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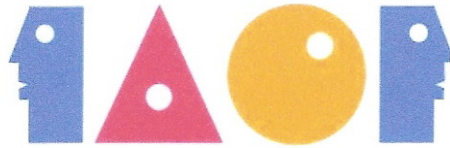
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THE EFFECT OF SOCIAL CAPITAL ON HUMAN CAPITAL: A RESOURCE
ACQUISITION PERSPECTIVE

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Abstract

Previous research has shown that an important advantage of social capital is an increase in the ability to acquire valuable resources. It has been a focus of interest by researchers from a wide range of discipline and has even become popular beyond academic institutions. Social capital has evolved from an interdisciplinary standpoint. Recently, interest in this topic has been instigated in the entrepreneur literature because of the arising need to understand its contribution to quality of resource-based management, such as human capital, which provides great possibilities for successful firm performance. Therefore, an in-depth investigation of the relationship between social capital and human capital acquisition is essential to the establishment of a framework that would shed light on the implications of social relations in the corporate world. The paper provides a framework for evaluating developments in perceptions about social capital over the previous years and for appraising future prospects. It argues for providing specific importance to social capital as a theoretical and experimental occurrence which is most productive when scrutinized in relationship with other elements of investigation or strategy. One particular interaction is addressed here: the effect of social capital on human capital acquisition.

Keywords: Social Capital, Social Networks, Resource Acquisition, Human Capital

Introduction

Social capital is a valuable resource that has been a focus of interest by researchers from a wide range of disciplines and has become popular beyond academic institutions. Previous studies have illustrated the development and interaction of diverse forms of social capital. The notion of social capital is commonly grasped in its association to other forms of capital rather than understanding it solely on its own. Human capital is fundamentally an individual asset, identified in terms of abilities, capabilities and qualifications, sometimes with regard to educational achievement. It may incorporate non-cognitive proficiencies, and may be found in a multiplicity of settings, definitely not merely in formal education. Social capital is sometimes considered as an individual asset, and is easier to evaluate if treated as such; yet it is most effectively applied to the relationships that are present within and among social networks, and not as an individual characteristic. The primary assertion is that human capital becomes unreliable as an analytical tool, and as a positive feature, if it is not connected to social capital since it is more difficult to attain and its importance is harder to appreciate (Schuller, 2007).

Social Capital vs. Human Capital

Comprehensively defined, social capital is an advantage that dwells in social affiliations and networks. Social capital “can exist either between employees and external actors or among employees” (Reed & Srinivasan, 2005, p. A2). An essential principle of social capital is that “networks of relationships constitute a valuable resource for the conduct of social affairs (Nahapiet & Ghoshal, 1998, p. 243, as cited in Reed & Srinivasan, 2005, p. A2). This means that the higher the number of relationships consisting of prestigious ranking, such as experienced and trustworthy partakers, the more valuable the relationship. Comparable to human capital, both internal and external social capital may transform to be immobile and may generally diminish

organizational adjustment. When consistently functioning within a group of collaborators, it may impede resourcefulness, although it may result in brainstorming, but only if the group is solid and receives external knowledge. Crucial turnover, the leaving of some employees from the group, may lead to the undermining of the organization or result in inefficiencies in the transmission of knowledge. In summary, managers have power over the diversity of their ISC (employee-employee relationship) and ESC (employee-client relationships) on the basis of the processes they use to control these resources. Reed & Srinivasan (2005, p. A2) initially assumed that when situated in a dynamic environment, elevated intensities of social capital, both internal and external, will have a positive effect on financial performance.

Furthermore, while maintaining that human capital is related with performance, contemporary additions to the social capital literature recommend that the unique importance of human capital can be improved through the “the goodwill that is engendered by the fabric of social relations and that can be mobilized to facilitate action” (Adler & Kwon, 2002, p. 17). This is accomplished as composite social relations employees gain knowledge on their own and with each other. It is through social communication that individuals can establish common sense and infer modifications in the environment, or endeavor in sense-making (Reed & Srinivasan, 2005, p. A2). The social networks that are present among employees in a company can smooth the progress of a firm’s adjustment of human capital to the demands of a new and dynamic environment. Hence, the importance of ISC and ESC is controlled by the reality that they are associated to human capital. Consequently, it may be adequate for a firm to sustain competitive leverage through exclusively adjusting its human capital, ISC, or ESC autonomously. Thus, Reed and Srinivasan (2005, p. A2) hypothesize that in a dynamic environment, enhancing both human

and social capital, both internal and external, at the same time, will have a synergistic influence on financial performance.

On the other hand, there were studies conducted which used the social capital literature to gain an insight into obstacles confronted by promising academic entrepreneurs. Bozeman and Mangematin (2004, as cited in Mosey & Wright, 2007, p. 911) maintain that social mechanisms underscore the generation of knowledge and are essential for its ensuing allocation and application. Thus, Mosey & Wright (2007, p. 911) suggest that social capital is relevant for the establishment of ventures founded upon university study. However, the social network of academics is normally limited to a constricted scientific research system. Academics may have intimate or well-established ties with group members in their division resulting in the creation of connecting social capital. Nevertheless, several academics may perhaps maintain weak ties with actors situated outside their department. An academic aiming to partake in a difficult venture creation may improve their ties to acquire access to important information that would not be thorny or expensive for them to get hold of (Cooper & Yin, 2005, as cited in Mosey & Wright, 2007, p. 911). Weak ties between an academic participant and industrial actor may result in linking social capital (Adler & Kwon, 2002). Academics who interact with industrial actors may consequently improve their social and entrepreneurial capabilities, which may lead to flourishing relationships with a range of nonacademic actors.

The human capital aspects of academics may be improved through emphasizing weak ties with industry actors also (Davidsson & Honig, 2003, as cited in Mosey & Wright, 2007, p. 912). Furthermore, weak ties can occasionally convert into strong ones, resulting in relationships founded on mutual dependence that consequently facilitate resources to be within reach. Hoang and Antoncic (2003) recognized three dimensions of social networks:

“First, is the network structure, defined as the patterns of relationships between actors in the network. Second, is the network content, defined as the nature of the resources exchanged between actors. Third, is the network governance, defined as the mechanisms that govern relationships between actors.” (as cited in Mosey & Wright, 2007, p. 912). These three dimensions represent a structure within which to examine additional particular elements of social capital.

The academic entrepreneurship literature has failed to recognize the contribution of previous entrepreneurial experience, yet has latently understood that scientists are launching a business for the first time. Nevertheless, academic entrepreneurs may be diverse with regard to their prior entrepreneurial practice. Knowledgeable entrepreneurs in a profit-making environment probably create weak ties to new prospects and strong ties with skilled managers and employees within their business enterprise that are indispensable to the venture’s assets, unique competence, and social capital (Vohora et al, 2004, as cited in Mosey & Wright, 2007, p. 912). In the conventional academic environment, there are concerns about whether the course of action with the human capital of immature and veteran intellectual entrepreneurs is associated to the progress of social capital. Currently, little is known regarding these relationships. Hence, Mosey & Wright (2007) formulated the following research questions: “What structural social capital is in place at the start of new venture development for academic entrepreneurs with different levels of prior business ownership experience?” and “What new ties are developed during the early stages of new venture development by academic entrepreneurs with different levels of prior business ownership experience?” (p. 912).

Moreover, taking into account social network configuration, knowledgeable entrepreneurs in a profit-making environment likely have access to more varied resources through their social

relations. On the contrary, insufficiently skilled entrepreneurs with more restricted social networks may lack opportunities to initiate finance, manufacturing knowledge to be acquainted with opportunities, or access to venture finance. Therefore, Mosey & Wright (2007) created another research question which is, “What is the nature of the resources gained through the social networks of academic entrepreneurs with different levels of prior business ownership experience at the early stages of venture development?” (p. 912).

Taking into consideration network domination, knowledgeable entrepreneurs in a marketable setting probably will have constructed relationships founded upon trust that may improve the quality of the flow of resources through social networks. Confidence and added indefinite contracts put into effect by loss of reputation are specifically favorable when developing technology-based business enterprises where the path to market and expansion timescales are intrinsically erratic (Yli-Renko, Sapienza, & Hay, 2001, as cited in Mosey & Wright, 2007, p. 912). Through previous business proprietorship experience, entrepreneurs can create such social networks and have developed a positive reputation and integrity with primary actors. Less skilled entrepreneurs are less likely to possess a recognized reputation and may be uncertain on the process of building such. They may experience difficulties interacting and communicating with actors from outside the technological research set of connections due to dissimilarities in knowledge, objectives and assumptions (Davidson, 2002, as cited in Mosey & Wright, 2007, p. 912).

However, the social network theory assumes that network’s structural holes provide opportunities which may be changed into profit by financial and human capital of actors (Burt, 1992, as cited in Batjargal, 2007, p. 610). End products of motivated actions of actors rely on combinations of a variety of types of capital contributors to carry them into market (Coleman,

1988, as cited in as cited in Batjargal, 2007, p. 610). The means in which entrepreneurs take advantage of new prospects in networks is dependent on the motivation, competence and experience of entrepreneurs. The opportunities hidden in networks are acknowledged and developed by empowered and trained actors. In this manner, human capital, such as education, skills and the enthusiasm of entrepreneurs can take advantage of prospects recognized in set of connections into concrete advantages.

Moreover, a structural hole is identified as a “relationship of non-redundancy between two contacts. The hole is a buffer, like an insulator in an electric circuit; as a result of the hole between them the two contacts provide network benefits that are in some degree additive rather than overlapping” (Burt, 1992, p. 18). In other words, a structural hole is a detached or exceptionally fragile relationship between two contacts. Structural holes are widespread occurrences evident in any human network including “American, Chinese, French and Russian managerial networks” (Batjargal, 2007, p. 610). Entrepreneurs who were able to preserve personal networks that are loaded with structural holes are more likely to accomplish their goals because of the advantages that these meager networks produce. These ties may result in greater entrepreneurial prospects in the structure of new transactions and supplier agreements, access to promotion channels, financial capital and critical decisions, and involvement in associations and joint ventures. As aforementioned, the vital leverage entrepreneurs acquire from a sparse set of connections is opportune to access non-redundant information and recommending sources. Entrepreneurs whose status in a network is essential among detached groups are likely to manipulate the transmission of knowledge and information, and in this manner, they are likely to produce better credit slips, which improve their exchange influence. Weakly knitted networks spawn more varied and innovative insights since individuals who reside in the crossroads of

social dimensions have the proclivity to possess valuable information. Widely scattered networks advance deeper structural independence that facilitates entrepreneurs to operate upon innovative opportunities and counterbalance damaging effects of expensive compromises to strong ties (Burt, 1992).

Human Capital vs. Social Capital

Human capital has been argued for a considerable amount of time to be an imperative resource for discriminating financial performance among companies. It incorporates both knowledge reserves, such as appointing skilled and highly qualified individuals, and the transmission of knowledge, such as improving of high levels of codified and experiential knowledge about a particular business and its specific market circumstances (Pennings, Lee, & van Witteloostuijn, 1998, as cite in Reed & Srinivasan, 2005, p.A2). However, during ecological or commercial changes, human capital may transform to become immobile as employees' capabilities simultaneously become obsolete. Hence, a high level of human capital at one instance may be unproductive in another condition if the environmental adjustments occur drastically and human capital fails to cope. Instead of making use of preparation and training to enhance mandatory skills, companies may discover it is easier to acquire human capital through hiring new people who possess the essential skills for the new situation. Therefore, human capital is flexible and organizations can reinforce the workability of human capital to organize for change either through its employing practices or its training and growth practices. Thus, Reed and Srinivasan (2005) assume that "in a changing environment, increasing levels of human capital will have a positive influence in financial performance" (p. A2).

Academics may provide a perspective on where the development of social networks based on trust and reputation are poles apart and convoluted. Educational institutions have initiated

technology transmission officers intended to link structural holes between research and industry networks. Nevertheless, some authors dispute their usefulness. An alternative method is the bringing into play of substitute entrepreneurs, that is, knowledgeable managers that can support the growth of the business venture, yet recognizing that these entrepreneurs may necessitate the university to formulate appropriate networks (Franklin et al, 2001, as cited in Mosey & Wright, 2007, p. 913).

Moreover, scholastic colleagues may function casually as instructors to academic entrepreneurs yet may possess limited proficiencies. Nevertheless, previous studies have not formulated the procedures for addressing the challenges through business ownership experience by academic entrepreneurs. Thus the research question posed by Mosey & Wright (2007) “What governance mechanisms are utilized by academic entrepreneurs with different levels of prior business ownership experience to access resources through social networks at the early stages of venture development?” (p. 913). However, ownership experience may not be the only characteristic of human capital controlling the growth of social networks. Earlier research allocates a potentially significant position to the level of education. Comparatively, there may be a relevant involvement to human capital from the authority foundation of education and research; various subject matters may incorporate various business frameworks with unstable lead times, initial capital demands, and association with customers for both improvements and proceeds streams. Industrial familiarity may also play an important role to human capital and facilitate access to social relations for the recognition and utilization of opportunities. The extent of success of previous business ownership may also be connected to the development of social capital. Entrepreneurs may gain knowledge from previous shortcomings to develop more efficient social networks; on the other hand, entrepreneurs may not adjust adequately to the

demand to develop new social relations in new settings if prior efforts have been productive (Mosey & Wright, 2007, p913).

Interdependent Capital: Social and Human

Human capital has been conceptualized as the intangible assets which employees possess, such as knowledge, skills, education, and experience (Forbes, 2005). These practices are generally regarded as the most important assets in human capital. Human capital has been argued for a considerable amount of time to be an imperative resource for discriminating financial performance among companies. It incorporates both knowledge reserves such as appointing of skilled and highly qualified individuals, and transmission of knowledge such as improving of high levels of codified and experiential knowledge about a particular business and its specific market circumstances (Pennings et al., 1998). Moreover, human capital has been regarded recently as a critical resource for distinguishing financial performance among companies entails both accumulated knowledge and transmission of information. Whereas human resource management academics propose that human capital is positively correlated with performance, current expansion of social capital assumptions past its socio-economic beginnings implies that the unique importance of human capital can be reinforced by the good will that is spawned by the framework of social relations and that can be activated to smooth the progress of decision making and actions. In simple terms, productive internal and external social relations that are constituted of prestigious or effective and trustworthy participants from a variety of disciplines can diminish the quantity of time and assets necessitated to amass information. In view of that, these relationships can serve as valuable channels for knowledge dispersal and transmission. They can also permit knowledge amalgamations, which can both reinforce knowledge producing organizations and improve a firm's intellectual capital. Also, as firms possess human capital

leverage, the complicated procedures that develop as an outcome of productive employee communications can lead to human process benefit. The combination of human and social capital has courses of action that can also bolster financial performance. Blyler and Coff (2003) argue that “human capital (education, training, skills, and so on.) will not bring in critical new resources unless it is coupled with social networks” (p. 679, as cited in Reed, Lubatkin & Srinivasan, 2006, p. 871).

Therefore, it can be assumed that increased levels of social capital, such as more valuable social relations, should improve the positive connection between human capital and firm performance. This implies that social capital’s effectiveness depends principally on its capacity to control the productivity of human resources, a perspective advocated by an expansive range of human capital-related occurrences such as inter-unit resource switch over and product improvement, free enterprise, new undertaking accomplishment, inter-firm education, the production of intellectual capital and cross-operational team productivity (Reed, Lubatkin & Srinivasan, 2006, p. 871). Following this line of argument, if social capital offers informational advantages, it also implies that the further knowledge can enrich a company’s internal and external social relations, and the better its employees will perform. Consequently, the more effective the employees, the more they will consider, assimilate, and use knowledge from information-supplemented social relations. This can activate into action a forceful sequence; the further a firm’s human capital is improved by social connections, the more striking employees become to extra information-supplemented and prestigious social relations, and so on. In isolation, it can be expected that human capital is related with a firm’s financial performance, yet its direct association is improved, or controlled, when combined with the firm’s intrinsic social capital and also by the firm’s outside social capital. Maintaining properly these two conditions

which are, “a firm’s internal social capital will leverage the value of its human capital such that the relationship between human capital and financial performance is contingent on the level of the firm’s internal social capital” and “a firm’s external social capital will leverage the value of its human capital such that the relationship between human capital and financial performance is contingent on the level of the firm’s external social capital” (Reed, Lubatkin & Srinivasan, 2006, p. 871).

Moreover, there are two arguments that sustain the unlimited contribution of human capital investment to firm continuity. “First, professionals endowed with a high level of human capital are more likely to deliver consistent and high-quality services and their firms are, therefore, better able to retain clients or attract new ones. Industry specific and firm-specific human capital helps professionals produce high-quality professional services. Second, potential clients may use a professional’s human capital credentials as a screening device for choosing their service providers” (Pennings, Lee & Witteloostuijn, 1998, p. 426). These arguments imply that firms whose professionals exhibit a high level of human capital are less likely than other forms to disband because they have the ability to retain current clients and to attract more clients. Nevertheless, the effects of aging should be considered in constructing theoretical outcomes of human capital developed through either industry or company experience. These two kinds of capital are fundamentally evaluated through industry term and firm term, correspondingly. When accountants become old, they will resign from their firms, pass away, or liquefy their firms, so gradually more levels of industry-specific human capital and of firm-specific human capital will motivate a better inclination toward firm liquidation (Pennings, Lee & Witteloostuijn, 1998).

On the other hand, firm-level social capital can also diminish a firm’s probability of closure just as it reinforces the firm’s capacity to sustain and magnetize customers. Pennings,

Lee and Witteloostuijn (1998) characterized a firm's social capital as the "aggregate of firm member's connectedness with potential clients" (p. 427). These ties are among an organization's most precious capital since, other things being equal, prospective clients will select a company as a service provider in terms of prior interpersonal relationships with the company's specialists. The advantage of maintaining organizations with members bestowed with important social relations have been demonstrated in earlier research. For instance, a proprietor's strong ties with influential providers or purchasers improve his/her company's endurance (Uzzi, 1996, as cited in Pennings, Lee and Witteloostuijn, 1998, p.427). Social capital contributes more in economic business dealings when information with regard to value of professionals is flawed, as is the situation in professional service firms. Critical social relations in specialized service industries incorporate those that absorb prospective customers that the company serves (Pennings, Lee and Witteloostuijn, 1998, p.427).

Conclusion

Researchers in the arena of strategic human resource management (SHRM) have increasingly depended on the resource-based view of the firm or the contribution of human resources practices in firm performance. Undeniably, theoretical investigations on SHRM have implied that structures of human resource practices may result in improved firm performance and may serve as the basis of continued competitive advantage since these schemes of practices are often exceptional, causally indefinite, and complicated to replicate. Nevertheless, human resource practices can merely be a starting point of propped up competitive benefits when they advocate resources or proficiencies that grant significance to a firm. Hence, some analysts have debated that SHRM studies should recognize resources that are crucial for advantage in an

existing competitive setting and the human resource practices to construct and support these resources (Collins & Clark, 2003).

A well-known question in the business world regarding the building of human capital says, “Which adds more to productivity: a 10 percent increase in worker education or a 10 percent increase in capital stock?” (Davenport, 1999, p. 143). The conclusive answer came from the survey of the National Employer Survey (NES) conducted in 1994 in telephone conversations with managers and owners of more or less three thousand establishments hiring approximately exactly twenty or more employees. The answer was “put your money on education” (Davenport, 1999, p. 143). Surveys shows that an increase in the duration of employees’ schooling provides valuable inputs to productivity than increases in either capital stocks or work hours.

Organizations can choose from a diverse array of approaches to building human capital. However, it will be more relevant in the contemporary business enterprise setting to research more on the promise of formal education in improving both the social capital and human capital in an organization. There are countless research studies on the employee selection or hiring options of firms. Hence it is opportune to conduct investigations on learning strategies implemented within the managerial environment. Specifically, for knowledge and capability components, learning prospects can make a considerable involvement to individual and in totality to human capital.

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FROM MANAGEMENT INNOVATION TO MANAGEMENT PRACTICE

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Abstract

Organizations and their managers have been criticized for corrupting management innovation whenever they adopt them. Although some of the criticisms are justified, the critiques appear to neglect the reasons why organizations adopt and modify management ideas in the first place. This partly explains why we live in two “different worlds” - *The world of theory* and *the world of practice*. The goal of this paper is to stimulate research that would lead to the development of theory on modification of management innovation. Thus, propositions and typologies on modification of management innovation have been advanced in this paper. We believe this new knowledge will generate debate on the topic leading to a better understanding of the issues involved in the transfer of management theory to practice.

Keywords: Management Practice; Management Innovation; Modification of Management Innovation.

From Management Innovation to Management Practice

It is widely recognized that the management practices that exist in organizations are not the same as the ones written about in books and academic journals. Yet writings and commentaries continue to present management practices and management innovations (MI) as *monoliths*. When theories and practices differ, there is a tendency in some quarters to criticize why organizational practices deviate from the theory. Although some of the criticisms are justified, the critiques appear to neglect the reasons why organizations adopt and modify management ideas in the first place. This has led to inadequate research and theorization on modification of MI by adopters. While the adoption of MI has received extensive attention from theorists and researchers (*see* Abrahamson, 1991; 1996; Abrahamson & Rosenkopf, 1993; Alvarez, 1997; Gill and Whittle, 1992; Huczynski, 1993a; 1993b; Micklethwait and Wooldridge, 1996; Noria and Berkely, 1994; Rogers, 1983; 1995), their modification has attracted extremely less attention from researchers and theorists. For example, the seminal work by Rogers (1983; 1995) dedicated not a chapter but a few pages on modification of innovation. In fact, while there are theories on the adoption and diffusion of MI (*see* Abrahamson, 1991; Arias & Guillen, 1997; Bolton, 1993; Colin, 2000; Donaldson & Hilmer, 1998; Gibson & Tesone, 2001; Lozeau; Langley; & Denis, 2002; McCabe, 2002; Mazza, 1997; Newell, Robertson & Swan, 1997), the same cannot be said, with confidence, about their modification. Extensive review of literature on organizational innovation by Rogers (1995) indicates that modification of innovations by organizations is very common. In fact Rogers (1995) reported that most organizational innovations go through some degree of modifications before or after implementation. However, there are arguments for and against the modification. For example, Hill and Wilkinson (1995, p.10) argued that "Companies seem to pick up bits and pieces of TQM and then report that they

are operating TQM when in reality most schemes appear an ill-matched mixture of quality circles, employee involvement, quality tools and long established quality assurance systems". Commenting on the 75% failure rate of TQM (*see* Choi & Behling, 1997; Eskildson, 1994; Mathews & Katel, 1992), proponents of TQM blame some organizations for radically altering the idea to the point that they can no longer claim to be operating within TQM paradigm. However, Wood and Caldas (2002, p. 20) pointed out that firms imposing MI without modification are taking a huge risk. Rogers (1995, p.177) also has seen the utility of modification when he argues that:

The choice available to potential adopter is not just adoption or rejection; modification of the innovation or selective rejection of some components of the innovation may also be options. Some implementation problems by an individual or an organization are unpredictable by nature, so changes in the originality planned innovation often should occur. Re-invention often is beneficial to the adopters of an innovation. Flexibility in the process of adopting an innovation may reduce mistakes and encourage customization of the innovation to fit it more appropriately to local situations or changing circumstances. As a result of re-invention, an innovation may be more appropriate in matching an adopter's preexisting problems and more responsive to new problems that arise during the innovation-decision process.

William Ouchi (1981) is one of the earlier researchers who advocated modification of MI when he came up with *Theory Z* or *Type Z* Organization. Professor Ouchi advocated modification (*hybridization*) of Japanese management to suit American context. Other writers who advocate modification of MI include Klein (1989), Young (1992) and Zipkin (1991). However, the fact that MI undergoes deliberate and unconscious modifications does not mean that the motives behind it are always rational. Just as organizations and individuals adopt MI for non-efficiency reasons (Abrahamson, 1996), so also their modification can be due to non-efficiency reasons. This is why modification of MI is sometimes viewed as undesirable interference that will destroy the credibility and efficacy of the innovation (Rogers, 1995).

This paper argues that modification of MI has not received theoretical attention it deserves. The state of theoretical development in the field deserves urgent attention given that most organizational innovations are modified during or after adoption (see Rogers, 1995). Another reason why the topic should be treated more seriously by researchers and theorists is because proper understanding of the process of modification and the factors influencing it will enable researchers to identify critical success factors in operating with MI. It will also help in guiding and advising practitioners on how to go about modification efficiently and effectively. Identifying the motives for modification might perhaps offer some explanation to why certain MI do not live up to expectation. Similarly, by understanding the type and degree of modification that has taken place on a particular MI, it will be possible to advice practitioners with what has gone wrong and how to fix it.

Goal of the Paper

The goal of this paper is to stimulate the development of theory on modification of management innovation. We pursue this goal in the following ways: First, we present the rationale for modification of MI. Second, we advance a novel approach for understanding the concept of MI. This novel approach is accomplished by describing and explaining the structure of MI with the view of appreciating how it can be manipulated by adopters. Third, we present typologies of modification of MI. Finally we advanced a series of research questions that will direct future research on the subject.

In some ways, this paper is responding to the call for more research in at least two areas of organizational innovation (Abrahamson, 1991, 1996; 1997; Cool; Dierikx & Szulanski, 1997; Cooper & Zmud, 1990; Damanpour, 1991; Dougherty, 1992; Downs & Mohr, 1976; Meyer & Goes, 1988; Teece, 1980; Wolfe, 1994). Firstly, Wolfe (1994: 406) pointed out, that because of

the complex and context-sensitive nature of innovation, researchers should investigate the stages of the innovation process upon which a study focuses. Therefore, in this paper, we are focusing on the implementation and operation stages. Secondly, it has been argued that inadequate attention has been paid to what happens to innovations after they have been implemented by organisations (Meyer & Goes, 1988; Kimberly, 1981). This paper addresses these two key areas of concern.

Modification of MI: Some Definitions

Organizational innovation theorists and researchers have long acknowledged the notion of modification of innovation. However, the phenomenon has been referred to using many terms. For example, Rogers (1995) used three terms to refer to the same phenomenon, i.e., *reinvention*, *selective adoption* and *modification*. However, the most consistent term used by Rogers was *Reinvention*. Rogers (1995) defined reinvention as the “the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation” (p. 174). Rogers rightly argued that although the majority of innovations are modified, researchers are reluctant to investigate the phenomenon. We believe the lack of conceptual basis on which to research the topic could be the reason why researchers have neglected the issue. The neglect of this phenomenon has hindered the theoretical advancement of the field. This point has been echoed by Wolfe (1994, p. 409) when he argued that the central criticism of organizational innovation literature has been the “invariant perspectives of innovation.” Innovations are widely viewed as monolith in their conception, adoption and application.

Apart from Rogers (1995), some researchers used different terms to refer to modification of innovation. For example, the terms used are: *reorientation* and *variation* (Normann, 1971), *adaptation* (Bear & Ajami, 1996; Klein, 1989; Wood & Caldas, 2002; Young, 1992; Zipkin,

1991), *alteration* (Meyer & Goes, 1988; Pelz & Munson, 1982) *levels of transfer of innovation* (Lillrank, 1995; Westney, 1987), *degree of transfer of innovation* (Dolowitz & Marsh, 1996; 2000) *alteration* and *optimization* (Damanpour & Evans, 1984), *reconfiguration* (Henderson & Clark, 1990) and *hybridization* (Botti, 1997). Normann (1971) describes *variation* in innovation from the point of view of product innovation. - According to Normann (1971, p.205), *variation* is where an innovation is refined and modified while the sets of dimensions remain basically similar. *Reorientation*, on the other hand, is described by Normann (1971) as a modification that changes the system rather than keeping the basic dimensions of the innovation intact. Both Rogers' and Normann's conceptualization acknowledged the importance of attributes of innovation. The notion of attributes is important because no proper conceptualization and theorization of modification process can be complete without acknowledging the fact that the type and degree of changes made to an innovation will be influenced by its characteristics. This point is central to our conceptualization of modification of MI and the propositions to be advanced later.

It should be pointed out that the various terms highlighted above are sometimes used differently by researchers in order to emphasize specific issue. For example, the term *adaptation* is widely used to refer to changes made to organizational setting in order to accommodate an innovation (Bear & Ajami, 1996; Wood & Caldas, 2002). However, the same term is used to refer to changes made to the innovation itself so that it can fit the organizational settings (Mamman, 1998). In this paper, we use the term *modification* as a generic term to refer to alterations made to MI. The alteration can be in the form of *addition*, *omission*, *substitution* or *hybridization*. The four types of alterations will be explained later.

Modification of MI: Rationale

Why the Neglect of Modification of Management Innovation?

There are at least four reasons why researchers have relatively neglected the topic of modification of MI. Firstly, most of the theories and research on innovation are implicitly based on the idea that innovations are *indestructible monoliths*. Thus, when they are adopted, they are installed completely and remain intact until they are abandoned. Secondly, much of the earlier research and literature which currently dominate the thinking and approach to the field focused on innovations that are not easily amenable to modification (e.g., medical innovations, agricultural innovations, computers, software). Thirdly, few researchers and theorists on innovation have focused their attention on what happens after the innovation has been installed. This is because, rightly or wrongly, it is assumed that, after the adoption, the issue has become an operational matter best left to organizational change experts and researchers. Finally, there appears to be (in the earlier research at least) implicit assumption of homogeneity of innovations (Downs & Mohr, 1976; Meyer & Goes, 1988; Tornatzky & Klein, 1982). This assumption has inadvertently resulted in a theoretical bias against MI, hence the neglect of modification which is much more common to adopters of MI than technical innovations (Pelz & Munson, 1982).

Why is Management Innovation Modified?

Organizations or individuals may embark on modification of MI due to *rational reasons* or *non-rational reasons*. *Rational* reason is conceptualized in this paper as the modification of MI with the sole intention of achieving organizational objectives (directly or indirectly). Reason other than organizational is considered *non-rational*. The following sections discuss the reasons in detail.

Rational Reasons

From the rational point of view, the first and foremost reason why MI is modified is to achieve organizational objectives. For example, in the 1980's and 1990's, many organisations in the UK have adopted HRM practices while pursuing varying strategic objectives (Walton, 1985, Purcell, 1989). However, many of the organizations subsequently modified the practices to ensure that their specific objectives are achieved. The modification was necessary because each strategic objective requires specific HR strategy and practice. For example, the three generic business strategies of innovation, quality, and cost reduction each demands specific HRM policies that will generate specific employee behaviour (Schuler & Jackson, 1987). Given that organisational strategies are diverse, their interface with MI would lead to varying style and emphasis during implementation of the innovation. This will lead to different versions of the MI as well as different outcomes. Indeed, Rogers (1995) argued that innovations are more likely to be modified if they are adopted to solve wide range of problems.

Modification of MI is likely when the innovation requires specific capabilities essential for the implementation (Henderson & Clark, 1990). In other words, given that organizational capabilities are difficult to create or acquire (Hannan & Freeman, 1984; Nelson & Winter, 1982), some organizations may be forced to modify the innovation to suit their existing capabilities. It can be argued that large scale modification is more likely to take place in developing countries or poorer organizations due to inadequacy of resources, know-how and infrastructure.

MI is likely to be subjected to modification because, unlike *technical* innovation, they have certain characteristics which make them amenable to misunderstanding. Henderson and Clark (1990) drew a distinction between product as a system and product as a set of components. They argue that consumers of *technical* products need to have knowledge of the two dimensions

of the product. The first is knowledge about each of the core design concepts and the way in which they are implemented in a particular component (*component knowledge*). The second is the knowledge about the ways in which the components are integrated and linked together as a whole (*architectural knowledge*). This paper argues that lack of knowledge of components and architecture of the MI is likely to affect the implementation of MI leading to unconscious modification. We believe, this is more likely to happen because, unlike technical innovation, MI is an abstract concept (Rogers, 1978) that has many social interfaces (Lillrank, 1995), which creates room for misunderstanding. In fact, many researchers have acknowledged that innovations that are more difficult to understand are more likely to be modified (Larsen & Argawala-Rogers, 1977; Rogers, 1983; 1995). Hence, modification of MI is more likely to be common in developing countries due to cultural and technological gaps between the source of the innovation and the destination (Lillrank, 1995). For similar reasons, modification is more likely to take place when MI produced specifically for one industry is adopted by organizations in another industry. For example, because TQM originated from manufacturing industry, its diffusion to service industry has resulted in some modifications.

Related to the point made above, is the issue of tacit knowledge inherent in most MI. Modification of MI can be caused by the degree of tacit knowledge embedded in the innovation and, the degree of sophistication of the innovation. Given that some innovations have high degree of tacit knowledge embedded in it (Lillrank, 1995), adopters are unlikely to adopt a complete innovation or/and implement it completely. Similarly, sophisticated innovations such as Lean Production System or TQM are likely to undergo modification through *omission* either by design or default. This is because the more sophisticated the innovation, the more likely that it will demand resources or/and know-how which many organizations do not have. The lack of

resources and know-how leads to improvisation and subsequent modification (Rogers, 1995). MI is modified deliberately or unconsciously. The unconscious modification of MI is usually caused by misunderstanding during transfer of innovation from its source to the organization. Rogers and Shoemaker (1971) argue that one of the most distinctive problems in the communication of innovations is that the source is usually quite heterophilous to the receiver. The concept of heterophilous refers to the degree to which pairs of individuals involved in social interaction are dissimilar in certain attributes, such as beliefs, values, education, social status etc. Heterophily is responsible for the misunderstanding of the philosophy and assumptions underlying certain MI, hence, when such misunderstandings occur it usually leads to unconscious modification. This point is illustrated by Lillrank, (1995):

If you can build the best mousetrap, the world will beat a path to your door and return home with the best mousetrap available for action. If you figure out the best way to management a complex assembly operation, the world will still come to learn from you, but it is not at all clear what it will be able to bring back home.

The above statement clearly indicates that MI can undergo modification even before they are implemented. This is because the understanding of the innovation and the hidden knowledge embedded is always likely to differ between the adopter and the producer of the innovation. Lillrank (1995) argued that because the transfer of innovation requires abstraction, “the larger the distance (*between the source and the adopter*) the more is lost due to misunderstanding, incomplete information and essential parts of the original context which are missed” (p. 974).

Although abstraction is necessary in the process of transfer, achieving optimum abstraction before implementation is not an easy task. Adopters can undertake too low or too high abstraction in the process of transfer. Lillrank (1995) illustrated this point:

Take a direct, unsophisticated observation, say, that Japanese workers sing a company song in the morning (*too low abstraction*). Transfer it as such, without any abstraction, to a German factory as the secret of high productivity and the result is a complete loss of

power of the original idea, which may be systematic building of organizational cohesion through face-to-face interaction. On the other hand, try making a high level abstraction of Japanese Labour market practices in terms of Buddhist cosmology (*too high abstraction*) and it will burn the fuses of an American executive struggling with high labour turnover.

The above statement indicates that modification of MI is not only inevitable but sometimes necessary. This is because adoption of MI without *localization* could result in the loss of efficacy of the idea. Therefore, when adopting innovation, there should be interpretation, reapplication over several learning cycles until the level of abstraction suits the local condition (Lillrank, 1995; Mamman, 1998).

Perhaps one of the strongest reasons why MI is modified is because many if not most, are not fully developed before they diffuse across organizations and industries. In fact research on technical innovations such as machine tools, software and consumer products has indicated that innovations do not emerged fully developed at the outset of their commercial lives (Abenathy & Utterback, 1978; Clark, 1985; Mansfield, 1977; Rosenberg, 1982; Sahal, 1985). Indeed the lack of philosophical development of many management techniques has been widely criticized (see Argyris, 2000; Burrell, 1989; Donaldson, 1995; Pascale, 1990). Thus, many MI can be considered as work-in-progress. This work-in-progress provides the adopters the opportunity to experiment, manipulate and finally modify innovations to their specific needs.

The advent of MI such as Business Process Reengineering (BPR) Management by Objectives (MBO), Total Quality Management (TQM) and Quality Circles (QC) was occasioned by experimentation, manipulation and subsequent modification partly because the concept was “sold” to organizations by some consultants who did not fully understand or/and comprehend it. Also, some innovations are usually not fully articulated and communicated to the adopter. For example, Henderson and Clark (1990: 14) pointed out that, “The emergence of new technology is usually a period of considerable confusion. There is little agreement about what the major

subsystems of the product should be or how they should be put together”. This statement applies to MI as well. Given their scope and complexity (Lillrank, 1995) MI such as TQM and BPR are more amenable to confusion than MI that is less complex such as Statistical Process Techniques. It is worth acknowledging that researchers on technical innovation have argued that it is possible for dominant innovation to emerge after the initial confusion (Abernathy & Utterback, 1978; Henderson & Clark, 1990; Sahal, 1986). However, this paper argues that, because most MIs provide room for interpretation and therefore more amenable to manipulation, it is not possible to have dominant version of most MI. In other words, strictly speaking, all MIs have versions in practice due to deliberate or unconscious modifications.

Another rational reason for modification of MI can be found in the contingency theory. According to the theory, changes to the organizational forms emanate from external environment (Lawrence & Lorsch, 1967) and changes in organizational forms usually necessitate changes in administrative and technical systems (Damanpour & Evan, 1984). The authors (Damanpour & Evan, 1984) provided evidence to show that the adoption of administrative technology tends to trigger the adoption of technical innovation. This is because ‘fit’ between the two systems is necessary for the organization to function effectively (Galbraith & Nathanson, 1978). Therefore, the need to find a fit between the two systems (administrative and Technical) will necessitate modification of MI in order to achieve optimum performance (Mamman, 1998).

The evolution of many versions of MI can be triggered by the existence of many components of the innovation (Von Hippel & Finkelstein, 1979). For example, in a survey of suppliers of U.K. automobile manufactures by Lascelles and Sale (1988), the authors found the use of 30 TQM techniques by the suppliers. However, the frequency of the use of the techniques varies from organisation to organisation. This variation can be described both in terms of

modification (e.g. omission of some techniques) as well as versions (i.e., some organisations emphasise the use of some techniques over others). For instance some organisations use JIT as part of their TQM programme while others omit it. Therefore it creates two versions of TQM one with JIT and the other without.

Writing on the transfer of public policy across countries, Dolowitz and Marsh (1996; 2000) argued that there are several factors that may serve as constraints to policy transfer, such as policy complexity, institutional constraints, structural constraints, feasibility constraints, past relationships, and language. The complexity of a programme affects the ease of transferability. In other words, the degree of transfer (modification) can be influenced by the factors highlighted above. For example, organizations would deliberately omit certain components of an innovation if they felt that it could not fit with its structural requirements. This is what Rogers (1995) referred to as selective adoption.

So far we have presented reason which can be described as *rational*. There are other reasons which can best be described as *non-rational reasons*. These are reasons associated with individual selfish interests or reasons that are not intentionally associated with the achievement of organizational objectives.

Non-rational Reasons

Many MI are modified as a result of political process in the organization. Evidence has shown that elite values, and political systems within an organization act as screening devices or/and influencing factor in the adoption of the innovation (Baldrige & Burnham, 1975; Hage & Dewar, 1973; Huczynski, 1993a; Kimberly & Evanisko, 1981 Normann, 1971). We argue that, rather than reject innovations that are incompatible with the values and power systems, the organization or its member(s) would adopt MI and proceed to modify it to fit with the value and

power systems. Individuals who have the psychological inclination to stamp their mark on everything they do would be tempted to modify MI. Similarly, individuals who wish to achieve specific political or selfish goals would modify MI to enable the achievement of the goals. Havelock (1974) reported that desire for local pride of ownership of innovation sometimes leads to modification.

Modification of MI: Structure and Typologies

Structure and Components

To understanding the concept of modification of MI, it is necessary to appreciate that management ideas have components. The components define the structure of the innovation and the degree to which it can be subjected to manipulation. As Rogers (1995: 178) pointed out:

A tightly bundled innovation is a collection of highly interdependent components; it is difficult to adopt one element without adopting the other elements. A loosely bundled innovation consists of elements that are not highly interrelated; such an innovation can be flexibly suited by adopters to their conditions.

Thus, some MI can be tightly bundled to the point that it cannot be radically or/and easily disentangled and modified, whereas, others can easily be subjected to manipulation and subsequent modification because of their structure. The following section provides a description of an illustrative structure of MI that sheds light on how MI can be amenable to modification and the areas that can be modified.

For illustrative purpose, MI can be viewed as an idea composed of concentric circles. At the core is the philosophy (i.e. the theory or way of thinking informing the idea). Next to the core are the principles that guide the implementation of the idea. The outer layer is composed of the practices which can be demonstrated and observed. The inner two layers cannot be easily observed, as a result, sometimes adopters unknowingly will adopt only the outer layers thinking

that they have adopted the whole package. Thus, within the context of MI, there are three *building blocks*. They are *Philosophy, Principles, Practices* (i.e., *Techniques*); the **3Ps** in short.

Philosophy: This is a way of thinking or assumptions regarding how to manage an organization or tasks or how to solve organizational problem. Therefore, the philosophy of MI is the core foundation on which principles and techniques are built. Every MI, implicitly or explicitly, has underlying theory pertaining to the organizational issue or problem it is addressing. But as we will demonstrate shortly, the theory (i.e. way of thinking) might not be: (a) generally shared by adopters, (b) explicitly stated, (c) effectively communicated to adopters, and (d) properly understood by adopters. As a result, philosophies of MI are subject to modification. This is because, sometimes adopters will have their own assumption and predispositions about the problem or how organizations should operate. Their assumptions will influence their interpretation of the philosophy of the MI. As an example, the philosophy of Quality of Work Life (QWL) is based on the notion that employees will perform at their best when the full range of their needs are met (Certo, 1997). However, some managers believe that employees' problems outside the "factory gate" are not organizational matter. Hence, such managers' interpretation of QWL will be narrow.

Perhaps it is worth noting that the philosophy of MI are not always fully thought through and articulated even by the producers of the innovations. This has attracted criticisms of observers of management innovation (Argyris, 2000; Burrell, 1989; Donaldson, 1995; Neal & Groat, 1984;; Pascale, 1990; Pierce & Newstrom, 1990; Zilbergeld, 1984). These critics attack the oversimplification of organizational reality or/and the lack of scientific basis or rigour of research upon which the management ideas are based. As a result, poorly developed management philosophies are produced (Jackson, 2001). For example, Zilbergeld (1984) and

Pascale (1990) were particularly critical of portrayal and oversimplification of how easily organizational problems can be solved by management gurus. They argue that such oversimplification leads to the production and consumption of MI without in-depth grasp of their underlying foundation. Writing on what he calls attack on *contingency theory* by U.S. academics Donaldson (1995:1) also weighed in:

Moreover, it shows that much of the academic work in the United States is scientifically wanting, lacking in theoretical coherence and often at odds with evidence from empirical studies of real organizations. The source of the increasing fragmentation in US organization theory is not genuine scientific development, but rather a push for novelty fuelled by individual academic career interests.

Principles. These are rules that guide the application of the philosophy. However, not all MI come with explicit principles. For example, some MI are theories of how an organization should think about a particular problem or issue _____ a philosophy without principles. In fact, in academic circles, some view TQM as a set of -principles without philosophy while others view TQM as a philosophy guided by a set of principles (Dean & Bowen, 1994). When MI come in the form of *Philosophy* only, organizations can make up their own principles and techniques of how to put the philosophy into practice (Westney, 1987). Usually, the organization will package existing principles and techniques to implement the philosophy. This is why there are many versions of MI. However, if MI has **3Ps**, distinct sets of principles will be outlined. For example, Dean and Bowen (1994) argued that TQM is a philosophy of management that is characterized by three principles: Customer focus; Continuous Improvement and; Teamwork. Obviously the principles are subject to interpretation. Therefore, the principles of MI can be modified (e.g., adding more principles or omitting some principles).

Practices/Techniques. This is a way of carrying out a particular task and executing it to the end within the context of the MI. It also pertains to what an organization and its members do

to demonstrate that they are actually operating with the MI. Like principles, not all MIs come with a set of to-do-list or techniques. Thus, sometimes adopters are left to their own devices to develop their own techniques to implement the philosophy. Some MIs like TQM come with specific package of techniques and practices such as: *process analysis*, *plan/do/check/act*, *flowcharts*, and *fishbone diagram*. The existence of such practices will be an indication that the organization has installed TQM. Modification of practices can take place in the form of adding more techniques or omitting some of the techniques. Thus, variation to MI across organizations can be attributed to the modification of practices. For example, the key practices for customer focus as a principle of TQM is characterized by (a) direct customer focus, (b) collecting information about customer needs, (c) using information to design and deliver product and services, (d) customer survey and focus groups (e) quality function deployment (Dean & Bowen, 1994). Hence, variation in the way TQM is operationalised can be accounted for by assessing the degree to which organizations include the five key practices in their operations.

However, as pointed out earlier, the **3Ps** in many, if not most MI are not well articulated and communicated to the adopters (Argyris, 2000; Burrell, 1989; Pascale, 1990). Similarly, the lines of demarcation between the **3Ps** are not always discernable to the *naked eye*. This is because sometimes it is only when the MI is put into practice that its complexity will be observed. For example, while some draw a distinction between practice and techniques (Dean & Bowen, 1994), we do think that this is always possible to determine. Similarly, some may view philosophy and principles as one and the same. Nevertheless, we believe that producers and consumers of MI have their own interpretation of the **3Ps** based on their understanding and experiences. This helps them to determine whether and to what extent MI can be modified. As we shall demonstrate later, modification can take place at the three levels of the MI structure.

Also, the type and degree of modification will be influenced by the *intrinsic* and *perceived attributes* of the innovation to be presented shortly.

