationship was also noted by Woodruff (1997).
2. **Pricing value:** this component can refer to the fair price or the value price. The fair price refers to customers believing they are paying a fair price for a product or service; the value price refers to a price that justifies the benefits of purchasing a product.
3. **Relationship value:** this component refers to the firm's efforts to create and deliver a hassle-free purchase and consumption experience.
4. **Co-creation value:** this component is added when customers find it beneficial to influence various parts of the business system to co-create or co-produce their own unique purchase and consumption experience.

A firm's value creation strategy begins by identifying what points of value to provide to their customers and then have a pre-emptive strategy to provide the benefits that customers are looking for in the marketplace (O'Cass and Ngo, 2011). A firm's customer value proposition (CVP) signals the pre-emptive value that a firm proposes to create for customers. A CVP identifies target customers, the job that the customer needs to have done and the offering that fulfills the

customer's requirements. Anderson, Narus and van Rossum (2006) build on the concept of customer value propositions in relation to business models and mention that manager's use the term customer value in one of three ways. The first way is to list all the benefits they believe they provide to their customers, these are referred to as points of parity. The second way is to list the points of difference between their offering and the next best alternative; this has the shortcoming of assuming that the points of difference must be valuable to other customers. The third and most effective way is to actually research customer needs and list a few points that will deliver the greatest value to the customer in the near future; thus providing a resonating focus for the customer. A CVP forces a company to focus on what its offerings are really worth to customers and make smarter decisions when it comes to new product development efforts (Anderson, Narus and van Rossum, 2006).

A CVP can be constructed by identifying the barriers that limit customers from getting a job done. The four most common barriers identified by Johnson, Christiansen and Kagermann (2008) are insufficient wealth, access, skill and time. The CVP is at its strongest when customer satisfaction with the current market offer is at its lowest, the customer's need to get a job done is high and the CVP offers a better alternative than the current market offer (Johnson et. al., 2008). The extant literature pool agrees on the aspect that firms focus on the creation of superior customer value to gain a competitive advantage (Landrogez, Castro, and Cepeda-Carrión, 2011; Woodruff, 1997). The effectiveness of a customer value proposition depends on how precisely it gets a job done and this requires that

companies do not dilute their efforts by doing many things but rather focus on the main points of value that matter to their customers (Johnson et. al., 2008).

In contrast to the traditional view of conducting market research and identifying points of value that matter to customers using predictive logic; an effectual approach relies on non-predictive logic to determine how value can be created for customers (Read, Dew, Sarasvathy, Song and Wiltbank, 2009). The logic of effectuation relies on non-predictive control, meaning that individuals do not need to predict the future if they can control it instead. In contrast, a predictive approach is a way to control the future by predicting it. Read et. al. (2009) studied expert entrepreneurs and managers and determined that successful entrepreneurs tend to use an effectual logic that relies less on market research and more on their experience. Read et. al. (2009) identify effectuation as a means to co-create value with customers that commit to a venture in advance. Goals emerge as an outcome of using the means available to an entrepreneur and they can not be pre-determined.

2.3.1 Customer value creation in open source businesses

OSS is geared towards more sophisticated users (Lerner and Tirole, 2002), as there is little in terms of documentation, support, user interfaces and sometimes a lack of backwards compatibility (West, 2007). Business buyers of commercial open source products expect a richer whole-product that includes support, services, customization, upgrades and integration (Fitzgerald, 2006). The value for customers is created by suppliers of open source products and services that

integrate open source and proprietary offerings to meet customer needs. Table 4 identifies the types of value that can be created with OSS as a key resource.

Table 4: Value creation in OSS

Morgan and Finnegan, 2008	Price value Scalability/Quality Staff Development Consumer demand Desire of top management OSS components Reduced vendor lock-in New way of collaboration	Reasons why firms embrace an OSS strategy
West, 2007	Price value Less vendor lock-in	Ways in which buyers identified that OSS created value for them

From a technical perspective, the points of value for customers are quality, reliability, security, performance and compatibility (Morgan and Finnegan, 2008). From a business perspective, the value of OSS lies in its merits such as reduced costs and comparative performance (Krishnamurthy, 2005; West, 2007). In a contrasting view on the demerits of open source, Fosfuri, Giarratana and Luzzi (2008) propose that some companies with large pools of proprietary software are reluctant to use open source because of a fear of the devaluation of brand name and quality. Other advantages of open source are less vendor lock-in or flexibility for end users (Krishnamurthy, 2006; West, 2007; Morgan and Finnegan, 2008) and an increase in perceived customer value by customizing software (Bonaccorsi et. al, 2006).

2.4 Lessons learned

2.4.1 Customer value propositions

A business model explains the value creation and value capture strategy of a firm. The components of a business model might differ from one author's viewpoint to another in the extant literature pool, but customer value creation is an integral part of every business model. To be willing to pay, a customer must derive value from a market offer. The concept of customer value is defined as a trade-off between give and get components and relates to the way in which customers perceive value in a product or service that they purchase.

The customer value proposition is a means for suppliers to signal the value that their products and services provide for customers. A firm identifies a need in the market and proposes a solution whose customer value proposition is to fulfill a job that customers' deem as important. To develop compelling customer value propositions, a supplier needs to keep in mind the following:

1. There are two stages at which customers assess value: before and after they purchase a product or service.
2. Value is perceived at various levels; therefore, value needs be delivered at various levels.
3. Understanding what customers' value is the first step in delivering customer value.

2.4.2 Customer value creation

Some of the key attributes of customer value creation that need to be considered when developing compelling customer value propositions are:

1. Customers perceive value from product attributes, from the consequences of using a product, and from whether they achieve their desired goals
2. For a convincing customer value proposition, a firm needs to identify how value is perceived by customers and then offer those identified points of value in the form of a pre-emptive value offering
3. A value creation tool should identify the various types of value a firm can create.

A firm's value creation strategy (figure 2) is comprised of combining existing resources and capabilities to create a customer value proposition that may convince customers to buy a product or service. Customers perceive value based on the product and services they buy and it is this value perception that firms can use to fine-tune their resources and capabilities to provide superior customer value.

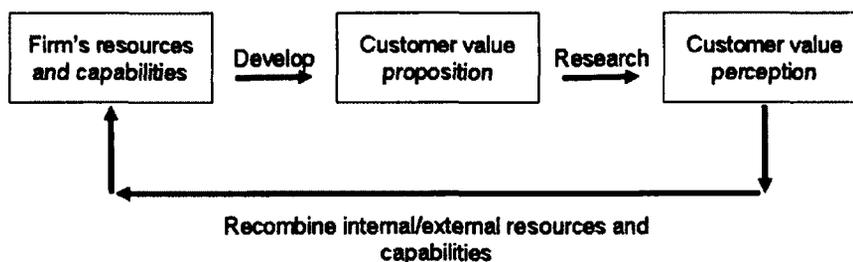


Figure 2: A firm's value creation strategy

2.4.3 Customer value delivery

The challenge for suppliers is not just recognizing what value to create or what the benefits are, but to operationalize customer-facing processes to deliver value to customers. Table 5 synthesizes views from the extant literature pool on customer value delivery; it shows how suppliers of products and services can use their understanding of customer value to their advantage.

Table 5: Customer value delivery process

Understanding of customer value concept	Actions that suppliers can take	The supplier's advantage
Points of value that matter to customers*	Develop market offer based on points of value that matter to customers	Create customer value proposition with a resonating focus*
Dimensions along which value is perceived†	Identify opportunities for new value creation propositions‡	Compete based on points of value other than just cost
Customer's desired needs change over time**	Observe customer environment to better understand changes in customer requirements	Deliver value proactively by anticipating changes in customer's desired needs**
Customer feedback†	Combine existing organizational capabilities (market orientation, knowledge management, customer relationship management)††	Improve value proposition of existing products and services

* Anderson et al. (2006)

† Woodruff (1997)

‡ Smith and Colgate (2007)

** Flint et al. (2002)

†† Landroquez et al. (2011)

Table 5 relies on a predictive strategy to determine how customer value can be delivered. An effectual strategy can also be used to deliver value to customers;

this is especially useful under circumstances where the product, the market and the details involved in the first column of table 5 are not known.

2.4.4 Creating customer value with OSS as a key resource

A large pool of literature on open source business models focuses on how firms can generate revenue from software that is essentially free and available for review by competitors and co-creators. There is very little in the extant literature pool on components of open source business models such as value creation strategies and value capture strategies; with two exceptions. The first exception is West (2007) where low cost and less vendor lock-in are identified as sources of value for customers. The second exception is Morgan and Finnegan (2008) who identify a few more sources of customer value creation and capture such as lower cost, better quality and performance. It can be concluded that the literature pool on value creation is still very new and customer research is needed to replicate the findings in the extant literature pool and identify new sources of value that matter to customers.

