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System on chip design service e-business value maximization through a novel MCDM framework

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ABSTRACT

As the IC (integrated circuit) industry migrates to the System-on-Chip (SOC) era, the SOC design service industry is emerging. Meanwhile, in the past decade, the emergence of Internet has changed the high technology marketing approaches while e-commerce has already become one of the most efficient marketing channels. Thus, most leading SOC design service firms tried to leverage novel e-commerce business models to provide better services including online silicon intellectual property (SIP) sourcing, transactions, integration, etc. to assist customers in enhancing their innovation competences to shorten their time to market and thus, time to money. However, defining appropriate e-business models for commercializing new SIPs or SOC design services is not easy for both aspects of technology as well as business development. On one hand, from the aspect of technology, the technical site R&D or production managers are familiar with SOC technologies while do not really understand the needs of customers' over the Internet. On the other hand, from the aspect of business development, the sales or marketing managers may be familiar with online customers' needs, wants as well as demands while are unfamiliar to SOC technology developments. To overcome the above mentioned problems, an appropriate e-business model definition framework can overcome this cognitive gap and maximize the value-added of online SOC design services. In this paper, a novel analytic framework based on the concept of design service customers' competence set expansions by leveraging high technology service firms' capabilities and resources as well as novel multiple criteria decision making (MCDM) techniques, will be proposed. The framework being proposed can be leveraged by the design service firms to define an appropriate e-business model for possible SIP or design service businesses. Based on the proposed MCDM framework, an empirical study of an SIP commercialization e-business model definition inside an SIP Mall, an SIP e-commerce mechanism being operated by a SOC design service firm, will be provided for verifying the effectiveness of this novel analytic framework. The feasibility of the proposed framework in the real world can be verified by the empirical study. In the future, the novel MCDM framework can be applied to novel e-business model definitions in the SOC design service or other high technology industries.

1. Introduction

In the past decade, the Internet has become an enabling technology in almost any industry and as part of almost any strategy (Porter, 2001). Uses of the Internet and e-commerce have converted the traditional way of running business and have thoroughly changed the channel of enterprise transactions (Shaw, Gardner, & Thomas, 1997). As industries in general, and high technology industries in special, are being reshaped and the nature of competition changes (Raisinghani, Meade, & Schkade, 2007), deciding on an e-business model, a competition strategy for the marketplace and a structure of business processes for the entire electronic trade course (Wang, 2001), has become daily important for modern high technology firms.

As stated by Young and Johnston (2003), there are a number of traditional business strategy theories that have been used to discuss business-to-business (B2B) e-commerce strategies: transaction cost economics, resource-based view, Porter's market forces theory, and channel theory. However, there currently exists no comprehensive framework linking these theories into a method to rigorously assess value delivery strategies, and in particular to determine how to maximize the impact of the Internet as a value delivery channel (Young & Johnston, 2003). Raisinghani et al. (2007) also mentioned that although the strategy to rebuild a

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robust e-business model has not been as widely implemented as had been anticipated, it has had a significant influence on company performance.

Moreover, as the IC (integrated circuit) industry migrates to the System-on-Chip (SOC) era, a novel business model, the SOC design services, is emerging. Now, when the Internet is emerging while e-commerce has already become one of the most efficient marketing channels, most leading design service firms tried to leverage novel e-commerce business models to provide better services. The novel design services include online silicon intellectual property (SIP) sourcing, transactions, integration, etc. to assist customers of SOC design services in enhancing their innovation competences (INCs). The INCs, critical capabilities as well as resources for commercializing SOCs or SIPs, can shorten the time to market and thus, time to money, of both SOC design firms' and design service customers'. However, defining appropriate SOC design service e-business models are not easy. On the technical site, R&D or production managers of the SOC design service firms are familiar with SOC technologies while do not really understand the needs of customers' over the Internet. On the business site, sales or marketing managers of the SOC design service firms are familiar with online customers' needs, wants as well as demands while are unfamiliar to SOC technology developments. Thus, how to establish a decision support framework for defining appropriate SOC design service e-business models to commercialize new SOC/SIP products or services has already become one of the most critical issues for the SOC design service firms. Meanwhile, the proposed framework can also enhance insufficient linkages between traditional business strategy theories and value delivery strategies through the Internet which was mentioned by Young and Johnston (2003) as well as Raisinghani et al. (2007).