Types of Modification

Whether and how MI are modified will depend on the degree of critical reasoning. Wood and Caldas (2002) define critical reasoning as “the skill to carry out an objective and broad analysis that is at once connected to the context and dispassionate as regards the adoption of managerial expertise” (p. 24). These authors argue that “both unchecked admiration of imported models and complete denial thereof are examples of low critical reasoning. Managers with keen critical reasoning will neither accept nor reject a concept or model *a priori*; rather, they will analyze its entirety and its parts, its appropriateness, and its applicability” (p. #?). In a review of literature on the adoption of Japanese management practices by American manufacturing firms, Young (1992) found that the firms undertake three types of modification when adopting the Japanese management practices. The first type of modification is retaining all the characteristics of the imported practices while modifying the organizational and working environment (e.g., Reward System employee attitudes and behaviour). The second type of modification is modifying some or all of the imported practices while maintaining the organizational and work environment. The third and final type involves modifying some or all of the imported practices while at the same time modifying the organizational and work environment. Young (1992) argues that the third type is more likely to produce positive outcome than the first two.

Some researchers use the term *level of transfer* to describe or explain the degree to which all components of innovations are adopted and implemented (Dolowitz & Marsh, 2000; Lillrank, 1995; Westney, 1987). For example, Westney (1987) describes *emulation with innovation* as the adoption of core abstract ideas of an innovation while building new applications to suit local

conditions. Lillrank (1995) also alluded to the idea that adoption of innovation can be at *copy-and-edit* level, *intelligent* level or *emulation with innovation* level. As we will describe shortly, these are description of deliberate or unconscious modification of innovation. According to Dolowitz and Marsh (1996, 2000), policy transfer is not an all-or-nothing process. This is because consciously and unconsciously actors tend to copy bits and pieces of policy ideas rather than wholesale adoption. Thus, four different categories of transfer is possible. The first category is complete transfer where the whole idea and its content is transplanted. The second category according to the authors (Dolowitz & Marsh, 1996, 2000) involves only the transfer of the idea but not the whole components. The third category is hybridization where different policies are mixed to come up with one policy. The final category is where a particular policy idea is used as an inspiration for the development of totally new policy.

Using the literature reviewed so far, we advanced four typologies of modification of MI. This is shown in Table 1. below.

Based on the typologies presented in Table 1 above, we present our first research question.

Question 1: Are tightly bundled MIs less likely to be modified?

Attributes of MI as Moderating Factor

In this section we will demonstrate how the attribute of the innovation can influence its modification, albeit, indirectly. Literature on the classification of attributes of MI hardly exists at all. Downs and Mohr (1976), Rogers (1983;1995) are the few authors who made significant attempt to classify the attributes of innovation. According to Downs and Mohr (1976: 702),

Table 1: Typologies of Modification of Management Innovations

Typologies	Explanation	Examples
<i>Addition</i>	This is where some elements are added to the components (3Ps) of the MI to achieve specific objectives (i.e. To meet the organizational or individual goals for adopting the idea in the first place).	For example, many quality gurus, notably Deming (1986) argued against performance appraisal as part of TQM. However as an attempt to modify TQM through addition, many organisations have used performance appraisal as part of their TQM programme (Bowen & Lawler, 1992; Wilkinson et al 1993). In order to make it more palatable, employees are appraised on their adherence to quality standards and targets.
<i>Omission</i>	This is where some elements are omitted from the 3Ps of the MI to make it workable (i.e. To meet the organizational or individual goals for adopting the idea in the first place).	For example, due to lack of resources or know-how, an organization may decide not to apply certain techniques in its operationalization of a particular MI. Sophisticated MI such as Lean Production System are more likely to be operationalized with some of its practices and techniques missing.
<i>Substitution</i>	This is where some elements of the 3Ps are replaced with “new elements”.	For example, due to limitation of resources or lack of proper understanding by adopters, an organization might find it more convenient to substitute its own tried and tested techniques for the original technique that came with the MI.
<i>Hybridization</i>	This is where elements of the 3Ps are combined with elements of 3Ps of another MI in order to achieve specific objective(s). Hybridization can involve <i>omission</i> or/and <i>addition</i> . The notion of hybridization has been widely advocated when adopting MI across cultures or sectors of the economy (Botti, 1998; Ouchi, 1981).	For example, TQM advocates the use of flexible and broad job description (Bowen & Lawler, 1992). This allows for teamwork and multifunctional work structure. However, many organizations adopting TQM combine multifunction team structure with detailed fixed job descriptions for most of their employees.

attributes of innovation can be classified into (a) primary attributes and (b) secondary attributes.

The former refers to the intrinsic characteristics of the innovation while the latter is in the *eyes of*

the beholder. Similar distinction was made by Rogers (1983; 1995). However, Rogers concentrated largely on the perceptual dimension of attributes because he believes that they have more power in explaining the diffusion of innovation. Using similar tradition, in this paper we classify attributes of MI into: *Perceived attributes* and *Intrinsic attributes*. The former is largely based on the adopters' perception and interpretation.

Intrinsic Attributes

It is important to note that although subjective understanding of the attributes of the innovation will provide the initial assessment of the feasibility of the type and degree of modification to be undertaken, the *intrinsic attributes* would ultimately determine whether any modification takes place at all. *Intrinsic attributes* are the objective characteristics and qualities of the innovation. They are overtly represented by the *principles* and *practices (techniques)* and covertly represented by the *Philosophy* of the MI. For example, intrinsic attributes of TQM are overtly represented by the importance attached to teamwork (*principle*) and Statistical Process Control (*Practice/Technique*) and, covertly represented by the belief in human capacity to continuously improve (*Philosophy*).

All management innovations have specific attributes which can influence the degree to which they can be tempered with. Several authors have assembled a number of attributes of management innovations (Beyer & Trice, 1978; Nord & Tucker, 1987; Pelz, 1985). A handful of attributes are considered most relevant to MI (Wolfe, 1995). The first attribute is the organisational focus of the innovation. This refers to the dimension of organisation to which the innovation is most relevant. According to Nord and Tucker (1987), the innovation could focus on technical or administrative aspects of the organisation. These paper argues that technical innovations are less likely to subject themselves to modification than administrative innovations.

This is because the degree of specificity is more likely to be higher in the former than in the later. Also, the degree of social interface is higher in administrative innovation than in a technical one (Lillrank, 1995).

Question 2: Are technically oriented MIs less likely to be modified?

The second attribute is the degree of uncertainty associated with the innovation. This specifically refers to the knowledge concerning the link between the innovation's inputs, processes, and outcomes (Pelz, 1985). Wolf (1995) argues that high degree of uncertainty pertaining MI can result in power and politics being important during its implementation. We argue that high degree of uncertainty will lead to modification. For example, when power and politics are involved in the adoption process, certain key individuals would modify the idea to suit their personal agenda. The ability of the individuals to modify the MI will be largely influenced by the degree of uncertainty inherent in the innovation. This is because high uncertainty will guarantee modification with minimum (if any) detection of hidden agenda. Conversely, low uncertainty will enable easier detection of hidden agenda associated with the modification.

Question 3: How does the degree of uncertainty inherent to MIs influence the potential for modification?

The third attribute of MI is its degree of pervasiveness. This relates to the proportion of behaviours of members of the organisation that will be affected by the innovation (Beyer and Trice, 1978). Wolfe (1995) related this attribute to the concept of human Resource management innovations (HRMIs). He argues that "HRMIs with little pervasiveness/magnitude would tend to engender minimum resistance while HRMIs which imply considerable displacement of existing organisational procedures/behaviours can result in considerable perceived threat to the status quo

and, thus, in resistance. These attributes, therefore, are relevant to whether power and politics are important determinants of HRMI implementation'' (p.316). Central to Wolfe's argument appears to be that pervasiveness of MI can be threatening to organisational members' "natural behaviour'' (p. # ??). It can also be argued that certain MIs can threaten the values held by the members of the organization. Threat to behaviour and values not only engender resistance (which is sometimes fruitless) but trigger proactive effort to limit the pervasiveness. This will result in minor or major modification. Given that the degree of pervasiveness can either be high or low, the extent of modification would vary accordingly.

Question 4: Are pervasive MIs more likely to be modified?

The final intrinsic attribute of innovation considered in this paper is radicalness. This refers to the extent to which innovation is novel and represents change and demands change in behaviour (Nord & Tuckers, 1987). Wolfe (1995) contends that radical innovations are likely to contain high degree of uncertainty and, therefore, generate resistance from members of the organisation. As we have argued earlier, uncertainty represents threat to "natural'' behaviour which would be countered by modification as a means of reducing the threat. It should be pointed out that the term threat is used to refer to threat to individual's goal as well as organisational goal. Thus, it can both be objective and subjective.

Question 5: Are radical MIs more likely to be modified?

We think the above characteristics still did not capture the whole intrinsic qualities of MIs. This is because, regardless of whether they are administrative, non-radical and non-pervasive, certain MIs may not be amenable to modification. Hence, the concept of modifiability is advanced in this paper.

Modifiability: This refers to the *malleability* and *ductility* of MI. If an idea is *ductile*, it means it can be extended vertically across organizational hierarchy. For example, MBO can be applied across organizational hierarchy. However, this extension could cause the idea to lose its core structure and identity. As a result it could render the idea unrecognizable. This is because when ideas are applied across organizational hierarchy, they are more likely to be subjected to radical interpretation or misinterpretation which will lead to systemic modification to suit the level in the hierarchy. For example, when quality assurance scheme was introduced across a particular hospital, doctors, nurses, and paramedics had different interpretation and application of the concept. As a result, quality assurance at lower level of the hospital does not resemble one another at higher level of the hospital. *Malleable* ideas can be extended horizontally to cover other areas of the organization. If an idea is *Malleable*, it can maintain its core structure and identity despite *addition* or *omission* of components (sub-ideas) of the idea. This is because if an idea is applied at the same level it is unlikely to be subject of radical modification. For example, some financial reward systems are malleable.

Question 6: How does *malleability* and *ductility* of MIs influence the potential for modification?

Perceived Attributes

The use of the concept of adopters interpretation of innovation is important because as Rogers (1995: 209) pointed out: “Receivers’ perception of the attributes of an innovation, not the attributes as classified by experts or change agents, affects its rate of adoption”. Another significance of the concept of perceived attributes to innovation is that 49 to 87% of the rate of adoption is explained by its attributes (Rogers, 1995: 206). Rogers strongly argued that “subjective evaluations of an innovation, derived from individuals’ personal experiences and perceptions and conveyed by interpersonal networks, derive the diffusion process”. We also

argue that the perception of the attributes will play a moderating role in the determination of the type and degree of modification to be undertaken. The following five attributes of an innovation advanced by Rogers (1983; 1995) are presented within the context of modification of MIs.

Relative Advantage: According to Rogers (1971, 1983), relative advantage of an innovation is the extent to which innovations are considered better than the one currently used. Thus, it refers to the degree to which MI is perceived as better than the *status quo*. Relative advantage of MI would be determined on the basis of its ability to meet the goal it was adopted for. A MI that has high relative advantage is less likely to be modified because to do so would defeat the objective of adopting the innovation in the first place.

Question 7: How does relative advantage influence modification of MIs?

Compatibility: Rogers (1971, 1983) regard this concept as the degree of fit between an innovation and organization's values and systems. Therefore, compatibility can be regarded as the degree to which MI is perceived to be consistent with existing culture, experience, strategy, resources and needs of the adopters. Compatibility can also refer to the degree of fit between the MI and the goal to be achieved. Given that institutional pressure can force organizations to adopt MI that are incompatible to their values and systems (Abrahamson, 1991), the innovation will be subjected to modification to fit the values and systems of the organization. For example, some components of the innovation would be omitted or hybridized.

Question 8: Is *compatibility* of MIs less likely to lead to modification?

Complexity: According to Rogers (1971, 1983), complex ideas are ideas that are difficult to understand. Therefore, complexity is the degree to which a MI is perceived as difficult to understand and use. Lillrank (1995) also pointed out that the level of abstraction during transfer of innovation is affected by the level of complexity of the innovation. Lillrank (1995) considers

complexity of the idea as well as the number of and types of social interfaces. He argued that ideas or tools requiring little or no social interfaces do not need modification, whereas, ideas with high human components such as QC requires “careful packaging before being transferred”. Another dimension of complexity acknowledged by Lillrank (1995) is the amount of tacit knowledge embedded in management innovations. He argues that the more the human component, the more tacit knowledge embedded in the innovation. Therefore, he concluded that high context management techniques (i.e., complex ideas) require high levels of abstraction for the transfer process to be successful.

Question 9: Is *complexity* of MI more likely to lead to modification?

Triability: This refers to the degree to which an innovation can be experimented with on piece meal basis (Rogers, 1971; 1983). Triability of MI can be considered as the degree to which the idea may be experimented with on a limited scale. This will help determine the degree of uncertainty inherent in the idea. The more *triable* the idea, the more the opportunity for modification. This is in spite of the motive for adopting the innovation in the first place.

Question 10: Is *triability* of MI more likely to lead to modification?

Observability: This refers to the degree to which the result of an innovation is observable (Rogers, 1971, 1983). The concept of observability is similar to what Rogers and Shoemaker (1971) refers to as consequences of innovation which can be categorized as (1) functional versus dysfunctional; (2) direct versus indirect; (3) manifest versus latent. Thus, observability of MI is the degree to which the results of MI are visible to others. The rate of imitation and mimicry within an industry will depend on *observability*. According to Lillrank (1995), observability generates demands for ideas that have low abstraction. He gave examples of quick fixes, slogans and practical tools as ideas will low abstraction generated by the observance of Japanese

manufacturing success in the early 1970s. *Observability* will influence the type and degree of modification of MI but in a multiple of ways. For example, when poor result is *observed*, to the extent that the organization has to adopt the innovation, it is likely to be modified to fit the objectives. Also, the less observable the idea the more likely it is to have many versions of the idea in operation because organizations would not have the opportunity to accurately benchmark, or would they be aware of the tacit knowledge embedded in the innovation. Thus, unconscious modification might take place.

Question 11: Are observable MIs less likely to be modified than those that cannot be observed?

Groups: That formal and informal groups within and outside the organization can influence adoption of innovation is a phenomenon widely acknowledged. For example, evidence indicates that organizations tend to adopt innovations when specialist groups support the adoption (Bigoness & Perreault, 1981; Moch & Morse, 1977). Similarly, evidence indicates that when trade unions are not consulted before the adoption of an innovation, they tend not to support its implementation (Trice; Beyer & Coppess, 1981; Trice; Hunt & Beyer, 1977; Trice & Schornbrunn, 1981). In fact, Fennell (1984) reported partial support to the hypothesis that specialist groups will support or discourage the adoption of certain innovations in an organization. Certain aspects of MI can be perceived as threatening to trade unions. For example, TQM has the following features that some trade unions were suspicious of: TQM advocate participative structures such as QC, teamwork and shift towards removal of work demarcation through broader job description. In fact, some observers argued that TQM implicitly adopts *unitary* perspectives to employment relations. As a result, unions have expressed concern about the implementation of TQM in organisations and insisted on active involvement during implementation. In some cases the involvement leads to some form of modification

(Marchington, 1995). Thus, an important moderating factor in the modification of MI is the influence of groups within organizations. In particular, trade unions and professional/occupational groups within the organizations can act as filters in the implementation process. This action can result in the modification of the idea to satisfy sectional interests.

Question 12: Is MI more likely to be modified in organizations that have strong trade unions or professional influence?

Conclusion

The central purpose of this paper is to stimulate research that would lead to the development of theory on modification of management innovation. It is intended to address the issue of why the management ideas written about in books and academic journals are not necessarily the same as the ones practiced by organizations. Indirectly, the paper is an attempt to answer the question of *why* and *how* management ideas are modified. Therefore, the paper's key objectives and contributions are: (a) advancing novel way for understanding MI, (b) presenting the rationale for modification of MI, (c) presenting typologies of modification of MI, and (d) identifying a set of testable propositions for future investigation.

From the review of literature, it is clear that organizational and individual reasons play important role in determining the future of MI when they are adopted. However, the characteristics of the MI itself (i.e., its Attributes) will play some part in determining the type and degree of modification undertaken. The paper advanced typologies and propositions to guide future research in the field. This is based on the belief that, although criticisms of organizations and their managers vis-à-vis modification of MI abound and are sometimes justified, research on why MI are *corrupted* or *modified* has not received the attention it deserves. We hope this paper will generate debate and research on the topic. We, therefore, call on fellow researchers and

theorists in the field to test some of the propositions advanced in the paper. Finally, perhaps the following questions will guide future research and help refine the propositions and typologies advanced in the paper. Within the context of this paper, the questions worth seeking answer to are: Which is the most common method of modification of MI? What are the evidences for the consequences of modification of MI? Which type of modification is likely to be most successful in delivering organizational objectives? What are the factors that influence modification of MI? Which element of the **3Ps** is more likely to be modified? What are the consequences of modifying each element of **3Ps**? Are some industries more prone to modifying MI than others? Evidence indicates that organizational characteristics such as structure, size and composition of the workforce can affect diffusion of MI (Damanpour, 1987). The logical question is, are some organizations more prone to modifying MI than others? Given that the economic cycle influences the adoption of MI (Abrahamson, 1997), how does it affect modification of MI, if at all? Finally, there may be other forms of modification which this paper did not address. For example, *Division* and *Unification* have been reported in product modification (Giffin & Mitchell, 2005). Do organizations undertake such modifications to MI? Perhaps research aimed at seeking answer to the above questions will help in the development of theory and body of knowledge in the field of modification of MI in particular and transfer of management theory to practice in general.

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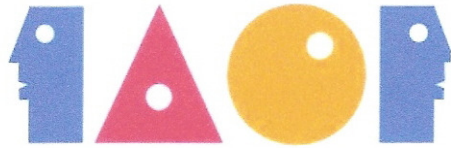
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RESEARCH ON RECONFIGURABLE HARDWARE CELLS BASED ON FPGA

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Abstract

In order to adapt to a large number of different business of user applications, the network has been modified to become more complex, with lower transmission efficiency, and ultimately, is overwhelmed by the need to re-build the network. In order to break the tightly coupled relationship between the user business and network services of traditional networking technology framework, flexible structure of Composition of custom processors has been developed and attracted more and more people's attention. This paper presents a designed model of reconfigurable processing unit core based on Field Programmable Gate Array (FPGA), called reconfigurable hardware cell, which divided applications into a number of components, through the processing components of the state machine to achieve the corresponding data transmission and control of components. On this basis, a part of the elements in space can be mapped to Reconfigurable Hardware Cells (RHCs) and was assembled into a variety of components corresponding different states. Discussion on the realization program of the model on Virtex FPGA is provided.

Keywords: Opening Programmable Router; FPGA; RHCs; Dynamic Reconfiguration

Introduction

Over the years, the network has been supported along the business-oriented technical system development, building network for particular business and transforming network for emerging new businesses. In this traditional network technology framework, there has been a constant need to expand transmission link bandwidth, improve node processing speed, enlarge the node processing capacity, and increase the complexity of control algorithms and protocols and so on. With all these demands, it will not be able to accommodate the difference between different business loading demands of users, and pay the heavy price of increased network complexity and lowered transmission efficiency on the contrast. The existing network can not adapt to increasingly different user business demands. To this end, we propose service-oriented network technologies to provide a new system that allowed the relationship between users business and network services to be loosely coupled. Each network service can support a variety of user that has the similar characteristic, so most of that the new user business can use existing network services except a small number of emerging businesses. Therefore, the risk of transformation in the original network is substantially decreased, and the robustness of network support to user business is significantly increased.

Research on router, the major Internet network equipment, has become the most important topics of new network technology system. The architecture of traditional routers is closed; that is, the various components of a router are usually only made by the same manufacturers. Users can only set it by the hardware or software of the same manufacturer, so users were greatly restricted. For this reason, we have to look at an opening, programmable, multi-service supported new reconfigurable routing equipment. "Opening" means that the hardware element resources of the router must be fully opened up to users, through unified definition of each component and

standard definition of interfaces and communication protocols, so that it will have a high degree of mutual cross-manufacturer compatibility and interoperability. "Programmable" refers to programming control of the hardware element resources in order to re-build the elements or components of router for different user business demands on operation level. "Reconfigurable" means that re-combination some of the elements or components of router on the same platform, resulting in support for a variety of functional requirements of different business or the different indicator requirements of the same business, finally realized the integration services of multi-business.

With the development of micro-electronics and computer technology, especially the emergence of large-scale high-performance programmable devices and the improvements of design methods and design tools about hardware and software, reconfigurable circuit technology has gradually become a new hot topic in international computing systems research. Reconfigurable computing systems makes the limits of hardware and software become increasingly blurred on traditional sense, not only have high-performance of hardware processing, but also have the flexibility of software. Reconfigurable technology uses reconfigurable hardware circuit to build the reconfigurable system, according to the needs of the application or the middle results dynamically set the realization forms of circuit in order to have the very high acceleration ratio of the different applications on the same platform of reconfigurable systems, and meet the needs of wide range technological applications (K Compton, S Hauck, 2002). Reconfigurable technology originated in the idea of a programmable FPGA structure, as a result of its compromise between high speed and flexibility in applications, so this technology filled the gap of traditional realization program between hardware and

software. The use of FPGA as the core of reconfigurable system can significantly reduce development time of system and have high flexibility so as to save system hardware resources.

In order to meet the application needs of reconstruct processors and reconfigurable systems, the “soft” structure of composition in custom processors attracted more and more people’s attention. Generally speaking, the composite chip structure of conventional processor-based instruction, framework and co-processor can not be change, but reconfigurable hardware cells can adjust its structure to applications dynamically, which have service-oriented hardware elements. Reconfigurable system is consisted of one or more FPGAs, external memory and I/O equipments, sometimes it can be used with Mainstream PC or Embedded Microprocessor (Wu Dong-dong, Yang Xiao-jun, 2006). Therefore, the structure of FPGA is suitable for the demand of reconfigurable processing system. This article discussed the design model of FPGA-based reconfigurable router.

Design Model of Reconfigurable Hardware Cells (RHCs)

FPGA-based reconfigurable logic means that users can change its gate-level logical structure, that is, users can build the application processing system with reconfigurable logic according to their requirements. RHCs mainly have three technical features as the following:

- Consists of many small-scale processing elements;
- Algorithm can be mapped in corresponding processing elements, and different topology connection of processing elements can reconstruct different reconfigurable model;
- The instruction transformation for each processing element can be completed in dynamic conversion of hardware.

In addition, the main characteristic of RHCs is that processing ability can be mapped into small-scale processing elements. It is not listed with a gate-level programmable logic device, but

makes it as the important part of processing elements and can use its instruction conversion function for the hardware structure transform functions.

As shown in Figure 1, RHCs is the core part of configurable router, its flexible hardware processing approach can be used to meet the requirements of different applications.

As shown in Figure 1, the design model of RHCs divided applications into a number of processing components roughly, and then through the state machine of each processing component realized transmission and control of corresponding data. On this basis, some part of the component in space can be mapped into RHCs and RHCs also can be assembled to reconfigurable hardware elements corresponding to different states (The group of Reconfigurable router components, 2007). When the configuration processing runs in the RHCs, we must change the topology of RHCs adapted to different states so as to complete system task at the best form of components. Traditional parallel processing methods divided applications into parallel processors

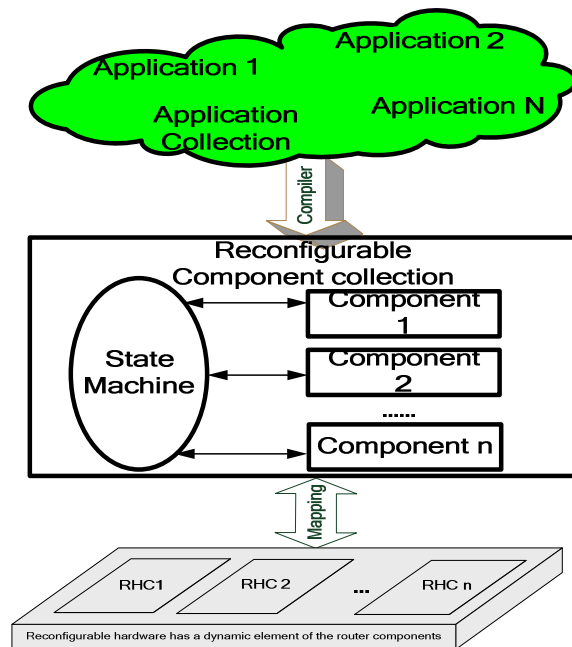


Figure 1 Design model of RHCs

or parallel thread at first, then compiled task or thread into instructions of each processor, finally realized in the corresponding processors, respectively, according to the order of each instruction. Although RHCs is an array of many processing elements in forms, but its implementation way is different from the traditional way of parallel processing, which is based on FPGA as the basic hardware environment, and make different application mapped into hardware processing elements.

This reconfigurable system has the following advantages:

(1) Improve the efficiency of hardware assembly

In terms of both efficiency and parallelism, reconfigurable system based on FPGA changes the original way to deal tasks one by one. After reconfiguration, FPGA can be integrated more hardware functions in the same silicon area, and upgrade the efficiency of hardware assembly greatly.

(2) Make hardware have the flexibility of software

Reconfigurable system based on FPGA can download larger-scale hardware resources to RHCs on-demand, which may not be processed in the limited hardware space, so as to liberate designers from the constraints of the circuit space and realize scalable hardware architecture. Therefore, Reconfigurable technology is the technology that combined high-performance of hardware with flexibility of software, and is the technology bridge of hardware and software.

FPGA Is Core Components Of Reconfigurable Router

Currently, reconfigurable technology has become a new hot topic of research fields. Mainly through programmable FPGA, as well as large number interconnected links of logic block achieved its reconfigurable function. Configurable combinational logic and one or more flip-flop composed one logic block, and it can be realized in the lookup table of random access memory.

Otherwise, distributed RAM which is responsible for the parallel storage configured and designated the function and logic connection of logic block.

Type of FPGA

According to the type of hardware configuration, FPGA can be divided into two types—Static FPGA and Dynamic FPGA: (1) In Static FPGA, configurable data have the same lifetime throughout the system, which is has not run-time adaptability. (2) In Dynamic FPGA, configurable data or part of configurable data is variable in order to change for different application requirements, which is shows that has flexible run-time adaptability.

Most of the applications are realized by static method, which is, realized by Static FPGA without self-adaptation. However, in recent years the application of Dynamic FPGA is becoming increasingly popular. When the system fails or need to change its functions, it is necessary to upgrade through the dynamic configuration.

The function of switching on-line can be realized on Dynamic FPGA, making use of a group configuration of FPGA converse with the other group configuration of FPGA, and ensuring their best performance at a specified period of time. Switching online function of Dynamic FPGA can be applied in reconfigurable router, which has rapid switch within one clock cycle that can provide significant throughput for the whole system. If one task can be divided into a group of independent task, Dynamic FPGA will configure each task within one clock cycle in orders, respectively. Therefore, during the period of the running time of reconfigurable system, the function of on-line switching can reduce the total execution time for numbers of tasks of designated example.

The best option for ideal on-line switching is that a set of different configurations can be switched at one clock cycle. To switch online. Now, the existing FPGA can not realize one clock

cycle on-line switch and each new configuration must be downloaded to external storage in order to achieved above function after it, so the existing FPGA still needs longer reconfigurable time. In order to solve this problem, a task can be divided into sub-task that have different particle size (M. U, D.O, 2004) to reduce the switching costs of different configurations. With the large-scale of device, the download time of configurations will also increase. Xilinx Virtex FPGA can reconstruct some part of FPGA, and reduce the total costs of system. According to different applications, users can program procedures for some parts of FPGA, thus reduced the switching time or completed new tasks.

Xilinx Virtex Structure

Virtex series of devices have different scale and characteristics, making Virtex-5 FPGA as an example. It has over 330,000 logic elements and 1200 I/O pins. Lower-power serial transceivers of ROCKET IO GTP and POWER PC 440 module can realized embedded processing with current industry standards. The highest-performance serial transceivers of Rocket IO GTX, built-in PCI Express endpoint and Ethernet MAC modules can realize part of reconfigurable function (Jim. Torresen, Knut Arne Vinger, 2002).

Realization of Reconfigurable Router Based On Virtex FPGA

Virtex FPGA can provide a group of circuit switching in very short time, that is, provide different configurations of circuit. As shown in Figure 2, FPGA configuration register is fixed in the run-time illustrated by the circuit of the gray background area. User-defined Defined Configuration Registers (UDCRs) manage User Defined Reconfigurable Logic(Jim Torresen, Knut Arne Vinger, 2002).The design composed by a team of UDCRs, each time only one of which is running, and the conversion between them can be carried out one or more clock cycle. Disadvantage of this approach is the needs for a certain amount of logic for placing, and on

behalf of abstract UDCR group of FPGA resources. Therefore, the rest number of the logic resources as the reconfigurable logic will be limited. However, the Virtex-5 FPGA has a very large numbers of logic blocks, and will not be subject to the restrictions on the number of logic blocks, so each logic block can be reconstructed in a configuration method feasibly.

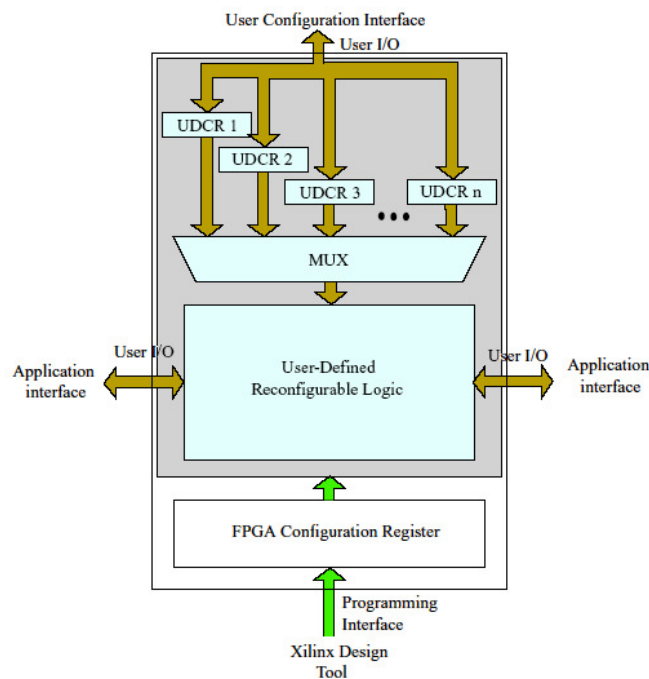


Figure 2 Realization Of Reconfigurable Router Based On Virtex FPGA

Summary

This paper introduces the prototype of Reconfigurable Hardware Cells, which provides a viable theory of the road for reconfigurable routers. With the increasing usage of FPGA, low-cost FPGA dramatically reduces the threshold of designing FPGA, and makes the programmable reconfigurable router to be possible. The design idea of Components processing technology with the supported platform (The group of Reconfigurable router components, 2007) is expected to become the mainstream technology and industry standards for the field of routing switching of product development and equipment manufacturers.

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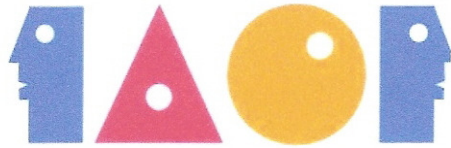
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ISSUES OF TECHNOLOGY: A STUDY OF PAKISTANI CONTEXT IN THE BANKING SECTOR.

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Abstract

The purpose of this paper was to test the presence of technology adoption issues in Pakistani banking sector. A survey of 151 banking sector employees and customers revealed that trust, lack of resource, services and security concern are the major issues in technology adoption in banking sector. Resistance to adaptability has provided neutral results in Pakistani scenario. Solution and future research has been recommended.

Keywords: Technology, Banks, Banking Issues.

Introduction

Implementation of the technology is the biggest concern in the developing countries nowadays. The technology has transformed the way banks deliver their services. This transformation is slow in the developing countries like Pakistan. In this study we tried to discuss the issues in the implementation of technology in banking faced by a developing country like Pakistan. From a regular literature review we did not find any relevant study in Pakistan. Due to this reason we have reviewed the literature from other developing countries and developed countries. On the basis of review we highlighted several technological issues in banking sector. Our motive is to test the presence of these issues in developing countries, especially in Pakistani context. For each highlighted problem we devised a hypothesis. A survey administered to test the existence of these issues in Pakistani banking sector.

Technology

The Internet is viable source of communication and information across the globe. Today developing countries are using internet to fulfill the gap with the developed countries (Xue, 2005). Industrial and service sectors were intended to adopt that technology in the last decade (Liao and Cheung, 2002). To eliminate errors, reduce cost and save money can only be possible due to that technology but it brings many issues (Bitner, 2001).

Technology In Banks

For the past 15 years technology has been increasingly used to deliver services (Joseph, McClure, Joseph, 1999). Banks are increasingly globalize and interdependent through that technology. Electronic banking includes Internet banking, Telephone banking, and Mobile phone banking (Brige and Riga, 2006). The adoption of internet technology is almost completed in developing countries and it changes the banking from traditional distribution channels to the

electronic distribution channels (Al-Hajri and Tatnall, 2008). Service industry now invests in technology due to reduced cost (Joseph et al,1999). By converting the traditional banking in the internet banking, saves 25%-30% operating expenses. Saves customers time as they have not to wait for services by the availability of ATM's and transportation cost by the use of internet.

Between banks communication occurs through e-mails and live chats (Ho and Yin, 2008). Through internet banking, banks can improve payment efficiency, competitiveness reduces cost and creates new customers who are users of internet but from the customer's behalf internet banking is not so important as compared to ATM and Tele-banking (Rotchanakitumnuai and Speece, 2003). Technology enables decreases the cost in banks, divide different operation and further more it can also be used to enhance banking functions (Curry and Penman, 2004). Physical branches require high cost due to which banking approach changes in which information technology included (Zhao, Lloyd, Ward and Goode, 2008).

Trust

Trust is an important factor for developing relationship between parties (Morgan and Hunt, 1994). Trust is the important antecedent of loyalty (Reichheld, Markey and Hopton, 2000). Trust is a base of building relationship but for successful relationship trust with confidence is necessary (Curry and Penman, 2004). There are so many customers' who have access to internet and willing to use internet banking services but there is lack of trust in there minds (Khanam, Ahmed and Khan, 2005). The bank customers have no trust on technology due to possibility of frauds and privacy violation problems (Al-Hajri, Tatnall, 2007). The customer's satisfaction is important to have positive impact on trust with banks; where as trust and satisfaction for the customer makes the commitment stronger between bank and customer (Rexha, KIngshott and Aw, 2003). On the bases of this review we can hypothesis that:

Hypothesis 1: Lack of trust is the major barrier in technology implementation in banking sector.

Lack Of Resources

Effective deployment of information system in organization is very important (Mathieson, 1991). The organizations have not enough resources for developing high quality IT solutions (Benamati and Rajkumar, 2002). There are less trained people in organizations that cannot able to handle technological issues (Rotchanakitumnuai, Speece, 2003). Lack of resources is an important factor in the adoption of technology in under developed and developing countries (Bow, Philadelphia, Claremont, and Anakwe, 2000). Now we can hypothesis that:

Hypothesis 2: Lack of resources is the major barrier in technology implementation in banks.

Services

The concept of services examined over 37 years ago (Levitt, 1972; Berry, 1980) Services are intangible, having a major problem of measurement (Gabbott and Hogg, 1998). The service quality is too much important because it includes customer's value human skills, by customer services, organizations maintain their customers (Al-Hajri and Tatnall, 2007). Technology failure resulting in organizational dysfunctions in designing services and service processes (Curry and Penman, 2004). Customers have many expectations from banks like services at reduced cost, personalized and at any time anywhere (Brige and Riga, 2006). Bank cannot receive customers input on a real time basis via the internet and they cannot process the customer's request until their business partners, including credit report companies, complete their contracted jobs because traditional way of services wasting a lot of time. This may create a vacuum for the service delivery and hence lower the customer's perceived quality (Jun and Cai, 2001). Electronic bank services can improve quality by observing six factors.

1. Convenient/accurate operations.

2. Accessibility and reliability.
3. Good queue management.
4. Service personalization.
5. Friendly and responsive customer service provision.
6. Targeted customer service provision.

Actually service quality and customer satisfaction interlinked with each other (Ibrahim, Joseph and Ibeh, 2006). On the biases of this review we can hypothesis that:

Hypothesis 3: Service quality of banks is based on successful technology implementation in banks.

Security

Security is a specific issue in online banking transactions (Sathye, 1999). When we compared the traditional and OBS (Online Banking Service), from security point of view customers are generally more concerned with the Security of OBS. Customers doubt the security measures which are detecting online frauds on credit card and information (Yeow, Yuen and Tong, 2008). Customers use internet as an alternate for banking purpose that they receive money through internet but the payments made manually to the parties because of high risk regarding security (Rotchanakitumnuai and Speece, 2003). Security and data base software are used by banks to manipulate fruitfully (Dannenbergh and Kellner, 1998). Online system quality depends on 6 dimensions, security is one of them in which privacy and information transaction safety is included (Jun and Cai, 2001). Now we can hypothesis that:

Hypothesis 4: Security of online transactions is major barrier in technology adoption in banks.

Resistance

Resistance requires more attention than innovation (Sheth, 1981). The possibility of product failure can be reduced by knowing the consumer resistance to adopt new technology (Ram, 1989). Resistance can interfere in successful innovation (Ram, 1987; 1989). In consumers' mind, innovation factor creates resistance to adopt the technology or consumers postponed their decision to adopt the technology until the accurate time of adoption comes, it may be due to unwillingness of adoption of technology at that time. Resistance also occurs due to consumer's habit or their satisfaction in previous technology or due to perceived risk while adoption of new technology. Performance uncertainty is also an issue to adopt new technology (Laukkanen, Sinkkonen and Laukkanen, 2008)

Hypothesis 5: Customers' natural tendency to resist the changes is a major barrier in technology adoption in banking sector.

Methodology

Data for this study is collected from banking sector of Pakistan who has recently faced technological issues. Total 200 questionnaires were circulated among respondents of banking sector. Only 176 returned with response rate of (88%). While entering data 25 responses were found with missing values and inappropriate to be included in analysis. Remaining 151 responses were accurate in all aspects to be included in analysis. Among respondents the sample of demographic items, thus, comprised as 61 bankers (40.40%) and 90 banking customers (59.60%), including 99 males (65.56%) and 52 females (34.44%) and their mean age is 33 years. We have focused two groups, bankers and customers who were involved in filling up the questionnaires to identify a series of issues of technology in the current banking sector of

Pakistan. The research population consisted of all Pakistani residents, who are eligible to have a bank account.

Measures

In first stage, this review produced having a long list of issues around which question items were initially developed because after a long search we have not found any question related to our topic. . The issues like trust, lack of resources, services, security and resistance were focused aspects of the questions which are measured on a five-point Likert scale, with the former having the following properties: 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly agree. In light of the foregoing literature review 4 items were identified as possible reasons of lack of trust, 4 items were identified as possible reasons lack of resource, 5 items were identified as possible reasons of service quality of banks is based on successful technology implementation, 5 items were identified as possible reasons of security as a major barrier and 2 items were identified as possible reasons of resistance for bank customers to resist technology in banks.

Analysis

For analysis we use SPSS-15 to analyze the response from data.

Results and Discussion

The results show that the technological issues under the supporting hypothesis *H1*, *H2*, *H3*, *H4* and *H5*. In table 1 the calculation of mean and standard deviation show the results. The result of trust, lack of resources, services and security accepts our hypothesis instead resistance. Customers have less trust in banks that's why that they are not adopting the technologies like internet banking as there is less intentions of bank customers in Pakistan towards technology.

	N	Minimum	Maximum	Mean	Std. Deviation
GENDER	151	1.00	2.00	1.3444	.47674
AGE	151	1.00	5.00	2.3775	1.45941
Resistance	151	1.00	5.00	2.9437	1.14389
Services	151	1.00	5.00	3.1642	.90335
Resource	151	1.00	5.00	3.3791	.78573
Trust	151	1.00	5.00	3.4073	.91041
Security	151	1.00	5.00	3.4702	.83177

Table 1. Descriptive Statistics

	Gender	Age	Services	Resource	Security	Trust	Resistance
Gender	1	.080	.146	.050	.009	.009	.085
Age	.080	1	-.233(**)	-.082	-.090	-.148	.007
Services	.146	.233(**)	1	.521(**)	.408(**)	.467(**)	-.133
Resource	.050	-.082	.521(**)	1	.642(**)	.548(**)	-.001
Security	.009	-.090	.408(**)	.642(**)	1	.612(**)	.044
Trust	.009	-.148	.467(**)	.548(**)	.612(**)	1	-.043
Resistance	.085	.007	-.133	-.001	.044	-.043	1

Table 2. Correlations

** Correlation is significant at the 0.01 level (2-tailed).

Lack of resource is a major barrier in implementation of technology in Pakistan as there are financial resources but they are lacking in technological resources such as skilled technical people who manage the available technological resources and the on job technical people performs a delay action after occurring of technical problems in banks. As there is a problem of services which are not delivering to customers as which are delivering in developed countries like bank statement of last 5 years, beside it Pakistani banking sector provides many services like availability of ATM's, online accounts of customers but indeed these services are not at the level of developed countries due to lack of advanced infrastructure. After all the customers and

bankers are agreed that service quality of banks are based on successful technology implementation in banks. There is an availability of online transaction for customers through internet but customers feel fear to use this way of transaction due to lack of trust and also due to inefficient security so security in online transactions is major barrier in technology adoption in banks. Our respondents remain neutral over resistance they have an opinion that they do not resist when there is any change or moderation in technology neither they adopt immediately. In table 2 the results show a positive relationship between all the variables except the relation of resistance with any other variable because the mean of resistance also shows the neutral response and the effect of neutral response directly effects the correlation.

Conclusions

This study explores the issues of technology in banking sector of Pakistan. As our results shows that lack of trust in technology, lack of resources and security of online transaction are major barriers in technology adoption in banking sector. When we talk about lack of trust in technology, people think that weather their transactions will successfully accomplished or not, customers remain indulge in doubts, lack of resources like technology infrastructure, the technical and specialized people are less in quantity that's why maintenance and service quality is not better through technology, there is lack of security measures and the reason is again that there are less trained people, the service quality of banks can only be improve by success full implementations of technology, customer neither resist nor adopt the new changes which are advancements in technology, they adopts the technology but after certain time.

Recommendations and Solutions For Issues

In order to increase customers, the relationship between customer and banks organization need to address the issues of customers (Keen, 1997).Banks recognize the problem of trust and it

can be resolved through IS management by continuous maintenance of database (Al-Hajri and Tatnall, 2007). For personalized services there trust is also added with other ones (Cox and Dale, 2001). Banks can enhance the customer relationships through building trust between their customers (Al-Hajri and Tatnall, 2007). The queries about service quality need to be born in mind. For IT-enabled services, quality can be measured more in terms of reliability, functionality, responsiveness and privacy for services given by technology (Zeithaml, 2002). There should be effective deployment of resources of information system in banks (Bow et al, 2000). The advance technology in this era provides necessary IP addresses, it has a feature of security (Dannenberg and Kellner, 1998). If there is low resistance there will be much more interaction of users towards adoption of technology in banks (Laukkanen et al, 2008).

Banks should start campaigns to build trust between customers through advertisements. They should hire trained skilled technical people and expertise to minimize lack of human resource and effective use of banks resources. Government should give incentives to those banks who make better their services and should support by providing better infrastructure of technology to the banks. Updated software can be used to maximize the security.

Future Research

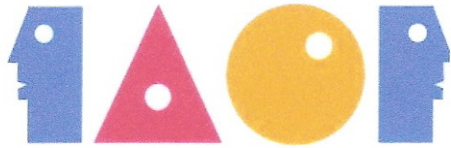
The issues highlighted by this study should be focused individually, to find out workable solutions for these problems. A comparative study of public and private banking sector can be useful to discuss their issues in detail. A comparative study of technology adoption in developing and developed countries. An experimental study can be useful between two banks. One with implementation of technology and without technology, to highlight the importance of technology adoption in banking sector is recommended for future researchers.

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AN APPROACH BASED COMPONENT FOR IMPLEMENTING A
SERVICE-ORIENTED INFORMATION INTEGRATION PLATFORM

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Abstract

Research on the information system integration is of academic and practical value for enterprise application integration. Service oriented message driven Platform (SOMDP) is proposed for constructing flexible, distributed information integration platform. Taking the form of a service component unit (SCU), multiple adapters are designed to encapsulate various heterogeneous information systems within an enterprise and then transfer them into an information integration system. A software component sustentation environment is presented as a basic platform for SCU registration, combination and communication. Hierarchical architecture and module pattern are used to improve agility, interoperability, and the integration ability of application systems and to support the efficient operation on massive information.

Key Words: Information Integration; Service-Oriented; Software Component; Message-Driven

Introduction

With the development of the technology, dynamic and wide bandwidth were the main performances provided by of the Web service, at the same time real-time parallel and distributed service was one of them too. However, the information integration technology deals with the “information anode” problem, there are some problems in implementing the information integration of the enterprise, for example, the integration of an exterior resource and providing reliable web service. SOA (Newcomer E, 2004) is a new concept of software architecture in the Internet environment, which constructs software by a distributed service component. This form technology is superiority in refactoring, agility and extending, it can also be used in the information integration of the enterprise. By constructing a platform which is independent of programmed language and is a relax coupling of information integration, it can provide technique sustain for information integration multi-enterprises. The system design method based on a message-driven system not only improved the system parallel performance, but also helped to implement standard interface and simple web service applications.

OASIS is doing the standard work for the reference model of the SOA; they want to define the smallest SOA key concept, confirming the co-relationship relation of them, between the construction of common SOA public semantics constructing the common SOA public semantic (MacKenzie, 2006). The SUN Company initiated putted forward the operation integration criterion JBI for Java scopes (Ron Ten-Hove, 2005). It well sustained the operation integration in the Java technique, emphasizing the naming rule and significance of the interface, assuring the Java platform was being compatible.