The OSS production model could be used in open source or proprietary software development. It is the way in which the software is used by a firm to create value for customers that can be used as a differentiating point, to create value for customers. Frameworks such as those proposed by Smith and Colgate (2007) could be applied to an open source setting to better understand what points of value customers want in OSS offerings. Some points that should be considered by suppliers of software where open source assets are a key resource are:

1. OSS software is a shared asset; differentiating value for customers can only be created where unique value can be added in software and services.
2. OSS source code is freely available to competitors and firms can not charge for the software itself.
 - a. The value of complementary assets, support and services should be considered for a value creation strategy.
 - b. The value of easily and conveniently combining proprietary software resources with OSS should be considered for a value creation strategy.
3. Customers can demand customized software and solutions. The value of co-creation or having a say in the suppliers offering is an important aspect of open source solutions. Co-creation value would be an essential aspect of an effectual strategy as a supplier can co-create products and services in partnership with customers, other suppliers and the open source community.
4. Due to the nature of open source licenses, it is less costly for customers to acquire OSS. Customers are also not locked in with a license and switching costs are expected to be lower.

2.4.5 Model on value creation

Figure 3 illustrates a firm's value offering organized into five value components: functional value, cost/sacrifice value, relationship value co-creation value and brand value.

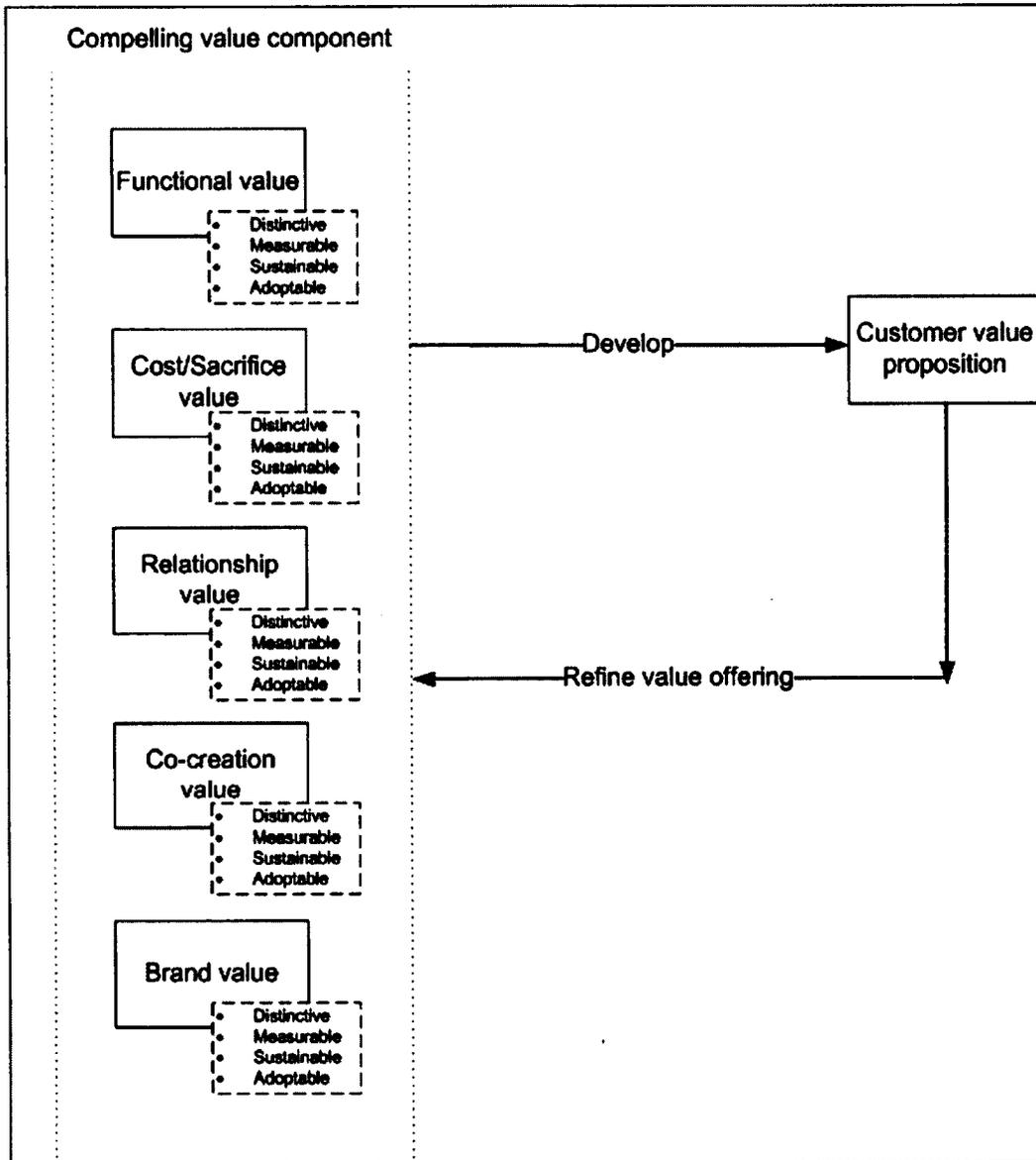


Figure 3: Model on customer value creation from literature review

Each value component identified in figure 3 can be used to create a customer value proposition and every customer value proposition must be distinctive, measurable and sustainable (Johnson et. al, 2008) in order to create a compelling customer value proposition. A customer value proposition also needs to be adoptable, meaning that a customer should be able to integrate and utilize a supplier's offering in their environment with a reasonable amount of effort. The

customer value proposition itself is a high level overview of each compelling value component that a firm proposes to deliver to customers. For a customer value proposition to have a resonating focus feedback from customers is required to meet the requirements that matter to customers. Figure 3 proposes that value creation is an iterative process and a firm's value creation process should be refined constantly, to achieve a resonating focus.

2.4.5.1 Compelling value components

The five compelling value components identified in figure 3 are described below.

1. Functional value

The product attributes that help create value creation as identified by Morgan and Finnegan (2008) are cost, quality, reliability, security and performance. These attributes of OSS are features of the product itself; they do not focus on other dimensions of value creation such as attribute consequences and goals.

Woodruff's (1997) customer value hierarchy identifies that customers perceive value not only from the attributes of a product itself but also from the consequences of using a product and the goals achieved by it.

2. Cost/sacrifice value

Customer value perception is often defined as a customer's evaluation of what they get in return for what they give (Zeithaml, 1988). The cost/sacrifice value identifies the customer's perception of whether the value created is worth the cost paid. The cost paid can be in monetary terms, time, effort spend defining requirements or any other way in which the customer invests in a firm's offering. The commoditization of OSS allows suppliers to provide undifferentiated

software at a lower price point; increasing the customer perception of value added (West, 2007).

3. Relationship value

The overall customer experience when they interact with the supplier. Value can be added to a relationship along dimensions such as product quality, service support, delivery performance, supplier know-how, time-to-market, personal interaction, price and process costs (Ulaga, 2003). OSS can be combined with complementary assets such as support, customization, integration or upgrades (West, 2007) to create value for customers. Such value-added offerings encourage customers to develop and maintain a relationship with suppliers to obtain a hassle-free purchase and consumption experience (O’Cass and Ngo, 2011). Firms that use OSS could also create value for their customers by re-using code and reducing time to market, production costs and using this saved time and money towards enhancing business processes or employee development (Morgan and Finnegan, 2008).

4. Co-creation value

The value perceived in either modifying available source code or defining requirements that allow a product to be customized to meet a customer’s needs. It is the value customers perceive in having a say in a supplier’s manufacturing process (O’Cass and Ngo, 2011). The nature of OSS allows users to co-create value by actively participating in the OSS development process and receiving a customized product that meets their exact requirements. When a firm promotes customers’ involvement in the production of software, they can increase

perceived value (Bonaccorsi et. al., 2006). An effectual approach (Read et. al., 2009) also advocates the value of co-creation where firms collaborate with partners and customers to co-create the future market or their products and services.

5. OSS Brand value

The value that customers perceive in the OSS brand itself. For example, value could be perceived by gaining legitimacy in the OSS community or creating partnerships with other companies. Customer value creation strategies could change based on the extent to which OSS resources are used in an offering (Bonaccorsi et. al., 2006). For example, the value in a pure OSS offering could be in the supplier's ability to customize without incurring high marginal costs.