Therefore, this research aims to establish a novel multiple criteria decision making (MCDM) framework, which intends to link between INCs being required by novel SOC design services. The proposed MCDM framework intends to maximize values of both the SOC design service e-business models and end SOC products of SOC design service customers'. The INCs, or evaluation criteria, are first summarized using the Delphi method. Then, the relationships between the criteria will be derived by DEMATEL (Decision Making Trial and Evaluation Laboratory). The weights of each criterion versus the goal of the MCDM problem, maximizing the values of SOC design services e-business models, then will be derived based on the structure of the decision problem by using the Analytic Network Process (ANP). After the criteria are derived, the relationships between the INCs (criteria) as well as e-business models will be derived by using the grey relational analysis (GRA) based on the weights of each criterion being derived by the ANP. Finally, the most appropriate e-business model with the highest grey grades which may compensate the current INCs of SOC design service e-business customers and maximize the value of customer's products and thus, the value of the high technology e-commerce channel, will be selected.

A case study on commercializing a silicon intellectual property (SIP) being developed by an IC design house through an SIP Mall, a web based SIP e-commerce mechanism, being operated by an SOC design service firm will be used for demonstrating the effectiveness of the novel MCDM method. The case study results demonstrated that the IP commercialization model of the SIP Mall which may assist a small-scale IC design house without enough resources to commercialize its SIP products and maximize the SIP value through SIP verification, qualification, marketing, sales, technical supports, etc. will be the most appropriate e-business model to maximize the value of this SIP.

The remainder of this paper is organized as follows: In Section 2, the concepts of innovation, INCs, e-business models, e-business model evaluation and INC set expansion are introduced. In Section 3, an analytic framework and methods are proposed for constructing the evaluation criteria and e-business models' definitions. The background of the SOC design service, SIP, SIP market and SIP e-business models will be described in Section 4. Then in Section 5, a case study follows, defining an e-business model for commercializing an SIP being developed by an IC design house which is in lack of SIP commercialization resources. Discussion will be presented in Section 6. Section 7 will conclude the whole article with observations, conclusions and recommendations for further study.

2. Innovation competence and e-business model assessment

Researchers have successfully explored the definitions of business models, e-business models, e-business model evaluation as well as innovation, INC, INC set expansion and resource based view. In the following section, the related literature will be reviewed.

2.1. Business model and e-business

The term business model is widely used in business literature. Lumpkin and Dess (2004) defined business model as a method and set of assumptions that explains how a business creates value and earns profits in a competitive environment. Tsalgatidou and Pitoura (2001) defined the business model as a logical architecture for product, service, and information flows, including a description of the involved business actors and their roles, as well as sources of revenue. Wise and Baumgartner (1999) mentioned that business models are cases or scenarios. Moore (2003) mentioned that a business model is categorically, a way of making money, the form an offer takes, and the manner in which it is paid for.

Externally, a business model is an implicit contract which a customer expects and a vendor commits to. Internally, a business model is a platform for execution, a basis for prioritization and trade-offs, and an infrastructure for resource commitments. Finally, a business model is the methods of doing business by which a company can sustain itself, that is, generate revenue (Moore, 2003). The basic categories of business models include brokerage, advertising, infomediary, merchant, manufacturer, affiliate, community, subscription, and utility (Rappa, 1998).

According to Afuah (2004), a business model is a framework for making money. Chesbrough (2006) also defined the business model to be a useful framework to link ideas and technologies to economic outcomes. It also has value in understanding how companies of all sizes can convert the technological potential value (Chesbrough, 2006). It is the set of activities which a firm performs, how it performs them, and when it performs them so as to offer its customer benefits they want and to earn a profit. Business models are usually represented by a mixture of informal textual, verbal, and ad hoc graphical representations (Gordijn & Akkermans, 2001).

Young and Johnston (2003) defined the strategic options for delivering values from suppliers to customers as specific business models that outline the essential details of how an organization can deliver value to a target customer (Seddon & Lewis, 2003). These business models are a key component to an overall strategy that determines the long-term position of the organization (Porter, 1996, 2001; Young & Johnston, 2003).

As stated by Afuah (2004), a firm makes more money than its rivals if its business model creates and offers superior customer value and positions the firm to appropriate the value. To perform the activities that enable a firm to offer superior customer value and appropriate the value, a firm needs resources. Resources in and of themselves do not, however, produce customer value and profits. Firms must also have the ability or capacity to turn resources