Literature Review

Liu mingzhou, Liu Zhengqiong, Guo Jia, 2006) introduced how to establish the information integration model in the special domain. Research conducted by Literature (Huhns (2002) and Li Houfu (2005) M N, 2002, Li Houfu, 2005) research explored the work stream of the multi-enterprises, which introduced a dynamic alliance of the construction method. Hu and Haitao (2005) Literature (Hu Haitao, 2005) putted forward introduced an approach which addressed the size of the large big granularity, as well as the refactoring and efficiency for a service combination. This method It could satisfy the necessary dynamic which user requested. Further literature on the construction of the above-mentioned general-purpose platform for enterprise information integration is rarely associated with the technology, such as how to solve a variety of enterprises has with heterogeneous systems integration, as well as how to face concerns with facing a common platform to solve the stability, reliability and efficiency issues.

Raised in the article's message-driven service-oriented platform The SOMDP (service-oriented message driven Platform) can integrate the a third-party developed software component as the same time providing a it also has a good reliable interoperability and a higher software reuse capacity. , at the same time, Through real-time perceived changes in the external load, it can adjust the strategy to improve the effectiveness of the information integration services

The SOMDP system is constructed by the core components and the external service components. A service component is a software component; it provides an element service in the system. The operation and management of the core components of all services supported the operation of its components. This in turn, helped to it achieved the inter-service component of interoperability. based on the news. External service component services with standard interfaces and components through the registration of a notice to the core database means the capacity of

their service. SOMDP developers develop a way to serve the third-party components which is accessed to system components. This proved to be a very efficient and quick means to achieve it also quickly achieved cross-organizational integration of information. An application message queue is introduced so that the various service components are in accordance with the load and the resources available to carry out an independent control. In order to effectively use system resources, service components can be carried out on the system resources thread for scheduling and distribution, to achieve the small size of the management and control of system resources.

The article described in section 2 of the message-driven service-oriented architecture, Section 3 describes in detail the system architecture SOMDP, Section 4 is the reference implementation SOMDP, Section 5 given domestic and foreign-related research and prospect of future work.

Message-Driven Service-Oriented Architecture

Service-Oriented Architecture

Service is a standard contract with the software component, it usually is coarse-grained, self-contained and can be assembled. Services used to create new business logic and a combination of new applications, can achieve interoperability between the different applications. SOA is an agile pursuit of integrated software architecture, which will the specific specify the business logic and the system of segregation, therefore, enabling to follow out the architecture of the application system structure to adapt to business and the continuous development of technology. SOA services are loosely coupled that service information through a standard interface between the exchanges of information to achieve interoperability. Users cannot rely on service providers to the concrete the realization of consumer services. Users do not have to care about the underlying operating systems and programming languages. SOA services, using the dynamic registration

and business-aware, in accordance with SOA, is conducive to software reuse, information integration and services reconfiguration. Reconfigurable

Service Component

Service component is the element services software component in the SOMDP. It has processing power and I/O interfaces; this component includes a dynamic thread pool and a message queue. Message queue and thread pool are standard software modules, which through standard interfaces allows access to the to access elements of each service. SOMDP use of message-driven technology to drive the business flow, the design uses a small amount of the thread, it does not need to be assigned for each service request thread. This design provided a good concurrent processing capability.

Capabilities.

The Standard Message Queuing component favors is in favor of the facilitated code as well as and the management of the system load. The various service modules can be decoupled, developed and tested at the same time. Simply a service member is separated into a number of services. Designers can be dedicated to the business logic and the various service components concurrency management, and then mixed them into a complete service process.

Message Queuing also provides information on the service control point that allows information services through the various components to be monitored and managed, could be monitoring and management. In order to relax in message-driven scheduling strategy concurrency requirements, SOMDP use thread pool to drive the system. For each service component using a thread pool, complex services can be broken down into the message queue of the service components. This enables the systems to work together that is in favor of the entire system performance and the QoS analysis for formal modeling.

SOMDP system Architecture

Factors of a SOMDP include should have the intelligence, collaboration, accessibility remodeling, openness and integration. The traditional method of software management cannot meet these demands. To this end, the paper puts forward new component-based software component management solutions to solve the issues of management, the ability to be reconfigurable, openness, and integrated abilities issues when using a used SOMDP for reconstruction services and integrated services. Information integration will be involved in a variety of resources and interfaces integrated in a unified platform to support the software component of environmental management support that to ensures the safety and reliability of the support platform and reliable. It can achieve SOMDP data unity, resource sharing, and collaborative work.

SOMDP calls in relationship between the components are divided into static and dynamic invocation calls. With When system initialization, the component determines the relationship called static call., The system then loads load changes according to the component, which determined the relationship called dynamic invocation. Components through the Message Queue are implemented and inter-linked. SOMDP system architecture as shown in Figure 1, include a including user management module, component deployment management, running and management module, component databases, and software components sustention environment. These are addressed below.

1. User management module. SOMDP through the user management interface to receive user's instructions and explained the instructions.

2. Component deployment management. It queries components information through a component operation module and certifies the certification of the components to be used. Once

certification is completed, after certification the component implementation continues.

Development of third-party software components and a component management through the deployment of a third-party component provide an interface code to receive third-party components. Function logic modules described in this component is is responsible for logic functions. Data access modules determine the resource requirements for this component.

3. Running and management module. A management module is responsible for running the operation and management of the maintenance and updating of SOMDP. It is the core of a SOMDP system. Users information integration services requests often requires a number of services which are a completion of component composition. An operation management module is responsible for a combination of services and decoupling components.

4. Component databases. It is responsible for the maintenance of online and offline component elements, adding the component information and real-time information of third-party components to databases, and storage data and information of throughout the SOMDP.

5. SCRSE (software component sustentation environnement). It is the reconstruction and information to support a business integration platform, which is responsible for the hardware resources and system resources that are needed when the management and delivery of components are running. The goal of a SCRSE is in the PC operating systems ability to achieve OS isolation and computing environment reproduction. reproducing. It provides links to compile third-party components code, without prejudice, to the premise of the functional components, implementing isolation of the operating system that a third-party code directs calls to.

It is equivalent to the insertion of insert a layer between the application system and the operating system to reproduce the type of operating system computing resources.

SOMDP Reference Implementation

In SOMDP, the information integration was seen as a series of message queues with the task of the composition of the network components and component services that are in motion to achieve functional components. Component database to preserves the topological structure of different services, according to the different users that are needed to needing to carry data or control information messages through different components to complete the different services. As shown in Figure 2, the user launches a service request, the SOMDP component query

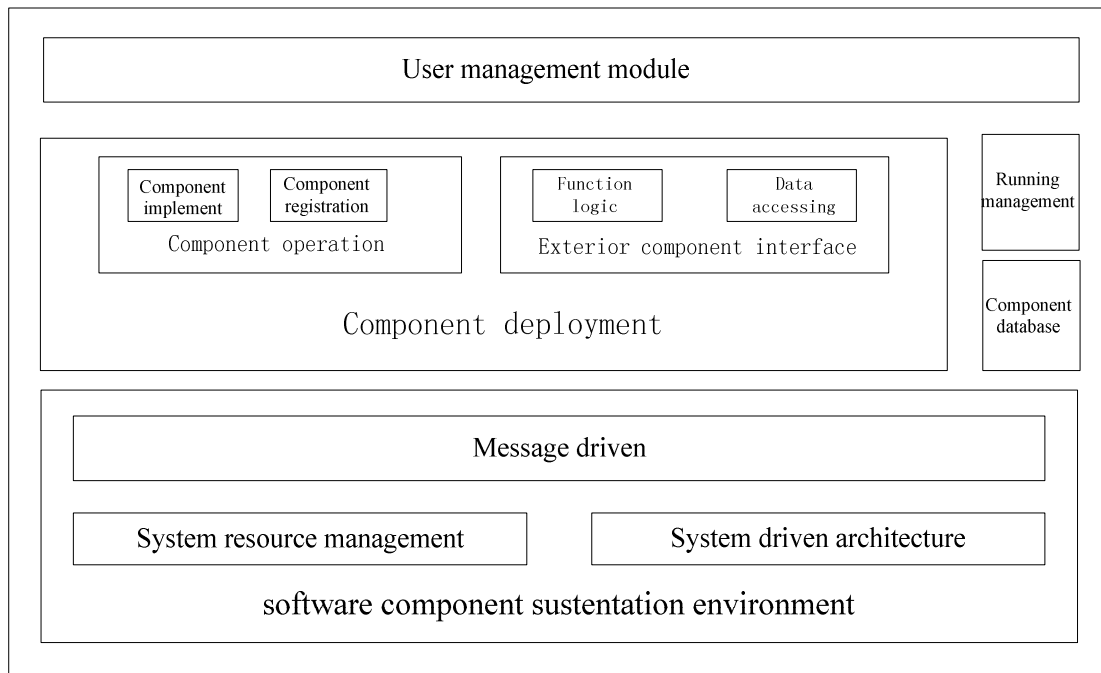


Figure 1 SOMDP System Architecture

database and determine the topology of components and determine whether they can provide this service. When the service does not require component services reconfiguration, the services that are provided to users will be dealt with in accordance with the normal go through process the necessary process to complete the processing of the components. When the user service needs a remodeling component, SOMDP query the database and retrieves get a new component

components topology. , Following this, control information is sent then send control information to prepare the related components as well as sending followed by sending the data information which begins the beginning the normal process.

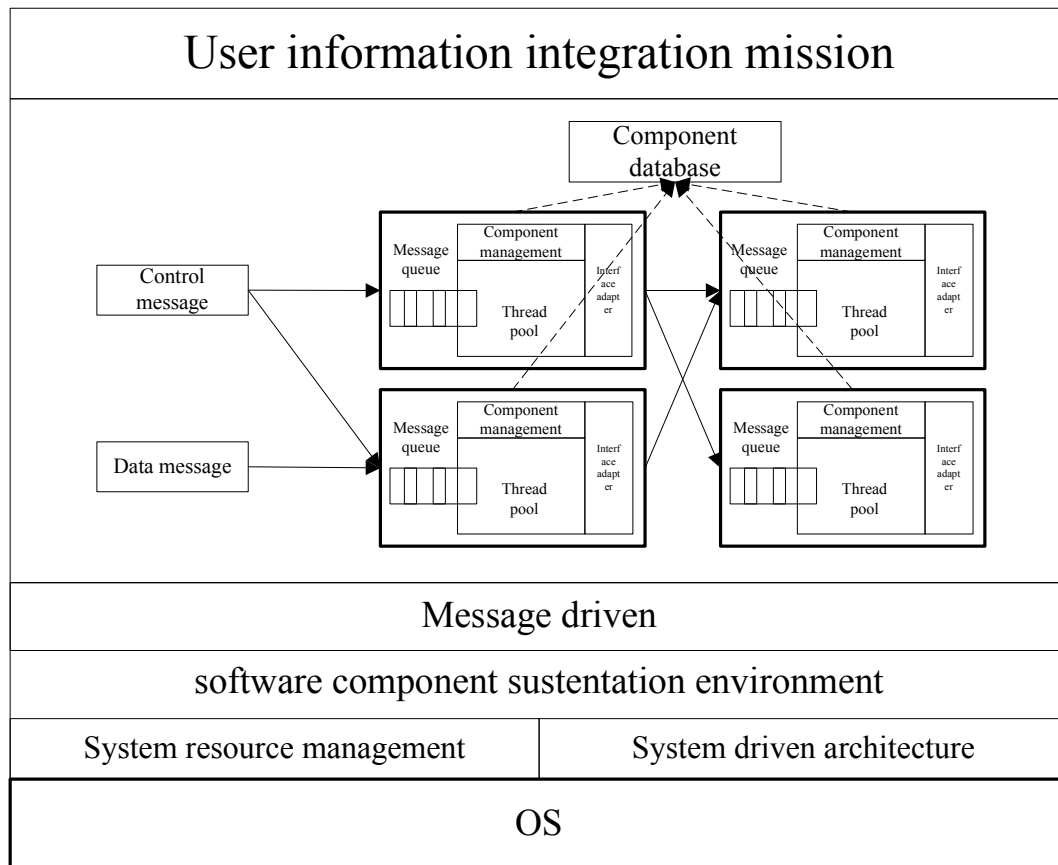


Figure 2 SOMDP Information Integration Framework

Service Component Unit

In the service-oriented architecture, the service is packaged as a component. Figure 3 shows. Like shown in Figure 3 the description of a services component described as a component with input and output interfaces and computing power in the unit. In order to ensure the relationship between the service components loosely coupled, the interface of service components should be the standard interface. Service components included the dynamic pool of threads, message

queues, component management, and interface adapters. These modules are standard software modules.

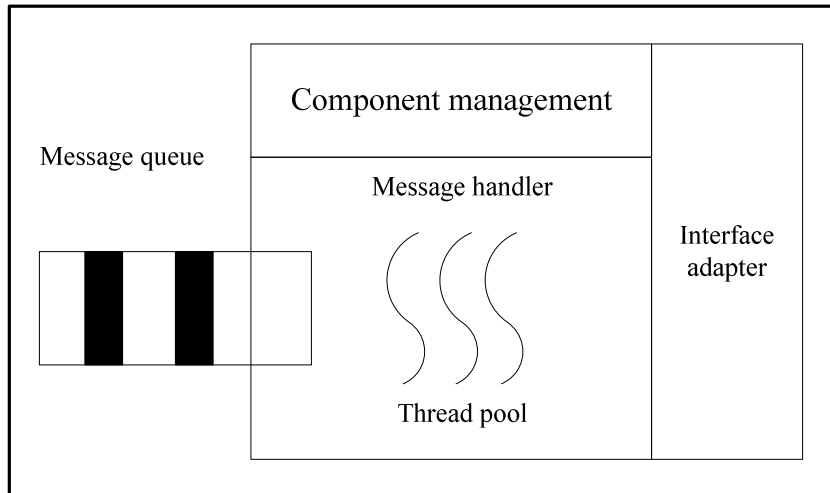


Figure 3 Service Component Unit

1. Message queue: Message means the user-specific demands and calls to the system, message queues, connecting all services component of the request buffer unit, provide service requests that need to be addressed to the service component. Message Queuing service component decoupling unit, can support the detection and control to the system. Services between components can call called each other by message queue, service components are not exposed a specific function interface, but to accept a specific type of request message, at the same time the release of other types of information, receive and release of information without one-to-one

2. Component management: It is responsible for resource allocation and scheduling, thread allocation and access control. It could deal with the priority of information, processing order and QoS management.

3. Thread poll: Multi-threaded provide concurrent mechanism. Using the operating system thread management can take a similar approach to the scheduling the component. The scheduling of a component is transparent to underlying hardware.

4. Interface adapters: Because follow-up services are for the different components, the message will be dealing with a different messages format. Interface between service components include: control information interface for passing control information between components, reconfigurable topology information, security information; data interface—deal with the normal transmission of information.

Control Information Processing

A management module is responsible for running the operation and management of the maintenance and the updating of SOMDP. As shown in figure 4, when the user launches a service demand, SOMDP user management interface conducts a detailed analysis. After receiving the order, after received the order; the Operation and Management modules determine the object after the Analysis operation order, then inquire a sustention environment about the components information. After the required operation, the object moves through the required the operation object through component database where the security certification Authentication Module authenticates authentication components information through the pre-stored components. This ensures reconstruction of components such as query history, components of the operating rights, security and other authentication information. Components that are filtered through the certification, operation and management modules are then in place to inform the members to prepare the implementation of reconfigurable modules, including the request for resources, the port registered with all the modules involved in coordination, and finally to generate new members. A new component management module is enacted by running the

software components to support the return of the environment. At the same time, the registration database to the new software component of the corresponding provides component information.

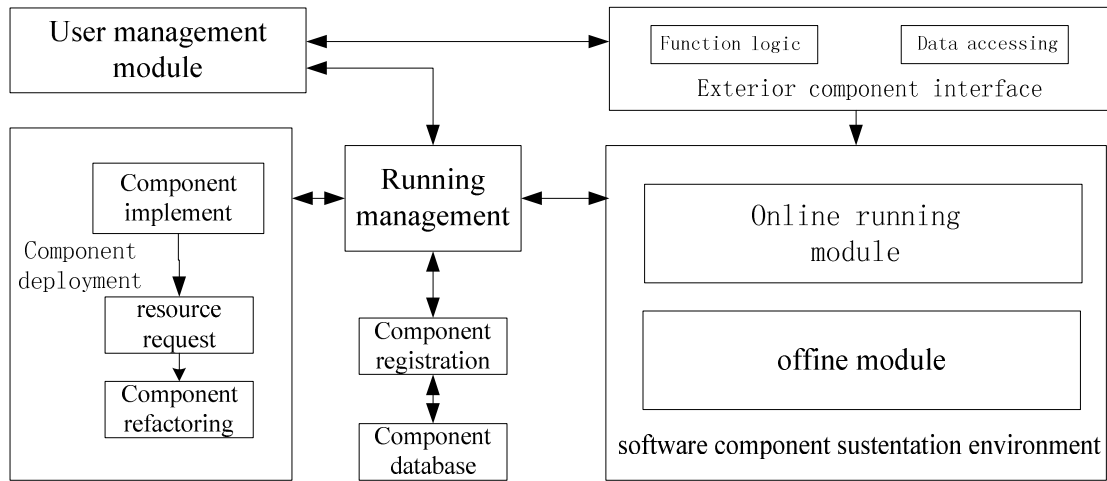


Figure 4 Control Information Processing

Transmission Of Database Information

SOMDP component database used to record the data information, components database management module SOMDP management operation. Data transfer process shown in Figure 5.

The main functions of the database components include :

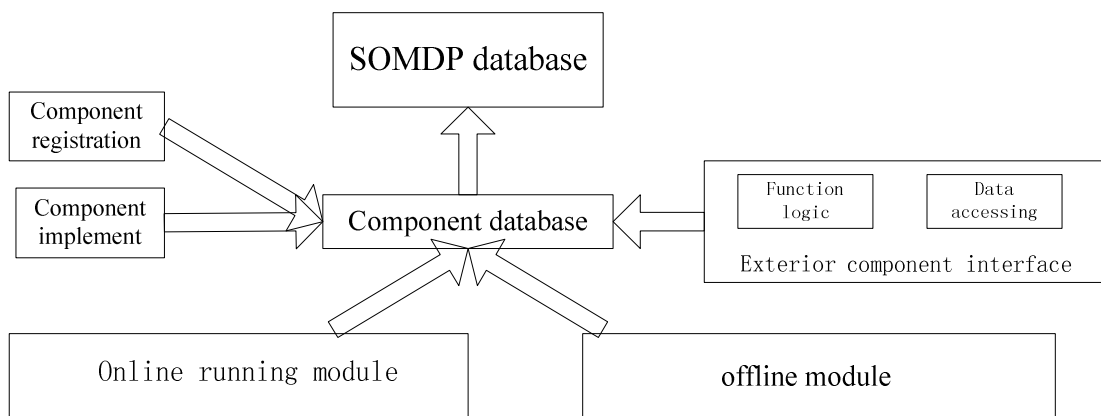


Figure 5 Transmission of Database Information

1. For the main SOMDP the main database requires turning over the data to the SOMDP information, including the operation of the log and database updates.

2. For certification of components, identifying component databases in advance to preserve the correct authentication of information at the same time recording the results of the current certification

3. For the implementation of the component modules, the implementation of module components and the results of the operation are recorded. the implementation of module components and recording the results of operation.

4. For third-party components, recording third-party components to load information collection component of the new component name, the logic function, the name of the provider, security, authentication information, and the resources required components, communications ports and other information. Third-party components through the component registration database environment to authentication the component information.

5. For on-line components, record the module to create online components running time, running time, support the environment, the name of each component, logic function, the name of the provider, security, authentication information, the resources required components, communications port, etc.

6. For an offline component, recording elements of the module was created by supporting the environment, naming the name of each individual component, providing a logic function, the name of the provider, security, authentication information, audit information, the resources required components, communications ports and other information.

Concluding Remarks

SOMDP-based information integration system not only has a good software architecture but can also improve system interoperability, agility and integration capabilities, as well as and can increase the throughput of large data processing capability of integration services, while changes in the external load leads to successful adaptability. and changes in the external load has a good adaptability. In addition to software components that to support system environment, data integration services for all components are in the form of software packages, where the components achieve interoperability using information calling. Systems can make external enterprise applications services (third-party components) components by accessing access system modules in the form of service and implementing enterprise application integration agile resources. The system uses the information mechanism, reduces the coupling between service components, and increases the cohesion and reusability of the software components. To further enhance the credibility and controllability of the system, and controllable, follow-up to the main message schedule scheduling algorithms for load balancing algorithms and research, the use of evolutionary algorithms, fuzzy control, and neural network control algorithms.

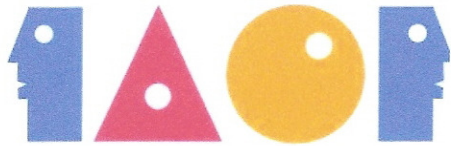
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A PROPOSED FRAMEWORK FOR MEASURING FIRM
INNOVATIVENESS IN THE HOUSING INDUSTRY

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Abstract

This conceptual paper proposes three constructs to measure firm innovativeness in the housing industry. Considerable research interest in the field of innovation has led to the development of measurement tools for measuring innovation. However, due to the shortcomings identified in the previous tools by scholars and nature of housing industry, there is need for the development of suitable instrument that will capture the innovativeness of firms in the industry. The proposed conceptual framework aims at providing a groundwork from which future research can be conducted to examine the constructs. It is expected that this paper will motivate scholars to focus more on innovativeness research such as development of innovativeness index for measuring the innovativeness level of firms in the housing industry.

Keywords: Firm innovativeness, Measurement, Housing industry

Introduction

For firms to sustain their achievements, survive the competitive and turbulent market, in which there is rapid change in products life-cycle, technologies, competitors, laws, and societies, they need to protect their tangible and intangible assets against the market uncertainties (Davila et al., 2006). Innovation gives the organization the ability to adapt and evolve to meet changing market conditions and customer demands. It is generally and widely acknowledged as a key ingredient of productivity success and it involves Procedure, People, Process and Product. Innovation, at the level of an individual firm, can be defined as the application of ideas that are new to the firm, whether the new ideas are embodied in products, processes, services, or in work organization, management or marketing systems (Gibbons et al, 994). In business, innovation is something that is new or significantly improved, done by an enterprise to create added value either directly for the enterprise or indirectly for its customers (BCA, 1993).

The crucial role innovation plays in enabling firms to secure competitive advantage has made organization and researchers show more interest in the field of innovation and innovativeness (Porter, 1980). Consequently, innovativeness research interests of scholars have led to the development of two different constructs. The first construct is consumer innovativeness developed from literatures such as marketing, Psychology and Sociology (Clark and Goldsmith, 2006). This construct focus on consumer adoption behavior in terms of purchasing new products introduced into the market. Firm innovativeness is the second construct developed from management, marketing and economics literature (Hult, *et al.*, 2004). The second construct tends to measure the ability or propensity of firms to innovate. The recognition of the weaknesses of innovativeness measurement by Deshpande and Farley (2004); and Crespell *et al.*, (2006) currently available and the call for a universally reliable tools for its

measurement is a clear indication that there is need for more research in this field of study. A firm is considered innovative when the firm adopts innovation, but the extent of the firm innovativeness depends on the number of innovations adopted (Daft, 1982; and Attewell, 1992). In this paper, we consider the inclination of firm towards adoption of innovation in our definition of innovation.

In this paper, we define innovation as an interactive, dependent, systematic, problem-solving and strategic process of adoption of new product, process, technology, management and market, aimed at maintaining or improving competitiveness, while satisfying the customers, driven by the learning process within the firm, between firms and external environment.

Considerable innovativeness researches have been conducted by various scholars (Foxal and Haskin, 1986; Damanpour and Evan, 1992; Desphande, *et al.*, 1993; Wolf, 1994; Subramanian and Nilakanta, 1996; Wang and Ahmed, 2004; Hult *et al.*, 2004; Barlow, 1999, 2000; Clark and Goldsmith, 2006). While all of these studies contribute substantially to our ability to measure innovativeness, they do not specifically address the firm innovativeness of housing developers. The very few innovativeness studies that dwelled on residential construction tend to focused mainly on wood industry, (Fell et al. 2002; Shook and Ganus, 2004; Knowles 2007).

This conceptual paper takes small steps towards this goal by presenting a conceptual measurement framework specifically for firm innovativeness of housing developers. The framework combines the constructs of self-evaluation on innovation, propensity to adopt innovation and current technology of a firm. The proposed framework relies on the empirical research and the adaptation of Knowles, (2008) to suit the housing developer firms in the housing industry. The next part of the paper will attempt to demonstrate the relevance of

readiness theory to the adoption of innovation in an organization. The remaining section is devoted to reviewing a number of earlier studies that have discussed innovativeness, how innovativeness is measured, and the limitations of the current methods of measuring innovativeness. A definition of firm innovativeness in the context of housing industry and a proposed conceptual framework for measuring firm innovativeness of housing developers are presented.

Literature Review

Innovativeness

Scholars have provided various definitions in an attempt to explain what they understand by innovativeness. Those that explain innovativeness from the perspective of adoption of ideas and concepts that are new to the firm or to the industries, define innovativeness in terms of number of unit of adoption by the firm, (example, Utterback, 1997, Draft 1982 and Attewell 1992). Foxall, (1984) defines innovativeness as “the capacity and tendency to purchase new products and services”. Foxall’s (1984) definition focuses on consumer innovativeness which has to do with the rate of acceptance of new products or services introduced into the market; hence, his definition is from the psychological point of view.

Subramanian and Nilakanta’s (1996) definition is from the behavioral point of view. They understand organizational innovativeness as an enduring organizational trait; meaning that truly innovative organizations will exhibit innovative behavior over time and in a consistent manner. In other words, innovative firms exhibit a consistently high level of innovativeness not just for a short period of time. The emphasis is on the mean number of innovations over time, mean time of innovations’ adoption and consistency of the time of innovations’ adoption. Lumpkin and Dess’s (1996) perception of innovativeness include both behavioral-related and product-related

concept which implies that firm innovativeness may start from the desire to try something new to an actual commitment to master the latest in new products or technological advances.

Cooperate culture of a firm to openness and the ability to allow new ideas or the readiness of a firm to accept new ideas is what Hurley and Hult, (1998) consider being innovativeness. The openness to new ideas as culture of a firm is not enough; the extent of adoption or implementation of new ideas introduced within the firm should determine the innovative level. Even though, their definition embraces both adoption and introduction of new ideas, it does not entail the actual end process of adoption of ideas new to the firm or implementation of new ideas introduced within the firm. Roger, (2003) examines innovativeness in relation to the time of adoption. He defines innovativeness as “the degree to which individual or other unit of adoption is relatively earlier in adopting new ideas than any other member of the system”. In this context, “system” could refer to firms within an industry, and among industries. It implies that those firms that adopt an innovative idea or concept earlier than the rest of the firm are considered innovative firms. Looking from another perspective, Gebert *et al.*, (2003) define innovativeness as “the capacity of an organization to improve existing product and or processes, and the capacity to utilize the creativity to resources of the organization to the fullest”. They considered the extent to which a firm makes maximum utilization of its human capitals creativity and improvement of their existing product and or process as innovativeness. Innovativeness reflects a firm’s tendency to engage in and support new ideas, novelty, experimentation, and creative processes that may result in new products, services, or technological processes. Wang and Ahmed, (2004) define organizational innovativeness as “an organization’s overall innovative capability of introducing new products to the market, or opening up new markets, through combining strategic orientation with innovative behavior and process”. However, researchers of

organizational innovativeness like Sethi *et al.*, (2001), Daneels and Kleinschmidt, (2001) still adopt only product innovativeness in their scale, which of course is a uni-dimensional. To this end, Wang and Ahmed, (2004) observe that product innovativeness of an organization emphasizes the end-result innovative capability but does not take into account other factors such as behavioral change of the organization, process innovation and strategic orientation towards innovation. Innovativeness has been regarded as an important organizational capacity to secure long-run competitive position and bottom-line performance, (Khalifa, 2007). We therefore argue that any definition provided by scholars should reflect a particular industry because of the differences that exist between the industries.

The housing industry depends on the manufacturing industry for innovative component and building products that are incorporated into building (Blayse and Manley, 2004). Also, organizational concepts, such as “Business reengineering” (Hammer and Champy, 1993); “Total Quality Management” (Ishikawa, 1985) are all concepts that were adopted from the manufacturing industry. This paper therefore adapts the definition of innovativeness given by Knowles *et al.*, (2008). Although, the Authors’ definition is in the context of wood industry, the definitions provided and the conceptual framework proposed in this paper are within the context of housing industry.

In this paper, we define innovativeness as the propensity of a firm to adopt innovative products, construction methods/practice; management system and adopts or introduce business systems that are new to the firm and or the housing industry.

Measurement of Firm Innovativeness in Literature

Firm innovativeness has been measured by several measurement approaches. Such approaches which Salavou, (2004) identified include the elapsed time of adoption; a

dichotomous variable, level of research and development expenditure, the economic value of innovations; the number of innovations adopted by a firm out of innovations; and subjective measure. While the measurement approach Knowles, (2007) identified are Current Technology; Self-Evaluation, Research and development funding, Number of new product introduce by firm and Intellectual property.

Current Technology

One of the approaches used for measuring innovativeness of a firm is the current technology usage of firm (Knowles, 2007). This approach is further split into two categories. The principle as behind the first category known as Cross Sectional method (Roger, 2003), is that the research conducting the innovativeness study provides a list of processing machinery, and the respondent selects from such list to reflect the level of their technology in terms of number machines currently used in that firm. The innovativeness is evaluated and classified by panel of experts in the field of innovation. Some innovation scholars that used this approach to measure firm innovativeness include Robertson and Wind, (1980); Damanpour and Evan, (1992), Subramanian and Nilakanta, (1996); and recently Shook and Ganus (2004). The other category under the same approach of using current technology is the time a firm adopts a technology. Such time to be investigated could be relative time of adoption (Knowles, 2007) or the absolute time of adoption of technology (Attewell, 1992).

The essence of considering the time of adoption is to trace the openness of the firm being studied to new idea, concept, system and product (Subramanian, 1996). The Cross-sectional method has been traced to Robertson, (1971). Due to the weaknesses observed in both categories, Fell *et al* (2003) developed a combination of both categories based on the time element of adoption and degree of adoption of an innovation by a firm. Using current technology

to measure innovativeness of more than one firm will require the research to measure each type of technology across the firm, a situation that could be influenced by the firm size and resources. The non-availability of the same technology across all firms under study will narrow the study to focus on one or few technologies (Rogers, 2003). Since this approach only focuses on current technology, neglecting the process and business systems innovativeness, it does not capture all aspects of firm innovativeness (Knowles, 2008).

Self- Evaluation

The measurement approach in this method is that the respondent will be an employee of the firm under study and understands the firm's daily operation. Depending on the dimension the researcher wants to study, the respondent (employee) will be required to rate the firm innovativeness using an interval scale (Knowles, 2007).

Self-evaluation method of measuring firm innovativeness has been traced back to 1959 (Knowles, 2007). This was the period when Carter and Williams, (1959) used this method to assess the technical progressiveness of firms. This was achieved by using scale of 0 to 10 on 29 aspects of the firms studied. Some of the characteristics of the firm scaled were: good information sources, seeking outside standard performance, no secretiveness, readiness to cooperate, good chief executive, good intermediate manager, forward-looking tendencies, shop-floor resistance to innovation and adequate finance (Knowles, 2007). Self-evaluation method is also what Capon *et al.* (1992) used for measuring elements of firm innovativeness of large manufacturer. The elements of firm innovativeness examined in the study are the growth realized by the firm, revenue generated from technology, tendency of technology in the firm. The last two elements were measured using interval scale (Knowles, 2007). In their study, Wind and Mahayan, (1997) used self-evaluation method of firm innovativeness measurement as it relates

to the use of best practices in new product. Deshpande and Farley, (2004) also measured innovativeness of firm in business-to-business market using self-evaluation method. In this study, the respondent's assessment of their firms was based on interval scales on five items adopted from Capon *et al.*, (1992). Crespell *et al.*, (2006) also made use of the method to measure innovativeness of firms in Sawmilling Industry. In this study, questions were asked on the source of innovative ideas, the factors driving innovation process, number of new product developed, investment in research and development as well as the number of employees at the respondent's Sawmill.

Intellectual Property

This approach is based on the principle of applying some value on the intellectual properties of a firm including patent even though not all innovation are patentable.

Measurement of intellectual property can be done based on patent (Artz *et al.*, 2003) as well as trademark of the firm. Patent as an intellectual property of a firm has been demonstrated in the work of Malewicki and Sivakumar, (2004) and intellectual property is commonly the key asset of start-up firms (LanJouw and Schankerman, 2001). Patent reflects the technical field and innovative activity of the firm. It also enables the tracking of innovativeness over a Long period of time (Knowles, 2007). The reflection of innovative activities resulting from the patent and other forms of intellectual property may not be accurate because the patent-innovation relationship can change as time goes on.

Research and Development Funding

To survive in today's competitive market environment, firms have to continuously invest in research and development (R&D) as well as enhance their innovative capacity and competitiveness. R&D activities are seen as the "cornerstone" of the long-term sustainability of

companies in developed countries as well as in the developing world (Zainol *et al.*, 2008). Research and development fund also measures the level of firm innovativeness. This reflects the capital expended or allocated to research and development in a firm. This method provides some measures of product and process only.

Number of New Products

Base on Wang and Ahmed's (2004) definition of innovativeness as "an organization's overall innovative capability of introducing new products to the market, or opening up new markets, through combining strategic orientation with innovative behavior and process". This approach measures the number of new products or services introduced internally by the firm under study within a given period of time (Greve, 2003; Gudmundson *et al.*, 2003; Vazquez *et al.*, 2003). The number of new products can be represented by the number of sales of the new product within a given time period.

While Capon *et al.*, (1992) emphasize the need for a more universally reliable scale for measuring innovativeness, Wang and Ahmed, (2004) observe that there is little empirical evidence in terms of development and validation of organizational innovative scale. In order to bridge shortcomings in the previous methods of measuring innovativeness discussed in this paper, Knowles, *et al.*, (2008) developed a framework based on the three processes outlined by Churchill (1979), DeVellis (2003), and Netermeyer *et al.*, (2003). The terminologies used in these three processes differ slightly; nonetheless, the underlying ideas and the steps involved are similar (Knowles *et al.* 2008).

Although the approach discussed above has been used by various scholars to measure innovation, there are notable weaknesses associated with them. Current technology approach for measuring firm innovativeness, according to Robertson and Wind (1980); Damanpour and Evan,

(1992); Subramanian and Nilakanta (1996); Shook and Ganus, (2004), does not account for product or business systems innovativeness because it often focuses on one or a few technologies. This approach is based on the assumption that each technology is equally available to all firms. Self-evaluation which authors such as Capon *et al.* (1992); Gebert *et al.*, (2003); Crespell *et al.*, (2006) advocated is associated with potentials for respondents' bias. Research and development funding approach, which Cohen *et al.*, (1987) advocated is that funding has not been consistently shown to correlate positively with more innovations and it is not easy to distinguish R&D funding in all firms, and this does not account for all aspects of innovativeness. Number of new products which Acs and Audretsch, (1988); Audretsch and Acs, (1991); Vazquez *et al.*, (2001) advocated does not account for all aspects of innovativeness. Intellectual property advocated by scholar such as Mansfield, (1986); Dutta and Weis, (1997); Artz *et al.*, (2003) is that many ideas are not patented or are not patentable. Patent does not mean the idea is being used.

Theoretical Background

In order to successfully implement innovation, firms need to introduce something that is new, and this requires the introduction of a routine that is completely new and usually involves the modifications in culture and value system of the organization's members (Schien, 1996). We develop our conceptual framework from a perspective of readiness change theory. Coch and French, (1948) classic study of the Harwood Manufacturing Plant is the first to suggest the need for a complementary construct of readiness to change. Their study cited as one of the most influential studies of organizational change, also helped set the foundation for organizational change research. The author's assertion and findings concluded that resistance to change efforts

could be altered by organizational interventions which will set the foundation for subsequent discussions that lead to what is now commonly referred to as readiness.

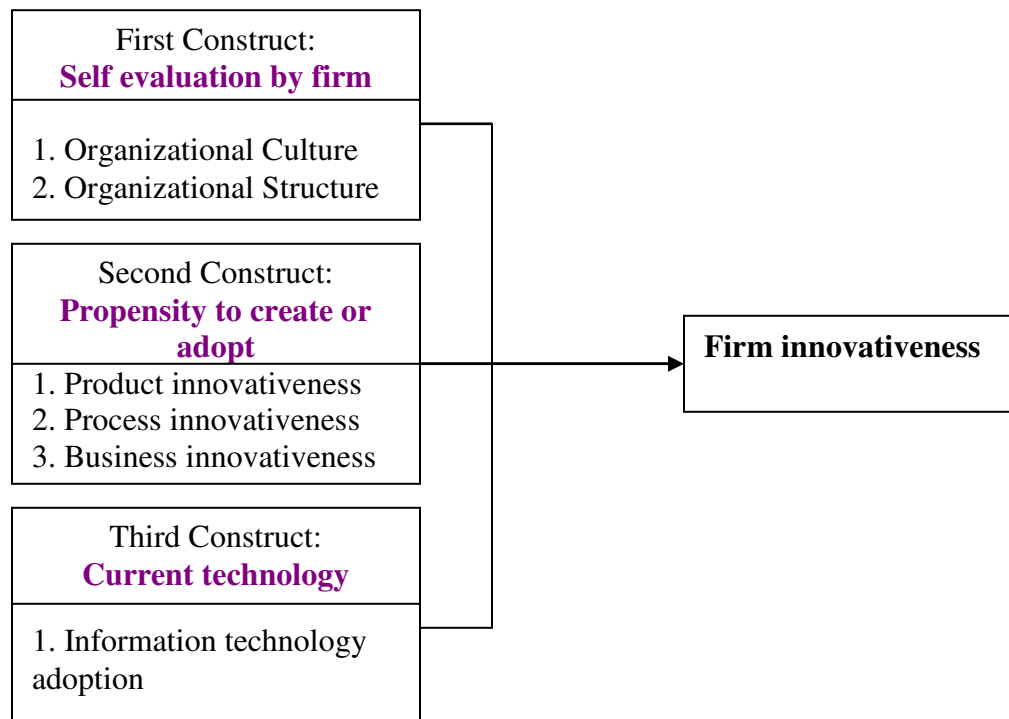
The relevance of readiness theory to innovation adoption by an organization is supported by the work of Armenakis and Bedeian, (1999). The authors developed a theory-based model of change. The model consists of three-stage process from readiness for adoption to integration of change into organizational process. Armenakis *et al.*, (1993) define readiness as a psychological state that occurred in an organization, when its members develop positive attitude, belief and intention toward the change to the extent that individuals involved in the process begin to adopt to change and behave in the manner that conform with the change. There is an increasing interest in the concept of change by scholars in the field of readiness for change. This is due to the fact that readiness to change decision is a contributory factor to success or failure of change in an organization. Scholars such as Armenakis and Bedeian, (1999); and Armenakis and Harris, (2002) identified the two types of responses an individual will face when he finds himself in a change situation. He or she may opt for redlines for the change he encounters or resistance to the change he encounters. To further explain the change behavior of an individual, Bovey and Hehe, (2001) explained how people tend to examine the nature of change, its impact on them or how it will influence their old practice. Such evaluation of the proposed change will determine the person's decision to accept the change or resist it. However, there are factors that contribute to individual decision of accepting to change or resist the change. The two basic factors Eby *et al.*, (2000); Holt *et al.*, (2007) identified are both individual and organizational factors. To further explain the individual factor that contributes to change readiness, Kotter and Chen (2002) suggested four types of individual barriers to change readiness. The first is boss barriers; second is the system barrier; third is mind barriers; and fourth is the information barriers. Based on the

argument of Judson, (1991) in relation to organization factor of change readiness, the six determinant factors that influence organizational resistance to change are: General feeling about the change, the difference between the current culture and one embedded in change, the questions that arise relating to change and remain unanswered, historical events, the threat brought about by the change on basic needs and how the change impacts on his views about how important he is.

Scholars such as Caruth *et al.*, (1985) consider resistance to change as a natural behavior that cannot be avoided, as a result of fear of what the change might cause. This is why Washington and Hacker, (2005) attribute any change failures to the “unavoidable” resistance to the people involved in the change process. For this reason, overcoming resistance has become a major challenge to organization that implements change (Washington and Hacker, 2005). In order for organizations to effectively manage and overcome resistance to change, Judson, (1991) suggests both reactive and proactive approach. The reactive approach is done by increasing pressure that can overcome resistance while the proactive approach is by minimizing the very force that induces resistance. Depending on what is intended to be emphasized, scholars have provided different definitions to the term readiness and readiness for change. The definition of Powelson, (1995) is that readiness for change is “an attitude based on trust, personality, history or other factors preceding acceptance or resistance of change”. His definition laid emphasis on factors such as trust that influences the decision on change readiness. Huy’s (1999) definition laid emphasis on the propensity of individual to be involved in his organizational activities. He defines readiness for change as the extent to which an individual is prepared to participate in different organizational activities. Bernerth’s (2004) definition of the term “Readiness” explains how acceptance of change reflects an individual state of mind. He stated that “Readiness” is a

state of mind reflecting a willingness or receptiveness to changing the way one thinks”. Holt *et al.*, (2006) stated that “Readiness” occurs when environment, structure and organizational members attribute are such that employees are receptive to a forthcoming change”. Prior to this Holt, (2002) noted that the context of manager’s effort to avoid employee’s resistance to change resulted in the concept of readiness for change.

**PROPOSED CONCEPTUAL FRAMEWORK FOR MEASURING FIRM
INNOVATIVENESS IN HOUSING INDUSTRY**



The first construct is the self evaluation. We propose that this construct should consist of items that measure organizational culture and structure. In order to know what goes on in an organization, how is it run and how it can be improved, there is need for understanding of its

culture (Schein, 1992). Culture within the context of organizations is defined as the deeply seated values and beliefs shared by employees at all levels manifested in the characteristics of the organization. Shared values and beliefs, and expected behavior resulting from the values and beliefs are the basic element of culture. The literature provides a very strong relationship between innovativeness and culture (Hurley and Hult, 1998). Both value and beliefs have been found to be influencing innovation (Harris, 1998; Tesluk et al., 1997). This is also consistent with Schein, (1984) and Weick, (1985), who both described culture as the linchpin to innovation in organizations. We consider culture in the first construct of the proposed framework because the extent to which an organization can be regarded as innovative will be limited by its culture (Dobni, 2008). Cameron and Quinn, (1999) identified four types of firm culture: The Clan, Adhocracy, Hierarchy, and Market culture. Clan culture has been described as very friendly place to work where people share a lot about themselves. It is like an extended family. The heads of the firm are considered to be mentors. The firm is bound together by loyalty or tradition. Commitment is high. The firm emphasizes the long-term benefit of human resources development and attaches great importance to cohesion and morale and success is defined in terms of sensitivity to customers and concern for people.

Adhocracy cultured firm is such a dynamic, entrepreneurial, and creative place to work. People stick their necks out and take risks. The leaders are considered to be innovators and risk takers. The thing that holds the firm together is commitment to experimentation and innovation. The emphasis is on being on the leading edge. The firm's long-term emphasis is on growth and acquiring new resources. Success means gaining unique and new products or services. It is important to be a product or service leader. The firm encourages individual initiative and freedom.

A firm embedded with hierarchy culture is a very formalized and structured place to work; procedures are what govern what employees do. The leaders pride themselves on being good coordinators and organizers who are efficiency-minded. Maintaining a smooth-running firm is most critical. Formal rules and policies hold the firm together. The long-term concern is on stability and performance with efficient, smooth operations and success defined in terms of dependable delivery, smooth scheduling, and low cost.

Market cultured firm is result-oriented in which the major concern is getting the job done and is a place where people are competitive and goal-oriented. The leaders are producers, competitors, tough and demanding. The thing that bound the firm together is an emphasis on winning. Reputation and success are collective concerns and success is defined in terms of market share and penetration. Competitive pricing and market leadership are of so much importance and the firm style is hard-driving competitiveness (Cameron and Quinn, 1999).

Organizational culture is the pattern of shared value and beliefs that help individual understand organizational function and thus provide them with norms for behavior in the organization (Deshpande and Webster, 1989). Ravichandran, (2000) believes that culture is a powerful social control system which influences an organization to either introduces innovation or adopts innovation. This is in line with Wilson, (1966) who argues that the probability of a member of an organization to conceive and propose or adopt innovation is influenced by the extent of diversity in that organization. The greater the diversity is, the greater the probability of adopting innovation in the organization. Quite a number of researchers have proposed measurement tools for measuring organizational culture, (Maloney and Federle, 1993; Cameron and Rowleson, 2005; Zhang and Liu, 2006). We propose the adoption of Cameron and Quinn,

(1999) “Competing Value Framework” as well as their tool named “organizational Culture Assessment Instrument” (OCAI) to measure culture.

Scholars seem to have developed a common belief that decentralized and formal organizational structure facilitates innovativeness. This is due to the flexibility and openness of this type of structure, whereby new ideas are encouraged from members of the organization (Subramanian and Nilakanta, 1996). On the other hand, centralization of power is believed to be a major barrier to adoption of innovation in a centralized organization (Aiken and Hage, 1971). We submit that this item of the construct measures the degree of centralization, formalization and specialization in the organization. In this paper, centralization relates to the decision making and instruction concerning an operating department within an organization. Formalization relates to written job description, policies and procedures that guide the actions of employees in an organization. Specialization refers to the willingness and ability to transfer employees among different departments within an organization (Subramanian and Nilakanta, 1996).