2.4.5.2 Key value attributes

The key attributes of a customer value proposition that should be considered by firms are also identified in the model in figure 3. A customer value proposition must provide distinctive, measurable and sustainable value (Anderson, Narus and van Rossum, 2006). A distinctive value proposition is superior to the competitor's offering, a measurable value proposition allows customers to quantify value in monetary terms and a sustainable value proposition ensures that customers can continue to provide value to customers. A customer value proposition must be adoptable by customers; it should identify solutions to the barriers that limit customers from getting a job done. The four most common barriers identified by Johnson et. al. (2008) are wealth, skill, access and time.

To determine what customers want, what job they need to get fulfilled and what barriers they face a firm needs to conduct customer value research. Based on customer data firms should then refine their value creation strategy to provide value along the dimensions of value that customers identify as important to them.

3. Research Method

Chapter 3 is organized into three sections. Section 3.1 identifies the unit of analysis. Section 3.2 identifies the time period of the study. Section 3.3 is an overview of the research method and section 3.4 has details on the steps taken to carry out the research.

3.1 Unit of Analysis

The unit of analysis is a response to a questionnaire completed by decision makers at two levels within the firm: senior management and project leaders of operational projects that use OSS. Senior management is responsible for supporting project teams; this includes allocating financial and political resources to project teams. Project leaders are individuals that have the power to make decisions; they hold organization-wide authority and have the ability to mesh firm competencies to meet market needs and manage their project teams (Brown and Eisenhardt, 1995).

3.2 Time period

Responses to a questionnaire on the value of OSS solutions were gathered between June-July 2012 and covered OSS solutions that were used on or after July 1, 2002 to January 1, 2012.

3.3 Research method

Interviews with managers and leaders of companies were conducted to understand how they perceive value from OSS. Table 6 shows the research method and identifies the inputs, activities and outputs for each step in the research method.

Table 6: Research Method

	Step	Inputs	Key Activities	Outputs
1.	Develop a model to identify customer value creation in an OSS business context	Literature pool on OSS business models, customer value creation and customer value perception	Review literature Identify approaches for value creation Identify approaches that apply to value creation in an OSS business context	Model that identifies types of value that matter to customers and how value is created by OSS solution suppliers
2.	Develop questionnaire	Model developed in step one	Develop questions that will achieve deliverables: a model on customer value creation and	Questionnaire

			points of value that matter to customers	
3.	Refine questionnaire and have it approved by the Carleton University Research Ethics Board (REB)	OSS solution suppliers in the Ottawa area	Discuss questionnaire with OSS solution suppliers Apply for clearance from the REB	Refined questionnaire
4.	Select sample of companies that use OSS software solutions	Population of managers and leaders in the selected companies	Request an interview, email questionnaire and consent form	Convenience sample of 9 managers and leaders
5.	Data collection	Three sets of interview candidates	Deliver questionnaire and record responses	Responses to questionnaire
6.	Iterative data analysis	Answers to questionnaire from first three candidates	Refine model and identified points of value after each set of interviews	Refined questionnaire with version 2 of the model

		Answers to questionnaire from next three candidates	Refine model and identified points of value after each set of interviews	Refined questionnaire with version 3 of the model
8.	Final model development	Version 3 of the model, responses to questionnaire from last three candidates	Refine model	Final model
9.	Propositions and managerial guidelines	Final model	Develop propositions and managerial guidelines anchored around the model	Set of propositions anchored around the model Managerial guidelines

3.4 Research steps

The following research steps were undertaken:

3.4.1 Develop a model on customer value

From the literature reviewed in chapter 2, every value creation strategy is either a general proposition on how value can be created or a specialized set of value drivers that applied to one particular business environment. To develop a model on customer value creation, the various types of value were first identified. Key characteristics of customer value propositions as mentioned by Anderson, Narus and van Rossum (2006) and Johnson et. al. (2008) are also identified in the model. The model is presented in chapter 2 of this thesis.

3.4.2 Develop questionnaire

The questionnaire was developed using the model presented in Figure 3. The questionnaire is presented in Appendix A of this thesis. The three OSS solution suppliers identified in step 3.4.2 were consulted on the relevance of the questionnaire; the questionnaire was refined based on their feedback.

3.4.3 Refine questionnaire

Three OSS solution suppliers were considered. The selection criteria for the OSS solution suppliers selected was:

- The company had to be in the Ottawa area, so that in-person interviews could be conducted.
- The company had to be established and selling an OSS solution for more than 2 years. This is to ensure that there was an established customer base.
- The company had to have at least 4 customers.
- OSS has to be a major part of the company's offering.

Each company was contacted via email and requested to participate in this research. The questionnaire was emailed in advance and the questions were discussed during the interview. Feedback from the supplier on the relevance of the questions was recorded.

3.4.4 Select sample

A convenience sample of enterprise customers of OSS was used in this study.

Individuals interviewed met the following criteria:

1. Geography: company has an office based in Ottawa
2. Company size: enterprise users of OSS.
3. Position: The interview candidate had to have been in a position to make or influence a decision regarding the acquisition of an OSS solution.
4. Software type: The OSS selected had not been developed specifically for the one customer

3.4.5 Data collection

A multiple case study was chosen so as to confirm findings across multiple cases (Eisenhardt and Graebner, 2007) and also to compare and extend emerging patterns across cases (Yin, 1993). This research uses an inductive theory building approach as research on customer value perception of OSS is still relatively new; there is a need for rich, qualitative data and the development of testable propositions (Eisenhardt and Graebner, 2007) in order to explain how customers perceive value with OSS.

The questionnaire developed was used to ask open-ended and probing questions to initiate a discussion to record rich, qualitative data. Nine semi-structured interviews were conducted based on the questionnaire developed. Seven interviews were in person and two interviews were conducted over the phone. Each interview lasted 45-60 minutes and responses were recorded by the interviewer on a notepad during the interview.

3.4.6 Iterative data analysis

Data was split into three groups of cases, allowing the researcher to break simplistic frames and increasing the probability of developing novel theory by identifying similarities and differences across sets of data (Eisenhardt, 1989). Comparing interview data allowed the researcher to perceive patterns and at the same time eliminate the possibility of any chance associations (Eisenhardt, 1989).

In each stage of the three stages of data analysis, the interview data is presented in a summary table, as recommended by Eisenhardt and Graebner

(2007). The summary table is followed by changes that were made to the model as a result of the data collected. The next stage of data collection uses the refined model and questionnaire from the previous stage of data collection.

3.4.7 Develop propositions

Propositions were based on the developed model and the managerial implications of these propositions were identified.

4. Analysis of Results

Chapter 4 is organized into three sections. Section 4.1 is an analysis of the first set of interview data. Section 4.2 is an analysis of the second set of interview data. Section 4.3 is an analysis of the third set of interview data.

4.1 First set of interview data

Table 7 shows an analysis of the first set of interview data and table 8 shows the ranking given to the various types of value by the three OSS customers that were interviewed.

Table 7: Analysis of first set of interview data

	Customer 1	Customer 2	Customer 3
OSS Customer	Director of classroom technology at a university	Manager of instructional technology at a university	Manager of all web services at a university
OSS SW used	Moodle, Big Blue Button	Moodle, OS Ticket	Wordpress
Scope of software	Course management	Course management , ticket tracking system	University websites
Functional value - the functional attributes of the product itself	Meets needs of large community of users: simple, extensible, customizable. Good feedback from users.	Functionality is important when looking for specialized software that meets a specific requirement.	Meets needs of large community of users. Allowed creation of a common and uniform web service for all university departments.
Cost/Sacrifice Value - is the product worth the sacrifice	Management is easier if the work is done externally, even if it is at a higher monetary cost.	It is free, so cost is not a factor. It is worth it because it does a specific function.	There is no monetary cost. It is worth it because "It lets us be good at our jobs".
Co-creation value - the value of customizing a solution	This is a subset of functional value. Some features are customized.	Not important. "The ability to give back to the open source community is something I believe in."	Having the flexibility to customize to specific requirements is important. For example, the Wordpress blogging

			capability was converted to a news feed function.
Relationship value - derived from a relationship with the supplier or the open source community	Supplier relationship important for a less mature product that requires more bug fixes, features and support. Mature product requires less support, patches and extensions can be built in-house	Not important as the product (Moodle) is mature. Only used for migration from current system to Moodle.	Support contract was not used. The product is mature, documentation is good and customizations are easy to make. Community relationships are important: developer conferences, code contributions.
Brand Value - value of the OSS brand itself	OSS is important but this is not part of the primary software selection criteria. As a university the principle of using OSS is important.	"People look at you differently when you use OSS". As an educational institution it is important to foster information sharing. The online reputation of the software is a deciding factor.	Although the software is free, switching costs are high due to the scale of the deployment. "Wordpress brand is important to me and my team."
Reason for choosing open source	The user experience and cost were both good. Comparable market offers were either better in terms of price or user experience, but not both.	Online reputation was good.	Online reputation was good. Support and functionality was lacking in comparable market offers.
Comments on model	Co-creation value is more a subset of functional value Brand value is the least important	View was accepted as-is.	View was accepted as-is.

Table 8: Ranking of types of value from first set of interviews

	Customer 1	Customer 2	Customer 3
Functional value	1	1	2
Cost/Sacrifice Value	2	2	1
Co-creation value	3	5	2
Relationship value	4	4	4
Brand Value	5	3	5

Based on the analysis from customers, the model was modified to include four additional attributes to functional value: simple, adoptable, customizable and extensible. Measurable was removed as a functional value attribute. Co-creation value was added as a subset of functional value (functional value attribute in the refined model was “extensible”). Relationship value was divided into relationship with the supplier and the customer. Sustainability was the only attribute of relationship value that customers identified with so all other value attributes were removed from the model. Vendor lock-in was added to the questionnaire as customer 3 mentioned a perception of being locked in which is contrary to the extant literature pool on the value that OSS creates for customers. The refined questionnaire is presented in appendix B of this thesis.

4.2 Second set of interview data

Table 9 shows an analysis of the second set of interview data and table 10 shows the ranking given to the various types of value by the three OSS customers that were interviewed.

Table 9: Analysis of second set of interview data

	Customer 4	Customer 5	Customer 6
OSS Customer position	Senior product architect	Senior engineer	IT officer for a research department at a university
OSS SW used	Linux OS	Linux OS	Scientific Linux, R, TeX, Octave
Scope of software	Used on their carrier grade product	Used on their carrier grade product	Scientific research tools
Functional value - the functional attributes of the product itself	Differentiating function was the fault isolation capability	The software met the requirements we were looking for	The software meets the research requirements. Interoperability is an essential function. Alternatives might take longer to find and procure.
Cost/Sacrifice Value - is the product worth the sacrifice	"We can get the job done with fewer resources" (people and money).	Worth it, better than the option of making our own in-house OS	Worth it as it is free, the software is developed to fulfill a specific need and there are no other alternatives available.
Co-creation value - the value of customizing a solution	The ability to build patches was important	"Without our proprietary drivers and hardware added on, we have no business". Customization is part of our business model.	Flexibility to customize is a key value driver.
Relationship value - derived from a relationship with the supplier	Not very important. Suppliers are useful if they can help mitigate the risks associated with OSS.	Not very important. The experience and expertise of the supplier does matter.	We usually do not source the software directly from a supplier, usually directly from the OSS community
With the OSS community	Large pool of potential employees that require less training. OSS community is useful for support and problem solving. Fast responses are valued.	Less training and ramp-up required for new hires. Community responses are fast but not always accurate.	Community responses are more frequent for newer products, less frequent for older and more hardened products.

<p>Brand Value - value of the OSS brand itself</p>	<p>We sponsor OSS community by sponsoring conventions. The brand is not important to our customers. OSS does signify a higher level of interoperability with other vendor's offerings and with our own internal software and hardware.</p>	<p>The brand is not important to us. Switching costs are always high in an OS, as changing the OS is a major change for us and requires a huge QA cycle.</p>	<p>Reputation of OSS supplier does matter. Switching costs are lower with OSS, we have the freedom to switch and try alternatives.</p>
<p>Lock-in or switching costs</p>	<p>"We think 10 times before making a change to the OS". This is a major change and requires a lot of related changes, therefore switching costs are always high for an OS. When OSS is used in an internal tool the lock-in is not a factor, but it is embedded in a customer facing product the lock-in and switching costs are high.</p>	<p>We have to spend time on a lot of QA cycles if we make a change to the OS, so switching costs are always high.</p>	<p>Switching costs depend on the complexity of the software in use and the size of the deployment. Sometimes we have low switching costs and have the flexibility to try alternatives before committing to one software solution.</p>
<p>Reason for choosing open source</p>	<p>Functionality was better. The OSS provided better fault isolation than other operating systems. Good interoperability. The potential to hire a pool of already trained developers.</p>	<p>Open source allowed focus on core functionality instead of having to build an OS in-house. Good interoperability.</p>	<p>Open source provided the exact functionality that no other software provided</p>

Comments on model	Enterprise users' value suppliers that can help mitigate risks and guarantee support.	Cost/Sacrifice value is part of every value component. There is a cost/sacrifice associated to functional value, brand value and relationship value.	Co-creation value could be added to the model.
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Table 10: Ranking of types of value from second set of interviews

	Customer 4	Customer 5	Customer 6
Functional value	1	1	1
Cost/Sacrifice Value	3	3	2
Co-creation value	2	2	1
Relationship value	4	4	4
Brand Value	5	5	5

Based on customer feedback the model was refined to include risk-free as an attribute of relationship value with a supplier and responsiveness as an attribute of relationship value with the open source community. Brand value attributes were modified to include the reputation of the software and the supplier. The refined questionnaire is in Appendix C of this thesis.

4.3 Third set of interview data

Table 11 shows an analysis of the third set of interview data and table 12 shows the ranking given to the various types of value by the three OSS customers that were interviewed.

Table 11: Analysis of third set of interview data

	Customer 7	Customer 8	Customer 9
OSS Customer	Manager	CEO	Product line manager
OSS SW used	Spring framework, MySQL, Bird	Drupal commons	Jboss, Solaris10, Java
Scope of software	Integrated into a software provisioning utility	Embedded in a software application	Carrier grade platform for user management functions
Functional value - the functional attributes of the product itself	We did not have to re-invent the wheel. We could use what was already developed by others	The software met our exact requirements and it was modular	Functionality reduces time to market. We do not have to build from the ground up.
Cost/Sacrifice Value - is the product worth the sacrifice	Worth it because we do not have to deal with licenses and negotiations with suppliers. The licensing cost is not transferred to our customers either.	It was worth it as offering a low price point is a part of our business model, a source of competitive advantage.	We can control the up-front cost with open source. There are hidden costs that develop over time though.
Co-creation value - the value of customizing a solution	We do not customize or co-create as such	Extensibility is important. "we need the ability to customize quickly" "Speed of responding to market requirements is important"	We do not co-create or extend the OSS itself.
Relationship value - derived from a relationship with the supplier	There is no supplier as such; we only use the free versions, unmodified. We do not perceive any risk with OSS, our developers are highly qualified and we are comfortable handling risk ourselves.	Our supplier was unable to implement our vision. We wasted time and money and then decided to build internal expertise	We do have a support contract that we use frequently. The responsiveness and flexibility to address problems in a timely manner needs improvement in open source

With the OSS community	"I think my developers have some interaction with the community."	We do have some interaction with the community, it is important to us.	Collaboration with the community is limited. If we did use the community, we would want a large community that is well managed and controlled.
Brand Value - value of the OSS brand itself	The reputation of the software itself and the fact that it is a mature product is important. The fact that we use open source is not important to our customers, we do not advertise it.	The online reputation of the product was important to us. The OSS brand itself is not important to us or our customers.	Some of our customers do care about the reputation of the OSS software we use, the brand of the software itself is important.
Lock-in or switching costs	We are locked in for the framework but for software that is used peripherally, we could switch if required.	We are locked in for now, just because of the way in which we use Drupal in our solution. It is at the core.	We are locked in because the software in our infrastructure. We will switch if it is worth it in monetary terms.
Reason for choosing open source	Lower cost, licensing is complicated and costs are transferred to end customers	Providing services at a lower price point was essential, licensed software was not even considered	Cost savings
Comments on model	View was accepted as-is	View was accepted as-is	The size of the open source community signals credibility and is a value driver

Table 12: Ranking of types of value from third set of interviews

	Customer 7	Customer 8	Customer 9
Functional value	1	1	2
Cost/Sacrifice Value	2	1	1
Co-creation value	5	2	3
Relationship value	4	4	5

Brand Value	3	5	4
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The final model based on customer feedback had only one additional change, the size of the community was added as an attribute of relationship value. The final model is presented in Appendix D and discussed in chapter 5 of this thesis.

5. Discussion

Chapter 5 is organized into six sections. Section 5.1 is a discussion of the research results. Section 5.2 identifies anomalies; section 5.3 links the literature with the anomalies and research results. Section 5.4 examines the validity of the research results. Section 5.6 states the research insights and section 5.6 suggests managerial guidelines.