In the literature, the term ‘organizational structure’ is discussed as the way in which an organization is organized for the purpose of achieving expected outcomes. Sehanovic and Zugaj, (1997) define the organizational structure of a firm as the things that represents the totality of links and relationships between and within its factors at all levels of the organization in precisely defined quantities. These constitute the organization of production means and rational design of environment, organization of the working personnel, division of the task to every detail, organization of interior relations, and determination of time sequence of tasks. The dimensions of organizational structure in any firm are basically two. They are the configurational and structural.

Dalton *et al.*, (1989) exemplify the configurational issues to include whether organizational hierarchies are flat or tall, and which activities are assigned to which hierarchies. Organizational configuration dimensions are those that are normally represented by what is called organizational chart. The structural dimensions include the extent of formalization and specialization. Centralization refers to the centrality of location of decision-making while specialization refers to specialized skills of personnel in the entire functional areas firm (Subramanian and Nilakanta, 1996).

Innovation researchers have established the fact that several aspects of organizational structure affect innovation (Katz and Allen, 2004). There are two types of structure; the organic and mechanistic structured types of organization. Organic structured is the type where there is joint specialization, employees work together and coordinate task forces and teams are primary integrating mechanisms. The practice in mechanistic structured firm is individual specialization where employees work separately and specialize in one task and the hierarchy of authority is well-defined. Duncan, (1976) suggests that firms that have organic structure are more likely to enhance innovation initiation but the mechanistic structured types of firms are more likely to facilitate implementation. Similarly, Cohn and Turyn, (1980) suggest that formalization and centralization will deter innovation adoption. Conversely, the authors hypothesized that low levels of formalization will facilitate innovation adoption. Formalization is the extent to which decision-making power is concentrated at the top of the organizational hierarchy (Cohn and Turyn, 1980).

The second construct consists of items for propensity to adopt new and innovative building materials, propensity to create or adopt new construction process, methods and concepts, and propensity to create or adopt new business system. Business system innovativeness is a

combination of behavioral, strategic and market innovativeness. The term 'propensity' has been described as the ability of a firm to capitalize on its posture based on cultural acceptance of innovation; it reflects a process, routines, and capabilities of the firm (Carayannis and Provan, 2008). The authors argue that propensity to adopt innovation is crucial in an organization because a firm may possess all the resources needed to innovate and higher innovation stature externally, but lacks the required capacity to innovate due to certain constraints. In the context of housing industry, we consider firm's propensity to adoption of innovative products, materials, new construction process, business, and practice as a major construct in the proposed innovativeness measurement framework. Posture is the organizational, technological and market life cycle of a firm that reflects its readiness to adopt and benefit from innovation (Hauser *et al.*, 2006). The items in this construct measures Product innovativeness, Process innovativeness and Business innovativeness (Knowles *et al.*, 2008). Product innovativeness relates to the propensity for adoption of new innovative construction materials and products. Process innovativeness item measures the propensity for the adoption of new and innovative construction methods and concepts such as green and sustainability, just-in-time, supply chain management concepts. Business innovativeness measures the propensity to adopt new business concepts such as partnership. "Adoption is the acceptance and continued use of a product, service, or idea. The adoption process refers to a series of mental and behavioral states that a person passes through leading to the adoption or rejection of an innovation." (Howard and Moore, 1988)

The third construct is the current technology of the firm. We propose that the items in this construct should measure the adoption of information technology by the firm. Effective use of information technology can foster innovation in a firm (Tang, 1999). In addition, the ability of a firm to effectively exchange information can be improved by the use of technology. Information

technology formation is adopted by firms to improve communication and prevent loss of information (Mastura *et al.*, 2007). The survival of today's business world, by firms of various size, both public and private, from leaders to those that just start-up depends on their strategies to catch up with Information Technology (IT). Information technology is needed to create new way to find new markets, discover or create new sales channels and get closer to customers and business partners through communication channels, which is enabled by e-Business. It also enhances business transactions and the information flow within and between organizations. Its application allows the organization to provide better, faster and cheaper service, (Issa *et al.*, 2003). The Web has become a source for obtaining information, goods, and services, and a means of communication for the industries worldwide. Information technology has made globalization, communication, and collaboration of companies much easier. It is now possible to conduct business transaction through e-market provided by the internet services. Raish, (2001) identified the benefits of e-market to include adding value to the enterprise by increasing revenues and decreasing costs while improving customer service, at the same time deliver new varieties of revenue opportunities while decreasing the direct costs of sales.

The successful adoption of innovations in the housing industry can have substantial social, economic, and environmental benefits to the populace. By incorporating new technologies, techniques, and materials into construction practices, it is possible to: Create more affordable housing; Improve energy efficiency and conserve energy resources; improve the quality of housing stock by reducing the need for frequent repairs and maintenance; Increase the longevity of the housing stock; reduce the flow of scrap materials into the waste stream and Conserve scarce natural resources. Adoption of innovation is known to be a highly complex behavior. In addition, adoption patterns vary across industries, and housing development as an industry is

significantly different from other industries, where more research has been conducted on innovation. Consequently, research specifically focused on home building is required before applying any of the findings from studies of adoption and diffusion in other industries. More so, research in other industries has shown that the firm's size, industry concentration, human resources, organizational structure, culture, information channels and Information technology are important contributors to the adoption of innovation. The role and importance of these characteristics in the diffusion of innovation in housing industry must be clearly established (Koebel, *et al.*, 2004).

Conclusion

This conceptual paper presents the definition of innovation and innovativeness in the context of housing industry and the conceptual framework for measurement of firm innovativeness in the industry with an adaptation of Knowles *et al.*, (2008) empirical study. Future research should examine the reliability and validity of the constructs when data have been collected. Thereafter, the innovativeness level can be determined using an innovativeness index. The proposed framework is based on the innovativeness concept of firm culture, structure, propensity to adopt innovation and underpinned by readiness change theory. The first items in the first construct are proposed to examine the innovative culture of firm and whether the firm structure is the type that supports innovation adoption. Likewise, the items in the second construct are proposed to examine the firm inclination to innovation adoption of innovative product, process and practice. The items in the third construct are proposed to examine the adoption of technology by firm.

Damanpour *et al.*, (1998) identified Administrative and Technical innovations as the two main classification of organizational innovation. The authors relate Administrative innovation of

an organization to the components that affect the social system and members, such as rules, roles, procedures and structures that relate to communication and exchange between the members. The Technical aspect of an organization occur in operating component and affects the technical system, such as equipment, methods of operation use in their production. This type of innovation can be through the adoption of new idea relating to product or services or the introduction of new elements in production process or services of an organization. The proposed framework will measure only the technical innovativeness of a firm. Further study should focus on the administrative aspect of firm innovativeness.

Any study by itself cannot address all of the complexity that surrounds the adoption of new construction materials, products, practices new business and technology. Consequently, this study is one of several studies needed to help establish groundwork for measuring innovativeness in the housing industry. At the same time, this study is a major step forward in advancing our knowledge about innovativeness in the industry.

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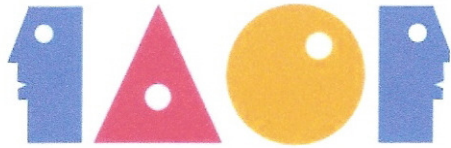
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IDENTIFYING UNIVERSITY FACULTY ATTITUDES IN ONLINE GAMES

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Abstract

The purpose of this study was to identify and categorize the perceptions of university faculty before we allocate the resources to design, develop, and implement digital game-based learning in high education institution in Taiwan. Q-methodology was conducted for this study because it is a quantitative analysis of subjective data. Thirty faculty members from a university were surveyed and asked to rank-order 30 statements about online games. Factor analysis was used to identify the number of factors and the correlation study attempts to identify the individuals who are highly correlated with one another in each specific factor. In this study, the data were processed and analyzed following the usual steps of Q-methodology by using the PQ Method software. Three operant factor types were identified. It is concluded that respondents' attitudes about online gaming are not affected by age or by hours spent online daily, but by gender and prior game-playing experiences.

Key words: Nominal Group Technique (NGT); Massively Multiplayer Online Role Playing Game (MMORPG).

Introduction

In recent years, Massively Multiplayer Online Role Playing Game (MMORPG) is becoming a form of both entertainment and socialization for the youth. Despite the fact that online games are still held in low regard by a majority of public critics, a growing number of researches indicate that games have promising potential as learning tools (Gee, 2003; Squire, 2004). The needs and demands of Net Generation students are changing rapidly. Today, students not only expect a traditional e-learning with accessibility and availability, but also demand multiple forms of interaction in distance education programs. What the future of e-learning holds is yet to be known, but much attention has been directed toward integrating features of online gaming systems into the e-learning environment in order to meet the new demand of learners. In fact, numerous studies have shown that digital game-based learning is the next generation's educational media (Foreman, 2003; Oblinger, 2004). This new paradigm of e-learning has challenged our fundamental perception of education and games and our role in it. Subsequently, it has the potential to reshape the future of higher education in order to adapt to new demands from learners.

However, as we are excited about the discovery of a new paradigm in e-learning, numerous studies have shown that university faculty are not enthusiastic about participating in course delivery through distance learning environments due to lack of adequate institutional commitment and policy, insufficient time, or lack of expertise in technologies (Pajo & Wallace, 2001). Despite enormous investments on online learning technologies, most of the available data showed that one of the major obstacles to e-learning is culture resistance. Thus, the purpose of this study is to identify and categorize the perceptions of faculty before we allocate the resources to design, develop, and implement digital game-based learning in high education institution in

Taiwan. Therefore, the research questions that guide the study are as follows:

1. What are the subjective opinions of university faculty in Taiwan on online games?
2. What are the factors that represent faculty members who share similar patterns of thoughts?

Methods

Measuring Subjectivity

Q-methodology was chosen for this study because it is a quantitative analysis of subjective data. In this study, the instrument was developed based from the in-depth interviews. In addition, factor analysis is used to identify the number of factors and the correlation study attempts to identify the individuals who are highly correlated with one another in each specific factor.

Participants

Thirty faculty members participated voluntarily for Q-sampling procedures. In addition, the faculty were interviewed twice in order to collect the concourse and the Q-sorts. The Q-sorts include 27 people ranging in age from 31 to 50 years old. Eighteen (66.7%) respondents were males; the other nine (33.3%) were females.

Procedures

The participants were recruited from a private university in Taiwan. First, concourse (i.e., a set of comprehensive statements) was collected to reveal the possible paradigms via the first interview with faculty participants. The research instrument, Q-sample in this study, was developed based on the results of the first interview and through literature review. Each participant sorted 30 statements in the Q-sample according to those with which they most agree (+4) to those with which they most disagree (-4). Eventually, 30 faculty members were

interviewed and 27 Q-sorts were collected. The 27 Q-sorts from the faculty group were processed and analyzed following the usual steps of Q-methodology by using the PQ Method software. Overall, three operant factor types were identified.

Findings

In this study, the 27 Q-sorts of the faculty group were processed following the steps of Q-methodology. Correlation, centroid factor analysis, and judgmental rotation (hand rotation) were employed to derive significant factors. It extracted three factors covering 21 of the 27 Q-sorts. Twenty-one (77.8%) of the 27 faculty members' Q-sorts are accounted for in the three operant factors. Of the remaining six Q-sorts, one was not considered to be statistically significant (loadings less than 0.36 on these three factors) and another five were confounded; that is, loading significantly on more than one factor. Overall, three operant factor types were also identified: (1) Factor I: Philosophical Opposers, (2) Factor II: High Tech/High Touch Supporters, and (3) Factor III: Content and Health-concerned Supporters (see Table 1).

Factor I: "Philosophical Opposers"

The Group I participants (57.1% of the faculty) are philosophically opposed to online gaming. Most of the female participants (85.7% of females) are in Group I. Group I participants reacted affirmatively to most of the negative statements about online gaming (see Table 2), including its relation to low academic performance (statement 6), players' health problems (statement 8), waste of time (statement 3), violence and sexual content in gaming (statement 15), social isolation (statement 16), online crime (statement 25), slow development of online gaming-related regulations and policies(statement 10), and Internet addiction related problems (statement 1). Overall, Philosophical Opposers positions are quite in line with most public discourse which professes the negative effects of and conventional fears about video

games being harmful to players.

Table 1 Factor Structure for Faculty Group (*)

ID.	Gender	Age	Hours spent online daily	Player	Rotated Factors		
					Factor I	Factor II	Factor III
022	M	7	1	Y	85		
017	M	4	1	N	78		
006	F	4	3	N	78		
007	F	5	1	N	70		
027	F	5	1	N	64		
005	F	5	3	N	63		
008	M	6	1	N	62		
021	M	7	2	N	61		
010	F	5	1	N	61		
018	M	6	1	N	59		
009	F	5	1	N	58		
026	M	5	3	N	51		
002	M	5	2	Y		79	
013	M	6	1	N		66	
001	M	7	1	N		63	
004	M	5	3	N		63	
024	M	5	1	N		61	
011	F	4	2	N		51	
015	M	6	1	N			67
020	M	5	1	N			63
003	M	6	2	Y			40

(*) only significant loadings shown ($p < .01$), decimals omitted; 6 undefined Q-sorts are not included.

M: Male; F: Female; Y: Yes; N: No; Age 1: under 20 years old; Age 2: 21-25 years old; Age 3: 26-30 years old; Age 4: 31-35 years old; Age 5: 36-40 years old; Age 6: 41-45 years old; Age 7: 46-50 years old; Age 8: Above 50 years old; Hours spent online daily 1: 1-2 hours; Hours spent online daily 2: 3-4 hours; Hours spent online daily 3: above 5 hours.

Factor II: "High Tech/High Touch Supporters"

Furthermore, members of Factor II (High Tech/High Touch Supports), representing 28.5% of the faculty group, are the supporters of online gaming who had high philosophical value ratings and high technical value ratings in this study. 83.3% of Group II participants are

males. Factor II faculty recognize the benefits of gaming (see Table 2): it offers pleasant visual art design (statement 1), provides a highly interactive and social environment (statement 14), enhances leadership managing skills (statement 12), develops problem-solving and logical thinking (statement 21), enhances eye-hand coordination (statement 21), and provides multiple role-playing identities and anonymity in the virtual world (statement 27). Overall, the Group II position is quite in line with current Massively Multiplayer Online Gaming (MMOG) literature which professes the positive effects of virtual world.

Factor III: "Content and Health-concerned Supporters"

In addition, members of Factor III have different conceptualizations concerning online gaming. All the group III participants are males. Compared to the other factor groups, Group III participants have more neutral attitudes toward online gaming (see Table 2). Members of Group III recognize some positive effects of online gaming, including providing pleasant visualization and graphic design (statement 1), enhancing typing skills and English proficiency (statement 5), stimulating the development of the gaming industry (statement 19), and improving reaction time and real-time judgment skills (statement 21). However, they are concerned about the inappropriate online gaming contents (statement 15), game players' frequent health problems (statement 8), online gaming security (statement 29), players social withdraw and isolation and internet addiction related issues (statement 26).

Conclusion

Overall, the results of this research have illustrated the followings: (1) most of the faculty are philosophically against online gaming; (2) online games are a social activity and an interactive medium; (3) the concerns of female faculty need careful consideration; and (4) people often have conservative fears and common stereotypes about video games. Accordingly, my

findings indicate that respondents' attitudes about online gaming are not affected by age or by hours spent online daily, but by gender and prior game-playing experiences. Overall, several participants had both a low philosophical value and a low technical value toward gaming. Indeed, the concerns of female faculty need careful consideration. The findings of this study provide new information that female faculty may not choose to engage in digital game-based learning methods.

Interestingly, most of female faculty members do not recognize the positive aspects in online gaming. Therefore, an attention should be paid to gaming narratives, graphic design, game characters, and story structure. Especially because the gaming industry, game worlds,

Table 2 Faculty Group's Statement Scores by Factors/Opinion Types

Statements	Factors (*)		
	I	II	III
1. The visualizations, 3D graphic design, and sound effects of motion pictures in online gaming are nice; the design of characters is cute; the design of the scenes is vivid and sophisticated.	1	4	2
2. Playing online games is a waste of time.	3	-4	2
3. Many university students play online games. Online gaming is a common topic among students' peer groups.	2	2	1
4. Playing online games can make money (selling an account number and virtual objects).	-3	-2	-2
5. Playing online games can develop typing skills; playing an English version of an online game can improve English proficiency and can also allow joining gaming competition abroad.	-4	0	3
6. Gaming reduces the time available for studying, which can negatively impact academic performance.	4	-2	-1
7. Online gaming is one way of making new friends. People who came from different places or players who have the same interests can chat, disclose their feelings, and care for each other online. Also, fellow players sometimes meet each other and have fun together in the real world.	-1	1	0
8. Players might stay up for playing online games. Playing day and night will cause health problems, as well as nearsightedness and other vision problems.	4	-1	3
9. Oftentimes, some players voluntarily help fellow players in online games, such as guiding the way, lending tools and equipment, teaching how to reach the next level. Some players voluntarily share their experiences battling monster and level-up know-how for other players as reference guides on gaming-related web sites.	-2	1	0
10. Up till now, there was no online game rating or age regulatory system for players. The government is too slow and too far behind to develop online gaming-related policies.	2	3	-4
11. Playing online provides an environment that allows individuals to become familiar with computers and develop computer literacy. It helps players to develop interest in computers.	-4	0	-3
12. There are jobs and ranking ladders within players' role-play, which will help players to develop their managing and organizing skills.	-2	2	-4
13. Playing online games will stunt brain activities and people will become very stupid.	0	-4	-3
14. Gaming is highly interactive. Individuals can play their own roles, organize a team for adventures, and accomplish tasks in order to gain experiences and advance in levels.	0	4	-1
15. Some online games contain too much sex or violence. Thus, they are not suitable for	3	-3	4

everyone to play.			
16. I think online game play will lead individuals to isolate themselves from other family members. It will raise concerns on family relations.	2	-3	-3
17. The higher the level, the higher the achievement. For pursuing victory, individuals will keep playing continuously.	0	-2	-1
18. I feel online games only target those specific groups of people in Internet cafes and only target youth. The market is not fully penetrated yet.	-2	-1	1
19. Online games can stimulate the development of the software industry.	1	3	2
20. Virtual society. I think online games become virtual social communities, which allows players to learn and solve real-world problems in a simulated environment. Players' game characters battle and interact with their opponent's game characters in online games and the player's character interacts with what appear to be other humans in real life.	-3	0	0
21. Playing online games can improve reaction time, enhance real-time judgment skills, stimulate brain activities, enhance logical thinking, and improve eye-hand coordination.	0	3	4
22. I will be in good mood if my avatar dresses appealingly - those virtual objects makes me feel gorgeous!	-3	0	-2
23. Online games occupy Internet broadband usage and waste public resources. Online games have not much value – we should not give them too high a regard or over-promote online games.	1	0	0
24. Playing online games is a waste of money.	0	-3	-1
25. Online games, with a lot of hidden online crime, have increased problems in society.	3	-1	0
26. Individuals are vulnerable to Internet addiction while gaming. If players are addicted to the virtual world, this would lead to social withdrawal in real-world.	1	-1	3
27. I think online games ensure privacy and anonymity. They provide a form of escapism and help players forget about the real world troubles and pressures, as well as being an activity for killing time.	-1	1	-2
28. I think online games will lead users to a degree of social withdrawal and have anti-social behaviors toward society. It has a negative impact on players' human relations in general.	0	0	1
29. Security issues are a very high concern, because accounts, passwords, and virtual objects are easily stolen.	-1	2	1
30. Online games provides different role-plays and players can assume a “reinvention of self” and experience different identities which are distinct from their real life. Players can self-manipulate and control what they cannot achieve in the offline settings. I think online games satisfy personal imagination and fantasy.	-1	1	0

* Item rankings: -4 = most unimportant in this sample; 0 = ambivalent; +4 = most important in this sample

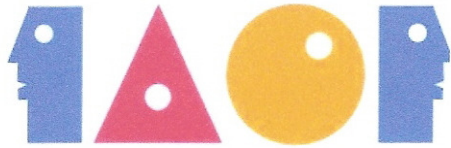
and education policy makers are usually male-dominated, such information can be useful to game developers and higher education administrators as they recruit more females to make strategic decisions about games design and digital game-based learning projects in the curriculum. In sum, it is recommended that future studies should consider investigating gender and digital game-based learning.

Final Thoughts: Innovation for Learning

In this internet economy era, school administrators face a number of challenges, one of which is how universities ought to relate to media. In this study, the researcher has gathered data to diagnose internal realities in universities. Overall, this research indicates that the majority of students showed negative feelings about online gaming. Should schools turn their backs to emerging media? This research does not propose that this is the end of the story for digital game-based learning. Clearly, if schools are going to face demands for change, they should also be sensitive to the external realities, especially in this networked, global world. Generally speaking, it is unlikely that the trend and the development of digital game-based education will abate in the foreseeable future as the literature review suggested previously. Few young learners today live in a home without a computer and few elementary school students today have known a world without video games in countries such as Taiwan and South Korea. Ultimately, no one really knows what tomorrow will bring and no one can foresee what the future of higher education will be. Higher education institutions need to be prepared for what lies ahead. A successful game-based learning program, therefore, will consistently delight students by empowering them to find their knowledge and to teach each other.

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EMPIRICAL ANALYSIS OF THE IMPACT OF FDI ON PAKISTAN'S
CURRENT ACCOUNT BALANCE

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Abstract

In this paper, we perform empirical analysis on how Foreign Direct Investment (FDI) can impact negatively on the Current Account Balance of Pakistan; at the same time generating positive results for GDP. We emphasized the Granger causality test and impulse response function to analyze the dynamic influence of FDI on current account balance. The results suggest that FDI has a negative effect on current account and a positive affect on GDP.

Keywords: Empirical Analysis; FDI; Current Account Balance, Granger Causality

Introduction

Pakistan's foreign policy and investment regime have changed substantially post reform era hence witnessing a steady growth in FDI during past few years. The evidence is mixed on existence of positive spillover effects of FDI for a host country, yet the positive role of FDI is well documented in literature. The economic growth of the country is positively associated with the level of FDI inflows and FDI trends to be directed to those countries and sectors that enjoy actual and potential comparative advantage. This growth in FDI may be attributed mainly to macroeconomic reforms by the government.

Modern empirical literature draws a forgone conclusion that FDI in one way or the other benefits the host country, thus enhancing the overall development of the country, especially a lower developed country like Pakistan. Pakistan is among those countries who have been suffering from the problem of current account deficit and it has become chronic over many decades. Since independence, Pakistan has been facing problems regarding trade and current account deficits which pose both a short term risk and long term problem. At present, Pakistan is financing the large current account deficit with huge flows of workers remittances and foreign direct investment. If the flows of workers remittances and foreign direct investment decline, it will create a serious problem for Pakistan to finance the large current account deficit.

For Pakistan most studies concluded that FDI had a positive affect on economic development, because mainly the studies have focused on how to generate conditions to attract more FDI, rather than the negative effects for the host country.

The benefits of FDI have been confirmed by actual behavior which "ignores inconclusive academic literature" (Lipsey, 2006, 1), positive externalities continue to be publicized by international financial organizations. As a result, FDI has stayed the pillar of the development

strategies of Pakistan. In reality, the spill-over effects of FDI on economic growth can differ considerably. They can be positive or negative, both in the short and in the long run. On the other hand, FDI also poses a long-term problem to the Pakistan economy. To finance its large and chronic deficit, Pakistan needs to borrow money from other countries. Future interest payments on this borrowed money may lower the domestic standard of living and slow economic growth in Pakistan thereby leading to a vicious circle of poverty.

Previous researchers have studied the contribution of FDI to domestic productivity. There is a general agreement on the positive impact of FDI on economic development (Aitkin and Harrison, 1999). Although some found negative results (Levine *et al.*, 2000), most empirical studies found a positive relationship between FDI, productivity and growth (Markusen & Venables, 1999; Borensztein *et al.*, 1998; OECD, 1998; Blomstrom *et al.*, 1994).

Empirical studies also demonstrate a negative relationship between FDI & cost of capital in both developed and developing countries (Root & Ahmad, 1979; Khan, 1997; Love & Hidalgo, 2000; Auerbach, 1990; Lucas, 1993; Gallagher and Zarsky, 2004).

Our study is based on the fact, which has so far been the missing link, that FDI has had a long-term negative impact on the current account balance in Pakistan, but also created the current account deficit. The study also contributes to the discussion of the impact of Foreign Direct Investment by adding a new viewpoint to the literature.

The remainder of the paper is organized as follows: Setting Up The Model Framework and Describing Data Sources; Presenting The Empirical Results, Discussing The Granger Causality Tests; Discussing The Impulse Response Function; and Conclusions Of The Paper.

Model Framework and Data Sources

A regression analysis is used to explain the impact of the variables: current account, official development assistance, gross domestic product and worker's remittances. First, the equation variables are explained. Next, the relationship of the regression equation to the model is discussed. The best regression equation, based on the analysis of DW (Durbin-Watson), AIC (Akaike Information Criterion) and SC (Schwarz Criterion) is fitted.

In establishing the model, we included several indicators affecting the Foreign Direct Investment since 1971 to 2005 were considered. FDI, GDP, CAB, WR, ODA represent foreign direct investment, gross domestic product, current account balance, worker's remittances, and official development assistance in a year which was in million of dollars. The sample is from year 1971 to 2005. In Table 1, we present sample statistics for each of these variables. The related data are from Pakistan's Handbook of Statistics and the World Bank. The original model is:

$$FDI_t = \beta_0 + \beta_1 ODA_t + \beta_2 GDP_t - \beta_3 CAB_t + \beta_4 WR_t + \mu_t$$

Empirical Results

The Augmented Dickey-Fuller (ADF) unit-root tests were used because it gives the most reliable results. There are three types of different conditions in the ADF test for every time series. First, the random process includes intercept (c) and trend (t). Second, the random process includes intercept (c) but no trend (0). Third, the random process includes no intercept (0) and trend (t). One empirical approach the researchers employed was a visual observation of the time series plot of the data. If the graph shows such characteristics as changing variables over time (increase and decrease) and no obvious step trend, then the time series was best represented by the second situation.

Table I

Financial Years	FDI	ODA	GDP	CAB	WR
Amount in Millions (\$)					
1970-71	1	413.46	10602.06	-541	125.00
1971-72	17	304.73	9309.11	-443	132.00
1972-73	-4	282.35	6324.88	-130	136.00
1973-74	4	444.27	8773.03	-549	139.00
1974-75	25	656.92	11340.00	-1,168	215.97
1975-76	8.2	1011.75	13338.49	-949	339.00
1976-77	15.2	585.52	15126.06	-1,051	577.74
1977-78	32.3	633.37	17820.10	-605	1,156.33
1978-79	58.3	708.14	19707.98	-1,114	1,397.92
1979-80	63.6	1180.88	23689.70	-1,140	1,747.05
1980-81	108.1	820.78	28100.61	-991	2,115.93
1981-82	63.8	913.58	30725.97	-1,530	2,224.89
1982-83	29.5	726.05	28691.89	-554	2,885.45
1983-84	55.5	727.48	31151.82	-1,028	2,737.43
1984-85	131.4	767.49	31144.92	-1,593	2,445.92
1985-86	105.7	912.99	31899.07	-1,234	2,595.31
1986-87	129.4	815.69	33351.53	-719	2,278.56
1987-88	186.5	1353.20	38472.74	-1,682	2,012.60
1988-89	210.6	1410.50	40171.02	-1,934	1,896.99
1989-90	245.3	1126.62	40010.42	-1,891	1,942.35
1990-91	258.4	1368.87	45451.96	-2,171	1,848.29
1991-92	336.5	1011.49	48635.24	-1,346	1,467.48
1992-93	348.6	1001.69	51478.36	-3,688	1,562.24
1993-94	421	1603.25	51894.80	-1,965	1,445.56
1994-95	722.6	820.85	60636.07	-2,484	1,866.10
1995-96	922	881.91	63320.17	-4,575	1,461.17
1996-97	716.3	595.81	62433.34	-3,846	1,409.47
1997-98	506	1052.53	62191.96	-1,921	1,489.55
1998-99	532	732.93	62973.85	-2,429	1,060.19
1999-00	308	700.35	73952.38	-1,143	983.73
2000-01	383	1941.51	72309.74	-513	1,086.57
2001-02	823	2135.73	72306.82	1,338	2,389.05
2002-03	534	1070.54	83244.80	3,165	4,236.85
2003-04	118	1432.57	97994.78	1,314	3,871.58
2004-05	2201	1624.83	109502.10	-1,753	4,168.79

After observing graphs of all the variables in the model, the researchers found that some variables have the trend of time series, while others did not. Therefore, models intercept (c) and without trend (0) are applied. As we have taken annual data sets, we will use the lag (n = 1).

Therefore, we chose $(c, t, n) = (c, 0, 1)$ for without trend in the ADF test. The results of the test indicates that all the variables, gross domestic product, foreign direct investment, current account balance, official development assistance and worker's remittances all have a unit root in their levels and are stationary in their first differences.

Table 2

Variables	Types of test (c, t, n)	ADF test statistic	DW Statistic	Probability
FDI	c 0 1	-3.646342	1.779479	0.8584
Δ FDI	c 0 1	-2.954021		0.0360
Cab	c 0 1	-3.639407	1.666404	0.1201
Δ Cab	c 0 1	-2.951125*		0.0170
ODA	c 0 1	-3.639407	2.083611	0.0331
Δ ODA	c 0 1	-2.951125		0.0036
GDP	c 0 1	-3.646342	2.055104	0.9956
Δ GDP	c 0 1	-2.954021		0.0059
Wr	c 0 1	-3.639407	1.464067	0.8536
Δ Wr	c 0 1	-2.951125**		0.5412

Note:

- 1- * rejected null hypothesis at 1% significant level
- 2- ** rejected null hypothesis at 5% significant level
- 3- Term c, t, and n represent intercept, trend, and lags respectively.
- 4- Probability means MacKinnon (1996) one-sided p-values.
- 5- Δ Indicate the first differential of variable.

When the variable is unstable, the regression between the variables may lead to furious regression. So care must be taken to ensure that the variables in the model are stable. Using Eviews5.0, an ADF test of the variables AIC and SC were used to identify their lags.

Table 2 shows the results of unit root test without trend. The test rejected the null hypothesis that there is a unit root in the first difference of every variable at a 1% significant level (for variables FDI, CAB, ODA, GDP) and at a 5% significant level (for variables Wr). The

Durbin-Watson statistics also supported the value of each variable as significant. In particular, a D-W statistic much less than 2 represented the case of positive serial correlation. Using Eviews 5.0 to do regression analysis based on the data and the results are presented in Table 3. From the analysis, a FDI model was developed.

Table 3 Estimated Results

Variable	Regression Coefficients	Std. Error	t-Statistic	Prob.
GDP	0.011151	0.002546	4.380556	0.0001
CAB	-0.086564	0.033771	-2.563246	0.0156
ODA	0.175451	0.149798	1.171250	0.2507
WR	0.000612	0.060351	0.010149	0.9920
C	-395.8671	125.9369	-3.143376	0.0037
		S = 93.9%		
R-squared		64.6328%		
Adjusted R-squared		59.9172%		
DW statistic		1.514546		
AIC		14.12927		
SC		14.35146		
F statistic		13.70611		

If the data in table 3 are inserted in the original model, the following equation shows the long-run relationship of variables:

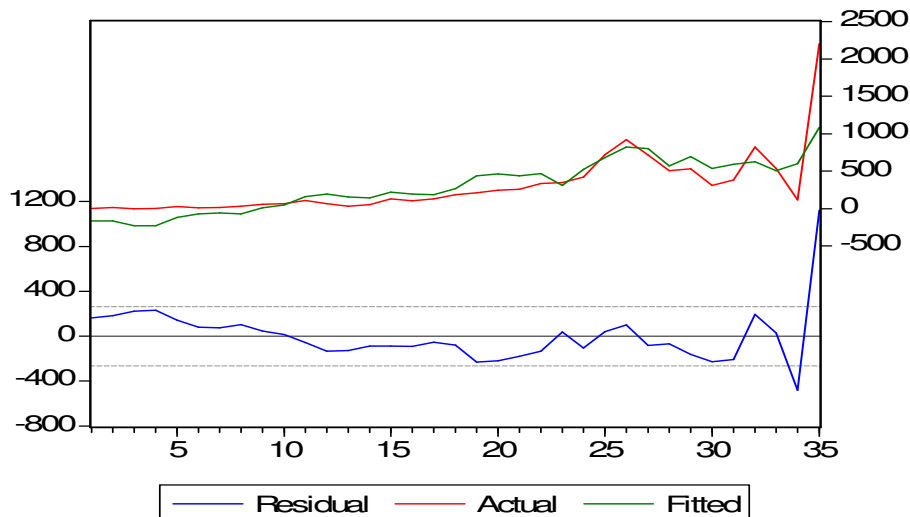
$$FDI = 0.011151Gdp - 0.086564Cab + 0.175451Oda + 0.000612Wr - 395.8671$$

$$(4.3805) \quad (-2.563246) \quad (1.1712) \quad (0.01014) \quad (-3.1433)$$

The negative sign of current account balance or the account deficit demonstrates that with 1% increase in the current account balance, the foreign direct investment will decrease by 8.65%, and vice versa, meaning the increase in FDI will also increase the current account deficit. On the other hand, with a 1% increase in the GDP and ODA, the FDI increases by 1.11% and 17.6%

respectively. Moreover, a 1 unit increase in Workers' Remittances leads to a 0.062% increase in FDI.

From the resultant equation the T-statistics of GDP, ODA, CAB, and WR are extinctive. They suggest that the regression equation fits very well as indicated in figure 1 below.



Granger Causality Tests

The Granger causality test was used to analyze further the relationship between the variables. The Granger causality tests results in Eviews5.0 are shown in Table V and Table VI. In Table 4 the lag is 1 while in Table 5 it is 2. The results suggest that when the lag=1, FDI is the Granger cause of CAB; while CAB is not the Granger cause of FDI.

When the lag=2, the Granger cause between CAB and FDI does not exist. This suggests that the cause effect of FDI to CAB is not extinctive. One possible explanation is that the samples were limited which led to the non-extinctive results. Another possibility was that the lags are different. But in short term, FDI was determined to be the Granger cause of CAB. Consequently, CAB contributed substantially to the FDI.

Table 4

Null Hypothesis: Lag =1	Obs	F-Statistic	Probability
CAB does not Granger Cause FDI	34	0.74722	0.39400
FDI does Granger Cause CAB		0.18194	0.67266

Table 5

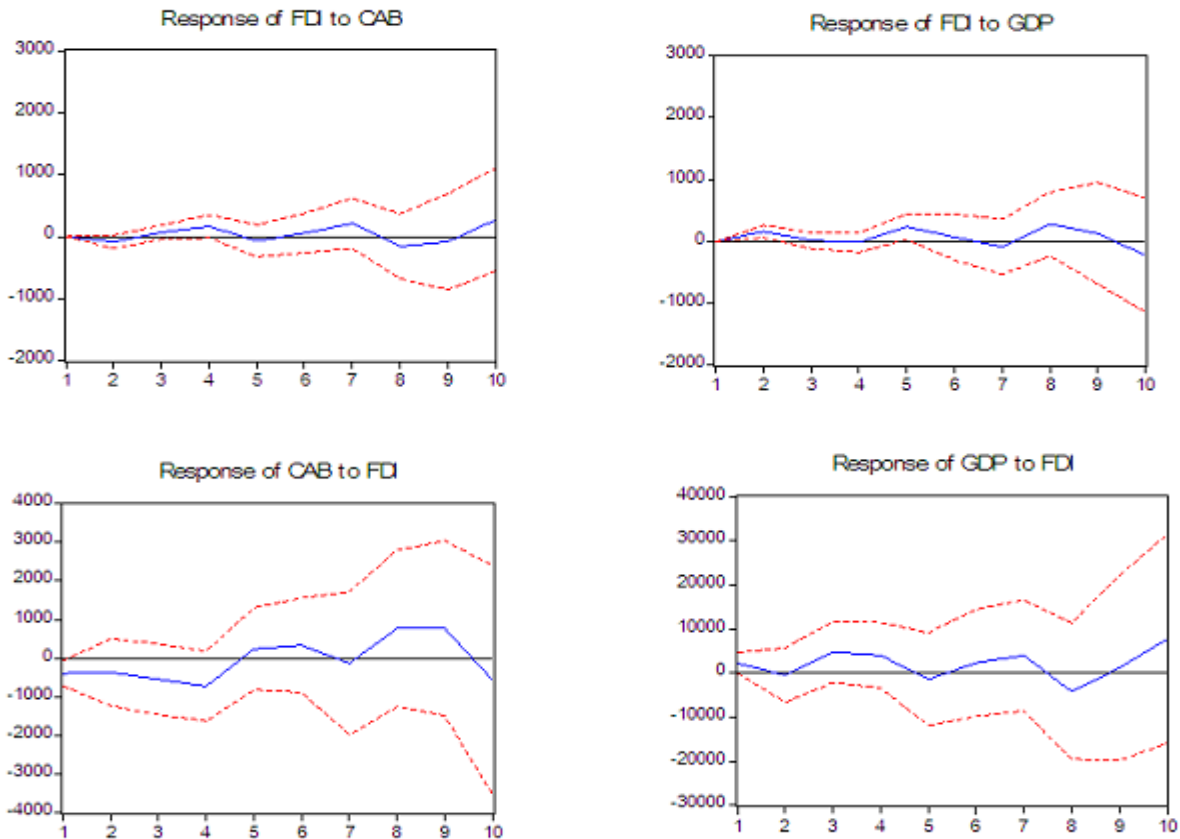
Null Hypothesis: Lag = 2	Obs	F-Statistic	Probability
CAB does not Granger Cause FDI	33	4.27645	0.02395
FDI does not Granger Cause CAB		0.52188	0.59906

Impulse Response Function

After estimating a VAR, it is important to be able to characterize its dynamic structure clearly. The impulse response shows how shocks to any one variable filter through the model can affect every other variable and eventually feed back to the original variable itself. Figure 2 shows the impulse responses functions. The horizontal spool delegates trace periods of the response function and the vertical spool delegates responses of dependent variables to independent variables. In Figure 2, solid lines are used to represent calculated values of response functions, dashed lines represent response function values and plus or minus double standard deviation confidence lines.

Figure 2 (a) shows the impulse response function of FDI to CAB. When a positive one-period shock is introduced to FDI, the response of CAB is not very extinctive. Only after a long period does it appear to have a negative effect which suggests that FDI has a negative effect to CAB over a long period. Figure 3 (b) shows a positive one-period shock to CAB. The response of FDI is not extinctive. However over time it rises slowly.

Response to Cholesky One S.D. Innovations ± 2 S.E.



Similarly we can see the exact opposite response for FDI and GDP, meaning that FDI has a positive impact on GDP in long and short run.

Conclusions

This study shows that FDI affects the CAB and GDP. GDP, ODA and WR are linked to FDI. The regression suggests that FDI contributes substantially to the current account deficits in Pakistan. The impulse response function analysis showed that FDI has a negative effect on CAB and even promoted the current account deficit. The FDI shows a positive relationship with GDP by Granger causality test. Hence, Pakistan's use of FDI can have a positive impact on the GDP, but also a lasting impact on the current account balance, thereby creating a current account deficit. A slight change in FDI would alter the country's dynamics.

Foreign ownership of the assets in Pakistan deteriorates the current account balance through the investment account and improves the capital account. However, because of the “structural” trade and current account deficit created by transition, the positive effects of foreign ownership on capital and trade balances may not prevail. Current account deficits will create a negative net external position which is financed by foreign savings (direct investment, portfolio investment, and credits). This will lead to future investment account deficits and contribute to present and future current account deficits. Indeed, Pakistan faces a kind of a vicious circle: current account deficits demand new FDI which generates future current account deficits.

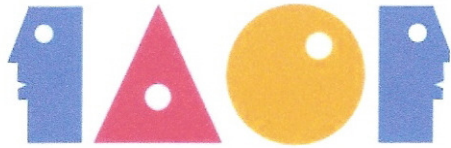
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A Study of Developing the Technology Creativity Scale Suitable for Junior High School
Teachers - The Case of Taichung Municipal
Junior High School Teachers

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Abstract

The aim of this study is to develop a feasible technology creativity scale for the junior high school teachers and to provide a research tool for researchers in the related field. Based on the divergent thinking test, the researcher integrated the knowledge in technology field, thinking procedure, and results to develop the scale with the consideration of the product-oriented concept. The content of the scale includes three dimensions: creative thinking, creative skill, and creative inclination. Among them, the items of creative thinking and creative skill are of non-structure design, while those of creative inclination are of structure design. The Technology Creativity Scale is done through empirical research. Its feasibility is confirmed empirically and can be used in a large-scale research.

Keywords: Creativity Ability, Technology Creativity, Technology Creativity Scale

Introduction

Research Background and Motivation

In the twenty-first century, human beings' technology development is too rapid to predict its next step. Human beings' belongings of daily life all are the products of technology. One of the basic capacities necessary for design and invention is creativity. Creativity is considered as a very abstract term. A number of scholars in different countries stated a variety of definitions of assessing creativity. For example, divergent thinking test, personality scale, attitude, and interest scale, others' assessment, biography-like asking and answering, outstanding people's avowal creativity activities and achievement, and products evaluation. These methods' feasibility is confirmed through empirical studies.

Recently, some scholars extended the field of the research and tried to develop a scale of combining professional field. The development of test of technology creativity is one example. The unique technology creativity test was developed by Yeh (2005). However, the proper subjects are limited to the students of 3 to 6 grades students in elementary schools.

Consequently, the related researches of this field are lack of proper research tools. To meet the need of the studies of technology creativity, the researcher of this study developed one suitable research tool to analyze technology creativity of junior high school teachers.

Objective of this Study

Based on the motivation and background of the research, the objective of this research is to develop one technology creativity scale for junior high school teachers.

Literature Review

The Theoretic Basis of Creativity

Creativity is a very abstract and complicated issue. In 1959, Guilford used factor analysis to do the related study. And he found that creativity includes fluency, flexibility, uniqueness, and exactitude (Yeh, 2004). The related research has been conducted by numerous researchers in behavior science field and education field. The results are rather abundant. Especially in recent years, plentiful professional books were published. And some integrated theories have replaced the partial or incomplete research findings and discussion. Two phenomena are worth of mentioning. One is that applicative and empirical studies are gradually replacing the conventional theoretic or conceptual studies. The other is that the academician scholars' discussions about the creativity of human beings are promoted from the general dimension to a domain specific product-oriented application (Yeh, Wu, and Zheng, 2000).

Although the dimension of the studies about creativity have been promoted from general and conceptual sphere, it is still necessary to illustrate the basic theories and definitions of creativity. The definitions of creativity are different from one school to another. Yeh (2000) defined creativity as an individual's procedure to generate a product with originality and value in a specific field. The procedure includes the integration and efficient application of cognition, skills, and affection. It means that creative performance is the result of the interaction among individual's knowledge, intention, skills, and the environments of organizations. This belongs to the definition of application dimension.

The Assessment of Creativity

The scholars whose professional field is the research of creativity commonly use the following eight methods to access creativity: 1. test of divergent thinking, 2. personality inventories, 3. attitude and interest scale, 4. others' evaluation, 5. the Q and A in biography, 6. eminence, 7. self reported creative activities, 8. judgments of products.

The creativity assessment methods, and assessment tools in Taiwan, and the scoring index of creativity assessment are illustrated as following.

1. Methods to assess creativity

There are various types of methods to assess creativity. Some Taiwanese scholars (Lin, 2002; Chang, 2003; Chen, 2006) argued that the most widely-used methods are the eight main categories stated by Hocevar (1981), and Hocevar & Bachelor (1988).

(1) Test of divergent thinking

It was developed according to the divergent thinking principle of the cognition operation dimension in intelligence structure theory.

Guildford and his co-worker developed many tests of divergent thinking. Among these tests, they use divergent thinking (D) to deal with the materials such as figure (F), symbolic (S), Semantic (M), and Behavior (B). They get the results such as units (U), classes (C), systems (S), transformations (T), and Implications (I). There are 24 combinations of results. For example, in DMT, namely Divergent Semantic Thinking Test: a subject would be asked to make a title for an interesting story. The story is that a person who ate the fish he had got and by this he lost a chance of winning a prize (Chen, 1984).

Torrance creative thinking test is usually employed to assess flexibility, fluency, originality, and elaboration. Besides, Creativity Thinking Activities (Lin & Wang, 1984) and New Creative Thinking Test (Wu, 1998) in Williams Creativity Test.

(2) Personality Inventories

The most widely-used tools are biography-like self-report scale, or psychology assessment tools which are lack of structure, such as reflection test, or the psychology

assessment tools with structure, such as California Psychology Scale. Adjective check-tables are sometimes used to assess creativity.

The Test of Divergent Thinking is to assess the inventories of cognition dimension. In fact, personality inventories have significant influence to creativity performance. Therefore, in the assessment, the personality inventories related to creativity (like independence, openness, imagination) can be used to infer the degree of the creativity of the examinees (Mao, 2001).

Torrance categorized 84 kinds of personality characteristics of the person of creativity. Among them 34 personality characteristics are the most significant (Kuo, 1992). They are accepting chaos, having adventure spirit, caring about others, passion, always feeling confused, being attracted by chaos, being attracted by mysterious things, being shy, constructive critical thinking, being responsible, being free from the restriction of the manners, owning super wishes, being sensitive to differences of values, being confused buy institutions, being very emotional, being hard in dealing with others, being free from the fear of being different from others, enjoying staying alone, doing judgment alone, irregular life style, never feeling tired, keeping asking questions, being a little wild, feeling exited about different ideas, being confident, owning sense of responsibility, being humorous, keeping away from power, being true, being automatic, being stubborn, sometimes shrinking, having imagination, being very talented.