5.1 Discussion summary

5.1.1 Insights from first set of interview data

Insights from the first set of interview data and updates made to the questionnaire were as follows. The refined questionnaire is presented in Appendix B of this thesis.

1. **Functional value:** The attributes of functional value were refined to include three additional attributes identified by customers: simple, adoptable and extensible. A software solution deployed to a large community has to be simple enough for a diverse set of users to understand and this increases the ability to adopt the new software solution by a large user base. Extensibility is needed to modify and update the solution based on the changing needs to a diverse user community with different requirements. For example, plug-ins could be required for allowing students to login remotely to a classroom.

Software functionality can not be measured in monetary terms and it is more

applicable in cost/sacrifice value, so it was removed from the list of functional value attributes.

2. **Co-creation value:** The value of co-creating or customizing software is important for customers but they perceive it as a subset of functional value according to customer 1. Customer 3 gave co-creation value and functional value the same rank. Therefore, the model was updated to include co-creation value as a subset of functional value. The questionnaire was updated to include co-creation as “customizable”, an attribute of functional value.
3. **Cost/Sacrifice value:** All customers agreed that the product had to be worth it in monetary terms or the purchase and use experience had to be hassle free for them. No changes were made to this section of the questionnaire or model.
4. **Relationship value:** All three customers valued the relationship to their suppliers. Relationship value was determined to have two aspects: relationship to the supplier or support contract supplier and relationship with the OSS community. Each customer has a different view of the OSS community.
 - For a mature product, the relationship with the supplier is not as important. Documentation is readily available and there is an established community of developers.
 - The relationship with the OSS community is important for a mature product. Customer 3 mentioned that the large community helps with bug fixes, identifying security threats, documentation. Customer 2 identified that the online reputation of mature OSS product can be used to determine if they want to deploy it.

- For a less mature product, the customer has to have a good relationship with the supplier as documentation might not be readily available and frequent bug fixes or customizations might be required.

Two updates were made to the questionnaire for relationship value. First, the model was updated to identify that the supplier could either be a third party providing services such as consulting and support or the OSS community at large. Second, the description of relationship value was changed to “supplier and with OSS community” instead of “relationship with supplier”.

5. **Vendor lock-in:** Customer 3 mentioned that with a large scale deployment the switching costs are always high, even if the software itself is free of cost; they are still locked-in even though there is no formal contract that locks them in with OSS. Customers 1 and 2 acknowledged the needs of a diverse community and their requirement of a support contract to assist with switching to Moodle. A question was added in section 1 of the questionnaire to ask customers if not being locked-in was an advantage with an open source solution.
6. **Brand value:** The OSS brand was important to customers 1 and 2 but not to customer 3. Customer 3 valued community involvement as an aspect of OSS. Measurable was removed as an attribute of brand value as the OSS brand itself can not be measured in monetary terms.

5.1.2 Insights from second set of interview data

Insights from the second set of interview data and updates made to the questionnaire were as follows. The refined questionnaire is presented in Appendix C of this thesis.

1. **Functional value:** The second set of interviews re-confirmed that functional value is an important value component for all customers. For example, customer 4 mentioned that Linux had better fault isolation and protection mechanisms than any other closed or open source offering. Customer 5 saw the OSS offering as the only solution that fulfilled their exact requirements, confirming that suppliers have to get the customer's exact job done in order to create functional value. Customers 4 and 5 integrated the OSS into their platforms; therefore the interoperability of the software with their hardware and other components on the system was important as it allowed them to extend the functionality of the software itself. This confirmed extensibility as an attribute of functional value.
2. **Co-creation value:** The value of co-creating or customizing software is perceived as a subset of functional value and this was confirmed by customer 6 who gave the same rank to functional and co-creation value. Customer 5 identified customization as their core competency; without the hardware and proprietary drivers added on to the system they built, they would have no business. This confirmed the change made to the model after the first set of interview data where co-creation value was changed to be an attribute of functional value instead of an independent value component.

3. **Cost/Sacrifice value:** All three customers agreed that the OSS solution was worth it for them as they wanted to focus on their core competencies; therefore sourcing the software functionality they needed externally so as to complement their core competency. The sacrifice in manpower, time and money if they decided to do the same job in-house was not worth it for customers 4 and 5.
4. **Relationship value to suppliers:** The difference in relationship value to suppliers (e.g.- integrators such as Red Hat) and the open source community was identified by all three customers. This confirms the change made to the model to differentiate relationship value between suppliers and the open source community was relevant. Customer 4 identified the requirement for an open source supplier to provide a risk-free experience where the quality and functionality of the software is guaranteed. Customer 5 identified that suppliers can only provide a risk-free environment if their software is used as-is. If the software is modified in-house, suppliers may not be capable of supporting the modified versions. The model was changed to add a risk-free attribute to relationship value.
5. **Relationship value to community:** The community can be useful in providing patches and bug fixes according to customers 4 and 5. Customer 5 mentioned that identifying a bug fix using community forums can sometimes take a lot more time; it is just easier for them to identify the problem and create the fix themselves. In customer 6's experience responses to questions and bug fixes from the community were faster if the product was newer and

slower for older products. The model was changed to include responsiveness as a value attribute to relationship with the OSS community.

6. **Brand value:** The open source brand itself is not the reason why customers choose open source solutions and this was confirmed by all 6 customers interviewed so far. The attributes of brand value were modified in the model as brand value does not need to be distinctive, measurable or adoptable for customers to buy an open source solution. Customer 6 identified that the reputation of the open source supplier and the reputation of the open source community itself do matter; therefore the model was modified to include these two attributes for brand value. Customer 2 had also mentioned that the online reputation of an open source offering is important to them.
7. **Vendor lock-in:** Customers 4 and 5 used an open source operating systems and due to the complexity of the software itself switching costs were high. Customer 6 commented on the complexity and the size of the deployment as factors that determine how high switching costs would be.

5.1.3 Insights from third set of interview data

Insights from the third set of interview data were as follows. The final model is presented in Appendix D of this thesis.

1. **Functional value:** Customers 9 identified reduced time to market when open source was used, as they some of the functionality they needed was already pre-built for them. Customer 7 mentioned that they “do not have to re-invent the wheel” and this reduces their development time and costs. A reduced time to market allows the OSS to be adoptable, confirming that the model reflects

the opinions of customers 7 and 9. Customer 8 mentioned that modularity makes it easier for them to pick the libraries they need to use; confirming simplicity as an attribute of functional value.

2. **Co-creation value:** The ability to customize quickly was important to customer 8 only. Co-creating was not important to customers 7 or 9 as they could not share their co-creation (proprietary code) with the community.
3. **Cost/Sacrifice value:** Low costs were important for all customers. For customer 8 in particular, offering their solution at a lower price point was identified as a primary source of competitive advantage.
4. **Relationship value to suppliers:** Supplier relationships varied for this set of interviews. Customer 7 had no supplier relationship; customer 8 had a supplier that could not meet their requirements and customer 9 though support from suppliers was an integral part of open source and needed improvement in two key areas. The first area was fast response times to support requests and the second area was the flexibility to be convinced of a problem and fix it fast. Risk management by providing these two improvements was considered a value driver by customer 9.
5. **Relationship value to community:** The ability to get support and documentation from the open source community was acknowledged by all three customers. The open source community was not an important value driver for any of the customers. Customer 9 did identify that the size of the open source community could be a value driver for them; they would be interested in a large community that was well managed. Customer 9 did not

perceive a small community as responsive or flexible enough to meet their demands for support within their time requirements. The size of the community was added as a relationship value attribute to the model.

6. **Brand value:** The reputation of the software itself was important for all three customers. The reputation of the software itself was important.
7. **Vendor lock-in:** All three customers agreed that they were still locked in even though there was no license to lock them in. All three customers were locked in because of the way in which the OSS was deployed. It was at the core of their platform; switching would be resource intensive. Customer 9 was in the process of switching from a closed source solution to an open source solution even though switching costs were high, the reason was a significant cost saving.

The final model in Appendix D was developed based on insights from the third set of interview data.

5.2 Anomalies

Three anomalies were identified.

5.2.1 Relationship to supplier and maturity of the product

Based on the first set of interviews (customers 1, 2, and 3); relationship value to the open source supplier was increased when the software was less mature and decreased when the software was more mature. From the feedback from enterprise users that had carried grade platforms (customers 4 and 9), relationship to the supplier was important even when the software was mature.

Customers 4 and 9 were both managed carrier grade platforms where turnaround time for support and the reliability of the software itself were critical, which could explain why they valued their relationship with the supplier more.

5.2.2 Vendor lock-in

The extant literature pool suggests that customers should perceive less lock-in as costs are low and there is no licensing because of which they are committed to a specific software solution. All customers expressed that they were locked-in and switching costs were high. The reasons were either because of the scale of their deployment, the complexity of switching to an alternative or the way in which the software was dependent on other components, making it difficult to switch. There could be two possible explanations for this anomaly. First, the extant literature pool focuses on individual user and supplier perspectives, which could explain why vendor lock-in was an advantage in those cases but the findings of this research show that it does not apply to enterprise users. Secondly, customer 7 identified lower switching costs for software components with fewer dependencies that were used peripherally; confirming that the way in which the software is used could determine switching costs instead of the software license.

5.2.3 Marketing strategies on open source

When asked for feedback regarding the model as a value creation strategy, customers 7 and 9 remarked that they have never been approached by open source vendors. There is no formal marketing or competition between open source suppliers that customers are aware of. Customers base their selection on the

reputation of the supplier and the software itself. This research identifies the lack of marketing strategy, future research is needed to identify how OSS vendors can compete with closed source vendors and if customers would accept a supplier's marketing actions.

5.3 Link with the literature

Lerner and Triole (2002) identify why firms participate in open source. Using data collected from 9 enterprise customers, this research confirms the reasons they state for firms to participate in open source.

Dahlander and Magnusson (2008) identify three ways in which a firm can participate in OSS projects: assessing, aligning and assimilating. This research focused on enterprise users that participated in OSS in one of these three ways.

Smith and Colgate (2007) propose a customer value creation framework that identifies the four major types of value that can be created by organizations. They identify how customers perceive value as the core of any marketing strategy. This research uses Smith and Colgate's (2007) identified points of value as a basis for developing a model on customer value creation.

Uлага (2003) identified relationship value drivers in a business to business context. This research extends the concept of relationship value to an open source business context by identifying how enterprise customers derive value from suppliers or the open source community.

Morgan and Finnegan (2008) identify a reduced risk of lock-in as a value driver for customers, the results of this research show that enterprise customers are still locked in to OSS, even when they do not have a formal license locking them in.

This is because of the scale of the deployment or the way in which the software is used that makes other components highly dependent on it. Switching costs were always high for enterprise users.

5.4 Validity of results and reaching closure

This study uses an iterative data analysis method; the final version of the model was reached when the number of changes between the previous model and the next model were deemed to be minor and insignificant. The final model presented in Appendix D of this thesis and the model in Appendix C had only one change between them regarding an attribute of relationship value with the OSS community.

The changes made between the first version of the model and the final version of the model were verified against at least two responses, this is to prevent any chance conclusions that might arise from just a single case study. A multiple case study approach prevents any chance associations (Eisenhardt, 1989).

5.5 Insights

5.5.1 Insights on value attributes

Functional value was ranked highly by all customers. Key attributes of functional value are the ability to provide a unique or differentiating solution and to get the customer's exact job done to perfection. The ability to co-create is inherent to OSS but it is perceived as a part of functional value by customers rather than an independent value component.

Proposition 1A: Functional value is increased when OSS provides differentiating functionality that fulfills the customer's exact requirements

Customers valued the ability to build on a solution that was already created by someone else, reducing time to market and allowing them to react faster to market demands.

Proposition 1B: Functional value is increased when OSS can be used to reduce time to market.

Cost/Sacrifice value is important in open source as a lower price point implies that more features can be provided to end-customers without transferring licensing costs to them. Other than the obvious cost savings, customers also perceived value from not having to re-invent the wheel and reducing time to market. In some customers' view, the only cost is monetary cost and all other types of costs (test cycles, manpower and time) could be translated to an ultimate monetary cost.

Proposition 2: Time and cost savings increase (in comparison to closed source) when customers use OSS in their product offerings

Relationship value changes depending on the maturity of the OSS. For a newer product with a smaller or less active community more support is needed and the customer-supplier relationship is more important. There are more bug fixes, additional feature requests and more interaction with the supplier as the customer sometimes acts as an incubator for the OSS.

Proposition 3A: Relationship value to an OSS supplier decreases as OSS product maturity increases

All enterprise users that valued high availability and incorporated open source in a carrier grade solution were only comfortable using mature open source products. The risks with a less mature product were too high for them to use. For mature OSS with an established and active community, the open source community itself can provide bug fixes and support. The community itself would have to be large, well managed and active. The management of a large community is important to control the quality of the code contributions and manage responses to questions from users.

Proposition 3B: Customer perceived value increases as the size and activity of the OSS community increases

Risk management and an effective support contract were identified as value drivers by customers but none of the customers had a support contract that met their requirements.

Proposition 3C: Relationship value increases when suppliers are willing to mitigate risk via a support contract

Brand value: the open source brand itself was not important to customers.

Once the model was refined to include the reputation of the software and the supplier as attributes of brand value, customers did comment on the importance of the online reputation of the OSS as a driving factor for them. They also identified that it was easy to determine the quality of the software and community support from the internet.

Proposition 4: Customers do not value the OSS brand; they value the reputation of the supplier and the OSS itself

Vendor lock-in: Although vendors believe that switching costs with OSS are always very low as customers are not locked-in with a license, the opinion of all customers is that they are locked in by other factors such as a complex or highly scaled software deployment that has the OSS embedded into it. If the deployment is large, switching and modifications require more time, money and have to be deployed over a large user base.

Proposition 5A: Switching costs increase as the scale of the software deployment expands

If the software is at the core of a component like an operating system, switching costs can be high due to the testing, quality assurance and re-designing that has to be done on dependent components.

Proposition 5B: Switching costs increase as the number of dependencies in the OSS code increase

In cases where the open source is used peripherally or as an internal tool that is not integrated into a product sold to customers, switching costs could be lower.

Proposition 5C: Switching costs are low when OSS is used peripherally.

5.5.2 Value points that matter to customers

The final version of the model identifies five key value points.

1. Functional value

These are the features of the product itself. There are six key attributes of functional value.

- **Distinctive:** the functionality should be different from what other market offers, providing the customer with a differentiating value driver
 - **Sustainable:** the functionality and quality should remain the same over time
 - **Extensible:** customers should be able to extend the core functionality of the product to interface with their software and services
 - **Customizable:** customers should be able to customize a solution to suit their specific needs
 - **Simple:** users should be able to understand the functionality of the software with a reasonable amount of effort
 - **Adoptable:** the software should be usable in the customer's environment without them having to make major changes to their internal environment
2. **Cost/sacrifice value:** the product should be worth it to the customer. The cost paid can be in monetary terms, time, effort spend defining requirements, or any other way in which the customer invests in a firm's offering. There are four key attributes of cost/sacrifice value.
- **Distinctive:** the sacrifice between give and get components for the customer should be less than other alternatives

- **Measurable:** there should be significant cost savings for the customer in comparison to other market offers or making the software in-house.
- **Sustainable:** the customer should perceive the sacrifice between give and get components as being worth it over time
- **Adoptable:** the effort required to overcome barriers to adoption should be perceived as worth it to the customer

3. Relationship value to supplier

The customer's relationship to an OSS supplier of complementary assets such as customization, consulting and integration. There are two key attributes of relationship value with suppliers.

- **Sustainable:** the supplier should provide the same value to the customer over time by constantly adapting to the customer's requirements
- **Risk-free:** the supplier should be able to guarantee a risk-free experience for the customer where support requests are resolved within the timelines required by the customer.

4. Relationship value to OSS community

The customer's relationship to the open source developer community, this includes their interaction on support forums, developer conferences and code contributions. There are three key attributes of relationship value to the OSS community.

- **Sustainable:** the community activity rate should be sustained over time. If the community becomes less active over time, customers do not perceive the same value from the community.
- **Responsive:** the community needs to be responsive to the customer's unique needs
- **Large:** customers perceive the size of the community as a signal for how responsive a community can be and the popularity of the software. A large, well managed community gives some credibility to the community.

5. Brand value

The open source brand itself is not important to customers, as this is not a factor that motivates them to use in OSS and neither is it a value driver for their end customers. The brand of the software and the supplier are value drivers for customers and there are three key attributes that can be associated to brand value.

- **Supplier reputation:** customers trust software that is from a reputable supplier brand that they can trust
- **Software reputation:** customers rely on the online reputation of OSS as their selection criteria
- **Interoperability:** customers consider the interoperability of OSS an advantage and the open source brand signals the potential for better interoperability with their own hardware and software

5.6 Managerial guidelines

Customers confirmed that a value proposition that contains the points of value identified in the model would be part of their software selection criteria.