(3) Attitude & Interest Inventories

Based on researches, people of creativity would show the attitude and interest positive for creative thinking activities. For example, the items in Pennsylvania Assessment of Creative Tendency developed by Raokey (1977) represent the living attitude and opinions about things. The examinees can answer according to the degree of their agreement. According to Mao (2001), scales of similar function are creativity tendency scale (Lin & Wang, 1987) in Williams' (1980)

Creativity Assessment Racket (CAP), Raudsepp's Creative Scale (Ding, 1991), Creative Perception Inventory developed by Khatena & Torrance (1976), and Group Inventory for Finding Interests (GIFFI) developed by Davis and Rimm.

(4) Teacher Nomination

Teachers generalize judgment criteria of behavior characteristics. They use the criteria to nominate the students of creativity characteristics.

(5) Peer Nomination

Provide some criteria for peer nomination, such as who have the most discourse, whose ideas are always the best. Ask students to nominate.

(6) Biography Inventories

From the description of the past experience, the creativity of the examinees can also be evaluated. Some questionnaires are usually designed for the examinees to fill in. The items of the questionnaires include personal experience, home's environment, and school's environment. One of the examples of this type is Alpha Biography Inventory designed by Taylor and biography inventory designed by Schaefer.

(7) Eminence

The eminence of identification can also be taken as criteria of evaluation. The investigation of outstanding peoples' characteristics can be used as the index of creativity.

(8) Self Reported Creative Activities & Achievements

The most convenient way to judge an individual's creativity is judging one's activities and achievements. For example, patents, public exhibition of personal works, the honor of science exhibition race, the literature works published in national newspaper, novels, and the drama performance. Holland has conducted considerable studies about this method of assessment

of creativity. Hocevar (1979) used to employ empirical methods to organize an assessment questionnaire according to the creative activities and achievement mentioned above. It can evaluate a person's creativity in art, technical, literature, music, drama, and mathematics-science dimensions. The user of it can check the frequency of a person's characteristics' matching the items. The frequency represents the degree of a person's creativity. In addition, Torrance (1969) and Runco (1986) also took similar check-table lists as the basis of evaluation. Lin (2002) argued that people can not judge what kind of activities and achievements can be seen as creative ones with ease, but its surface validity is rather high.

(9) Judgments of Products

This assessing method is different from other types mentioned above; some scholars considered that the products developed by individuals are the most direct basis to judge the degree of creativity. Those who judge products can be the experts of the professions, and can be general people. Different criteria of judgment can be made by different definitions of creativity (Lin, 2002).

The international indices of creativity of products include originality, practicality, and advancement of products.

(10) Supervisor Ratings

In industries, this method is always employed to select the employees with potential to receive advanced training.

Research Methodology

The Theoretic Basis of Technology Creativity

In the age of technology, the products are always updated very rapidly. The commodities used in our lives all belong to the products of technology. The design and invention of technology products require creativity, namely, the power of technological creativity. Hong (2006) stated that the definition of technology creativity is imitation, application, and innovation in the process of technology creation. Basically, imitation is not empirical. It can not belong to technology creation. On the contrast, the application and innovation must be empirical. The creation of technology can be seen from the dimensions of knowledge, empirical behavior, and experimental fabrication. Genuine creation of technology must match these three dimensions to some degree.

What can be called as the core abilities of technology creativity? Hong (2006) stated objective technology creativity and subjective technology creativity as the core abilities of technology creativity. Objective technology creativity refers to judge the technology creativity based on the product-oriented viewpoints. The cores are knowledge, the ease of making hypothesis, and the experience of experimental fabrication. Subjective technology creativity refers to an individual's ability to analyze, to think, to criticize, and to realize. The necessary characteristics are as follow.

The Assessment of Technology Creativity

The scholars who are dedicated in doing the research of technology creativity include Yeh Yu-zhu, who began the studies about creativity realization procedure. Later, Sun, Chun-zai, Yuan, Xian-ming also have considerable contribution of the studies of technology creativity.

Yeh Yu-zhu's technology creativity test is suitable to the third to sixth grades elementary school. Her test method includes individual test and group test. Lee, Da-wei's (2000) Scale of Technique Creativity also employs Yeh Yu-zhu's.

The Development of Technology Creativity Scale

The scale is based on the divergent thinking test. The technology knowledge, thinking process, and results are integrated in it. It is developed through the product-oriented concept.

The Content of the Scale

The scale includes three dimensions: two are of non-structural design, while one is of structural design.

(1) Creative Thinking: new combinations of the technology device used in daily lives. Show creativity by the combination of two or more technology devices.

(2) Creative Skills: inventing one kind of creative remote control. Include drawing the picture of the remote control, inventing its name, illustrating its characteristics and functions.

(3) Creative Inclination: including 33 inventories.

2. The Filling and Scoring of the Scale

(1) The first part, basic data, refers to the personal background of the subjects.

(2) The second part, scale content, includes the first and the second dimensions. The examinees are asked to write the combination's characteristics, name, and illustration according to their observation, cognition and imagination for the first and second dimensions. As for the third dimension, the examinees are asked to choose the proper items from the figures representing always do, usually do, sometimes do, seldom do, and never do.

(3) Scoring methods:

In the first dimension, one combination of creativity is given one point. The more the examinee writes, the more points he or she gets. There is no limit of the scores.

In the second, the drawing of the picture is given five points, one point of one characteristic. And one point is given to one illustration. The more the examinee writes, the more points he or she gets.

In the third dimension, the scoring is done by using R. A. Likert's scoring methods.

(4) The Validity and Reliability of the Scale

a. The subjects of the test: 100 male teachers and 100 female teachers in Taichung municipal junior high schools were chosen as the subjects by purposive sampling in this study. The number of the sample is 200.

b. The validity of the scale: with good validity of experts.

c. The reliability of the scale: The reliability of the two dimensions, creative thinking and creative skills, is between .995 and 1.000. The creative inclination dimension's Cronbach reliability is .916.

Conclusions and Suggestions

The aim of the study is to develop technology creativity scale which is suitable for junior high school teachers. After the initial study development, the scale is proved to be feasible for related studies. Furthermore, the scale can be used for the related studies of larger subjects.

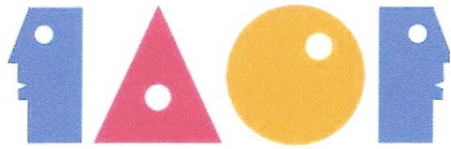
The application of none-structured design (open design) was used in the creative thinking dimension and creative skills dimension. Structured design (closed design) is used in the creative inclination dimension. However, it is suggested that researchers of further studies can adjust the modes of structures of inventories to meet the actual needs of the studies.

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**A SIMULATION OF GAUSSIAN OF AGGREGATED
STREAMING MEDIA TRAFFIC**

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Abstract

Internet traffic exhibits Gaussian characteristics, and this assumption has been validated in various studies of real Internet traffic at specified time scale or aggregation level. Because the analysis of aggregation characteristics of streaming media traffic provides a scientific basis for the general plan of streaming media oriented network, this paper investigates the nature of aggregated traffic. The aggregated traffic is generated from MPEG-4 video and commonly used applications, such as WWW, FTP, and SMTP. Based on earlier work of Kilpi and Norro, this paper investigates Gaussian at timescales at GoP. The study shows that GoPs of MPEG-4 video is roughly memory-less, and the aggregated streaming media traffic is approximating Gaussian at the GoP scale.

Keywords: Gaussian models Aggregation Streaming Media GoP Simulation

Introduction

In recent years, with developing of digital processing technology and network bandwidth, more and more applications based on streaming media technology are emerging on the Internet, such as video conferencing, audio/video-on-demand, television broadcasting and interactive games. And the Next Generation Broadcasting (Interpretation of NGB, 2008) is a new technical system advocated by the State Administration of Radio Film and Television, which is developed with "triple play", a combination of wired and wireless and the broadcasting television in a network. On the one hand the construction of NGB is based on the total conversion of cable television network and China Mobile Multimedia Broadcasting (CMMB). On the other hand the key technology of NGB is supported by the independent achievement of the "high-performance broadband information network (3TNet)"(Wu Jiang-Xing, 2006). So NGB is a streaming media oriented network, high quality of streaming media applications will be dominant, which is different from traditional data services and transmission-oriented Internet system. Thus novel applications and network need appropriate model to characterize the nature of the aggregated traffic.

Network traffic modeling has come a long way since the early days of telecommunications. In the IP world, various statistical models have been proposed to characterize traffic streams. The simplest model assumes Poisson arrivals of packets (C. Partridge, 1993), but such a model has the undesirable feature that it fails to incorporate the (positive) correlations between packet arrivals observed in real traces. For this reason, the model with (a superposition of) ON/OFF sources (R. Alexander, 1995) is an attractive alternative: a broad variety of correlation structures can be modeled by choosing appropriate distributions for the ON and OFF times. A variant of the latter model is the so-called M/G/1 input model (W.

Leland , Murad S. Taqqu and Walter Willinger, 1994) in which flows (groups of packets, with some general distribution) arrive according to a Poisson process, and generate traffic at a constant rate while being in the system.

The goal of this paper is to assess the claim that High quality NGB video traffic is roughly Gaussian, at GoP level time scale. Once the aggregation level is sufficient for using a Gaussian approximation, one can relax the exact self-similarity assumption and consider other Gaussian Models.

The paper is structured as follows: Section 2 gives an overview of the MPEG-4 video, and analyses the characteristics of GoPs, which is the scale of the following simulation. Section 3 outlines the simulation environment and methodology. Section 4 discusses the procedure to assess the Gaussian of aggregated streaming media traffic at the GoP scale. Section 5 provides the conclusions.

Analysis of Video Source Scale

Due to the difficulties to capture aggregation streaming video traffic directly from NGB, the paper use the MPEG-4 streaming media video that is commonly used in current backbone network environment for the material to generate streaming media traffic.

MPEG-4 video is expected to count for large of the traffic in the recent wired and wireless networks. And MPEG-4 provides very efficient coding the range from the very low bit rate of wireless communication to bit rates and quality level beyond high definition television (HDTV)

Trace file and other videos come from the Berlin University of the MPEG-4 video database (MPEG-4 Trace File, 2009) and all can be downloaded through its site. Take "Jurassic Park I" for example, the source is MPEG-4 standard encoding; frame rate is 30 frames/s, with

fixed encoding mode IBBPBBPBBPBB, and fixed QP 10, 14, 18. And all the video encoding is high-quality.

Let $X_n, n=1, \dots, N$ denote the number of bits in frame n . let G denote the number of frames per Group of Picture(O,Rose.1995).Let $Y_m, m=1, \dots, N/G$ denote the number of bits in GoP m .

so $Y_m = \sum_{n=(m-1)G+1}^{mG} X_n$. Table 1 gives an over view of the statistical comparing the frame statistics and the GoP statistics. And the statistical parameters, mean, CoV and Peak/Mean are listed.

Comparing the frame statics and the GoP statics, it is observe that smoothing videos over GoP is less variable

Table 1 Statistically Comparing The Frame And The GoP

trace	frame			GoP		
	Mean (kb)	C o V	Peak/ Mean	Mean (kb)	C o V	Peak/ Mean
Jurassic Park I	3.8	0.59	4.37	46	0.47	3.15
Silence of the ambos	2.9	0.80	7.73	35	0.71	6.22
Star Wars IV	1.4	0.66	6.81	17	0.38	4.29
Mr. Bean	2.9	0.62	5.24	35	0.40	3.73
First Contact	1.6	0.73	7.59	20	0.56	5.02
From Dusk Till Dawn	3.4	0.58	4.62	41	0.43	3.4.
The Firm	1.5	0.75	6.69	19	0.52	4.64
Formula 1	4.2	0.42	3.45	50	0.30	2.40
Soccer	5.5	0.41	3.24	66	0.33	2.72
ARD News	3.6	0.70	4.72	43	0.51	3.04
ARD Talk	2.7	0.63	5.72	33	0.31	3.60
Office Cam	2.0	1.09	4.99	24	0.10	1.74

So this paper chooses several class of video, and reassembles at GoP scale for the simulation source. As it is shown in the Figure 1 videos over aggregated GoPs is quite effective in reducing the self-similarity. Because the higher the degree of self-similar is the greater Hurst parameter H (A.Adas, 1997).

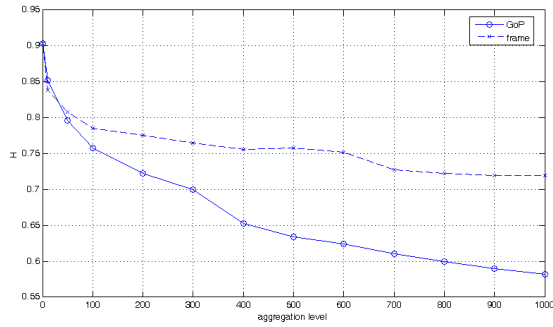


Figure 1 H of aggregation GoPs

Figure 2 gives the auto correlation coefficient of the $\rho_{GoP(k)}$ of the GoP size sequence $Y_m, m = 1, \dots, N/G$ as a function of the lag k in GoPs. It is observe from the figure that the GoP autocorrelation function of the proceed source encoding at high quality decays roughly exponentially. This indicates that the GoP size process is memory-less.

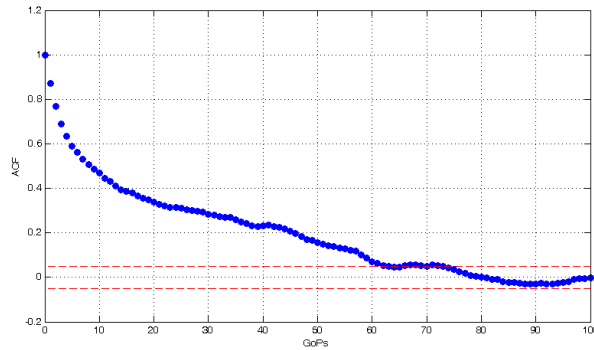


Figure 2 ACF of GoPs

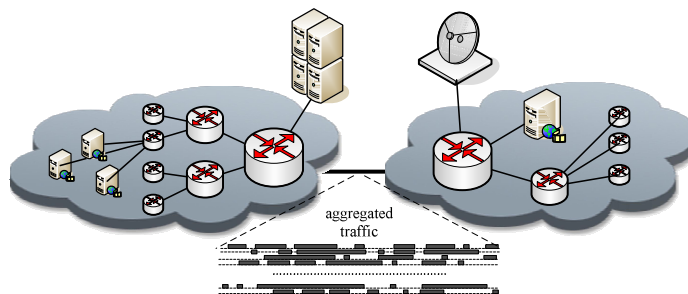


Figure 3 Network Deployment

Simulation Methodology

The Network Deployment In The Simulation

The simulation deployment shown in Figure 3 consists of several video servers on the network with structure of 4-level tree-dumbbell that is streaming unicast/broadcast video to a connected client. The video streams are aggregated from the network via the Access Convergence Router (ACR) (Wang Bing-qiang, Wu Jiang-xing, 2006). The background traffic is generated by a number of nodes with all background traffic being relayed through the ACR, including the www request and gets response, FTP and SMTP traffic.

The goal of this work is to investigate the effect the background traffic load has on a video streaming session. The experiment is designed such that the client and server establish a streaming connection with background traffic load all over time. The traffic trace can be generated in many different ways, for example, using different packet sizes will result in different packet rates to generate the same load. The following paragraph gives the methodology of traffic trace generation.

Traffic Trace

In this section, because there are only few studies evaluate aggregated MPEG-4 video traffic, due to a lack of sufficient large scale aggregated traffic trace, our goal is to generate a trace with *H* ON/OFF model that closely matches the corresponding empirical traces and also to match the statistics for GoPs and the correlation relationships among them.

A Number of ON/OFF source (one for each show high variability or infinite variance) directly are aggregated synthetic data generated after the sequence, showing the self-similar or fractal characteristics and the actual flow measured with the same characteristics, the model can be described as follows:

In ON/OFF model that a traffic source i generates cells at speed of $y_t^{(i)}$, alternates between two states: ON and OFF. During an ON period t the traffic is generated (transmitted) at a constant rate R , and during the OFF period no traffic is generated. The lengths of the ON and OFF periods are independent.

The lengths of the ON periods τ^t are drawn from a common distribution with mean a_τ , and the lengths of the OFF periods θ^t are drawn from another common distribution (possibly different to the distribution of on times) with mean a_θ . And τ^t is Pareto distribution with infinite variance:

$$P\{\tau > t\} \sim t^{-\beta}, \quad t \rightarrow \infty, 1 < \beta < 2 \quad (1)$$

So the traffic rate Y_t aggregated by the number of M independent ON/OFF sources is:

$$Y_t = \sum_{i=1}^M y_t^i \quad (2)$$

$$E\{Y_t\} = M \cdot R \cdot \frac{a_\tau}{a_\tau + a_\theta} \quad (3)$$

If the numbers of traffic sources aggregated go to infinite, the process of aggregation is long-range dependence and gradual self-similarity, Hurst parameter is $H = (3 - \beta) / 2 > 0.5$. When the exponential distribution and heavy-tailed distribution are contained, the heavy-tailed distribution of ON or OFF period can generate long-range dependence.

Two groups of traffic at GoP level and packed level are compared in the Figure 4: (•) denotes packed traffic scale, and (x) denotes GoP scale. The self-similarity packet scale (•) and GoP scale (x) composition has not essence change.

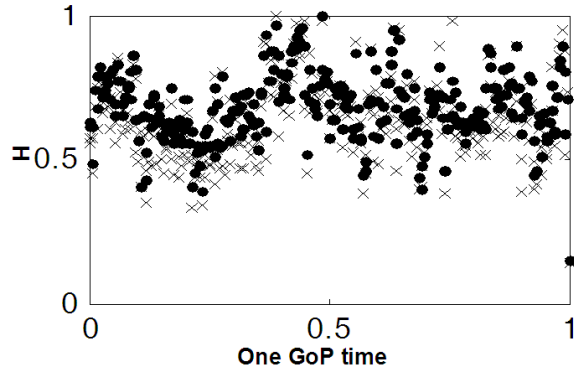


Figure 4 comparisons between packet and GoP scale

Assessing The Gaussian Character

Gaussian traffic is (R. van de Meent, M.R.H. Mandjes, A. Pras, 2006): for any $t > 0$, the amount of traffic $A(t)$ offered in an arbitrary time window of length t is described by a normal distribution, parameterized by a mean Mt and variance

$$V(t) = \text{Var } X(t) \quad (4)$$

In other words:

$$X(t) \sim \text{Norm}(Mt, V(t)) \quad (5)$$

The goal of this paper is to assess the claim that High quality NGB video traffic is roughly Gaussian, at GoP level time scale.

Gaussian Model Fitting

Gaussian model fitting procedure that we follow to assess the Gaussian of network traffic is rather straightforward, similar to the procedure followed by (J. Kilpi & I. Norros, 2002): Quantile-Quantile plots are made to compare the distribution of the observed traffic with a normal distribution, and this comparison is quantified using a ‘goodness-of-fit’ measure.

$$\bar{M} = \frac{1}{nT} \sum_{i=1}^n X_i \quad (6)$$

$$\hat{V}(T) = \frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{M})^2 \quad (7)$$

To assess the Gaussian of the network traffic, so called Quantile-Quantile (Q-Q) plots are used. In these plots, the pairs are:

$$\left(\Phi^{-1}\left(\frac{i}{n+1}\right), \alpha(i)\right), i = 1, 2, \dots, n \quad (8)$$

Here Φ^{-1} is the inverse of the normal cumulative distribution function with mean $\bar{M}T$ and variance $\hat{V}(T)$, and $\alpha(i)$ are the order statistics. When the traffic is ‘perfectly Gaussian’, all points in the Q-Q plot are on the dotted line.

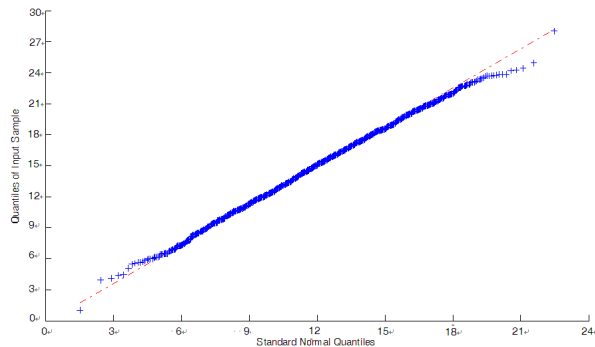


Figure 5 Q-Q plot compared to Norm

In Figure 5 a Q-Q plot is given according to the aggregated traffic traces. Most points are close to the dotted line. Hence, the traffic is ‘roughly Gaussian’. At the same time fraction points are quite faraway the diagonal at the ‘high-end’ and ‘low-end’ of the spectrum, that faraway the ‘expected’ value. This phenomenon is known as ‘heavy-tail’, and is often seen in Internet traffic. In the environment of the simulations, that network deployment and traffic

generation, the heavy-tail model conservative provisioning, the Gaussian model may not be accurate when backbone link utilization ratio rates are relatively high.

Conclusion

The analysis for network traffic is essential to characterize network performance. In backbone networks, the traffic rates can be very high, which is an argument for Gaussian modeling. However, the transmission speeds of individual sources can also be very much higher than in generated typical traffic data. Based on the theory of self-similar, the characteristics of backbone network traffic generated by MPEG-4 video at GoP scale are studied. Experiment data shows that at timescales at GoP. The study shows that GoPs of MPEG-4 videos are roughly memory-less, and the aggregated streaming media traffic is approximating Gaussian at the GoP scale. At the same time source aggregation, which works at a sufficiently large time scale, is needed to justify Gaussian modeling.

Therefore aggregation traffic of NGB network has roughly Gaussian characteristic.

Acknowledgments

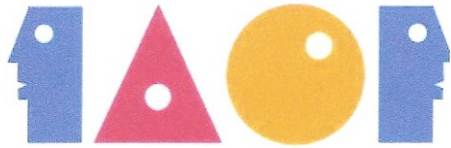
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MANAGING RELATIONSHIP EFFORTS TO INFLUENCE LOYALTY:
AN EMPIRICAL STUDY ON THE SUN LINK SEA FOREST AND
RECREATIONAL PARK, TAIWAN

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Abstract

Customer loyalty has become an essential concern and a strategic obsession for many managers and there is a growing interest in the business forums and in the academic community. Fewer studies, however, discuss the effects of relationship efforts on it. This study is aimed at investigating the potential role of a forest park's relationship efforts in influencing visitors' attitudes and is the first study that demonstrates the effects of relationship investment on behavioral loyalty mediated by relationship satisfaction, trust and commitment in a tourism setting. Structural equation modeling was adopted to analyze the proposed model. The findings show that relationship investment impacts behavioral loyalty by two ways and finally some more applications to practical managers and future researchers are drawn based on results of this study.

Keywords: Relationship Investment, Relationship Satisfaction, Trust, Commitment and Loyalty

Introduction

Customer loyalty, a major theme in marketing research, has become an essential concern and a strategic obsession for many managers (Bodet 2008). Due to the importance of loyalty in the service industry, there is a growing interest in the business forums and in the academic community. Researchers, for example, have found that customer loyalty is an important source of competitive advantage of a business. These kinds of studies, however, discuss how satisfaction, trust, commitment, service quality, involvement and other factors impact loyalty (Bove and Johnson 2006; Russell-Bennett, McColl-Kennedy and Coote 2007; Rauyran and Miller 2007; Hsu 2008; Kim, Yen, and Kim 2009), they seldom discuss the antecedents of these variables and what kinds of efforts for a service provider will impact loyalty.

De Wulf, Odekerken-Schröder, and Iacobucci (2001) developed and tested a model investigating the role of four different relationship marketing tactics in strengthening retailer-consumer relationships: direct mail, preferential treatment, interpersonal communication, and tangible rewards. Their results indicated that these relationship marketing tactics play a differential, yet consistently positive role in affecting perceived relationship investment, ultimately influencing relationship quality and behavioral loyalty. However, multidimensional concept of relationship quality including satisfaction, trust, and commitment was used as a mediator. The results were partially limited for managers and later researchers to apply because they couldn't understand relationship investment impact behavioral loyalty mediated by which part of relationship quality while the economic scale of a firm was still small and the resources were limited.

Besides, prior studies found that relationship quality could be measured with satisfaction, trust, and commitment (Morgan and Hunt 1994; Kumar; Scheer, and Steenkamp 1995; Garbarino

and Johnson 1999; Moliner, Sanchez, Rodriguez and Callarisa 2006). Some studies had pointed out that relationship investment could impact satisfaction (Chen and Chen 2004) and trust directly (De Wulf and Odekerken-Schröder 2003). Is relationship investment an antecedent of satisfaction, trust, or commitment? Does relationship investment impact behavioral loyalty mediated by satisfaction, trust, commitment or all of them? Keeping on clarifying the relationship investment-relationship quality-behavioral loyalty relations might have contributions on relationship marketing in a consumer environment and will be helpful for managers. This study has therefore attempted to test the relationship investment-relationship quality-behavioral loyalty relations based on five constructs including relationship investment, satisfaction, trust, commitment and behavioral loyalty, and it would like to draw some implications for managers and future researchers.

Furthermore, the Sun Link Sea Forest and Recreation Park is selected as a research object because 1) it is operated by private sector since 1976 and now is a well-known forest park in center Taiwan; 2) its business scale is big enough and has the ability and resources to implement the loyalty programs; 3) its manager has the need to know how to attract tourists continually while the inbound tourists are keeping growing.

Materials and Methods

The questionnaire is adopted as a material in this study. By integrating both theoretical frameworks, this study has proposed the conceptual model depicted in Figure 1 based on De Wulf et al. (2001), Chen and Chen (2004), De Wulf and Odekerken-Schröder (2003) and Yen (2008). Nine hypotheses are drawn based on prior studies (e.g., De Wulf et al. 2001; Chen and Chen 2004; De Wulf and Odekerken-Schröder 2003; Yen 2008) and are list as below:

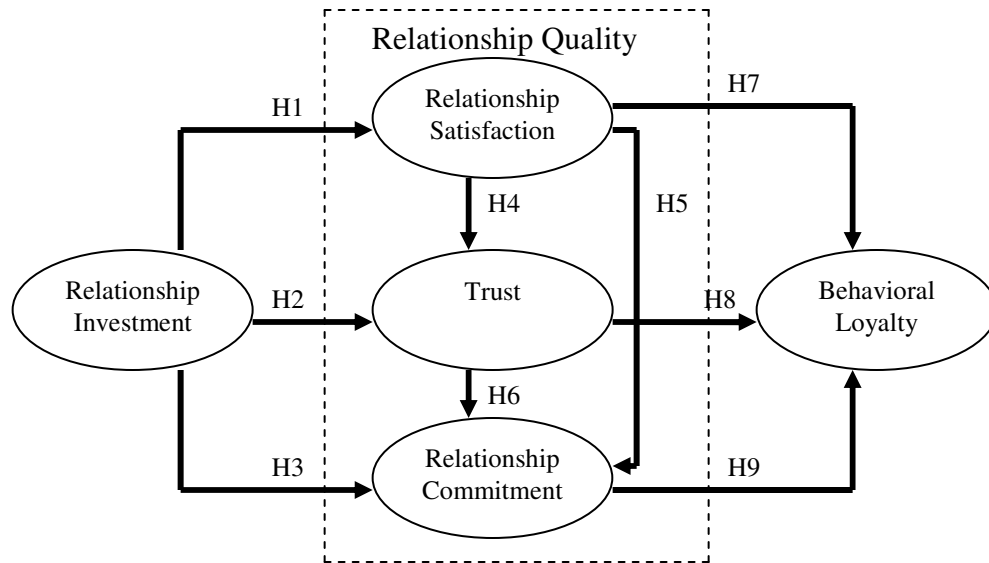


Figure 1 Conceptual Framework

H1: Within relationships between a forest park and its visitors, the higher level of visitors' perceived relationship investment leads to the higher level of relationship satisfaction.

H2: Within relationships between a forest park and its visitors, the higher level of visitors' perceived relationship investment leads to the higher level of trust.

H3: Within relationships between a forest park and its visitors, the higher level of visitors' perceived relationship investment leads to the higher level of relationship commitment.

H4: within relationships between a forest park and its visitors, the higher level of visitors' relationship satisfaction leads to the higher level of trust.

H5: within relationships between forest park and its visitors, the higher level of visitors' relationship satisfaction leads to the higher level of relationship commitment.

H6: within relationships between forest park and its visitors, the higher level of visitors' trust leads to the higher level of relationship commitment.

H7: within relationships between a forest park and its visitors, the higher level of visitors' satisfaction leads to the higher level of behavioral loyalty.

H8: within relationships between a forest park and its visitors, the higher level of visitors' trust leads to the higher level of behavioral loyalty.

H9: within relationships between a forest park and its visitors, the higher level of visitors' commitment leads to the higher level of behavioral loyalty.

To ensure the content validity of the scales, the items selected the constructs were mainly adopted from prior studies. The study used existing scales for measuring the relationship investment, satisfaction, trust, commitment, and behavioral loyalty. Twelve items for relationship investment were drawn as developed by De Wulf et al. (2001). Three items for satisfaction were drawn based on the studies of De Wulf et al. (2001). Three items for trust were drawn by Morgan and Hunt [35]. Three items for commitment were drawn by Morgan and Hunt (1994) and De Wulf et al. (2001). Three items for behavioral loyalty were drawn by De Wulf et al. (2001). Likert scales (1-7) with anchors ranging from "strongly disagree" to "strongly agree" were used for all questions. All of the scales showed they had a good reliability and validity in the prior research.

Visitors who have visited Sun Link Sea Forest and Recreation Park located in Nantou center Taiwan during the survey period were selected as the population in this study. Quota sampling was adopted with a personal interview method for the survey. To ensure that respondents were distributed across age and gender, 6 surveyors were trained before the survey and assigned to particular combinations of quota criteria, allowed selecting respondents who matched these criteria (e.g., friends, family, and neighbors) and maximum five visitors could be drawn in a bus after visitors finished visiting the park. Finally, a total of 195 valid questionnaires were completed after a survey in May of 2008. An overview of the demographic profile of the respondents show female (56 %), ages (17.9 % below 20; 23.2% ranged 21-30; 19% ranged 31-40; 22% ranged 41-50; 17.9% above 50), education background (16% junior high school or

below; 27% senior high school; 27% college; 30% university or above) and occupation (21.5% student; 13.8% manufacturing; 21% service sector; 18.5% public sector; 25.1%retired or other).

Two ways are adapted to treat the common method variance (CMV) problem. First, the study mixed the questions during the stage of questionnaire design. This will help the respondents reduce the probability of halo effects. Second, an exploratory factor analysis (EFA) was adapted to confirm that there is no CMV during the process of sampling (Podsakoff and Organ 1986). The results show that all of the model indices did not have a good model fit(GFI) in multiple factors. Confirmatory factor analysis (CFA), and then, were adapted to exam the validity and reliability of research model. The results of CFA (130 for chi-squares; 81 for df; 0.924 for GFI; 0.984 for CFI; 0.056 for RMSEA) show that all of the model indices have a good model fit than EFA (2161 for chi-squares; 90 for df; 0.441 for GFI; 0.350 for CFI; 0.344 for RMSEA). Generally speaking, CMV problem in this study should be controlled.

Results

This study tested the assumptions underlying the use of structural equation modeling. Because larger sample sizes are required in case of model misspecification, model complexity, non-normality of data, or the use of alternative estimation procedures (Hair, Anderson, Tatham and. Black 1998), this study used sample sizes (n=195) given the risk of moderate normality violations. Normality was tested by means of SPSS 12.0 based on the skewness and kurtosis of the observed variables (Bollen 1989). Both samples revealed acceptable kurtosis (-1.21 ~ -0.2) and skewness (-0.905~ -0.125) for most observed variables. This enables the study to proceed in evaluating the model fits.

A confirmatory factor analysis using AMOS 5.0 is conducted to test the measurement model. The chi-squares ($\chi^2 = 130$) is significant (p <0.05; Bollen 1989), a finding not unusual

with large sample sizes (Doney and Cannon 1997). The ratios of chi-square to degrees of freedom (df.) is 1.509 for measurement model and 1.49 for final structural model and are not exceed 2 (Marsh and Hovecar 1985). The value of goodness-of-fit is 0.924 and CFI is 0.984 for measurement model and structural model. The value of root mean square error of approximation (RMSEA) is 0.056 for measurement model and structural model. All of the model fit are higher or acceptably close to the standards suggested by Hu and Bentler (1999) 0.90 for GFI, 0.95 for CFI and 0.08 for RMSEA. Given that these batteries of overall goodness-of-fit indices were accurate and that the model was developed on theoretical bases, and given the high level of consistency samples, no respecifications of the model were made. This enables the study to proceed in evaluating the structural models.

In Table 1, this study reports the results of the measurement models. This study assessed the quality of the measurement efforts by investigating unidimensionality, convergent validity, reliability and discriminant validity. Evidence for the unidimensionality of each construct included appropriate items that loaded at least 0.831 on their respective hypothesized component and loaded larger than .30 on other components in a factor analysis. In addition, the overall goodness of fit supports unidimensionality (Steenkamp and van Trijp 1991). Convergent validity was supported by all loadings being significant ($p < 0.01$) and all SMC (square of multiple correlation) exceeding 0.691 (Hildebrandt 1987). This study assessed reliability jointly for all items of a construct by computing the composite reliability and average variance extracted (Steenkamp and van Trijp 1991).

For a construct to assess good reliability, composite reliability should be higher than 0.60, and the average variance extracted should at least be 0.50 (Bagozzi and Yi 1988). All scales demonstrate good reliabilities. To examine discriminant validity, this study compared the shared

variances between factors with average variance extracted of the individual factors (Fornell and Larcker 1981). The results showed (see Table 2) that the shared variances between factors were lower than the average variance extracted of the individual factors, thus confirming discriminant validity.

In summary, the measurement model demonstrated adequate unidimensionality, convergent validity, reliability, and discriminant validity. Figure 2 shows the results of structure model estimating that relationship investment has a significant and positive effect on satisfaction ($\beta= 0.5$; t value= 6.95), satisfaction has a significant and positive effect on trust ($\beta= 0.67$; t value = 9.4) and commitment ($\beta= 0.48$; t value = 4.94), trust has a significant and positive effect on commitment ($\beta= 0.31$; t value = 3.94) and behavioral loyalty ($\beta= 0.25$; t value= 2.66),

Table 1: Convergent Validity and Reliability

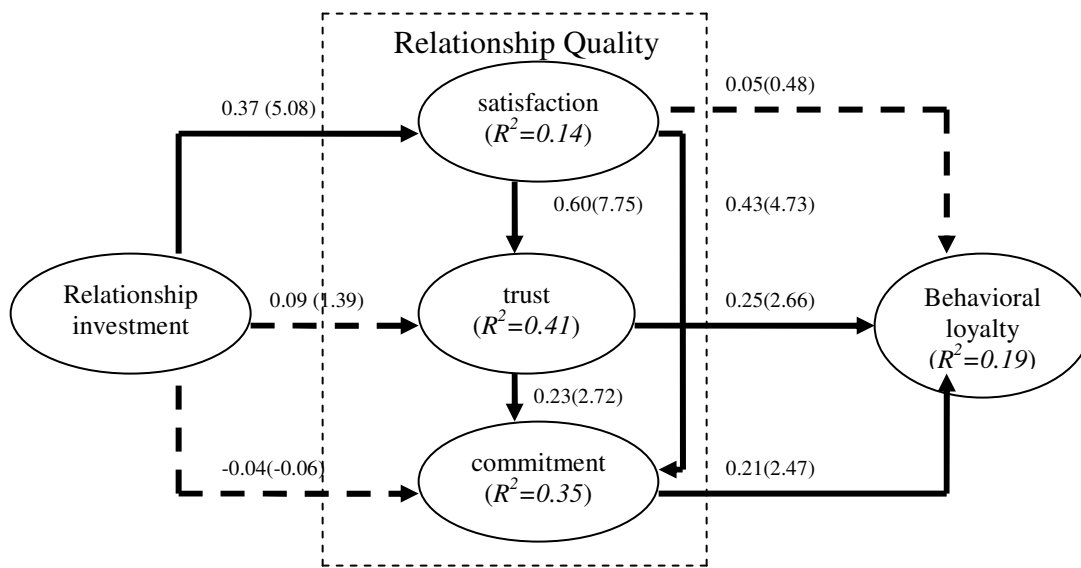
Construct	Items	λ	t-value	SMC	C.R.	AVE
Relationship Investment	Ri1	0.967		0.936	0.96	0.89
	Ri2	0.954	32.362	0.910		
	Ri3	0.951	31.777	0.904		
Relationship Satisfaction	Sat1	0.863		0.745	0.80	0.63
	Sat2	0.882	15.718	0.779		
	Sat3	0.863	15.233	0.745		
Trust	Tru1	0.831		0.691	0.86	0.75
	Tru2	0.935	17.357	0.875		
	Tru3	0.953	17.774	0.908		
Relationship Commitment	Com1	0.921		0.849	0.88	0.76
	Com2	0.989	27.625	0.978		
	Com3	0.866	19.257	0.750		
Behavioral Loyalty	Loy1	0.944		0.891	0.92	0.80
	Loy2	0.965	29.392	0.931		
	Loy3	0.933	25.842	0.870		

λ : factor loading; SMC: Square multiple correlation; CR: composite reliability ; AVE: average variance extracted

Table 2: Discriminate Validity

Concept	Mean	SD	RI	SAT	TRU	COM	LOY
RI	4.95	1.13	0.89				
SAT	4.97	1.39	0.344	0.65			
TRU	4.96	1.44	0.301	0.593	0.75		
COM	5.36	1.42	0.185	0.536	0.476	0.76	
LOY	5.14	1.49	0.134	0.309	0.362	0.354	0.80

Diagonal elements are average variance extracted. Off-diagonal elements are shared variances between factors.



Standardized Coefficient with T-value
Figure 2: Results of Structure Model Estimating

commitment has a significant and positive effect on behavioral loyalty ($\beta = 0.67$; t value = 8.115). As except, H1, H4, H5, H6, H8 and H9 are supported while H2, H3 and H7 are not supported in the proposed model. The R² is 0.14 for satisfaction, 0.41 for trust, 0.35 for commitment, 0.19 for behavioral loyalty.

Conclusions

This study was aimed at investigating the potential role of a forest park's relationship efforts in influencing visitors' attitudes. To this knowledge, it is the first study that demonstrates the effect of relationship investment on behavioral loyalty mediated by satisfaction, trust and commitment in a tourism setting. Before discussion, some limitations might be related to theoretical selection and data collection. For example, additional tangible elements in the tourism mix such as pricing and promotion, product quality and assortment, and service quality could be added as additional antecedents of satisfaction, trust, commitment and loyalty. Future study can keep developing the new model. Another potential shortcoming in this study is data collection. The current study only collected the data from one forest park so that the explanations and applications of the results should be limited. Future study may try to compare different types of forest park or different characteristics of visitors. Furthermore, the study only surveyed in a period, future research needs to adopt a longitudinal design to trace the relationship between the paths from relationship investment to behavioral loyalty.

The results of this study has highly clarified the gap of De Wulf et al.'s (2001) and De Wulf and Odekerken-Schröder's (2003) researchers and offered an initial conclusion that (1) relationship investment significantly have a direct effect on satisfaction, not on trust or commitment; (2) trust and commitment significantly have a direct effect on behavioral loyalty, but satisfaction does not; (3) relations among mediators are clarified that satisfaction significantly impacts trust and commitment, trust significantly impacts commitment.

In summary, relationship investment impacts behavioral loyalty with three ways including relationship investment to satisfaction to trust to behavioral loyalty, relationship investment to satisfaction to commitment to behavioral loyalty and relationship investment to satisfaction to

trust to commitment to behavioral loyalty. Three contributions of this study are discussed as below.

Firstly, apart from product and service efforts, the more relationship investment additionally contributes to visitors' satisfaction. Sending more direct mail, giving them more preferential treatments, adopting good skill of interpersonal communication and rewarding visitors for their patronage to forest park might increase the probability of visitors gaining better affective state resulting from an overall appraisal of his or her relationship with a service provider. The relationship from relationship investment to trust and relationship investment to commitment is not significant. The more relationship investment might not significantly increase visitors' confidence and to let visitors maintain the valuable relationship when they don't perceive satisfied relationship with a service provider. Secondly, this study empirically validated the relationship from satisfaction to trust, satisfaction to commitment and trust to commitment in a business-to-consumer context. In line with previous empirical research on satisfaction, trust and commitment (Bansal, Irving and Taylor 2004; Garbarino and Johnson 1999; Kim, Kim, and Kim 2009; Moliner, Sanchez, Rodriguez, and Callarisa 2006), trust is driven by satisfaction indicating that visitors will have a confidence to trust a service provider when they make a whole evaluation of affective state and perceived satisfaction with this service provider. Commitment is driven by satisfaction indicating that visitors will be committed to a relationship with a service provider when they satisfied with this service provider. Commitment is also driven by trust indicating that visitors will be committed to a relationship with a service provider when they have trust in this service provider. Finally, with regard to satisfaction, trust and commitment, behavioral loyalty is only driven by commitment indicating that visitors will revisit much often and spend more budgets with a service provider when they commit to a relationship with this

service provider. That behavioral loyalty is not significantly driven by satisfaction and trust might probably be caused by lower switching cost and more alternative attractions. As switching costs such as time, money, and effort (Fornel 1992) increased, visitors are more likely to perceive that they are “locked in” to their service providers, which in turn results in them being less likely to switch service providers. Visitors will not revisit much often when they perceived they spend the same time and money switching to other places is easier and visible. Furthermore, to the extent that alternative service providers are perceived to be attractive, visitors are less likely to feel “locked in” with their current service providers, which increases the likelihood of switching (Bansal, Irving and Taylor 2004).

Repeat visitors are an essential asset to any successful business and the most effective way to retain repeat visitors is to attain high visitors’ expectations or to provide a service that exceeds the visitors’ expectations (Kim, Kim, and Kim 2009). However, how to attain visitors’ expectations may be a practically unattainable goal. Fortunately, the results of this study provide useful insights into tourism industry and some more practical implications are suggested herewith.

Relationship investment impacts behavioral loyalty by three ways including relationship investment to satisfaction to trust to behavioral loyalty, relationship investment to satisfaction to commitment to behavioral loyalty and relationship investment to satisfaction to trust to commitment to behavioral loyalty where this relationship investment includes direct mail, preferential treatment, interpersonal communication, and tangible rewards. Firstly, managers could contact with current and potential visitors through direct mail after establishing or obtaining a visitors database. However, what kind of direct mail (e.g., postcard, e-mail, message on internet, phone message etc) to what kind of visitor (e.g., teens, adult, student, office staff,

housekeeper, outside worker etc) will be adapted by manager is another issue for future researchers. Secondly, as Sheth and Parvatiyar (1995) recognized that “implicit in the idea of relationship marketing is consumer focus and consumer selectivity- that is, all consumers do not need to be served in the same way.” Visitors should be served in the right way and preferential treatment should be managed effectively. Developing a regular system for those visitors who want to be served differently is probably needed for manager. What kind of service different groups needed might be an interesting issue. Investigating what does the group and individual visitor need or prefer is an urgent issue for future researchers. Thirdly, with respect to interpersonal communication, De Wulf et al. (2001) demonstrated the crucial role of retail employees who are in direct contact with customers and their employees should be trained and motivated to show warm and personal feelings toward customers. So managers should focus on the issue when hiring store personnel, store management needs to focus on candidates' social abilities that facilitate social interactions with target consumers (Steenkamp and van Trijp 1991).

However, which communicational skill is suitable for visitor and how to make regular customers receive a higher service level than nonregular customers are very important. Future researchers may try to clarify the different needs of interpersonal communication a visitor needed. Finally, Babin, Darden and Griffin (1994) stated that a basic duality of rewards exists for many human behaviors. Suitable tangible rewards can be adapted by manager. However, De Wulf et al. (2001) recognized that as tangible rewards become widespread, their absence may disappoint consume, whereas their presence would not necessarily boost customer retention. Competitors can easily imitate tangible rewards such as frequent flyer programs, customer loyal bonuses, and free gifts. Managers should be more careful when they decided to adapt tangible

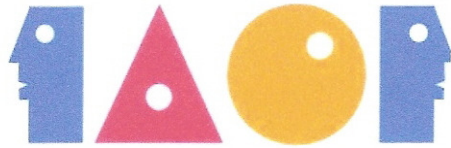
rewards as a marketing tactic. Which tangible reward is effective for a certain group is another issue for future researchers.

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An Empirical Investigation of the Relationships between Moral Intensity and Ethical Decision Making in Electronic Commerce

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Abstract

The purpose of this study is to examine the dimensionality of the moral intensity construct in four ethical online transaction scenarios and how the dimensions directly influence specific processes named moral recognition, moral judgment and moral intention, involved in moral decision making for online transaction consumers in Taiwan. A survey was conducted with 234 internet users. The results indicated that the dimensions of moral intensity were significantly related to moral recognition, moral judgement and moral intention in relation to moral issues. The mediational analyses revealed that moral judgement mediated the relation between moral recognition and moral intention and implied that the effect of moral recognition on moral intention was significantly reduced by a combination of moral recognition and moral judgement.

Keywords: Moral Intensity, Ethical Decision Making, Mediating Analysis, Electronic Commerce

Introduction

Electronic Commerce (E-commerce) has recently received a great deal of media attention due to strong growth in its adoption by both businesses and consumers. While ethical concerns regarding new technologies have increased markedly during recent decades, ethical dilemmas regarding electronic commerce are also pressing becoming increasingly pressing as consumer use of the Internet grows. Online transaction is a popular action but an anonymous environment with strong potential for fraud through E-commerce.