Cost was not always ranked as the most important value driver by customers; functional value was more important to some customers.

Guideline 1: A customer value proposition should include differentiating points of value and their relevant attributes identified in the model.

Customers of OSS require support, but the customers that were interviewed for this research did not express satisfaction with the support they received from a supplier or the community. Support contracts that accommodate fast response times and bug fixes are required by customers and they are currently not available.

Guideline 2: Customers require faster turnaround times for support with a credible promise to mitigate risk and provide bug fixes.

Lower switching costs were only perceived by customers when OSS was used peripherally, in a small scale deployment or when there were few dependencies between software modules.

Guideline 3: Lower switching costs should only be included in customer value propositions for OSS that is used peripherally, on a small scale or when the software structure is modular.

Regarding feedback on the model, customers 7 and 9 mentioned that the value creation strategy identified by the model would apply to them, but they usually do not get approached by open source vendors.

Guideline 4: OSS suppliers should market their abilities, to compete with software vendors that sell proprietary solutions.

Customers typically seek out the vendors themselves, using the reputation of the software and the supplier as a guide.

Guideline 5: OSS suppliers should build their online reputation to attract customers.

6. Conclusion

6.1 Research Conclusion

This research studied how enterprise customers valued OSS. This research subject is unique in at least two ways. First, it contributes to the academic literature on OSS by studying customer value perception from a marketing perspective. Second, it studies enterprise users where as most research on OSS to date has studied individual users or OSS suppliers.

The first conclusion of this research is that customers' relationship to software suppliers or the open source community depends on 4 factors: the maturity of the OSS, the size and activity of the community, the responsiveness of the supplier in providing support and the ability of the supplier to manage risks for the customer.

The second conclusion is that customers value the reputation of the software and supplier; they do not value the open source brand as much. Therefore suppliers of OSS should focus on managing their reputation and marketing the brand of their software solution.

The third conclusion is that customers value the functionality of the software; therefore functionality can be levered as a value driver by suppliers when it is not possible to compete based on cost alone.

The fourth conclusion is that customers select OSS based on the reputation of the software and the supplier; they are not approached by OSS vendors. This research identifies the need for a marketing strategy to enable open source suppliers to compete with suppliers of proprietary software.

6.2 Limitations

The limitations of this research are four. First, the data collected from interview candidates were interpreted by the interviewer; this data was subjective and could lead to inaccurate results. To reduce the risk of inaccurate interpretations, multiple interviews were conducted and all propositions were confirmed in at least two interviews.

Secondly, the researcher's lack of experience as a customer or supplier of OSS could lead to false interpretations. The literature review in this thesis provided a background and basis for the research conducted.

Third, the results can not be generalized to a large population or other geographical and cultural settings due to the small set of data derived from a geographically limited area.

Fourth, both public (universities) and private (for-profit companies) were included in this study and changes in value perception based on the size and profit model of the company were not taken into consideration.

6.3 Future research

The following suggestions are made for future research.

- 11 propositions were developed in this research. Future researchers could test and validate the propositions by interviewing customers from different fields.
- The model developed from this thesis does not recognize the changes in customer value perception over time. This could be an area for future research.
- All customers identified a requirement for support from a supplier or the open source community. Barriers such as intellectual property restrictions and requirements for faster than available support and bug fixes prevented some customers from using support contracts. Some customers even preferred to build in-house expertise rather than using an external source for support. Future research could be conducted on how effective support models can be developed by companies that sell commercial OSS.

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Appendix A: Questionnaire – version 1



TIM Thesis Questionnaire

OSS solutions: a study on customer value propositions

Research objective: To identify the points of value that matter to customers of OSS solutions

Instructions: This questionnaire has 3 sections. The interviewer will ask you the following questions and note down your responses. All responses will be kept anonymous. If you wish to withdraw from this study, please notify the interviewer at Aparna_shanker@carleton.ca no later than July 15, 2012.

Thank you for your time and cooperation.

Section 1: Types of value

The following value components were identified from the academic literature:

1. Functional value: the functional attributes of the product itself
2. Cost/Sacrifice value: the product is worth the cost
3. Relationship value: the value derived from a relationship with the supplier
4. Co-creation value: the value of customizing a solution
5. Brand value: the value of the OSS brand itself

Question 1A: Rank the five points of value above in order of importance to you.

Question 1B: How do each of the above points create value for you?

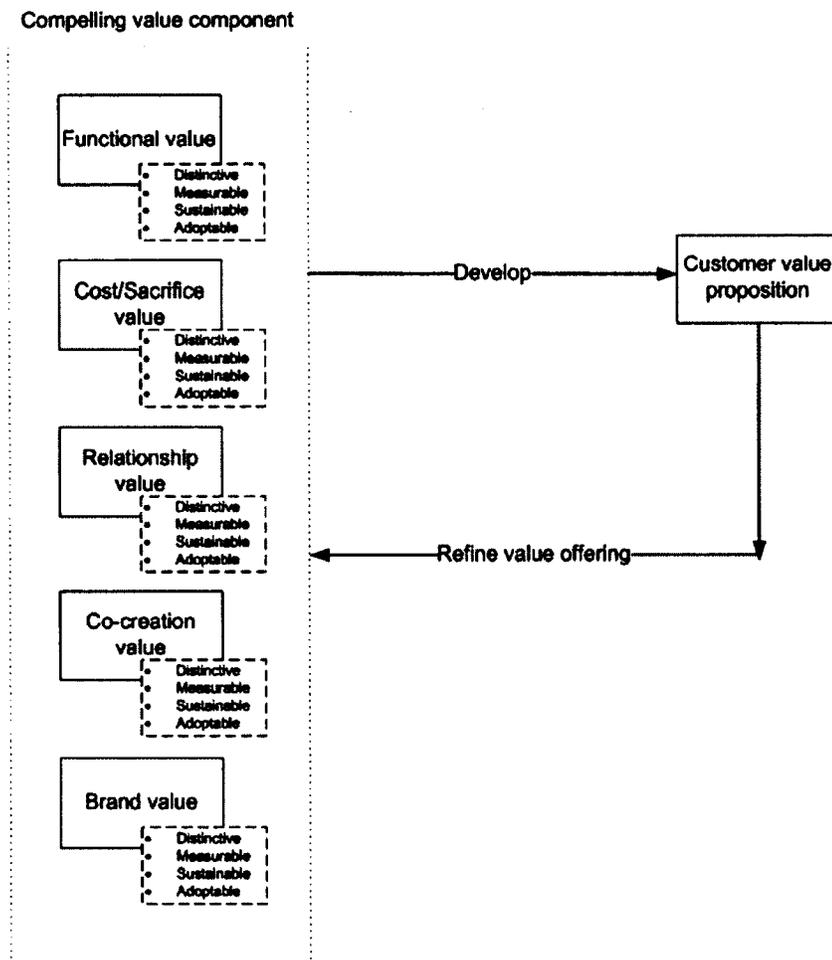
Question 1C: Are there any other points of value that you would add to the above list?

Question 1D: What made you choose an open source solution instead of closed source?

TIM Thesis Questionnaire
OSS solutions: a study on customer value propositions

Section 2: A model on customer value creation

The following model was developed from the extant literature pool. It identifies how suppliers create value for customers.



Question 2A: Do you think the value creation strategy above would be effective? Why?

Question 2B: How do you think the above model can be improved?

Note: details on how the above model was developed are available in the Author's TIM review article here: <http://timreview.ca/article/534>

Appendix B: Questionnaire – version 2



TIM Thesis Questionnaire

OSS solutions: a study on customer value propositions

Title of research project: OSS solutions: a study on customer value propositions.

Research objective: To identify the points of value that matter to customers of OSS solutions

Instructions: This questionnaire has two sections: the first section is on the types of value that matter to customers of open source solutions and the second section describes a model on customer value creation. The interviewer will ask you the following questions and note down your responses. You can decline to answer any of these questions. If you wish to withdraw from this study, please notify the interviewer at Aparna_shanker@carleton.ca no later than July 15, 2012.

Thank you for your time and cooperation.

Section 1: Types of value

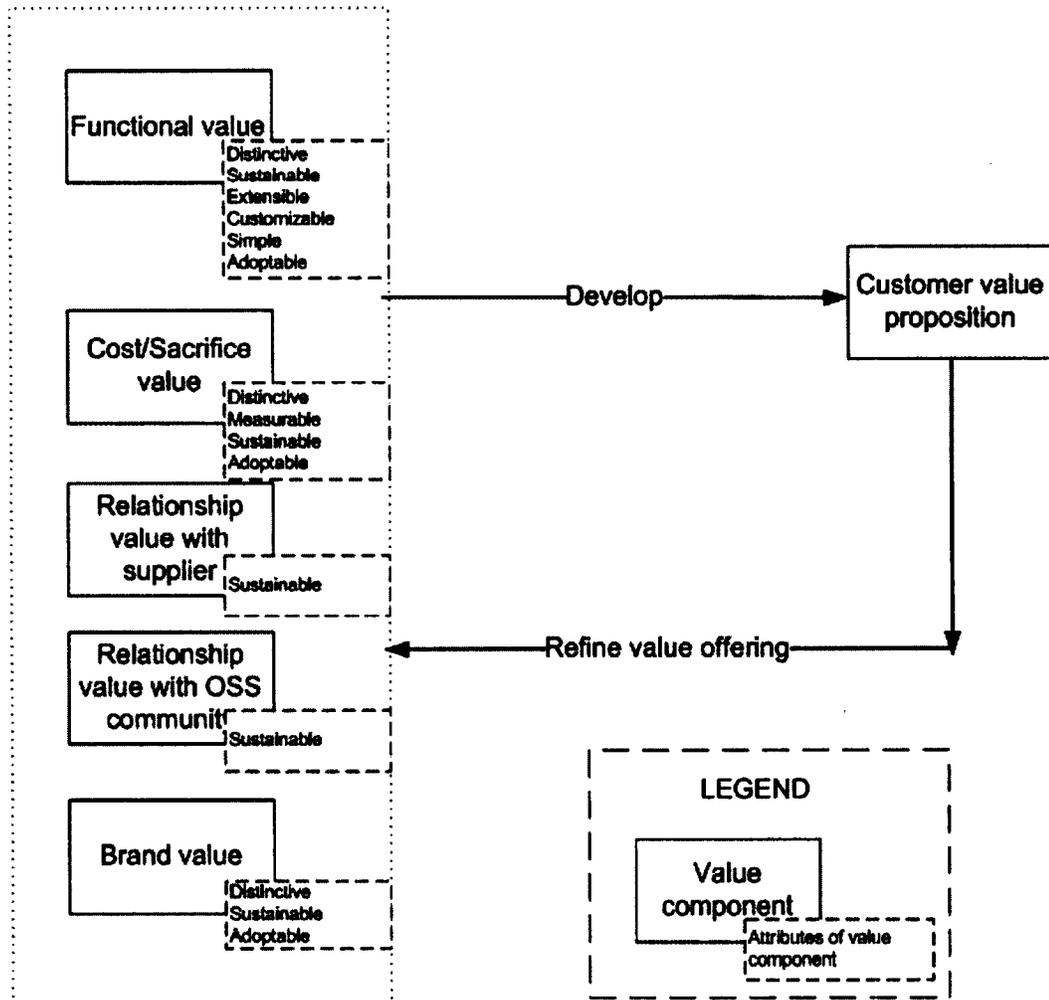
The following value components were identified from the academic literature:

- Functional value: the functional attributes of the product itself
 - Cost/Sacrifice value: the product is worth the cost
 - Relationship value: with supplier and with OSS community
 - Co-creation value: the value of customizing a solution
 - Brand value: the value of the OSS brand itself
1. Rank the five points of value above in order of importance to you.
 2. How does each of the above points create value for you?
 3. Are there any other points of value that you would add to the above list?
 4. What made you choose an open source solution instead of closed source?
 5. Do you have lower switching costs or feel less locked-in with an OSS solution than you would with a closed source solution?

Section 2: A model on customer value creation

The following model was developed from the extant literature pool. It identifies how suppliers create value for customers.

Compelling value components



1. Do you think the value creation strategy above would be effective? Why?
2. How do you think the above model can be improved?

Note: details on how the above model was developed are available in the Author's TIM review article here: <http://timreview.ca/article/534>

Appendix C: Questionnaire – version 3



TIM Thesis Questionnaire

OSS solutions: a study on customer value propositions

Title of research project: OSS solutions: a study on customer value propositions.

Research objective: To identify the points of value that matter to customers of OSS solutions

Instructions: This questionnaire has two sections: the first section is on the types of value that matter to customers of open source solutions and the second section describes a model on customer value creation. The interviewer will ask you the following questions and note down your responses. You can decline to answer any of these questions. If you wish to withdraw from this study, please notify the interviewer at Aparna_shanker@carleton.ca no later than July 25, 2012.

Thank you for your time and cooperation.

Section 1: Types of value

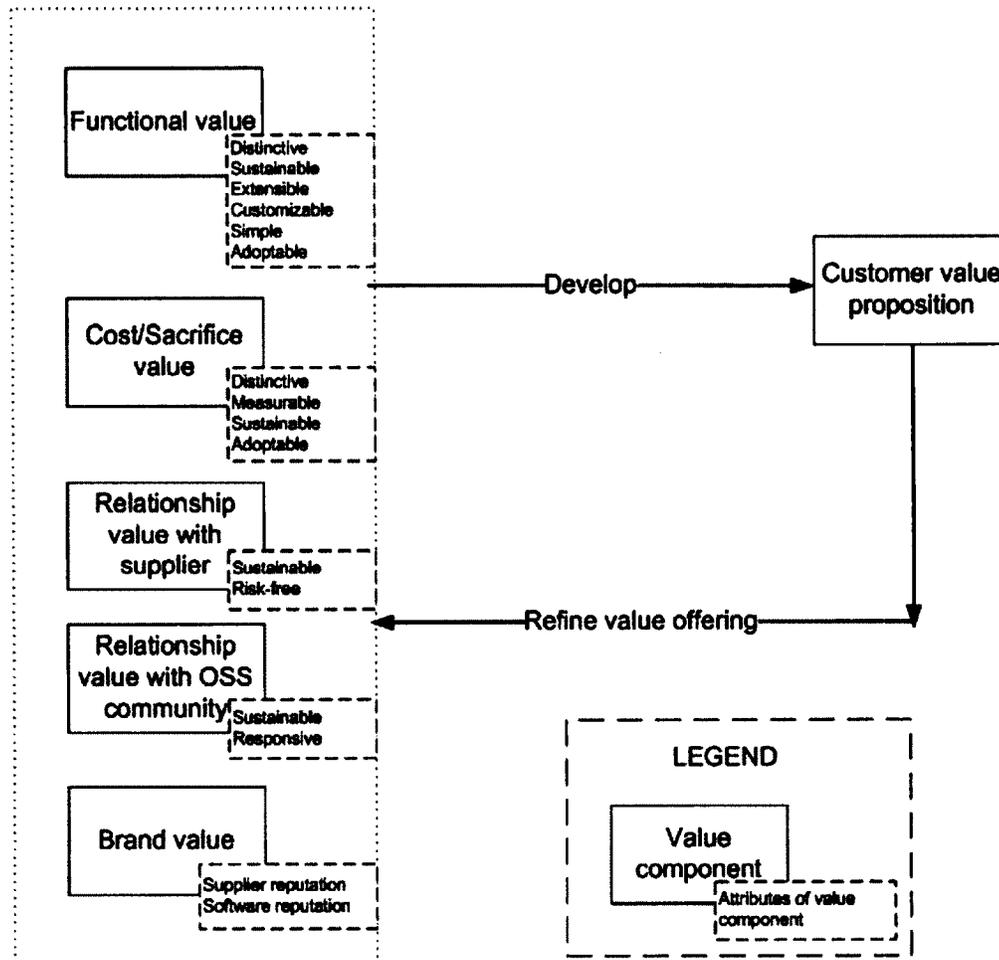
The following value components were identified from the academic literature:

- Functional value: the functional attributes of the product itself
 - Cost/Sacrifice value: the product is worth the cost
 - Relationship value: with supplier and with OSS community
 - Co-creation value: the value of customizing a solution
 - Brand value: the value of the OSS brand itself
1. Rank the five points of value above in order of importance to you.
 2. How does each of the above points create value for you?
 3. Are there any other points of value that you would add to the above list?
 4. What made you choose an open source solution instead of closed source?
 5. Do you have lower switching costs or feel less locked-in with an OSS solution than you would with a closed source solution?

Section 2: A model on customer value creation

The following model was developed from the extant literature pool. It identifies how suppliers create value for customers.

Compelling value components



1. Do you think the value creation strategy above would be effective? Why?
2. How do you think the above model can be improved?

Note: details on how the above model was developed are available in the Author's

TIM review article here: <http://timreview.ca/article/534>

Appendix D: Final model

Compelling value components