Recently, most studies on ethical issues related to the E-commerce have focused on privacy, intellectual property, and security (Banerjee et al., 1998; Conger and Loch 2001; Leonard et al., 2004). As part of this focus there has been extensive research on ethical perceptions and decision making in both the marketing and information fields. However, there has been little research on potential ethical issues investigates the Internet users in relation to online transactions. Several studies have discussed the processes involved in ethical consumer decision-making (Callen and Ownbey, 2003; Tan, 2002; Vitell et al., 2001). A recent review of the empirical literature on ethical decision making (O'Fallon and Butterfield, 2005) noted that there is little empirical research directed toward testing such theories in Chinese society. They reviewed 174 published articles from 1996 to 2003, of which, we are not aware of any Taiwanese literature on the relationship between moral intensity and ethical decision making in E-commerce context. Therefore, the purpose of this study was to apply Jones's (1991) theoretical model to the ethical decision-making process for Internet users regarding online transactions. It sought to contribute to the existing literature on ethics within the academic curriculum and, in particular, to focus on ethics within E-commerce in Taiwan.

Literature and Hypotheses

Most recent studies have applied a model of the ethical decision-making process developed by Jones (1991) in research on business ethics. This built upon the comprehensive four-stage process of Rest (1986), including the stages of moral recognition, moral judgement, moral intention and moral behaviour, to link with the theoretical model of ethical decision making by integrating moral intensity. Rest (1986) observed that his model had a logical sequence of steps which have distinct functions and interact with each other.

According to Jones (1991, pp.374-378), moral intensity comprises magnitude of consequences, social consensus, probability of effect, temporal immediacy, proximity, and concentration of effect. Jones (1991) hypothesised that the dimensions of moral intensity directly affect each of the first three stages (moral recognition, moral judgement, and moral intention) in the ethical decision-making process (see Figure 1). Previous studies have examined the influence of the dimensions of moral intensity on the above three stages (Singhapakdi, Rao & Vitell, 1996; Frey, 2000; May and Pauli, 2002). These studies found the dimensions of moral intensity to significantly influence the moral decision-making process of various subjects. However, to our knowledge no study has investigated how these dimensions influence the specific steps involved in the moral decision-making process of internet users dealing with online transaction. The hypotheses for our research were developed by following Jones's theoretical framework, as in Figure 1.

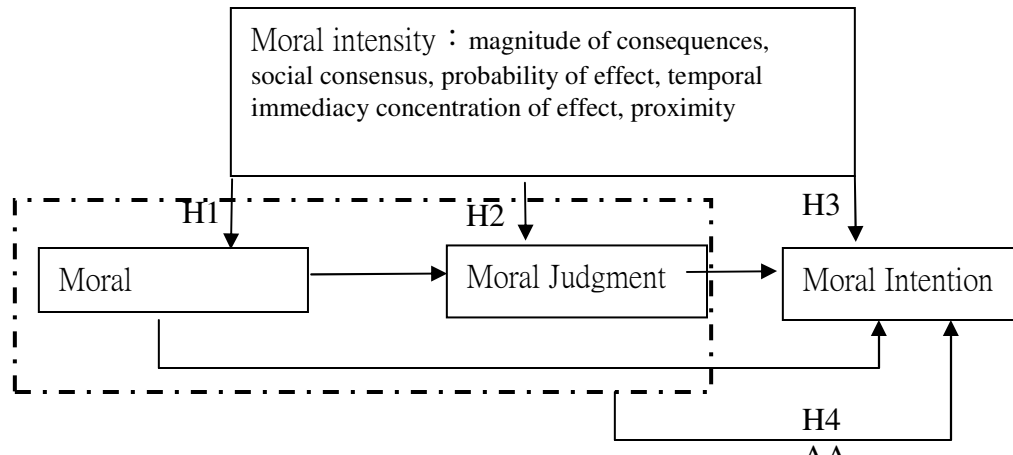


Figure 1: A Theoretical Framework for The Perception Of Moral Intensity In Ethical Decision Making Process (Adapted From Jones, 1991)

Moral recognition is the awareness of what actions are possible in a particular situation (Rest, 1986). Individuals must recognise an issue as ethical before considering its ethicality in detail (Hunt and Vitell, 1986; Jones, 1991). Jones (1991) observed that the intensity of an ethical issue affects its salience and vividness. Moral issues that possess high intensity (more unethical) will be recognised more often than issues of low intensity (less unethical). Prior empirical researches (Wright and Cullinan, 1997; Wright, Cullinan & Blin, 1998) have assessed the importance of moral intensity on the moral recognition of accountants. In an investigation of members of the American Marketing Association, Singhapakdi *et al.* (1996) found that all six dimensions of moral intensity influenced the ethical perceptions of marketing professionals. Furthermore, Dukerich *et al.* (2000) and Frey (2000) found that dimensions of moral intensity significantly influenced individual recognition of the ethical content of issues. Thus, we hypothesised:

H1: In ethical scenarios, the dimensions of moral intensity will be significantly related to the moral recognition of those engaged in online transactions.

Moral judgement refers to the ability of the individual to decide between what is right and wrong (Rest, 1986). Moral judgement differs according to individual level of moral development, which is a personal trait; but moral judgement is process oriented (Reidenbach *et al.*, 1995). Jones (1991) also stated that moral intensity influences moral judgement. Individuals are more apt to devote time and energy in situations of high moral intensity and economise their efforts in situations of low moral intensity. Some empirical studies have examined the influence of components of moral intensity on moral judgement with marketing professionals (Singhapakdi *et al.*, 1996), executive Master of Business Administration (MBA) students (Davis, Johnson & Ohmer, 1998), and business professionals (Frey, 2000) with various results. These studies have indicated support for Jones's (1991) model by suggesting that the dimensions of moral intensity were significantly related to the moral judgement of the respondents. This study thus hypothesises:

H2: In ethical scenarios, the dimensions of moral intensity will be significantly related to the moral judgment of those engaged in online transactions.

Moral intention refers to the prioritising of moral values above other personal values (Harrington, 1997). In ethical decision-making contexts, the intention of an individual is the expressed likelihood that the individual will perform a specific action (Hunt and Vitell, 1986). Jones (1991) postulated that moral intention would be established more frequently with issues of high moral intensity than those of low intensity. Previous studies have found moral intensity to be positively linked to the intention of decision makers (Jones, 1991; Harrington, 1997). Singhapakdi *et al.* (1996) also found that perceived moral intensity had a direct effect on moral intentions. Most recently, Tan (2002) developed a scenario involving the purchase of copied software to investigate the relationship between moral intensity and moral intention. Tan found

that consumer purchase intentions increase with the moral intensity of online transaction consumers. Thus, we hypothesize:

H3: In ethical scenarios, the dimensions of moral intensity will be significantly related to the moral intentions of those engaged in online transactions.

As observed above, Jones (1991) proposed that moral intensity would directly influence each stage of his ethical decision-making framework. His model also suggests that moral recognition would directly influence moral judgement. Next, moral recognition was proposed by Jones (1991) to influence moral intention only through moral judgement. That is, consistent with Rest (1986), no direct relation between moral recognition and intention was proposed in his issue-contingent model of ethical decision making. Thus, we expected moral judgement to mediate the relation between moral recognition and intention. Therefore, we hypothesised:

H4: Moral judgement will mediate the relation between moral recognition and moral intention.

Methodology

As the research is willing to test the moral perception of the Internet users, the authors post the questionnaire to a popular survey website – my3q.com, which allow register create questionnaire to be open public for six months. Initially, this research collected 497 of questionnaires through the survey website within 6 six months. Of the initial sample, we took out the uncompleted questionnaires and 234 were eligible to participate in the study finally, for an overall response rate of 39.67%. The respondents were 52.6% male, with females making up 47.4% of sample. The majority of the respondents were 20-29 years old (69.7%). Approximately 50.4 percent of respondents spent two to four hours online each day, while 30.3 percent spent five to seven hours online. Asked whether they had ever bought merchandise through online transaction, 74.8% had and 25.2% had not bought merchandise through online transaction.

The questionnaire consisted of four scenarios accompanied by questions designed to identify the ethical attitudes of respondents. Based on the results of interviewing 200 college students, the authors considered real situations involving online transaction behavior appropriate to Taiwan in developing four ethical scenarios related to online transactions, each containing questions related nine items dealing with ethical variables yielding a appropriate reliability of α 0.80. The main ethical issues of scenarios are discussed below:

Providing consumers' data. A threat to the consumers' personal information privacy is implied in the first scenario. Therefore the respondents may perceive the marketer of this scenario as an unethical action.

Misrepresenting product. The central issue, in the second scenario, is an online auction involves product misrepresentation which could possibly threaten the accuracy of the product received by consumers. Therefore the respondents should perceive the central issue of the marketer in this scenario as unethical behavior.

Failure to pay the bid. The central issue, in the third scenario, is that the online auction winner would not pay the bidden item because he (or she) has found a cheaper price than which he (or she) asked. Therefore the respondents should also perceive this winner (consumer) in this scenario as unethical behavior.

Using false accounts. The fourth scenario depicts actions that music online member registered many false accounts in order to download free music. As a result, the respondents may also perceive the member (consumer) of this scenario as involving unethical behavior.

Results

Table 1 lists means and standard deviations for the studied scenarios. On average, students considered the actions represented in the scenarios to lie between unethical and the most

unethical, with scores ranging from 4.27 to 6.61, where a neutral rating = 4. Overall, the perceived moral variables seemed to vary depending on the nature of the scenario situation.

Dimensionality of moral intensity

The moral intensity scale reliability analysis yielded acceptable individual alpha coefficients (0.70 or higher, Hair et al., 1998), for each scenario. The individual alpha coefficients were as follows: Scenario 1 $\alpha=0.80$; Scenario 2 $\alpha=0.796$; Scenario 3 $\alpha=0.827$; Scenario 4 $\alpha=0.805$ (see Table 2).

Exploratory factor analysis was performed on the six individual components of moral intensity for each of the four scenarios. The Kaiser-Meyer-Olkin measure of sampling adequacy ranged from 0.796 to 0.827, indicating that factor analysis was an appropriate technique (Hair et al., 1998). Table 2 lists the results of factor analysis for all scenarios using varimax rotations and

Table 1: Means and Standard Deviations For Primary Variables By Scenario (N=234)

Variables of interest	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	Means	S.D.	Means	S.D.	Means	S.D.	Means	S.D.
Recognition	6.28	1.07	6.61	0.67	5.36	1.38	5.81	1.19
Judgment	6.34	1.11	6.59	0.76	5.31	1.37	5.58	1.26
Intention	6.15	1.31	6.46	0.90	4.76	1.63	5.11	1.66
Magnitude of consequences	6.24	1.19	6.30	0.99	4.48	1.41	5.15	1.59
Social consensus	6.38	0.90	6.16	0.98	4.69	1.40	5.03	1.53
Probability of effect	5.95	1.30	6.09	1.17	4.27	1.42	4.91	1.62
Temporal immediacy	5.48	1.48	5.85	1.40	4.35	1.36	4.91	1.62
Concentration of effect	6.15	1.10	6.21	1.10	4.62	1.61	5.10	1.61
proximity	6.04	1.36	6.07	1.10	4.77	1.32	5.35	1.49

demonstrates that moral intensity could be separated into two dimensions (factors). Factor one comprises probability of effect, magnitude of consequences, concentration of effect, and temporal immediacy. This factor could be labeled the “perceived potential harm” and explained

between 46.11 to 48.28 percent of the variance depending upon the scenarios. The second factor consisted of the proximity and social consensus and was labeled “perceived social pressure”. This factor explained between 22.552 to 24.793 percent of the variance depending upon the specific scenario. The same two-factor solution for moral intensity was supported in all scenarios.

Table 2: Factor Analysis Of Moral Intensity Items By Scenario

Scenario	Perceived factor	Moral intensity items	Factor loadings	Eigen value	Variance Explained	α Value
1: Providing consumers' data	Potential harm	magnitude of consequence	0.87	2.791	46.516%	0.80
		concentration of effect	0.83			
		probability of effect	0.82			
	Social pressure	temporal immediacy	0.75	1.419	23.651%	
		Proximity	0.86			
		social consensus	0.70			
2: Mis-presenting product	Potential harm	probability of effect	0.89	2.767	46.110%	0.78
		concentration of effect	0.86			
		magnitude of consequence	0.82			
	Social pressure	temporal immediacy	0.68	1.353	22.552%	
		social consensus	0.87			
		Proximity	0.70			
3: Failure to pay the bid	Potential harm	probability of effect	0.90	2.895	48.258%	0.83
		temporal immediacy	0.85			
		magnitude of consequence	0.84			
	Social pressure	concentration of effect	0.76	1.488	24.793%	
		Proximity	0.87			
		social consensus	0.77			
4: Using false accounts	Potential harm	probability of effect	0.88	2.897	48.280%	0.81
		temporal immediacy	0.87			
		magnitude of consequence	0.80			
	Social pressure	concentration of effect	0.77	1.361	22.681%	
		Proximity	0.90			
		Social consensus	0.67			

The Relationship Between Intensity And Ethical Decision Making Process

To examine the relationship between moral intensity and ethical decision making, a preliminary correlation analysis of the two dimensions of moral intensity and ethical decision

making (moral recognition, moral judgement, and moral intention) was performed for all four scenarios. The analytical results (table 3) revealed that, with two exceptions, the two dimensions were significantly and positively correlated with the three steps of ethical decision making. Separate regression analyses were then performed for each of the four scenarios, with ethical decision making as the dependent variable and the two dimensions of moral intensity as independent variables. The results are listed in Table 4 and indicate that both dimensions of moral intensity significantly predicted ethical decision making. The findings suggest that the various dimensions of moral intensity were significant predictors of moral recognition, moral judgement and intention. Therefore, hypotheses 1, 2, and 3 were borne out for all scenarios.

Ethical Decision Making Framework and Moral Judgment Mediation

To test whether moral judgement mediated the relationship between moral recognition and moral intention, a series of regressions were run following the four-step process for mediation analyses used by Baron and Kenny (1986). In the first regression model, we hypothesised that moral recognition (independent) would have a significant effect on moral intention (dependent). In the second model, we hypothesised that moral recognition (independent) would significantly

Table 3: Correlations Analysis Among Moral Intensity and Ethical Decision Making

Scenario	Intensity dimension	Recognition	Judgment	Intention
1: Providing consumers' data	Potential harm	.346**	.477**	.495**
	Social pressure	.418**	.372**	.304**
2: Misrepresenting product	Potential harm	.334**	.456**	.349**
	Social pressure	.162*	.184**	.162*
3: Failure to pay the bid	Potential harm	.426**	.464**	.482**
	Social pressure	.280**	.349**	.458**
4: Using false accounts	Potential harm	.334**	.517**	.472**
	Social pressure	.452**	.323**	.320**

*p<0.05, **p<0.01

influence moral judgement (mediator). Furthermore, in the third model, we hypothesised moral judgement (mediator) would be significantly related to moral intention (dependent variable). If the results of the above three models were acceptable, we intended to proceed with a multiple regression model, in which we expected that the effect of moral recognition on intention would be reduced by the combination of moral recognition and moral judgement. In the fourth model, if the independent variable (moral recognition) was no longer significant when the mediator (moral judgement) was controlled, the finding would support *full (complete) mediation*. If the independent variable were still significant (i.e., both independent variable and mediator significantly predicted the dependent variable), the finding would support *partial mediation* (Wood *et al.*, 2008).

Table 4: Multiple Regressions: Moral Intensity Dimensions and Moral Decision Making Process

Scenario	Independent variables	Dependent variables		
		Recognition	Judgment	Intention
1: Providing consumers' data	Intensity dimension			
	Potential harm β	.346**	.477**	.495**
	Social pressure β	.418**	.372**	.304**
	Adjusted R ²	.0288	.260	.332
	F Value	48.163**	66.547**	58.973**
2: Misrepresenting product	Intensity dimension			
	Potential harm β	.334**	.456**	.349**
	Social pressure β	.162**	.184**	.162**
	Adjusted R ²	.130	.235	.141
	F Value	18.474**	36.805**	20.073**
3: Failure to pay the bid	Intensity dimension			
	Potential harm β	.426**	.464**	.482**
	Social pressure β	.280**	.349**	.458**
	Adjusted R ²	.254	.331	.437
	F Value	40.585***	58.679***	91.592**
4: Using false accounts	Intensity dimension			
	Potential harm β	.334**	.517**	.472**
	Social pressure β	.452**	.323**	.320**
	Adjusted R ²	.310	.366	.319
	F Value	53.320**	68.244**	55.686**

*p<0.05, **p<0.01

Table 5 lists the analytical results for the mediating effect of moral judgement between moral recognition and moral intention. Model 1, 2 and 3 were supported in all scenarios (see panel A & B). Thus, Model 4 was implemented (see Panel A), demonstrating that the effect of moral recognition on moral intention was significantly reduced by a combination of moral recognition and moral judgement (β value was reduced from 0.42 to 0.21 in Scenario 1; β value was reduced from 0.30 to 0.12 in Scenario 2; β value was reduced from 0.45 to 0.17 in Scenario 3; and, β value was reduced from 0.39 to 0.18 in Scenario 4). As moral recognition was still significant when moral judgement was controlled, there was evidence to support partial mediation.

Table 5: Regression Results For The Mediating Effect Of Moral Judgement Between Moral Recognition And Moral Intention

Panel A

Variable	Moral Intention							
	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	β_1	R ¹	β_2	R ²	β_3	R ²	β_4	R ²
Model 1:								
Recognition	.42**	.18	.30**	.09	.45**	.20	.39**	.15
Model 3:								
Judgement	.54**	.29	.45**	.20	.57**	.20	.46**	.15
Model 4:								
Recognition	.21**	.32	.12**	.20	.17**	.34	.18**	.23
Judgement	.44**		.39**		.57**		.36**	

Panel B

Model 2	Moral Judgement							
	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	β_1	R ²	β_2	R ²	β_3	R ²	β_4	R ²
Recognition	.48**	.23	.48**	.22	.60**	.36	.59**	.35

*p<0.05, **p<0.01

Conclusion and Implications

This study extended the theoretical model of Jones (1991) to moral decision-making process within the field of E-commerce. In particular, this investigation examined the dimensionality of

the moral intensity construct in four ethical online transaction scenarios and how the dimensions directly influence specific processes named moral recognition, moral judgment and moral intention, involved in moral decision making for online transaction consumers in Taiwan.

The factor analysis suggested that the six components of moral intensity identified by Jones could be synthesised into two dimensions, 'potential harm' and 'social pressure'. Two dimensions were assessed to determine if they were predictors of student moral recognition, moral judgement and moral intention. As expected, the results of the current study indicate that both dimensions were significant predictors of ethical decision making in the four scenarios, consistent with the studies of Barnett (2001) and Singhapakdi *et al.* (1996), which yielded similar results regarding the dimensions of moral intensity in relation to the moral decision-making processes. Practitioners interested in encouraging ethical behaviour might wish to focus attention on employees' recognition of the consequences of actions and on developing an organisational consensus on what constitutes ethical/unethical behaviour in specific decision-making situations. Thus, there is further evidence that the moral intensity of the moral issue is considered significant by E-commerce practitioners when making decisions about whether or not an ethical problem exists and when considering courses of action to follow in ethical situations.

This study also identified a positive relationship between moral recognition and moral judgement, similar to that found in other studies (Singhapakdi *et al.* 1996; Banerjee, Cronan and Jones, 1998). This finding was extended to examine the relationship between these two factors and moral intention, which revealed that both moral recognition and moral judgement were good predictors of moral intention. Our mediating analyses indicated that moral judgement mediated the relationship between moral recognition and moral intention. The findings suggest that the effect on the link between individuals' moral recognition and their intention to engage in moral

judgement was tied to perceived importance. Overall, our study suggests that future theorising and empirical work in ethical decision making should consider the role of moral intensity and the significant mediating role of philosophically based moral judgement.

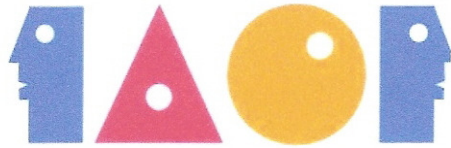
The findings of this work provide a valuable reference for business educators and internet users. Hopefully, the research results can help educators in integrating ethical instructional components into the computer science curriculum to satisfy professional initiative. The dimensions of perceived moral intensity give faculties more tools for addressing ethical scenarios and ethical role-playing. For example, professors can give lectures and organize open discussions on moral intensity issues, thus improving understanding of why student judgments regarding ethical recognition scenarios vary. When students are online, they gain insight into their own moral judgments regarding E-commerce behavior. Similarly, marketers in business organizations are likely to vary their intentions regarding ethical behaviors based on the potential harm and social consensus dimensions of moral intensity. Thus, executives may use the criteria contained in the dimensions to decide whether a specific situation contains an ethical problem, and then can train employees as to ethical issues they are likely to face at work.

With the accelerating growth of E-commerce, online transactions are increasingly common. As E-commerce evolves, so do the associated ethical issues. It is increasingly apparent to those doing business online that there is a need to instill ethical values into the industry. However, moral intensity and decision making processes can vary as individuals face different ethical situations, this study employing four hypothetical scenarios rather than using real world moral dilemmas, may have yielded different findings, and all variables were measured via self-reporting using a survey methodology that may influence the results, representing the final potential limitation of this study.

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RESEARCH ON HARDWARE COMPONENT DESIGN MODEL
OF RECONFIGURABLE ROUTER

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Abstract

As the new agreement and the business continue to emerge, the rigidity of traditional routers and closed the upper unable to meet its business development in the evolution of freedom and therefore the standardization of component-based open-assembled reconfigurable router is the trend of future development. In this paper, the router in reconfigurable hardware component model, through the formal description elements is conducive to the development of independent components. Component in the function and performance testing on the basis of and reconstruction of particle size as the basic component, the upper by mapping business processes to the underlying component assembly mechanism for the assembly of components between the changes in the way to deal with the evolution of the top business in order to achieve the function of routing reconfigurable platform.

Keywords: Component Assembly, Reconfigurable Router, Formalization, Size, Function Reconstruction

Introduction

The existing information network has been along for the business support the development of the technical system, that is, a network of support services as a major mode of tight coupling, such as telecommunications networks, as well as television networks such as the Internet (Next Generation Networks and the Cisco Carrier Routing System, White Paper, 2005). As a result of the upgrade and expansion of nodes can only be implemented by the original equipment provider, can not be achieved between different equipment manufacturers face the unified access to the endless stream of new business requirements, giving rise to a new business, have to be original equipment providers equipment to upgrade or transform, making the underlying network equipment design capability is far behind the top business development. Therefore, there is an urgent need to design a new routing architecture of switching nodes, to solve the existing network equipment in the open, standardized, component-based problems and so on.

Reconfigurable router is the core of the standardization of component design, through the introduction of elements of the network equipment design method (Penix J, Alexander P., 1997), so that the lengthy production process into network equipment is similar to architecture in a building block of the component assembly process, thus greatly reducing network equipment development time (Bracciali A, Brogi A, Canal C, 2005). To components for the smallest particle size, the dynamic realization of the update components, add and delete routing equipment to achieve the flexible restructuring of service functions, resulting in the need to support different business functions of the network node equipment and services to support multi-service integration, the Reconfigurable router to follow the development of business evolution, which has a strong ability to self-reconfiguration (Reussner R H, Becker S, Firus V, 2004).

In this paper, we mainly discussed the abstract model of hardware components and the assembly mechanism of component in switching equipment. First of all, the basis for the definition of quaternion components group attributes, and explain the basis of the internal components of the formal process, and then used to build complex details of the four components of the atomic assembly of the most basic way, and after assembly derived the form of composite components description, and finally conclusions are given and research the next step.

At present, many research institutions in the software aspects of reconfigurable routers proposed a number of valuable results. Scout is at Princeton University, the University of Arizona and the joint development of a modular communications-oriented operating system (Montz AB, Mosberger D, O'Malley SW, Peterson LL, Proebsting TA, 1995), and proposed a "path" of the abstract, for instructions to receive data from the beginning to send feature function components adopted by the end of the path. Click to MIT by the United States a component from the composition of fine-grained software router (Kohler E, 2001), the design goal is to make software more flexible router and easy to configure and manage. Routers Plug-ins from the United States Washington University and the ETH Zurich for a class of joint research and development of software reconfigurable router (Decasper D, Dittia Z, Parulkar G, Plattner B, 2000), the main idea is the dynamic run-time network subsystem plus/uninstall plug-ins (Plugins), through a plug-in control unit with other types of components provide the core components or other plug-in interface between the control path.

Reconfigurable router software advantage is its flexibility, but in dealing with the lack of capacity and performance, and therefore, it is necessary to introduce a hardware router in reconfigurable technology. DC Lee and others in the literature (Lee D C, Midkiff S F, 1998) proposed a reconfigurable router (reconfigurable router) the concept that the dynamic

reconfigurable router to improve network performance, with better adaptability. Paper (Lee D C, Harper S J, Athanas P M, et al, 1999) proposed a stream-based reconfigurable router prototype, and realized the reconfigurable hardware with FPGA. University of Washington research group reconfigurable based on the FPX (field-programmable port extender) to achieve dynamic reconfigurable router solution (Albrecht C, Foag J, Koch R, et al, 2006), and its aim is to make full use of reconfigurable high-performance and flexibility of hardware, development Application of the new network.

Reconfigurable router model for more than just for the router part of the functions of reconstruction, the function does not take a third-party modules loaded and thus the evolution of its business to support the capacity of the upper limited. If the router as the outside world as the computer systems of different manufacturers of motherboards, peripherals, memory, operating system, the different layers of software products can be integrated with a number of components, then its reconstruction will greatly increase the ability . Through the constant renewal of the underlying components, replacement and upgrades to the router with a reconfigurable functional capacity of the network equipment and the lengthy production process is similar to architecture in a building block components to the assembly process is conducive to the development of network equipment to shorten the time (Houidi, I., Louati, W., Zeghlache, D., 2006).

Formal Description of the Hardware Component Model

From the perspective of system integration, component is the functional unit which is packaged with a black-box nature and connected only through its own interaction with the outside.

In the switching or routing equipment, the potential target the hardware components to deal with is the input message; From the point of view of assembly components, the only

concern in the message is flow between components, that is, which interface from component to input, by processing of the component, which interface from component to output, and then flows to which interface of another component. As a result of its internal process by the hardware component is through events triggered, so the components must be set up the trigger condition. The object which must satisfy the trigger mechanism will be dealt with, that is the importation of components that must be met input constraints can output; otherwise, the hardware components have been running to deal with space state.

Based on the above features, the hardware component is defined as quaternion group by the input interface set, the trigger conditions set, feature set and the output interface quaternion set, the definition of the attribute (Hardware Component) (I, C, F, O), its black-box model is shown in Figure 1: I denotes that the elements of input interface, for example, $I = \{I_1, I_2, I_3\}$ that is to say the component has three input interfaces; O denotes that the output interface of the component; C denotes that the component set of trigger conditions. The object only to meet their trigger conditions $Q(x)$ will be deal with. Otherwise, the object will not be processed by this component.

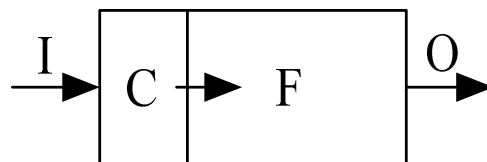


Figure 1 Definition of quaternion group of hardware component model

As an example of the component to support IPv4 packet forwarding, since the components based on standardization of interface design can be arbitrary interconnection. So, IPv4 packet forwarding component support other types of message input, but only the importation of IPv4 is the message of the component processing and output the results; the other types of messages are

discarded for the processing. Thereby triggering IPv4 forwarding conditions is $C = \{IPv4\}$. As the inside relates to complex processes of the keyword extraction, as well as features such as look-up table, through the external interface to encapsulate its internal implementation details, through F to express formal support of this component and does not need to care about their internal specific the realization of the process.

The Logic of Functional Testing of Hardware Components

Hardware components based on the abstract description of logic functions is in favor of opening component manufacturers in different independent. In the component development process using black-box model separates the interface and its internal function, thus shielding the internal functions of the specific implementation details. Using an open and standardized interface definition realizes interconnection between different components and hardware components based on the data coupling, as shown in Figure 2.

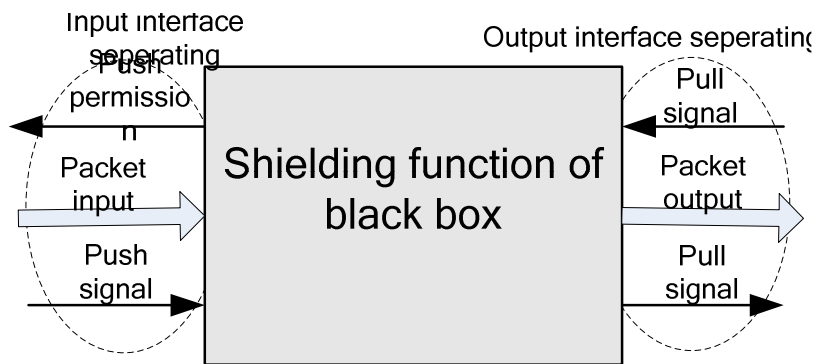


Figure 2 Logic test of hardware components of the black box model

The functional components based on unified interface of different vendors take functionality and performance testing, not only to ensure that the correct functional of components, but also to provide the component performance parameters. Functional testing of hardware components are relatively simple, it is that the output of the results of the hardware

components is matching pre-set pattern in order to determine whether the output is correct. For giving the result of packet out-of-order, packet loss rate, as well as processing delay based on component model in different sources, we use of VHDL hardware programming language to realize Bernoulli (Bernoulli) and burst (Burst) business source generator, as shown in Figure 3. The program is only to support the fixed-length packet message and to put reconfigurable devices (FPGA) in the internal clock cycle as the basic unit of time. We design standardized packet format, schedule its bit wide 128 bit, and take the first cycle for testing carrying packet head.

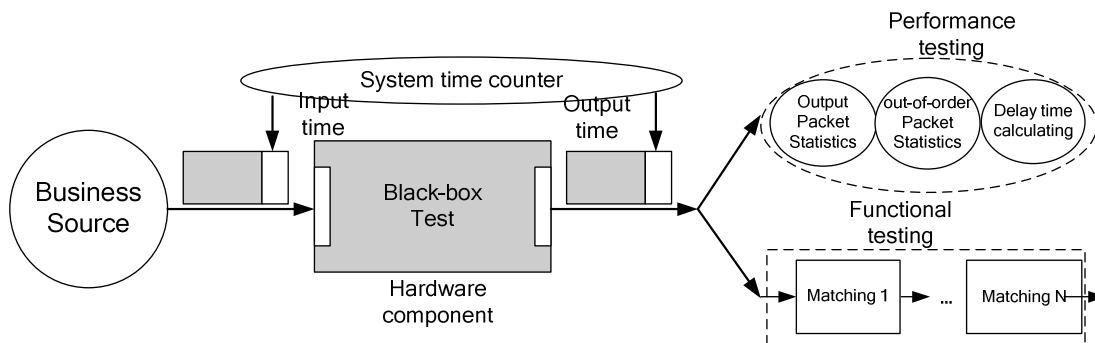


Figure 3 Testing processes of hardware components

Temporarily it will change carrying packet head as the specific content of testing and do not care about the packet data. When packet is input or output component, implanted in his head of the division of temporal and spatial attributes, such as Table 1, it mainly contains serial number of groups, the time of inputting and outputting attributes and so on. The other parts of the first division to be filled a fixed value.

Table 1 Temporal and spatial attributes of the first division

Bits	32	32	32	32
Attributes	The serial number of groups	The time of inputting	The time of outputting	Reservations

The serial number of groups is for setting the number of generated business group source and for counting the total number of packet generated by testing process; It is also in accordance with the serial number of outputting groups to determine whether there are any out-of-order packets in the components of the treatment process, and then recording the number of out-of-order packet. The time of inputting is the time of packet inputting the system of the hardware components, which is the start of packet processing time. The time of outputting is the time of packet outputting the system of the hardware components, which is the end of packet processing time? The delay of packet processing is subtracting between the time of outputting and the time of inputting. Through the statistics of the number of component outputting, we can calculate of the packet loss rate of the hardware components.

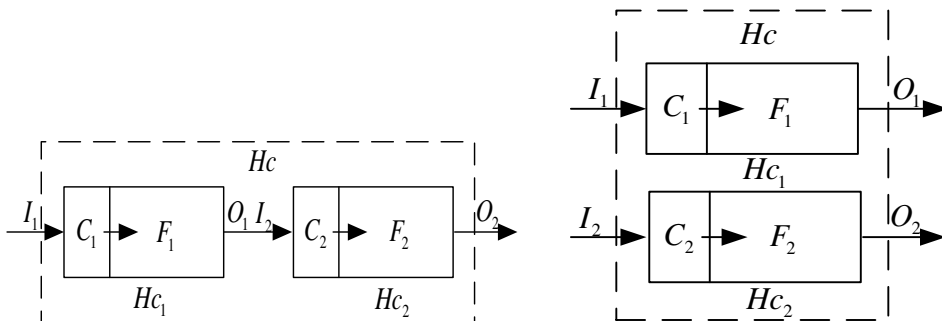
Component of Functional Reorganization

Reconfigurable router in the use of design elements to function as the basic component size, complexity of the top business need to complete a number of common components. Business process layer corresponds to the division between the different components of the flow, through the mapping operations will be allocated to the bottom of the upper component specific implementation, the upper function of the decision process between the different components of the assembly. A simple message processing for example, including input, forwarding and processing the output of three, As shown in table 2, if the reconfigurable router line card corresponding to the importation of processing elements, processing elements, as well as forwarding the output line card processing components, through the series of these three components can be the basic message processing.

Table 2 Process mapping and component assembly

Process	Input processing	Forward processing	Output processing
Component assembly	Line card component input	Forward to deal with component	Output Component Line Card

By mapping business for the bottom of the upper component of the assembly between the different methods, when the high-level service changes, the assembly methods of components will change, and update, add or remove the examples of the underlying components at the same time. Reconfigurable Component-based routing is the essence of an exchange platform between multiple component assembly process, the assembly is similar thinking in the field of software engineering, architecture plug and socket (plug and socket architecture) (Zhang S K, Zhang W J, Chang X, et al, 2001) , According to the top before and after the relationship between business, the elements of interconnection between the different ways. According to deal with objects in the flow of the interconnection between components, the components from the complex interconnection of four methods to extract the most basic component assembly, that is no longer sub-assembly approach, called atomic assembly, Is the order of their respective, parallel, branching and polymerization assembly method shown in Figure 4, the above four component assembly manner corresponding to the order of messages, parallel, branch and the four basic polymerization processes.



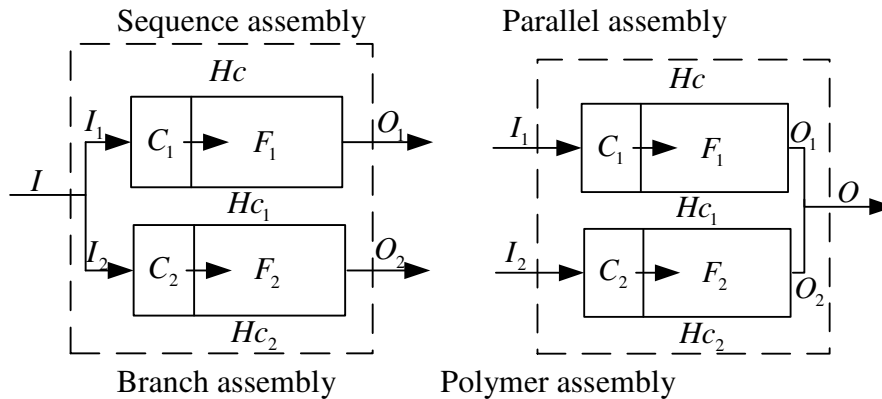


Figure 4 atoms assembled four basic ways

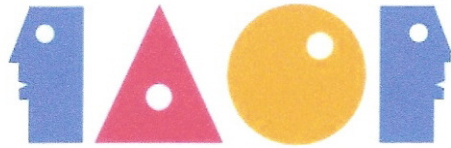
Through the assembly of above four components, it can realize task interconnection between multi-components, thereby corresponding to the complex processing of handling objects in the upper level. When the upper flow from changes in the future by adding, deleting and updating of different components, and change the way the interconnection between components in response to deal with changes in object processing.

The Logic of Functional Testing of Hardware Components

This paper first introduces the research of the router and pointed out that the openness of the future, the router may be reconfiguration of the development trend, thus the introduction of the assembly mechanism of component-based reconfigurable router architecture. Based on the formal description of hardware components and four different group attributes, it is in favor of opening independent components between different manufacturers. Through the functional and performance testing for components, abstracted four basic mechanisms of component composition based on component which is the smallest reconfigurable particle size. By the top business processes mapped to the underlying mechanism of component composition, so that changes in the basic inter-component assembly approach to the upper function should continue to update, add or remove in order to achieve the continuous evolution of their functions.

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ARE TRAVEL AGENTS IN TAIWAN READY FOR COMPUTER TECHNOLOGY?

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Abstract

The purpose of this study was to investigate the factors which will affect Taiwanese travel agents' behavioral intention to use computer technology. The present research was conducted based on the research model derived from the Technology Acceptance Model (TAM). The survey questionnaire was created and then published on a website and all the selected consolidated travel agencies received an email with the universal resource location (URL) of the survey website. Two hundred questionnaires were collected in order to investigate how the Taiwanese travel agents' attitudes regarding using computer and subjective norm affect their behavioral intention to use computers. The study was conducted to examine relationships between attitude towards use (A), subjective norm (SN) and behavioral intention (BI) to use computers. A multiple regression analysis was conducted to predict the BI from A and SN. The predictors were the A and SN, while the criterion variable was the BI. Means and standard deviations of study and Pearson product-moment correlation coefficients between the predictors and criterion variable were reported in the study. The results indicate that both attitude towards use (A) and subjective norm (SN) were important to individuals' behavioral intention (BI) to use computers, and attitude towards use was more influential than subjective norm on behavioral intention.

Keywords: Technology Acceptance Model (TAM), Attitude Towards Use (A), Subject Norm Towards Use (SN), Behavioral Intention Towards Use (BI).

Introduction

As a result of Taiwan's rapid economic growth and the increasing amount of disposable income, traveling has become a popular activity for many people. This has supported the development of Taiwan's travel industry.

Traditionally, travel agencies play an important role as intermediaries between airline companies, wholesale travel companies, hotels and customers. Online markets based on Internet technology offer customers an opportunity to search information easily and make purchases conveniently (Yang, Flynn, & Anderson, 2003). The major threat for traditional travel agencies comes from airlines and wholesale travel companies which offer their products and services directly to customers online bypassing the bridge role of travel agencies (Barnett & Standing, 2001). Meanwhile, online travel agencies provide another avenue for customers to conduct travel-related business. This also makes the travel industry more competitive. Despite the threat of disintermediation from customers using the Internet to purchase travel products in a do-it-yourself manner and competition from virtual online travel agencies, the Internet and web technology have also created opportunities for traditional brick-and-mortar travel agencies by providing additional online services and a virtual commerce platform to serve customers anytime from anywhere.

The popularity of the Internet and the World Wide Web has created new opportunities for travel agencies to conduct business with their customers. In terms of online commerce in Taiwan, online travel accounted for 68% of the total Business To Customer (B2C) online sales, up 20% compared with 2003 according to the survey from ACI-FIND, III ("B2C E-Commerce in Taiwan 2004", 2005). Most online travel enterprises had significant growth from 50% to 80% in 2004.

However, there are still stringent impediments especially for small and medium sized brick-and-mortar travel agencies to conduct business online, in particular for E-Commerce applications. These can include lack of specialized knowledge, shortage of skilled employees, and employees' anxiety about using new technology.

Thus, this study is aimed to investigate the factors which will affect Taiwanese travel agents' behavioral intention to use computer technology.

Historical Overview of Theory Development

The user's perceptions and behavior when adopting information technology (IT) and the diffusion of computer technology within workplaces are two important issues in IT related research (Straub, Limayen, & Karahanna-Evaristo, 1995). They are indicators of how well IT can be accepted by people and benefit enterprises. It is believed that IT can be applied to improve employees' productivity, reduce working time and then increase enterprises' competitive advantages. Therefore, computer usage is an important factor to measure IT effectiveness.

The Technology Acceptance Model (TAM) (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989) (see Figure 1) was first introduced to investigate the causal relationship between two constructs—Perceived usefulness (PU) and Perceived ease of use (EOU)-and Attitude to use (A), Behavioral Intention to use (BI) and Actual system use (B).

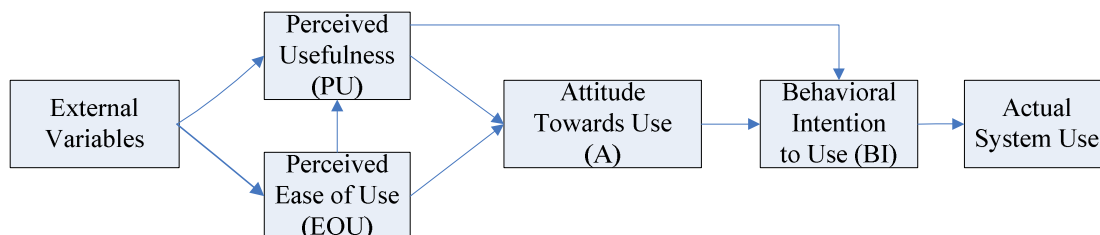


Figure 1. Technology Acceptance Model (Davis et al. 1989)

Based on the TAM model, PU and EOU have influences on attitude (A) which would determine users' intention (BI) toward the usage behavior. In other words, BI is a major determinant of computer usage behavior and can be measured to predict actual behavior.

TAM has become a very important model to explain users' intention and predict their behavior in adopting computer technology (Davis, 1989; Davis, et al., 1989). TAM has been widely applied in research and empirically proven to be appropriate for examining acceptance of any technology by various user groups in different organizations. For example, Kwon (Kwon, 2000) investigated cellular phone adoption and usage with TAM and the results confirmed that users' perceptions were significantly related to their intention to use cellular phones.

In addition to the many studies that have adopted TAM as a research model, there are also many studies which extended the model with other variables to explain and predict computer usage more comprehensively.

Previous psychology research has found the importance of subjective norm to intention and behavior (Ajzen, 1985). Based on the theory of reasoned action (TRA) (Ajzen & Fishbein, 1975) and the theory of planned behavior (TPB) (Ajzen, 1985), the notion of subjective norm (SN) is that individuals will be motivated to perform certain behaviors by people who are important to them even though they don't prefer the behavior or the outcomes. Thus, subjective norm was proposed to be an important determinant of technology acceptance.

The empirical research, however, has found mixed results on SN. Venkatesh and Davis (2000) developed an extended model of TAM (TAM2) with the introduction of social influence and cognitive instrumental process which explained perceived usefulness and intention. The study conducted by Taylor and Todd (Taylor & Todd, 1995) also found that SN had a significant impact. Mathieson (1991) reported SN had no significant impact on intention. In addition, other

research conducted by Hartwick and Barki (1994) detected the strong relationships between subjective norm and other constructs in users' participation regarding information technology in mandatory settings, but it is not significant in voluntary settings.

Analysis

Assumptions

One of the assumptions of this study was that the respondents who agreed to participate in the study would complete the questionnaire honestly and accurately. In addition, the sample of participants from randomly selected consolidated travel agencies represented the population of travel agents who work for the consolidated travel agencies in Taiwan.

Research Design

The present research was conducted based on the research model (see Figure 2) derived from the TAM. The survey questionnaire was created and then published on a website and all the selected consolidated travel agencies received an email with the universal resource location (URL) of the survey website. Due to the difficulty of obtaining the email addresses of individual travel agents, an email with the URL hyperlink to the survey website was sent to the email addresses of 16 randomly selected participating travel agencies found on the Internet from 82 consolidated travel agencies. Then the email receivers were asked to forward this email to other staff in their offices to participate in the research. After data collection, there were 200 useable questionnaires and the multiple regression was applied to investigate how the Taiwanese travel agents' attitudes regarding using computer and subjective norm affect their behavioral intention to use computers.

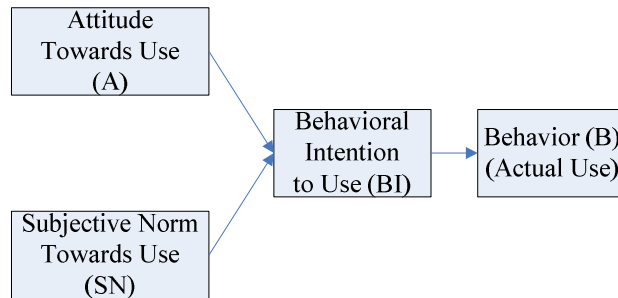


Figure 2. Research Model

Data Analysis

This study was to exam relationships between attitude towards use (A), subjective norm (SN) and behavioral intention (BI) to use computers.

A multiple regression analysis was conducted to predict the BI from A and SN. The general purpose of multiple regression is to examine the relationship between several independent or predictor variables and a dependent or criterion variable and to provide the statistical significance of these relationships.

Diagnostics for multiple regression analysis are applied in order to not only identify the unacceptable levels of collinearity or multicollinearity but also the observations with a disproportionate impact on the multiple regression results. The predictors were the A and SN, while the criterion variable was the BI. Means and standard deviations of study variables were reported in Table 1. Pearson product-moment correlation coefficients between the predictors and criterion variable were reported in Table 2.

The linear combination of two predictors (A, SN) was significantly related to the BI, $R^2 = .41$, adjusted $R^2 = .40$, $F(2, 197) = 67.79$, $p < .001$. The sample multiple correlation coefficient was .64, indicating that approximately 41% of the variance of behavior intention in the sample can be accounted for by the linear combination of two predictors (A, SN).

Table 1 *Mean and Standard Deviation of Study Variables*

Variables	<i>M</i>	<i>SD</i>
Attitude towards Use	5.76	1.07
Subjective norm	5.64	1.20
Behavior Intention	6.05	.87

Table 2 *Correlations of Study Variables*

Variables	Attitude towards Use	Subject Norm	Behavior Intention
Attitude towards Use	1		
Subjective norm	.41**	1	
Behavior Intention	.61**	.43**	1

Note. ** Correlation is significant at the 0.01 level (2-tailed)

The beta weight which is the ratio of the estimated predictive importance of the predictors indicated that attitude towards use ($\beta = .52$) had more predictive power than subjective norm ($\beta = .21$).

Conclusions and Recommendations

According to the statistical analysis, both attitude towards use (A) and subjective norm (SN) were important to individuals' behavioral intention (BI) to use computers, and attitude towards use was more influential than subjective norm on behavioral intention. Computer attitude is an individual's feeling associated with using computer technology, and ease of use could be a dominant factor to affect it because unfavorable perceptions would lead to resistance of users to new technology even when they are capable of adopting it (Chircu & Kauffman, 2000). It is recommended that easier and more user-friendly computer interfaces would change users' attitudes positively and then increase the acceptance. Venkatesh and Davis (2000) developed a TAM2 to explain the relationship between social influence and behavioral intention. The study

conducted by Taylor and Todd (1995) found that SN had a significant influence. Hartwick and Barki (1994) also detected strong relationships between subjective norm and other constructs in users' participation regarding information technology in mandatory settings, but it is not significant in voluntary settings. As computer usage has become mandatory in workplaces nowadays especially in the travel industry, it is suggested that the management level of travel agencies can provide on-the-job computer training programs for employees and encourage their technology adoption in order to reinforce social influence on travel agents' intention to accept computer technology.

Even though there was 41% variance of intention explained by attitude towards use and subjective norm, there was a considerable amount of variance not accounted for by these two factors. With further exploration of other variables, a greater variance explained might be achieved in order to better predict users' behavioral intention to accept computer technology.

Limitations

Instrumentation may have been a threat to the internal validity of the study. Participants from consolidated travel agencies might have been affected by the wording of the survey and misread the survey instrument and not provided responses accurately. Furthermore, this study relied on a self-report instrument, which lacked external validation (Podsakoff & Organ, 1986).

Statistical regression was a minimal threat since participants only responded once to the survey.

Recommendations for Further Research

As computer usage has become mandatory in workplaces nowadays, the effect of social influence and peer pressure in determining users' intention and behavior regarding using

computer technology should be reinforced in future research to investigate the impact on technology usage.

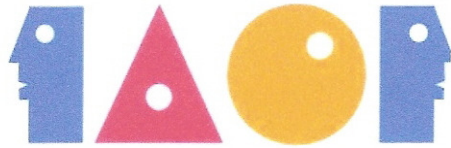
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A STUDY ON BRAND STRATEGY, CHANNEL STRATEGY
AND CHANNEL PERFORMANCE – AN EMPIRICAL
INVESTIGATION OF THE BARE SYSTEMS

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Abstract

This research is expected to provide some suggestions for improving relation between brand and channel. Core system computer of Taiwan is regarded as the research object. With the investigation method of the questionnaires and LISREL, we want to know the channel performance under different brand strategy by passing different channel strategy and brand equity. Main empirical findings are summarized as follows :

1. Brand strategy has effect on channel strategy and brand equity.
2. Channel strategy and brand equity have effect on channel performance.

Keywords: Brand Strategy, Channel Strategy, Brand Equity, Channel Performance.

Introduction

Using PC bare system host as the subject of research, this study attempts to explore the relationships between brand strategy, brand equity, channel patterns, and channel performance in order to find out whether brand strategy and brand equity impose influence on channel performance through all types of channels.

This study has integrated a series of relevant literatures into a theoretical framework in connection with the relationship between brand and channel in order to explore the influence on channel performance resulted from various brand strategies under all types of channel strategies and brand equities and, meanwhile, to discuss the relationships between all variables and to formulate marketing strategies for the reference of relevant industries, thereby making a positive contribution to brand strategies and channel strategies.

Literature Review

Brand Strategy

Kotler (2000) has focuses on two variables in connection with brand strategy; namely, 1. Line extension refers to new tastes, measurement, colors, packing, and additives added to the same products under same brand name. 2. Brand extension refers to the current brand name extended to new products of other category. Ove (2007) pointed out that, according to various researches, renovation is difficult in terms of brand extension for consumer products. Most importantly, the goal needs to bring about minimizing risks and without sacrificing profits. Furthermore, Byung, Jongwon, and Robert (2007) pointed out that, in consideration of production capability for products under same category, the performance effect will enhance brand performance for multiple brand extension.

Channel Strategy

Sertan, Nermin, & Gloria (2007) quoted allocation theorem, saying that channel, if allocated ideally, will be more contributive to the corporation than any other allocation Marc (2007) believed that manufacturers have to select proper channels, distributors, and formulate administration policies. Kotler (2003) divided channel strategy, according to structure and functions, into following categories: 1. Channel length. 2. Channel density. 3. Mission of channel members: All missions are written to serve as “trade relations mix” including following terms and conditions: 1. Price terms. 2. Sales terms. 3. Distribution area. 4. Mutual responsibilities. Based upon Kotler’s categorization (2003) of channel strategy, this study contains price terms, sales terms, sales area, and mutual responsibilities as variables under channel strategy.

Brand Equity

Aaker (1991) defines brand equity as an added value of product (or service) in connection with brand. and concluded that that brand equity contains five items as follows: 1. Brand loyalty: Chang & Tu (2005) believe that customers’ satisfaction and repeated purchase behavior are most effective indexes to measure brand loyalty. 2. Brand awareness refers to consumers’ ability to identify and remember a certain brand amid a product category and, therefore, stands for the familiarity and commitment to a brand. 3. Perceived quality refers to the consumers’ overall perception for the products affiliated to a brand, or the level of satisfaction as opposed to other brands. 4. Brand association, or brand image, refers to whatever retained in consumers’ minds related to the brand, including product features, customer’s benefits, use, user, lifestyle, product category, competitor, and nation. Aaker (1996) concluded that the measurement of brand association also means the measurement of brand image. 5. Other brand assets : Include patents,

trademarks, channel relationships, which obstruct competitors from penetrating into the corporation's market share and earnings, although they are often overlooked.

Channel Performance

Stern & Coughlan (1996) pointed out that channel performance could be discussed as follows: 1. an overall standpoint: labor division along the channel with consideration in costs and benefits. Measurement includes utility, fairness, and efficiency with emphasis on the channel's overall cooperation or group cooperation. 2. individual standpoint: measuring profits and costs. Lumpkin & Dess (1996) pointed out market share percentage, profitability, inventory level, and enterprise's reputation as the criteria for measurement in consideration of the added value of brand equity.

Research Methods

The operational framework is shown as Fig.1

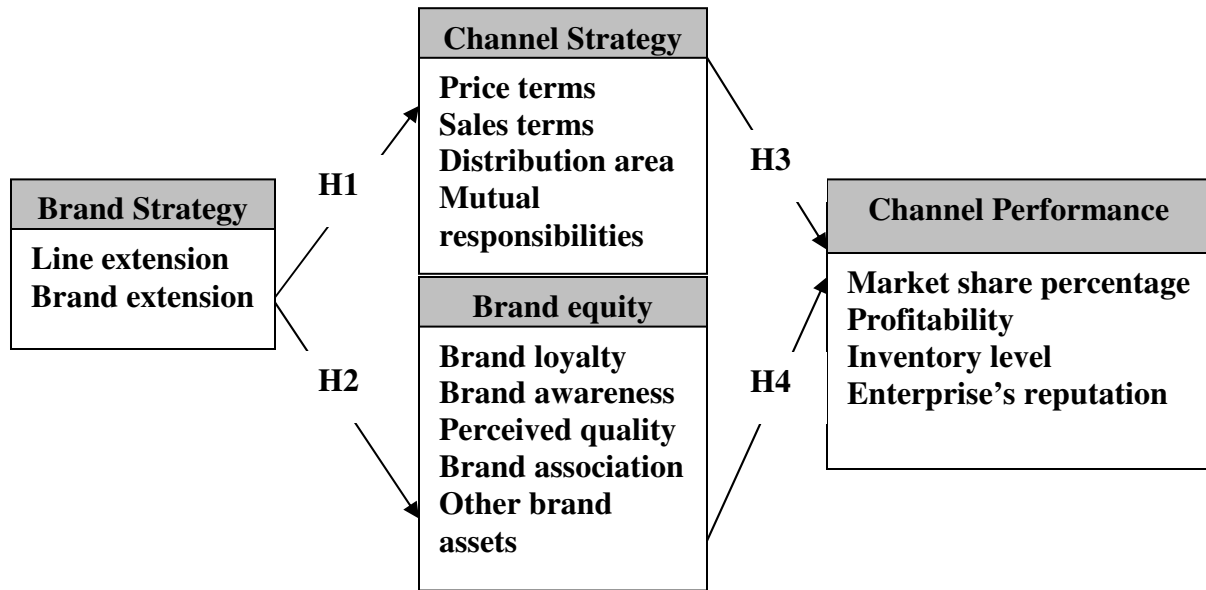


Fig. 1 Operational Framework

Hypotheses

Based upon research purposes and framework together with literature review, this study incorporates hypotheses as follows:

1. Relationship between brand strategy and channel strategy

Middle traders are concerned if manufacturers are offering different price terms or discounts to different middle traders or different quantities and whether manufacturer is offering price terms, discounts payment terms and product warranty to middle traders. Keller (1998) concluded channel as a tool by which corporations deliver products to consumers, therefore this study presents following hypotheses:

H1 : The wider the brand strategy extends, the clearer the channel strategy appears.

2. Relationship between brand strategy and brand equity

Leventhal (1996) concluded that brand stands for the tangible and intangible benefits associated with products and services, and includes the most comprehensive consumption information as well as assets related to conveyance of such information. Furthermore, Ashok, K., Dillon, W.R. and Yuan, S. (2002) concluded that brand equity can be created via several brand strategies. Apparently, different brand strategies contribute to different levels of brand equity. Therefore, this study assumes:

H2 : The wider the brand strategy extends, the higher the brand equity.

3. Relationship between channel strategy and channel performance

Stern and Coughlan (1996) concluded that channel strategy and planning affected channel performance. Horzeiski (2001) concluded that channels have to be adjusted punctually in accordance with customers' changing needs In consideration of profitability; nowadays

corporations tend to provide different service channels with different cost requirements in accordance with the revenue generated from customers. Therefore, this study assumes:

H3: The clearer the channel strategy, the higher the channel performance.

4. Relationship between brand equity and channel performance

Gobe (2002) concluded that a good brand provides customers a life of safety, dream, joy, hope, sensation, and convenience. In other words, enterprises create intangible assets via brands. Therefore, brand equity produces profits for enterprises indirectly. Voss, Spangenberg & Grohmann (2003) concluded that a brand would be remembered and cherished by consumers, if the product affiliated to that brand are proven practical and consumers are satisfied with that product. In such case, consumers will purchase same products repeatedly and thus the enterprise profits accordingly. Therefore, this study assumes:

H4 : The higher the brand equity, the higher the channel performance.

Questionnaires and Sampling

Questionnaires were designed in accordance with literature review together with experts' opinions. Following are the reasons behind the selection of bare system for empirical study: Bare system industry has just begun. At the time the compact-size bare system is likely to replace the large host in the near future; therefore brand and channel are both important. In Taiwan, brand establishment and administration are becoming more and more important in recent years. As such, brand strategy and channels are extremely important for distributing hi-tech products.

This study chose the bare system host retailers and e-market bare system retailers in Taipei as subject of research, and chose samples from the famous malls, 3D discount stores, independent distributors, and retailers engaged in e-transactions across Taipei. All retailers contained in the foregoing four categories were numbered according to a random number list.

Samples were selected randomly out of retailers. Interviewers delivered questionnaires to the selected retailers in person, and then collected the filled-up questionnaires from respondents. There are three types of distributors - independent outlets, franchisees, distributor's outlets. Head officers and marketing supervisors were invited to answer the questionnaires. Samples were selected randomly. To minimize the errors and misunderstandings caused by sampling procedure, this study gathered data via questionnaires and interviews.

Anderson & Gerging (1988) concluded that 100~150 samples are sufficient for LISREL maximum approximation method. Therefore, this study delivered questionnaires to 115 respondents.

Delivering and Recalling Questionnaires

To minimize the errors caused by the sampling procedure, all respondents were visited personally, thereby allowing interviewers to describe the questionnaires to the respondents, communicate with the respondents, and to recall the questionnaires on the spot.

The χ^2 derived from LISREL analysis falls in insignificant level ($\chi^2=0.675$), indicating samples were capable of reflecting the real data. Apparently, the samples were sufficient to represent the population.

Table 1 Samples Recalled

Sample size	Samples recalled	Percentage of respondents	Valid questionnaires	Invalid questionnaires	Effective response ratio
115	115	100%	107	8	93%

Source of Data: This Study

Data Analysis Method

Using LISREL as research method, this study attempts to verify the influence imposed by all variables contained in the framework in order to examine the inference derived from the hypotheses.

This study has measured all variables by Likert's 7-point scale. All variables are excessively loaded with factors and have reached significant level. Apparently, this study satisfies the requirements regarding validity.

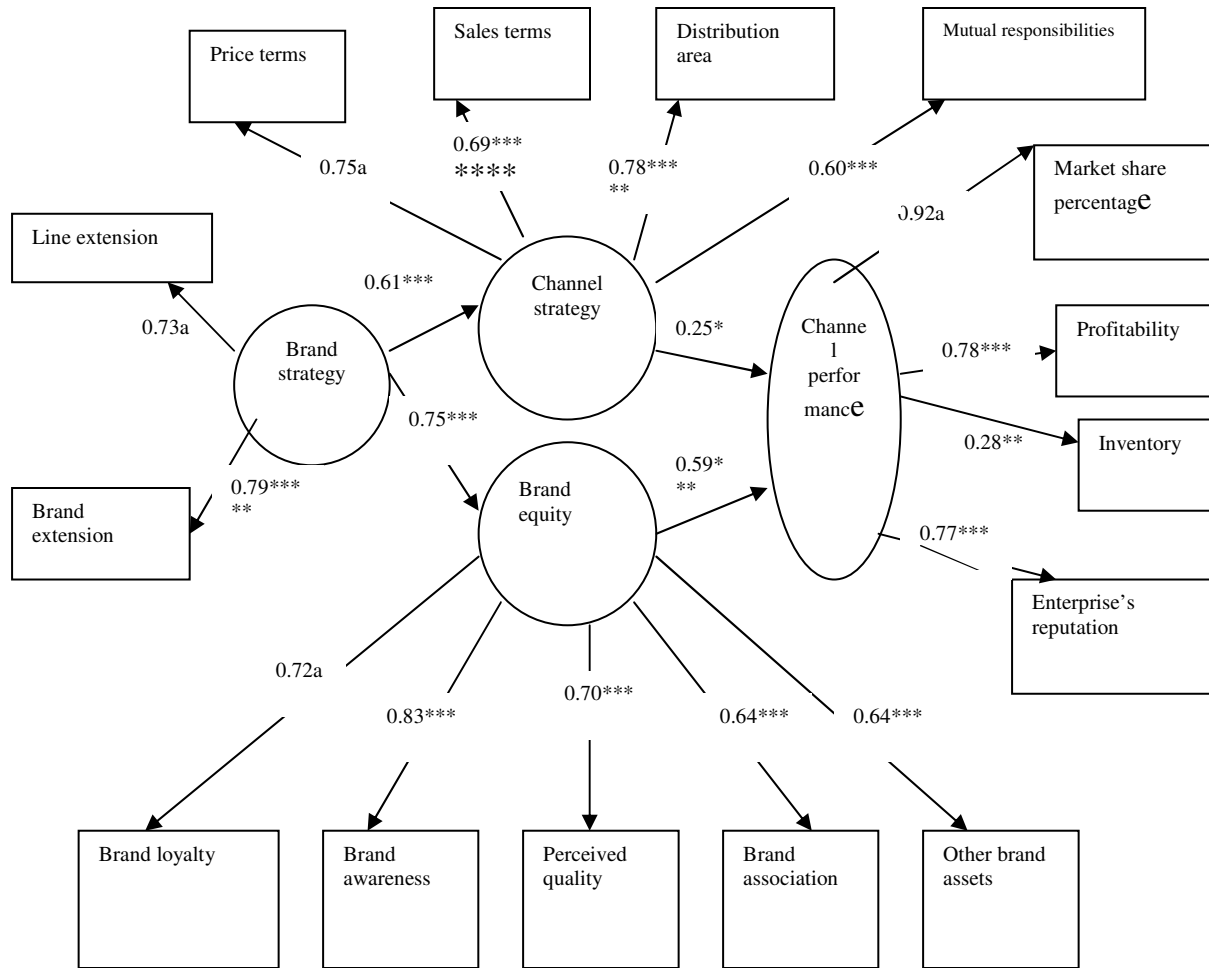
The report outputted by LISREL contains digits representing Squared Multiple Correlation (SMC) to indicate the reliability for variables. SMC falls between 0 and 1. Kline (1998) concluded that SMC larger than 0.5 is acceptable. All reliability Cronbach's α indexes fall in acceptable range.

First of all, the research concept was examined via Pearson Product-moment in order to identify the correlation. Secondly, the estimates generated by the model were analyzed via LISREL in order to find out the goodness of fit for the model and to analyze the effects related to all concepts.

A higher level of goodness of fit indicates the high feasibility of model, which in turn represents strategic significance of parameters. Fig. 2 below contains model's total paths of this study.

Conclusions

This study attempts to explore the influence imposed by brand manufacturers on channel strategy and brand equity under line extension and brand extension, discuss the influence imposed by channel strategy and brand equity on total performance.



Note : —————> significance - - - - -> insignificance

Set “a” as 1 with no estimate and, therefore, no significance test.
 * When t-value > 1.96, p<0.05, ** when t-value > 2.58, p<0.01
 *** When t-value > 3.29, p<0.001

Fig. 2 Total model paths

1. Influence imposed by brand strategy on channel strategy.

The support of H1 indicates that the wider the brand strategy extends, the clearer the channel strategy appears. In other words, brand strategy affects channel strategy positively. According to LISREL model’s total paths shown on Fig., line extension maintains a close

relationship with brand extension. Apparently, brand suppliers have to formulate their extension strategies in accordance with product features.

2. Influence imposed by brand strategy on brand equity.

The support of H2 indicates brand equity will be affected significantly when brand suppliers extend their products. Therefore, brand loyalty and brand awareness will be affected significantly and positively if brand suppliers execute line extension and brand extension adequately based upon their product features and brand images. The foregoing results lead to the same conclusions reached by Leventhal (1996). Apparently, brand produces some intangible assets, besides the tangible benefits for products and services.

3. Influence imposed by channel strategy and brand equity on total channel performance.

The support of H3 indicates the clearer the channel strategy, the higher the channel performance. Therefore, manufacturers and distributors have to formulate a comprehensive channel strategy and thus present a precise goal to channel members, thereby upgrading the overall channel performance.

The support of H4 indicates the higher the brand equity, the higher the channel performance. Therefore, customers' perceived quality and brand association become possible and channel performance will be upgraded significantly if brand manufacturer knows how to maintain a certain level of awareness and loyalty. The results lead to the same conclusion reached by Voss, Spangenberg & Grohmann (2003).

Marketing Implications

1. Formulating brand extension strategy, depending on product features

The bare system host manufacturers have to initiate guidelines accurately for channel members regarding price terms and distribution areas when they formulate line extension and

brand extension policies. By doing so, brand manufacturers provide channel members an accurate goal when they expand the width of product and brand, thereby allowing all channel members to comply with the standards set forth by brand manufacturers. Brand loyalty and awareness are subject to the influence imposed by extension of brand strategy. In addition, brand strategy enhances consumers' perceived quality, brand association, and other brand assets for the enterprises. Apparently, enterprises will be able to upgrade the overall channel performance

2. Creating cooperation accurately to upgrade total performance

According to the research results, channel performance is subject to the significant influence imposed by channel strategy and brand equity. Manufacturers have to deal with distributors in a cooperative manner and provide channel members an accurate goal to minimize uncertainties and, meanwhile, develop brand equity to upgrade the total channel performance.

Academic Achievements

1. Integrating brand strategy into channels: Most researches on channels discussed the internal power and conflicts between channel members. This study has combined brand strategy and channel strategy together, and then discussed, under the existing brand strategy, the influence imposed by brand equity on channel performance through channel strategy.
2. Applying brand and channel theorems to electronic product market: This study has researched the relationships between brand strategy, channel strategy, brand equity, and channel performance.

Research Contributions

1. Analyzing bare system host market

At the time technological advancement continues, more and more hi-tech products are introduced to the market and, as a result, channel patterns have changed dramatically. The analytical results serve as reference for the cooperation model decision-making and marketing strategy initiation between manufacturers and distributors.

2. Using linear structural model to evidence bare system host

Bare system host, a newly developed electronic product, has unlimited potential. Using linear structural model, this study has explored the brand strategy and channel strategy of bare system host, and has thus presented relational models with perfect goodness of fit.

Research Limitations

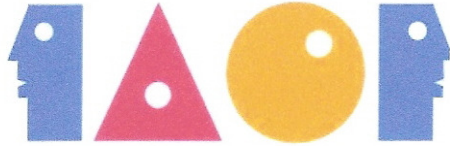
This study has not discussed manufacturers' feelings regarding the entire channel. Therefore, subsequent researchers are advised to continue the discussion if they intend to analyze the entire industry with emphasis on consistency research. Respondents were asked to answer questions based upon their memories. Therefore, distortion or bias is inevitable although data-collecting process was valid and reliable to a certain extent.

In the framework of this study, however, a number of variables were not included into consideration. Subsequent researchers are advised to add other variable in order to interpret the outcomes comprehensively.

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**THE STUDY OF REPURCHASE INTENTIONS IN EXPERIENTIAL MARKETING -
AN EMPIRICAL STUDY OF THE FRANCHISE RESTAURANT**

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Abstract

Product and service marketing in the past usually adapted low-price strategy and eventually led to battles in prices. However, times are changing; those traditional marketing techniques may not represent the main stream in this competitive new age. Experience economy arrived after knowledge economy. In the new era of experience economy, the aim of marketing demand is “creating valuable experience”. “Experience/ Experiential marketing” concept, proposed by Schmitt, has been a trend around the world. Surveying comprehensively for the past studies, sense in experiential marketing is rarely explored with its relations versus consumers' repurchase intentions. This study explored consumers of Mos Burger in Kaohsiung City and probed into how sense marketing could raise consumer loyalty to Mos Burger, and furthermore affecting repurchase intention. The purpose of this study is to explore different constructs of “sense marketing” in experiential marketing, and discovering the correlations among the variables of “customer satisfaction” and “repurchase intention” using regression model. The result proved that sense of experiential marketing is an indispensable factor and every construct of sense marketing also showed significant correlation between consumer satisfaction of Mos Burger and repurchase intention.

Keywords: Experience Marketing, Sense Experience, Satisfaction, Repurchase Intention

Introduction

Research Motive and Purpose

Ever since Pine & Gilmore (1998) introduced “welcome to the emerging experience economy” in their paper, “experience” has moderately becoming the noun that enterprises often use. Pine and Gilmore (1998) believed the differences between “experience economy” and traditional economy (agricultural economy, industrial economy) were in the pursuit of sensual experience economy and context shaping to create activities that consumers worthwhile, and focused on interactions between consumers and products. The concept of “providing customers with excellent experiences” has widely applied to every industry. Lots of enterprises not only aware of the importance of customer experience, but also successfully create a complete experience that is centered by them. For instances, Starbucks boldly surrounds their customers with unique experiences contexts from their brand, products and environments. IKEA builds a consuming environment where it is felt like a home, and all the furniture, decorations and layouts support customers’ imagination. All these are to satisfy customers’ experiences.

With promotion of service quality and rises of consumer awareness, the competition in food industry is increasingly fierce. It causes every food service provider to review oneself and rebuild its well operational foundation in order to gain the favors of consumers and thereby building long-term competitive advantages. Enterprises not only focus on product functions, but also concentrate on communication and stimulation between enterprises and consumers. Experience-based strategies therefore catch unprecedented attention.

Based on the data analysis by Taiwanese government, the turnover in August 2007 was 27.6 billion in food industry (including other food industries, restaurants, drink industries) and it increased 5.00% in comparison of August 2006. The turnover was 216.8 billion in accumulation from January to August 2007, increasing by 5.94% in comparison of the same period in 2006. It

is thus clear that food industry has becoming a market that can not be ignored. There are more and more fast food restaurants. Nowadays people ask for healthy and delicious food, but how do we leave consumers with our good service experiences? Reviewing current and past studies, only a few researchers explored the relationships between experiential marketing and repurchase intention. Therefore, taking Mos Burger in Kaohsiung City as example in this study, we explored the sense experience used in raising customer loyalty and the effects of these variables, and then provide the study results to Mos Burger with our practical recommendations.

Research Hypothesis

Experiential marketing staffers believe that the most powerful influence takes place between the stages of after-purchasing, real usage and experiencing, which are the key factors for customer satisfaction and brand loyalty. However, most traditional marketing methods only focus on the rhetoric that attract customers to purchase, and not paying too much attention on the matters after purchasing. Even though enterprises invested with great numbers to gain customers' favor, but it also caused customer dissatisfaction and high levels of brand switching due to lack of brand promise communication (Schmitt, 1999). Consuming experiences obviously affect repurchase intention of consumers. Hence, the hypotheses are proposed as follows:

H1: "Service location" will have significantly positive associations with "customer satisfaction" and "repurchase intention" of Mos Burger.

H2: "Product" will have significantly positive associations with "customer satisfaction" and "repurchase intention".

H3: "Customer satisfaction" will have significantly positive association with "repurchase intention".

Literature Review

Experiential Marketing

Meaning of experience: Keller (2003) stated “experience” was originated from “experiencia”, meaning exploring and testing. Keller also believed that experience was the perception after experienced a period of time or event and the progress of the processes. Experience is not a pure, simple feeling, but a sense of interpretative act with the spiritual processes of the link to the certain time and space. Csikszentmihalyi (1975) proposed the concept of “flow experience”, which means people fully integrated into the situations during activities, focusing and filtering all the irrelevant senses and perception, and finally entered a smooth flow state. Flow is the best experience and pleasure in life. Schmitt (1999) defined experience as individual feedback event occurring in some stimulation (i.e. marketing efforts before and after purchasing), and experience involved the complete nature of life. Experience includes the whole living element, and usually is caused by directly observing or participating in events, no matter if the events were real, dream-like or virtual. Experience usually is not unprompted but induced (Schmitt, 1999). In addition, Carbone (2004) stating experience as the images customers have in minds after facing products, services and enterprises, and it is the perception outcomes from varieties of sense information in combination.

So called "experience", it is what enterprises create as the service platform, using products as tools and surrounding it with customers, to create the activities that will be worth remembering by customers. Product is visible, and service is invisible. Experiences created which are unforgettable are so because experiences are internal. They exist in everyone's heart, and they are the outcome of personal physique, emotion, and knowledge. Experiences come from the interactions of one's personal mind and the events in it, so there will be no experiences

identical with others (Pine and Gilmore, 2003). There are also scholars who believe that there are no two same experiences. We will see type attributes belong to different forms of experiences. Therefore, the past marketing of agricultural economy is fungible, and industrial economy is goods tangible. Service economy is however the intangible product. Experience economy not only includes all the above mentioned forms, but also provides customers with memorable memories.

Strategic experiential modules: Strategic experiential modules are the basis of experiential marketing. Schmitt proposed 5 strategic experiential modules to provide customers with different forms of experiences, and they are listed as follows:

Sense: Sense marketing focuses on the five senses, which are vision, hearing, smelling, taste and touch. Sense marketing usually is stimulated through sense, providing pleasures, excitement and satisfaction of esthetics. For example, interior design, decoration, and jazz music in a Starbucks coffee shop.

Feel: Feel marketing is focus on customers' inner feelings and emotions, targeting to create emotional experiences. Most of self-sense feelings are encountered during the consuming periods. Feel marketing needs to be operated by understanding what sorts of stimulations can trigger emotions and encourage consumers to automatically participate. For example, Starbucks makes consumers think that drinking coffee is romantic.

Think: Think marketing is focus on intelligence, targeted to create cognitive thinking and solve problems for consumers using creative ways. Think marketing demands come through surprise, interest and attract consumers to think and concentrate. Think marketing encourage consumers to think with more concerns and be creative to trigger them to evaluate enterprises and products. When people need to think about the old assumptions and expectations all over again, think

marketing could possibly respond to those thoughts. It could even lead to a paradigm shift sometimes.

Act: Act marketing is focus on effecting physical experiences, life styles and interactions. Act marketing increases physical experiences to find the replacements for life styles, interactions and enrich consumers' lives. The strategies of act marketing are designed to create consumers' experiences for long term behavior patterns and live styles, which include the experiences after interacting with others. For example, Starbucks tries to make people think there shops are a good place to be outside of family and work locations.

Relate: Relate marketing includes sense, feel, think and act marketing. However, relate marketing bypasses personal personalities, emotions, plus “personal experiences” that make connections among personal, ideal-self, other people or even cultures. Relate marketing usually demands on self improvements (such as relating to the “ideal-self”) of personal desires, and demanding on others (such as classmates, boyfriend or girlfriend, spouse, family or co-worker) to show favorable feelings in order to connect people with a wider social system (a sub-culture, a country, etc.). Furthermore, a strong and powerful brand relationship and brand group could be built upon.

Sense Marketing

Sense marketing is focus on five senses, offering customers with pleasures or excitement. If managed well, sense marketing is able to distinguish company and product, stimulating customers' sense experiences and delivering values to customers. In order to create positive image, marketing personnel need to pay attention to the main elements, styles and topics. The key success of sense experience is to assure consistency and create diversity (Schmitt, 1999).

Customer Satisfaction and Repurchase Intention

The differences of overall satisfaction and specific customer satisfaction are on appraisals after purchasing or emotional reactions after latest interaction, rather than seeking temporary and special emotions of contacts (Oliver, 1993).

Overall customer satisfaction stands for the accumulated overall appraisals through time for all the experiences consumers have for purchasing a product or service (Anderson, Fomell and Lehmann, 1994). In this research, customer satisfaction stands for overall satisfaction.

Sense experience personnel believe that the most effective opportunity of a brand takes place after purchasing, and these experiences are the key factors of customer satisfaction and brand loyalty. However, most traditional marketing focuses on persuasion, encouraging customers to purchase the products, and did not pay too much attention on what happen after purchasing. The company that has expertise in communication with users will fair better, Siegel & Gale, already noticed that enterprises spend a lot to gain customers' attention but cause customer dissatisfaction and high brand switching due to lack of brand promise and delivery (Schmitt, 1999).

The satisfaction delivery of services and repurchase intention has certain levels of association (Anderson and Sullivan, 1990). Furthermore, Jones and Sasser (1995) stated that repurchasing is only the basic behavior after customers found their purchasing satisfied, and it should involve other behaviors like reputation or public recommendations.

Research Methods

Research Model

This research is to explore the levels of influence of each variance in sense experience and customer satisfaction from experiential marketing, and whether it affects repurchase intention from levels of satisfaction. Based on the literature reviews and hypotheses in the

previous chapters, a graphic is presented as below to show the concepts of this research specifically.

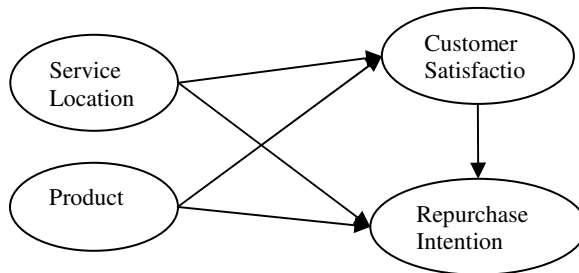


Figure 1 – Research Framework

Questionnaire Design

The variables of this research model are referred to the related literatures such as consumer shopping scenario elements from Belk (1974), and Schmitt (1999) stated that consumers did not treat products as an independent existence. Analyzing their abilities and benefits, and considering specialties such as the interior environmental designs and consumer behavioral decisions before each question is how this questionnaire is designed.

All questions in this questionnaire adopted the Likert scale, from 1 to 5 where 1 stood for strongly disagree and 5 as strongly agree, except for the parts (Parts 1 and 5) involving basic information of respondents in which a nominal scale of a non-metric scale is used. Respondents answered each descriptive question in the questionnaire by levels accordingly. This questionnaire included five parts, which are consuming behavior, sense experience, satisfaction, repurchase intention and basic information.

This study used convenience sampling, and the questionnaires were objective and given to customers in the 9 Mos Burger restaurants in Kaohsiung City. They are located in the

branches of Chun-Shan, Wen-Hwa, Min-Chen, Yo-Chang, Hu-Nei, Da-Li, Han-Shen, and Ding-Shan. Pre-questionnaires were filled-in during November to December of 2007, and the formal questionnaires were filled-in during January to February of 2008.

Reliability Analysis

Reliability stands for the levels of reliability of a measuring tool, which means the consistency and stability of measurement results. Cronbach's α is the most adapted reliability index in current behavioral science research (Cho, 2001). Hence, this study used Cronbach's α as the index of questionnaire reliability measurement. The α values of below constructs are higher than 0.7, which are "service location", "product", "customer satisfaction" and "repurchase intention". The α value in overall questionnaire is higher than 0.9, which indicates high levels of reliability. The overall data in the questionnaire is all shown to have reliability, and the details are listed below in a table.

Table 1 – Reliability Analysis of Each Construct in Questionnaire

Construct	Number of Question Items	Cronbach's α
Service Location	12	0.862
Product	10	0.861
Customer Satisfaction	3	0.813
Repurchase Intention	4	0.818
Overall Questionnaire Reliability	29	0.935
$\alpha > 0.7$ – Reliable, $\alpha > 0.8$ – Very Reliable, $\alpha > 0.9$ – Extremely Reliable		

Analysis of Customer Satisfaction and Repurchase Intention In Sense Experience

Regression Testing

Regression testing for "service location" and "product" upon "customer satisfaction":

With level of confidence under 0.05, $F(0.95, 2, 266) \square 7.36$, $F^* > F$, H_1 should be accepted.

Therefore, regression exists with independent variables of “service location”, “product” and dependent variable “customer satisfaction”.

Table 2 – Regression For Sense Experience and Customer Satisfaction

ANOVA ^b					
Source	Sum of Square	df	Mean Square	F	Sig.
1 Regression	42.137	2	21.069	151.679	.000 ^a
Residual Value	36.948	266	.139		
Total	79.086	268			

a. Predictor Variables: (Constant) Service Location, Product
b. Dependent Variable: Customer Satisfaction

Regression testing for “service location” and “product” upon “repurchase intention”:

With level of confidence under 0.05, $F(0.95, 2, 266) < 7.36$, $F^* > F$, H_2 should be accepted.

Therefore, regression exists with independent variables of “service location”, “product” and dependent variable “repurchase intention”.

Table 3 – Regression For Sense Experience and Repurchase Intention

ANOVA ^b					
Source	Sum of Square	df	Mean Square	F	Sig.
1 Regression	46.317	2	23.159	106.030	.000 ^a
Residual Value	58.099	266	.218		
Total	104.416	268			

a. Predictor Variables: (Constant) Service Location, Product
b. Dependent Variable: Repurchase Intention

Regression testing for “customer satisfaction” and “repurchase intention”: With level of confidence under 0.05, $F(0.95, 1, 297) < 1.17$, $F^* > F$, H_3 should be accepted. Therefore, regression exists with independent variables of “customer satisfaction” and dependent variable “repurchase intention”.

Table 4 – Regression For Customer Satisfaction and Repurchase Intention

ANOVA ^b					
Source	Sum of Square	df	Mean Square	F	Sig.
1 Regression	48.727	1	48.727	219.836	.000 ^a
Residual Value	65.830	297	.222		
Total	114.556	298			

a. Predictor Variables: (Constant) Customer Satisfaction
b. Dependent Variable: Repurchase Intention

Regression Model

Regression model for “service location” and “product” upon “customer satisfaction”:

Between the relationship of “service location”, “product” and “customer satisfaction”, this study found out that “service location” and “product” of Mos Burger have shown significantly positive correlation with “customer satisfaction”. The regression coefficient between service location and customer satisfaction is 0.273, and between product and customer satisfaction is 0.582.

Table 5 – Correlation Coefficient For Sense Experience And Customer Satisfaction

Coefficient ^a					
Source	Non-standardized Coefficient		Standardized Coefficient	t	Sig.
	B Estimates	Standard Deviation	Beta		
1 (Constant)	.838	.203		4.135	.000
Service Location	.273	.065	.233	4.222	.000
Product	.582	.058	.556	10.060	.000

a. Dependent Variable: Customer Satisfaction
Regression Model: $Y_1 = 0.838 + 0.273X_1 + 0.582X_2$

Regression model for “service location” and “product” upon “repurchase intention”:

Between the relationships of “service location”, “product” and “repurchase intention”, this study

found out that “service location” and “product” of Mos Burger have shown significantly positive correlation with “repurchase intention”. The regression coefficient between service location and repurchase intention is 0.295, and between product and repurchase intention is 0.603.

Table 6 – Correlation Coefficient For Sense Experience and Repurchase Intention

Coefficient ^a					
Source	Non-standardized Coefficient		Standardized Coefficient	t	Sig.
	B Estimates	Standard Deviation	Beta		
1 (Constant)	.537	.254		2.114	.035
Service Location	.295	.081	.220	3.643	.000
Product	.603	.073	.502	8.316	.000

a. Dependent Variable: Repurchase Intention
Regression Model: $Y_2=0.537+ 0.295X_1+ 0.603X_2$

Regression model for “customer satisfaction” and “repurchase intention”: Between the relationship of “customer satisfaction” and “repurchase intention”, this study found out that “customer satisfaction” of Mos Burger shows a significantly positive correlation with “repurchase intention”. The regression coefficient between customer satisfaction and repurchase intention is 0.762.

Table 7 – Correlation Coefficient For Customer Satisfaction and Repurchase Intention

Coefficient ^a					
Source	Non-standardized Coefficient		Standardized Coefficient	t	Sig.
	B Estimates	Standard Deviation	Beta		
1 (Constant)	.841	.213		3.952	.000
Customer Satisfaction	.762	.051	.652	14.827	.000

a. Dependent Variable: Repurchase Intention
Regression Model: $Y_2=0.841+ 0.762Y_1$

Conclusion and Recommendations

Hypotheses Supported Conditions

The hypotheses of this study are to explore the correlations upon different variables and experience elements between customer satisfaction and repurchase intention. The hypotheses are listed as below.

Table 8 – Hypotheses Supported Conditions

Hypotheses	Result
H1: “Service location” will have significantly positive associations with “customer satisfaction” and “repurchase intention” of Mos Burger.	Supported
H2: “Product” will have significantly positive associations with “customer satisfaction” and “repurchase intention”.	Supported
H3: “Customer satisfaction” will have significantly positive association with “repurchase intention”.	Supported

Research Findings

Consumer specialties: Most consumers in Mos Burger are female, around 1.5 times more than male consumers. The main groups are under 30 years old with a ratio of around 76.6%. These consumers are mostly students, 79.9% of them are still single and most of them have a college background with more of them without a regular income. This research discovered that most consumers in Mos Burger are students, and usually they are still relying on the support of their families. Even though most of consumers in Mos Burger reside in Kaohsiung City, however, there are still consumers from other cities, about 13.7%.

Of all the different orders such as packages, drinks, deserts in Mos Burger, packages have the highest order rate, more than cold drinks, hot drinks and deserts as the least ordered package. Most common spending is around 101~150NTD per order, about 75.3%. It could possibly be due to the fact that prices of different packages in Mos Burger happened to be between the range, and most consumers ordered packages. Most consumers claimed that they went to Mos Burger about

2 to 3 times a month, around 47.5%. In the next block, 36.5% of consumers claimed that they went to Mos Burger once a month. This research also discovered that most consumers went to Mos Burger mainly due to its delicious food, and secondly the quiet and nice environment. The fast food restaurants these consumers go to the most are Mos Burger and McDonald's.

The impact of consumer backgrounds vs. consumer satisfaction and repurchase intention: This study revealed with evidence analysis that marital status has significant differences in customer satisfaction and repurchase intention in Mos Burger's consumer background variables. It means that a different marital status lead to different levels of satisfaction and repurchase intention. We also found out in this study that educational backgrounds show significant difference in repurchase intention. We assumed the result came from the fact that most respondents in this research were students.

The impact of consumer background vs. experiential elements: This study revealed with evidence analysis that marital status also had significant differences in service location in Mos Burger's consumer background variables. It means that a different marital status lead to different levels of service location requirements. We also found out in this study that different sexes showed significant differences in product selection. We assumed the result also was affected by the non-average allocation samples like in the previous outcome.

The correlations among the experiential elements of “service location” and “product” upon “customer satisfaction” and “repurchase intention”, and the relationship between “customer satisfaction” and “repurchase intention”: Both experiential elements of "service location" and "product" impact on consumer satisfaction in Mos Burger, and “product” shows higher levels of impact. It shows that experiential element of product has higher impacts than service location in levels of customer satisfaction, and sense experiential element shows significant differences in

repurchase intention. In levels, product is still higher than service location, and higher customer satisfaction will also increase consumers' repurchase intention.

Conclusion

Management meaning for Mos Burger: This study showed that sense experience had impacts on satisfaction and repurchase intention. In other words, Mos Burger provided consumers with wonderful sense experiences. However, we also found out that “product” had stronger impacts than “service location” on customer satisfaction and repurchase intention. We hereby suggest that not only should they provide customers with good packages, but also should work on the environmental elements in order to increase satisfaction and repurchase intention, such as see experience, listen experience, and touch experience. This study also discovered that most regular consumers in Mos Burger are students and they usually have limited financial resources. We suggest that Mos Burger should provide consumers with more favorable offers. Since most consumers in Mos Burger are single, they could also consider holding activities such as an “MOS family day” to attract consumers to bring their families and friends to their stores. Other events could include special occasions like marriage, anniversaries or other important gatherings. Mos Burger could provide consumers with special arrangements, like VIP seats, discounts on meals and so on, in order to entice married consumers to spend their different experiences in Mos Burger.

Future Research

This study explored the relationships between sense experience and repurchase intention in Mos Burger. We suggest that the future research could have further verification. If any finding could be obtained outside of this study, it could help to regain an even more complete range for this topic. If the same results were discovered, it would help to build up and reinforce the theory.

We also suggest that future researchers could focus their research on other experiences in sense experience, and it would help to understand which of the 5 strategic experiential modules have more impact on sense marketing.

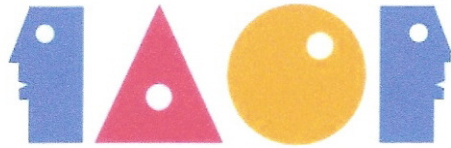
The object of this research is focus on Mos Burger in Kaohsiung City. We suggest the future researchers to explore the other industries in order to find out whether the results will be the same in different industry.

This study used a questionnaire as the investigation method. Respondents filled out the answers by themselves, for which credibility would be another subject to be worked on. We suggest the future researchers to combine open questionnaires with semi structured interviews as the investigation, in order to receive more accurate outcomes.

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DESIGN OF THE SECURITY COMPONENT IN A RECONFIGURABLE
ROUTER GIGABIT LE UNIT

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Abstract

With the continual development of network technology, new security threat and new security requirements come forth endlessly. In the existing rigid network circumstance, the adaptive capacity of security equipment is not very good. It results in a bad effect to network security position of our country. A method of exoteric and re-configurable security component is introduced in this paper. This component can fit the unborn requirement of network development. In addition an instance is introduced and analyzed as well.

Key Words: Re-Configurable, Security, Component, Router

Introduction

Ever since a long time ago, the network technology development has been driven along the direction of business service. In this traditional architecture of network technologies, many security services are added to the network framework as a specific function. Although the security equipment companies provide some software room to allow the users to set some function simply, but its basic function of the product can not be changed after being manufacture (Vincent Chan, Asuman Ozdaglar, Devavrat Shan, 2005). When the new security threat and security requirements emerge, in general, the user is not likely to add the functions to fit their own needs in those equipments by setting. Because it is not easy to do so, and those equipment manufacturers do not permit to do so as well. Unless the functions are all the features users' needs, the manufacturers would increase the functionality for us. These products designs have poor service adaptability and can not adapt to the change of security situation. Users want security products have the ability to provide flexible services. So we need to design an open general-purpose security component which can not only be used in the existing application environment, but also be set to meet the unborn possible security needs (Phillip Jones, Young Cho, John Lockwood, 2006).

In response to these problems, we must get away from the rigidity of traditional network architecture, which security products and services are provided by a fixed model. In service-oriented reconfigurable network environment, we must adjust the relationship between the users' security requirements and the network security services, changing traditional compact coupled relationship to incompact coupled relationship (Hemmati, H. Niamanesh, 2006). We designed a

security component with strong maintenance ability (such as loading, unloading, upgrade and update).It can be upgraded to achieve the reorganization, programmed and layered configuration.

In order to facilitate the discussion and facilitate analysis, this paper analyzes the security component in LE Gigabit application unit. This paper aims to discuss how to design an enterprise-level reconfigurable component in reconfigurable edge layer, which can provide security services. It has many merits such as low price, all-purpose, employability, etc. It can provide high-performance security services for the enterprise-class users based on the special chip. And this component has the network access to features and network security functions. Thinking about the existing business needs and the developing future business needs, our design philosophy is: separating the data plane and control plane, using FPGA assisted by the ASIC to process the data path. And achieve the following functions in the hardware, including: the second layer switching with line speed , IP&MAC address binding check, the dynamic line speed packet filtering based on the state, line speed packet filtering based on rules, NAT(network address translation) and PAT(private address translation) of line speed, line speed packet transfer and content filtering, etc. The immovable processing can be completed by a dedicated chip, such as the second layer switching with line speed and IP&MAC address binding check. The reconfiguration part can be process by the FPGA, such as the packet filtering and content filtering. The powerful CPU runs the system software, including operating systems, security module, user interface and driver. The security module is designed for completing a variety of security services. It supports IPTable / NETFILTER, transparent agents, etc. This can complete reconfiguration and reconstruction by the FPGA configuration and security module dynamically updates. It can provide a variety of highly efficient security services by combining with the dedicated chip.

Design Principle of Reconfigurable Security Component

Design Principle

In the reconfiguration network environment, thinking as a base unit of the three-tier (platform, element, and components) reconfigurable structure, this paper uses some special principles. The design method of this paper is: First, those network equipment with little differences and the same generic or basic functions can be abstracted to the same class model, such as: the second layer switching with line speed , IP&MAC address binding check, etc. Secondly, those basic function units with larger differences but easy to implement can be abstracted to different processing models, such as the components of the packet filtering and content filtering, etc. Again, those function units with large difference and hard to design can be re-demarcated and re-defined to decrease their difference, and then abstract them to the same processing model. It can get resource sharing; shield the difference of the different operations of resources (Hong Lai, Ling Song-he, 2007), such as the use of CPU module. The component-level reconfiguration can be completed by this three-level abstraction.

Component Architecture

Take the application of this component in Gigabit LE unit for example, in design of this security component, according to ours design concept; we extract and assemble the existing service demand and the corresponding functionality module. As shown in Figure 1, this component is made up of a dedicated chip, input and output processing FPGA and its hardware look-up table module, CPU module. First, 10 ways external signals (all support electrical signal, and 2 ways also support optical signal) can be completed physical layer processing in the PHY (Physical Layer) module. Then these signals can be finished Data Link layer processing in the

MAC module. After that, they can be delivered to the security component as the standard Ethernet frame format.

The specific functions includes: (1) the two-layer Protocol and data classification: this function can identify the type of the input Ethernet frame, and then, deliver it to CPU, if it is a protocol frame, IPv6 data frame or mpls data frame. Otherwise, if it is an IPv4 data frame, it can be delivered to the following hardware to carry on processing. (2) Data header inspection: process the IP header, including: the version number check, check sum calculation and comparison, routing looking-up table and so on. (3) State packet filtering: to carries on the access control based on the state table. (4) Rule packet filtering: carry on the access control based on the rule table. (5) Policy routing: make routing decisions based on policies set. (6) DNAT and SNAT: the goal network address translation and the source network address translation.

In order to achieve the purpose of dynamic reconfiguration and fit the future potential of new business security requirements, we can complete dynamic reconfiguration of the security software module by redesigning the CPU module. Also, we can upgrade the packet filtering and content filtering modules by configuring the FPGA.

Plan of Reconfigurable Component Implementation

In order to design the reconfigurable components, based on the concept of separating control side and data side, we design the architecture of opening reconfigurable security component. As shown in Figure 2, we divide the component to control side and data side, and change the compact coupled inter-connected relationship into the incompact coupled based on the full-switch network, combining the function request of each kind of network service processing node.

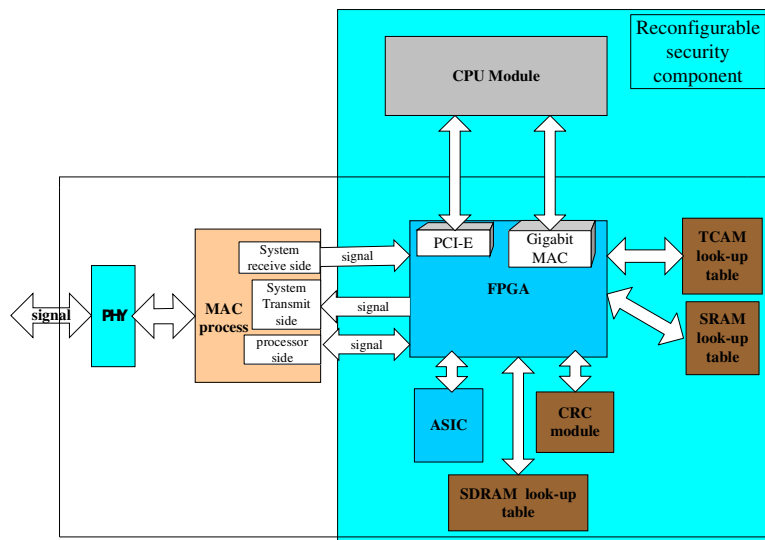


Figure 1. The Application Of Reconfigurable Security Components In Gigabit LE Board

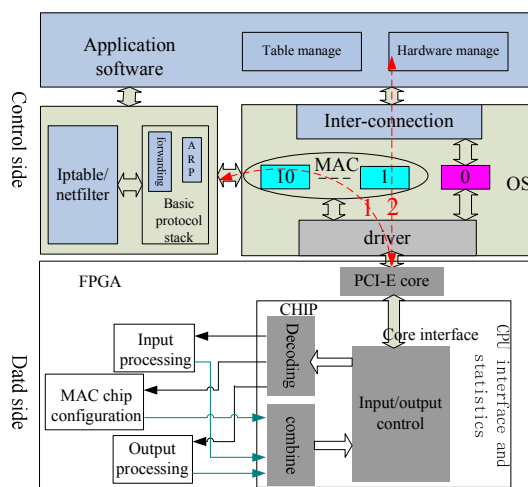


Figure 2. The Location Of CPU Interface And Configuration Statistics Decoding Units

CPU interface and configuration statistics unit is located in the dedicated chip. It connects with the input/output processing module (in the FPGA), the CPU interface in MAC chip, and an external PCI-E interface. It is the exchange channel between the dedicated chip and CPU interface. This design can real-time update application program and protocol stack easily. It can also upgrade the FPGA module easily. Based on the method, we can complete the dynamic

configuration and reconfiguration in the security component, so as to adapt to the emerging security needs in the future.

Dedicated Chip Design

According to the clustering of the processing mode, we get the statistics of the same hardware processing step in this kind of security component. In order to improve data processing speed and processing capacity and reduce the cost of a single device, we have to use the dedicated chip to complete these processing steps. Here, we also take the application of this component in Gigabit LE unit for example. As shown in Figure 3, we divide the processing step to three modules in this chip, including: input processing unit, CPU configuration, coding and statistics unit, output processing unit. The major data formats include two kinds: one is the internal data packet forwarding format; the other is CPU grouping data packet format, using in the data reporting and issuing. The CPU grouping data packet format consist of two channels: channel 0 and channel 1.

As shown in Figure 4-a, the data format in channel 0 is used to report the statistics data, return the results of the searching registers and table list which CPU has been visited, a variety of table items issued and also the chip configuration, etc.

As shown in Figure 4-b, the data format in channel 1 is used to report the destination address, report connection controlling data packet (connection establishment and the removal), the data need to output by the hardware which software had been processed, etc.

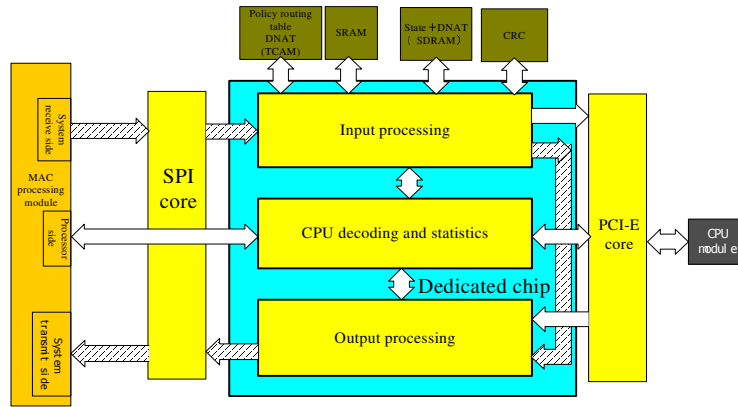


Figure 3 Dedicated Chip Diagrams

63	32	31	30	29	26	25	11	10	8	7	0
BUCK Code (E25C4B89)			Chn0	Table amount	length(64bit)	Pad length	Mark code				
Report data											
.....											
Report data											
Pad											

Figure 4-a channel 0 CPU data packet format diagram

63	31	30	29	26	25	11	10	8	7	0	
BUCK Code (E25C4B89)			Chn0	In/out interface	length(64bit)	Pad length	Mark code				
Destination MAC						Source MAC					
.....											
Original MAC frame											
Pad											

The last byte will list in the PCI-E reminding bus

Figure 4-B Channel 1 CPU Data Packet Format Diagram

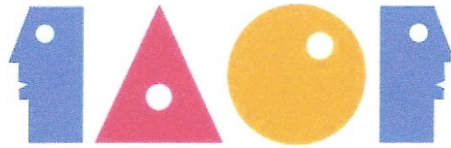
Conclusion

Based on the separation of the control side and data side, aggregating and extracting the sharing module of the public processing unit, this design of the reconfigurable security component can fit for the security demand of the enterprise-class switch-in network equipment. At the same time, it can also meet the security threats and security requirements which will appear in the future, by the component reconfiguration and software upgrading. It can reduce the repetitive investing to the hardware and waste of resources, and increase the activity of the

network escalation and renewing in the enterprise, so it can promote the next-generation networks in China.

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NEGATIVE IMPACT OF FDI: A CO-INTEGRATED APPROACH

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Abstract

This study aims to find the missing link between the Foreign Direct Investment (FDI) and its impact on the Pakistani economy. In this study, we utilized co-integration and error correction techniques in estimating the long run behavioral relationship between Pakistan's foreign direct investments and the current account balance and different economic variables. The empirical results advocate that there exists a significant long term relationship between the foreign direct investments and the gross national product, current account balance and official aid during the observed period 1971-2005. FDI has a negligible impact on GNP in the long run.

Key Words: FDI, Co-Integration, Error Correction, Current Account Balance, GNP

Introduction

Foreign Direct Investment (FDI) is usually favored on the grounds that it is a source of filling the saving, foreign exchange, revenue, management and technology gaps of developing countries. The unprecedented growth of FDI during the last 2 decades has changed, probably irrevocably, the underlying traditional economic relationships in the world economy. The world stock of FDI reached more than \$ 4 trillion in 1998, almost 8 times the level of 1980. The rate of growth of worldwide outflows of FDI since the mid 1980s has substantially exceeded that of world wide gross domestic product, worldwide exports and domestic investments. The number of transitional corporations has also increased significantly to more than 60,000 parent companies (with 500,000 foreign affiliates). The sales of these affiliates amounted to about \$11.4 trillion in 1998 compared to world exports of goods and non-factor services of \$ 6.6 trillion of which approximately one third took the form of intra firm trade. According to the WTO, whereas total world FDI outflows have increased nine fold between 1982 to 1993 world trade of merchandize and services has only doubled in the same period.

Economic policy makers and development strategists often regard it as the pillar of the economic development and neglect their potential long run repercussions; the inevitable current account deficit. FDI however affects current account balance by improving or deteriorating trade balance. In the case of Pakistan it was the deterioration in trade account, due to more imports than exports. Hence a direct hit at the current account balance. A lot of economic researchers have determined their efforts as to how to attract more FDI into the country, instead of focusing on the long term negative affect that it may cause. Previous researchers have studied the contribution of FDI to domestic productivity and there is a general agreement about the positive impact of FDI on economic development.

However, some other economists like Leff (1969) and Griffin (1970) have analyzed its negative impacts on growth. Mencinger, (2000 & 2008) outlined the structural current account deficit in NMS countries, and believed that foreign direct investment can have a negative affect on the current account balance of NMS.

Model Framework and Data Sources

We have selected three variables for our present study of foreign direct investment; current account balance CAB, gross national product GNP and official aid OA. The sample is from year 197 to 2005. The related data are from Pakistan’s Handbook of Statistics and the World Bank.

After specifying the Foreign Direct Investment account in liner form with an addition of error term μ_t ,

$$FDIt = \beta_0 + \beta_1GNPt - \beta_2CABt + \beta_3OAt + \mu_t \quad (1)$$

Empirical Analysis and Results

By applying the regression analysis, we form the FDI model.

Table 1. Estimated Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GNP	0.011285	0.002300	4.907382	0.0000
CAB	-0.077093	0.032600	-2.364818	0.0245
OA	0.106423	0.141986	0.749533	0.4592
C	-386.6363	121.8641	-3.172683	0.0034
R-squared	0.651473	Mean dependent var	303.3371	
Adjusted R-squared	0.617744	S.D. dependent var	418.6452	
S.E. of regression	258.8350	Akaike info criterion	14.05747	
Sum squared resid	2076863.	Schwarz criterion	14.23522	
Log likelihood	-242.0057	F-statistic	19.31524	
Durbin-Watson stat	1.645287	Prob (F-statistic)	0.000000	

Putting the data into the original model, we get:

$$FDI = 0.011285GNP - 0.077093CAB + 0.106423OA - 386.6363 \quad (2)$$

Gradients of The Function

Table 2. and Figure 1. allow us to observe the gradients of the objective function, to help us find a unit root before applying the cointegrating techniques.

The result of the function indicates that all the variables, gross national product, foreign direct investment, current account balance, official aid have a unit root in their levels and are stationary in their first differences.

Table 2. Gradients of the Objective Function

Coefficient	Sum	Mean	Newton Dir.
GNP	2.68E-07	7.66E-09	-2.92E-21
CAB	-6.52E-09	-1.86E-10	-1.96E-19
OA	-9.31E-10	-2.66E-11	1.88E-18
C	-3.18E-12	-9.09E-14	-2.11E-15

Co-integrating Techniques and Results

Statistics For Var Lag Order Selection

We found that all the series of four variables (FDI, OA, GNP and CAB) are integrated at order one I (1) preprocesses; it is important to determine whether any combinations of the variables have a co-integrated relationship. Before applying the co-integration tests, we first specify the relevant order of lags (p) of the VAR model. For this purpose we use: Final

Gradients of the objective function

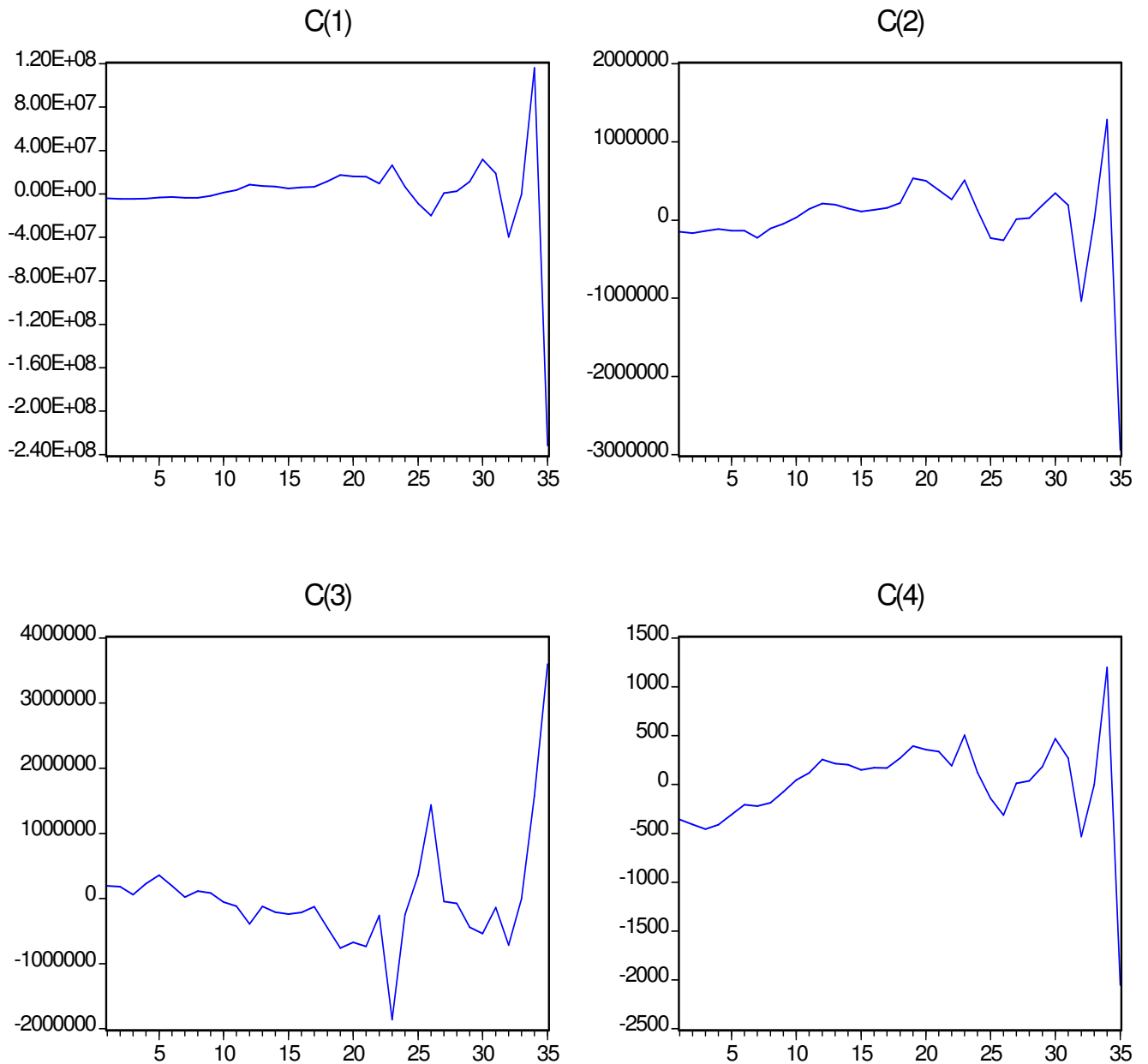


Figure 1. Gradient Graphs for GNP (1), CAB (2), OA (3), C (4)

Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ).

Table 3. shows the results of the optimal lag selection. According to the results of these tests, we selected the lag 2 in the VAR model.

Table 3. Statistics for VAR Lags Order Selection

Lag	FPE	AIC	SC	HQ
0	1.72E+32	88.41455	88.64130	88.49084
1	2.32E+29	81.78684	83.14730 \ominus	82.24460
2	1.06E+29 \ominus	80.88713 \ominus	83.38131	81.72635 \ominus
FPE	Final Prediction Error			
AIC	Akaike Information Criterion			
SC	Schwarz Information Criterion			
HQ	Hannan-Quinn Information Criterion			
\ominus Indicates lag order selected by the criterion.				

Var Co-integration Test Statistic

Johansen Co-integration Test

Co-integration test is a long-term equilibrium statistic of non-stationary economic variables. The results obtained from the Johansen Co-integration method are presented in Table 4. The first column illustrates H_0 , with $r = 0, r \leq 1, r \leq 2, r \leq 3$, denotes at most none, at most 1, at most 2, and at most 3 co-integration relationships. The second column points out the Eigen value. The third column gives us trace and Max-Eigen statistics and the remaining two columns represent 5% critical values. Here we are testing through unrestricted co-integration rank, which means no restrictions have been applied.

In our estimated results, the trace test indicates 1 co-integrating equation at the 5% level. The Max-Eigen value test indicates 1 co-integrating equation at the 5% level. These statistics indicate to us that only one null hypothesis is rejected. This means that there is one co-integrating equations $r = 1$ among the three variables at a 5% significant level. Therefore, our annual data from 1972 to 2005 appears to support our intention that in Pakistan there exist a long-run relationship between the foreign direct investment and current account balance with

Table 4. VAR Co-integration Test Statistic

Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.620906	59.20770	47.85613	0.0030
At most 1	0.464206	28.16859	29.79707	0.0761
At most 2	0.207100	8.200403	15.49471	0.4442
At most 3	0.023914	0.774553	3.841466	0.3788

Trace test indicates 1 cointegrating eqn (s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.620906	31.03911	27.58434	0.0173
At most 1	0.464206	19.96819	21.13162	0.0721
At most 2	0.207100	7.425850	14.26460	0.4401
At most 3	0.023914	0.774553	3.841466	0.3788

Max-eigenvalue test indicates 1 cointegrating eqn (s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

gross national product and official aid. In order to determine whether or not the observed relationship between the response and predictors is statistically significant, we need to identify the coefficient p-values. The MacKinnon, Haug-Michelis p-values are used. Estimation Of Co-integration And Adjustment Coefficient.

Adjustment Coefficients

Estimation of long-run cointegrating vector is given in the Table 5.

If we put the data of Table 5. in equation (2) we obtain the following Co-integration equation (3), showing the long-run relationship of variables:

$$FDI = 0.012860 GNP - 0.20092 CAB + 0.872364 OA + 313.4139 \quad (3)$$

Equation (3) describes that a 1% increase in the foreign direct investment causes a 2% increase in the current account deficit. Where as a 1% increase in official aid will bring about a 9% increase in foreign direct investments, and a unit of foreign direct investments would increase the gross national product by a negligible 0.1%. This is a

Table 5. Estimation of Co-integration and Adjustment Coefficient

Normalized Co-integrating Coefficients				
FDI(-1)	CAB(-1)	OA(-1)	GNP(-1)	C
1.000000	0.20092	-0.872364	-0.012860	-313.4139
	(0.03553)	(0.15229)	(0/00253)	
	[4.77318]	[5.72842]	[-5.07492]	
Adjustment Coefficients				
D(FDI)	D(CAB)	D(OA)	D(GNP)	
0.480301	-2.222602	-0.602744	6.395665	
(0.18819)	(1.26066)	(0.35429)	(2.25200)	
[2.55217]	[-1.76305]	[-1.70129]	[2.83999]	
Standard errors in () and t-statistics in []				

highlighting factor that the FDI's impact on the growth of the Pakistani economy is almost negligible, while the deficit is much stronger, which contradicts the fact that FDI increases growth. Many researchers before have performed same techniques, to GDP, but GNP has been included as a first incase of Pakistan and a surprising result has been bought forward. Figure 2. gives us a much clearer picture of how FDI's impact was negative for Pakistan, and how the economic growth was just negligible.

Conclusion

The basic problem is the negative correlation of current account balance with the foreign direct investment. It shows that Pakistan's foreign direct investment has been long the prime factor in creating the current account deficit in the country. The result of which is such that neither our trade balance, nor the capital account are surplus, there are deficits all over the place. Indirectly the relationship of foreign direct investment and current account balance has been negative, and we can see an addiction of the two.

From the above analysis it has been confirmed that the FDI has a negative affect on the current account balance in the long run. To stabilize the economy, Pakistan should not only depend on the Foreign Direct investments, rather than create more conducive environments for the domestic buyers. Increase competition and also increase the human capital by training etc. The Johansen test, gradients functions, VER and VAR test all prove our stance. The surprising factor is the negligible growth as opposed to the fact that FDI enhances growth, even if current account was negative. This gives a further cue in understanding the relationship between GNP and FDI.

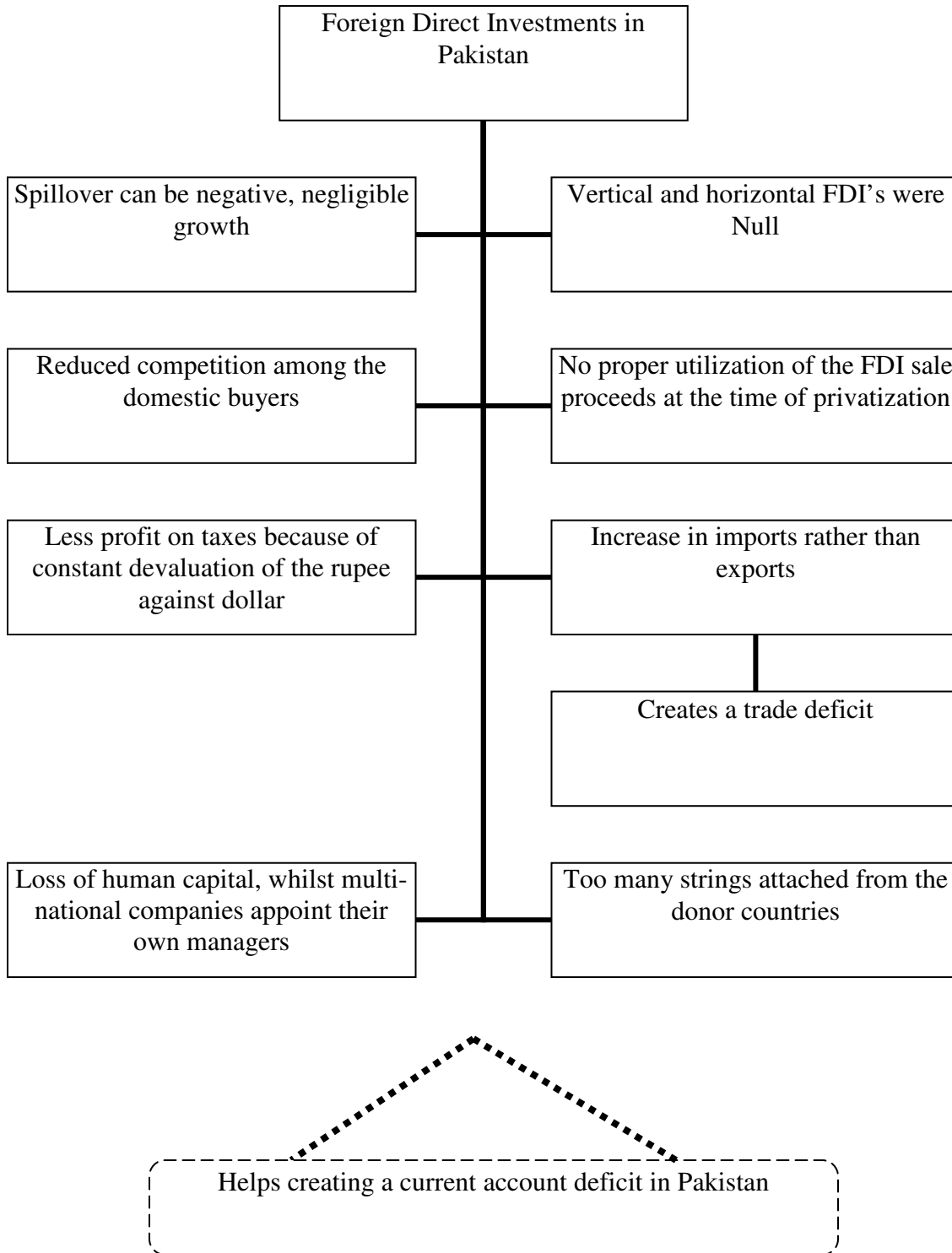


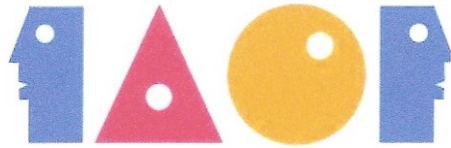
Fig 2: Negative Impact of the FDI in Pakistan

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SERVICE QUALITY AS MEDIATOR OF THE RELATIONSHIP BETWEEN
MARKETING MIX STRATEGY AND CUSTOMER LOYALTY:
THE CASE OF RETAILING STORES IN TAIWAN

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Abstract

Literature review support the theory that marketing mix strategy has significant impact on customer loyalty. This quantitative study was to comprehensively examine mediation influence of service quality on the relationship between marketing mix strategy and customer loyalty for the customers in retailing stores of Taiwan. The population for this research was identified as customers from four chain retailing stores, resulting in 200 individual surveys for analysis. The findings supported the hypothesis that there is no mediation effect for service quality between the marketing mix strategy and customer loyalty. The result also identified the predictors of marketing mix and service quality on the customer loyalty.

Key Words: Marketing Mix Strategy, Service Quality, Customer Loyalty

Introduction

A well-designed marketing strategy is necessary to maintain and develop the business in a highly competitive business world, (Kotler, 1997). For improving the customer loyalty, service quality has been argued the effective tool to improve the customer retention (Day, 1994). However, Rao and Monroe (1989) argued the study results of the relationship between price (marketing strategy mix) and service quality remain unclear. Metters, King-Metters, and Pullman (2003) argued the good service quality cannot ensure the profit for corporation. Very few studies have examined the relationship among marketing mix strategy, customer loyalty and service quality. The issue for the relationship between marketing strategy and customer loyalty with the mediation effect of service quality remain unknown. Therefore, the main purpose and the significant for this study are to comprehensively examine mediation effect of service quality on the relationship between marketing mix and customer loyalty for the customers in retailing stores and to generate the recommendations for managerial application for the business of retailing stores, and identify areas for future scholarly inquiry.

Literature Review

Marketing Mix Strategy

Kotler (2003) identified the marketing mix is the set of selling tools for helping companies to aim the target customers in marketing. The most well known marketing strategy tools are the 4 Ps model. McCarthy and Perreault (1994) suggested the 4 Ps model that the marketing strategy encompasses four factors, such as Product, Price, Promotion, and Place. Kotler, Keller, Ang, Leong and Tan (2009) identified the dimensions of Price encompassed the different element, such as variety, quality, design, features, brand name, packaging, size, service, warranties, and return. Kotler et al (2009) pointed the dimensions of Price encompassed the

different element, such as list price, discount, allowance, payment period, and credit term. In addition, Kotler et al (2009) pointed the dimensions of Promotion encompassed the different element, such as sales promotion, advertising, sales force, and public relationship. Finally, the dimensions of Place encompassed the different element, such as channel, coverage, assortments, location, inventory, and transport (Kotler et al, 2009).

Customer Loyalty

Customer loyalty referred to the customer's attitude which affects to purchase the same brand products (Tellis, 1988). Oliver (1997) claimed the customer loyalty will drive customers to buy the same brand products under the changes for competitors' benefit offers. Jones and Sasser (1995) indicated the customer loyalty is the behavioral intention to maintain the relationship between customer and service suppliers. Therefore, the customer loyalty may refer to the attitude that customer's desire and behavior to purchase the produce or service repeatedly. Muller (1998) pointed customer loyalty may help company to maintain and develop the market share. Sirohi, Mclaughlin, and Wittink (1998) stated customer loyalty may represent by customer satisfaction. Zeithaml, Berry and Parasuraman (1996) suggested the dimensions to measure the customer loyalty such as recommendations to others, complains, the attentions to pay more, and the possibility to transfer to other companies.

Service Quality

Current enterprises recognize quality is the critical factor to maintain the competency for business development. Deming (1981) and Garvin (1987) identified the service quality is the satisfaction for matching the customers' demand. Garvin (1987) also indicated the consumer's perception of service quality is recognized by subjective judgment which is different to the perception of tangible product management. Regan (1963) and Fitzsimmons and Fitzsimmons

(1997) pointed the for service industry are heterogeneous, intangible, participated, non-separated, perishable and flexible site-selection. Scholars had developed different research approach to measure the service quality. Parasuraman, Zeithaml, and Berry (1985) suggested the theory of Service Gap Model and SERVQUAL questionnaire (Parasuraman, Zeithaml, & Berry ,1988) pointed the five dimensions to measure the service quality are tangible, responsiveness, reliability, empathy, and assurance. Bolton and Drew (1991) also identified the SERVPERF scale to measure the service quality.

The Relationship among Service Quality, Marketing Mix Strategy, and Customer Loyalty

Kotler (2003) suggested marketing mix strategy has significant impacts on customer behavior, such as loyalty. Parasuraman et al. (1985) suggest the service quality has the significant impact on the customer behavior. Zeithaml et al. (1996) suggest customer loyalty is one important facet of behavioral intentions by customers. Very few studies have extensively examined mediation effect for service quality on the relationship between marketing mix and customer loyalty. Although scholars claimed the service quality is one of the vital issues to develop customer relationship, Metters et al. (2003) argued the good service quality cannot ensure the profit for corporation, although service quality has positive impact on the customer loyalty. Kotler (2003) claimed price issue is most sensitive issue to affect the customer behavior. Therefore, the research hypothesis (three) for this research is: There is no mediation effect of service quality between the perception of marketing mix strategy satisfaction and customer loyalty by customer.

Methodology

Research Hypotheses and Question

Based on the literature review and the purpose for this study, the researcher proposed three hypothesis and one research question as follows. 1). Research Hypothesis One: There is a significant and positive relationship between the perception of marketing mix strategy satisfaction and customer loyalty by Customer, 2). Research Hypothesis Two: There is a significant and positive relationship between the perception of service quality and customer loyalty by customer, 3). Research Hypothesis Three: There is no mediation effect of service quality between the perception of marketing mix strategy satisfaction and customer loyalty by customer, and 4). Research Question: Can the variables of service quality and marketing mix strategy predict the variable of customer loyalty?

Instrumentation

Three instruments have adopted in this study to measure three variables: marketing mix satisfaction (14 items), service quality (21 items), and customer loyalty (three items). The Marketing Mix Satisfaction Questionnaires are based on the definition by McCarthy and Perreault (1994)'s 4 P model which encompasses four dimensions, such as product (five items), price (three items), promotion (two items), and place (three items). The Factors Analysis following Varimax Rotation method was applied to reduce the dimensions for the 4 Ps model. After delete two low factor-loading items (factor loading value <.5), the Factor analysis resulted in two dimensions named Product Value and Place. The Service Quality Questionnaires (21item) were modified from the SERVQUAL questionnaire (Parasuraman, Zeithaml, and Berry ,1988) which encompasses five dimensions, such as Tangible (five items), Responsiveness (five items), Assurance (three items), Empathy (three items), and Veliability (five items). The Factors Analysis following Varimax Rotation method also was applied to reduce the dimensions for the

Service Quality Questionnaires. After delete two low factor-loading items (factor loading value <.5), the Factor analysis resulted in four dimension named Tangible, Attentive, Responsiveness, and Individual and Safe. The Customer Loyalty Questionnaires (three items) were modified from the Behavioral Intentions Battery questionnaire developed by Zeithaml, Berry, Parasuraman (1996) and were encompasses two dimensions, such as Recommendations (two items) and Repeated purchase (one item).

Population and Data Collection

The customers who shipping in the specific chain retailing stores have been selected as an acceptable population for this proposed study. To ensure the response rate, this research applied the method of convenience sampling. After contacting with senior managers of chain retailing company, four stores in the Kaohsiung city of south Taiwan agreed to participate in this research. Then, the researcher will apply the method of random sampling. Each store randomly invited volunteer customers who shipping in the store to participate the questionnaire survey. A total of 215 sales associates participated this study. After deducting 15 invalid response, the total number of valid responses was 200, providing an adjusted response rate of 93%.

Reliability and Validity Issues

The research applied reliability test for the three parts of questionnaire: Marketing Mix Satisfaction, Service Quality, and Customer Loyalty. The internal consistency as an estimate of reliability of the three parts of questionnaires ranged from .85 to .92. The researcher examined the Content validity and Construct validity to discuss the validity issues for this research. The researcher developed the questionnaires based on the academy theory or existed questionnaire which developed by scholar or specialists to improve the content validity. The researcher also applied Factor analysis to examine the construct validity for assessing the validity issue for the

three parts of questionnaire: Marketing Mix Satisfaction, Service Quality, and Customer Loyalty. The values of KMO test value ($>.8$) and Bartlett test ($<.05$) demonstrated the construct validity for the three parts of questionnaires are reasonable.

Results

1). Research Hypothesis One: A Person correlation was applied to explore the relationship between the perception of marketing mix strategy satisfaction and customer loyalty by customer and the results are summarized in Table 1. as follows:

Table 1. Full Correlation Matrix

		Value	Place	Marketing Mix
Recommendation	<i>r</i>	0.462	0.246	0.519
	<i>p</i>	0.000	0.000	0.000
Repeated Purchase	<i>r</i>	0.487	0.201	0.512
	<i>p</i>	0.000	0.004	0.000
Customer Loyalty	<i>r</i>	0.504	0.244	0.552
	<i>p</i>	0.000	0.000	0.000

The results revealed there was a positive, strong ($r = .552$) and statistically significant relationship between overall Marketing Mix and overall Customer Loyalty. Therefore, these results support the hypothesis in this research. In general, the facet of the Value (from .462 to .504) tended to much higher correlation value with all facets of Customer Loyalty than the value of facet of Place (from .201 to .246).

2). Research Hypothesis Two: A Person correlation was applied to explore the relationship between the perception of service quality and customer loyalty by customer and the results are summarized in Table 2.

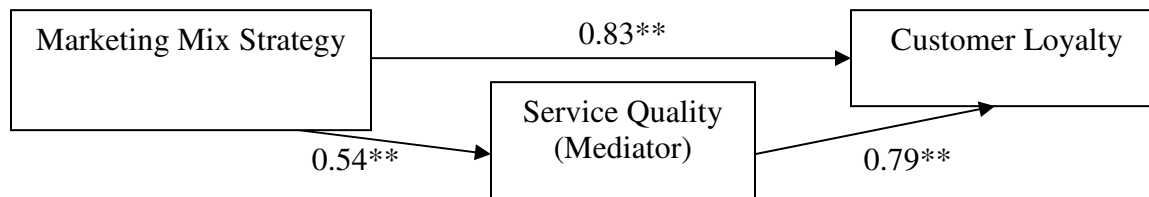
The results revealed there was a positive ($r = .490$) and statistically significant ($p < .05$) relationship between overall Service Quality and overall Customer Loyalty. Therefore, these results support the hypothesis in this research. The results also revealed there was not statistically significant ($p > .05$) relationship between Tangible and all the facets of Customer Loyalty. The

Table 2. Full Correlation Matrix

		Recommendation	Repeated Purchase	Customer loyalty
Tangible	r	0.075	0.084	0.084
	p	0.294	0.236	0.239
Attentive	r	0.359	0.267	0.347
	p	0.000	0.000	0.000
Responsiveness	r	0.281	0.287	0.303
	p	0.000	0.000	0.000
Individual and Safe	r	0.250	0.167	0.233
	p	0.000	0.018	0.001
Service Quality	r	0.487	0.411	0.490
	p	0.000	0.000	0.000

facet of Attentive had the highest correlation values ($r = .347$) with the facet of overall Customer Loyalty.

3). Research Hypothesis Three: Regression test was applied to explore the mediation influence of service quality between the perception of marketing mix strategy satisfaction and customer loyalty by customer. The path analysis diagram including the Beta values are as follows:



The Beta value for the path from Marketing Mix to Customer Loyalty is .834

which greater than the Beta value for the path Marketing Mix – Service Quality – Customer Loyalty is .426(.54 x .79). This result supports the hypothesis that there is no mediation effect of service quality between the perception of marketing mix strategy satisfaction and customer loyalty by customer.

4). Research Question: The regression model was applied to test whether the variables of service quality and marketing mix strategy predict the variable of customer loyalty?

The results are summarized in Tables 3. and 4. as follows:

Table 3. Regression Model Change Statistics

<i>R²</i>	<i>Adjusted R²</i>	<i>Change Statistics</i> <i>R² Change</i>	<i>F Change</i>	<i>DF1</i>	<i>DF2</i>	<i>Sig. F Change</i>
0.609	0.371	0.351	0.371	18.971	6.000	193.000

Table 4. Regression Model

<i>Model</i>	<i>Unstandardized Coefficients</i>		<i>Standardized Coefficients</i>		
	<i>B</i>	<i>SE</i>	<i>Beta</i>	<i>t</i>	<i>Sig.</i>
(Constant)	3.273	0.044		73.833	0.000
Tangible	-0.006	0.046	-0.008	-0.138	0.891
Attentive	0.152	0.051	0.195	2.982	0.003
responsiveness	0.147	0.048	0.188	3.049	0.003
Individual and Safe	0.096	0.048	0.123	2.007	0.046
Value	0.290	0.053	0.373	5.446	0.000
Place	0.097	0.051	0.124	1.913	0.057

Note. Dependent variable: customer loyalty. *SE* = standard error

Based on the results (Table 3.), R^2 value was 35.1%. This indicated that 35.1% of the variance in dependent variable (job satisfaction) was explained and predicted by independent variables (Tangible, Attentive, Responsiveness, and Individual and Safe, Value, Place). Based on

the results of regression model, four independent variables, such as Attentive, Responsiveness, and Individual and Safe, Value, had statistically significant relationship with a dependent variable. According to the Beta value revealed in the Table 4., Value (.29) had the strongest effect on the dependent variable. The 2nd, 3rd, and 4th strongest independent variables were Attentive (.152), Responsiveness (.147) and Individual and Safe (.096).

Discussion

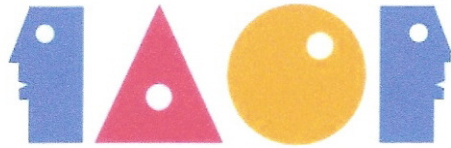
The result indicated the facet of the Price and Promotion issues are more sensitive to Customer Loyalty than the other factors for Marketing Mix Strategy. The result indicated the facet of Attentive had the strongest influence on overall Customer Loyalty comparing other facets of Customer Service. This result supported research hypothesis three indicating there is no mediation effect of Service Quality between the perception of Marketing Mix Strategy Satisfaction and Customer Loyalty by Customer. The result of research question revealed the facet Value(.29) for Market Mix had the strongest effect on the dependent variable Customer Loyalty and the 2nd, 3rd, and 4th strongest independent variables were Attentive (.152), Responsiveness(.147) and Individual and Safe (.096). In conclusion, the results from this research revealed the Price/ Promotion factors may have greater impact on the behavior for Customer Loyalty than Service Quality. In addition, among the four facets of Service Quality, customers are much care about the facet of Attentive and Responsiveness than other two facets. The results for this study may concord for the argument by Metters et al. (2003) that indicated the good service quality cannot ensure the profit for corporation, although service quality has positive impact on the customer loyalty. Comparing the issues of Service Quality, the marketing mix strategy is more important for keeping the Customer Loyalty. This research suggests: 1). The management may develop the aggressive marketing mix strategy to promote the customer

loyalty, specially on the activities of Pricing and Promotion., 2). The management may focus on the trainings for employee professional service skill to improve the service quality to promote the customer loyalty., 3) The management may focus on the price/promotion activities rather than the issues on service quality as the retailing business is highly competed on price., and 4) The management may recruit the personality who have attentive personality to enhance the customer loyalty.

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RESEARCH ON ADAPTIVE RANDOM PACKET SAMPLING BASED ON FLOW STATISTICS

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Abstract

Measuring and monitoring network traffic is required to manage today's complex Internet backbones. The measurement systems based on ensamples traces have inherent scalability problems. In order to overcome these deficiencies, the paper proposes a novel sketch called adaptive random packet sampling based on flow statistics. The sketch introduces the idea of stratified sampling and a parameter which is relevant with the number of traffic flows in order to control the memory resource. The easily-implemented packet sampling method presented in this paper can not only automatically adapt the sampling rate, but also give the right tradeoff between resource consumption and accuracy. Experimental results demonstrate that the proposed method can achieve controllability of resource consumption without sacrificing accuracy.

Keywords: Stratified Sampling, Adaptive Random Sampling, Number Of Traffic Flows, Flow Statistics

Introduction

Measuring and monitoring network traffic is required to manage today's complex Internet backbones. Such measurement information is essential for short-term monitoring (e.g., detecting hot spots and denial-of-service attacks), longer term traffic engineering (e.g., rerouting traffic and upgrading selected links), and accounting (e.g., to support usage based pricing). However, with today's high-speed (e.g., Gbps or Tbps) links, storing the information of every packet traversing a measurement point is prohibitively impossible. It may significantly impact router performance depleting processing resources. With off-board measurement devices, huge volumes of data are generated which can quickly exhaust memory space.

Packet sampling has been suggested as a scalable alternative to address this problem. Both the Internet IETF working groups IPFIX (IP Flow Information Export) (IPFIX, 2006) and PSAMP (Packet Sampling) (PSAMP, 2006) have recommended the use of packet sampling. In (Estan C and Varghese G, 2003), a probabilistic packet sampling method is used to identify large byte count flows. Once a packet from a flow is sampled or identified, all the subsequent packets belonging to the flows are sampled. In (Abhishek Kumar, Jun Xu, 2006), authors propose a sketch called SGS (sketch guided sampling) which can acquire the detailed information of flow distribution. However, this method needs inspecting every single packet which increases the system payload.

Static sampling method such as "1 out of N" is widely deployed by Cisco's Net-Flow. However, (Estan C, Keys K, Moore D, Varghese G., 2004) presents many problems with Cisco's Net-Flow as follows.

(1) Number of records strongly depends on traffic mix. A larger than expected number of records can overwhelm the router and the network path to the collection station.

(2) Network operator must set sampling rate. Setting the sampling rate involves trade-offs: when the traffic is low we want a higher sampling rate to obtain better accuracy, while when the volume of the trace is high and when massive attacks are in progress we need a lower sampling rate to protect the measurement infrastructure. Setting the static sampling rate is a hard decision for the network operator.

In (Estan C, Keys K, Moore D, Varghese G., 2004), the algorithm called Adaptive Net-flow which can automatically adjust the sampling rate. The contributions of the sketch are as follows.

(1) Sampling Rate Adaptation: Net-Flow uses a static sampling rate which is either suboptimal at low traffic volumes or can cause resource consumption (memory, bandwidth) difficulties at high traffic volumes. This adaptive algorithm, by contrast, provably stays within fixed resource consumption limits while using the optimal sampling rate for all traffic mixes.

(2) Renormalization of flow entries: The sketch introduces a new idea in traffic measurement called renormalization. The proposed efficient algorithms for renormalization that make adapting the sampling rate feasible. Renormalization also enables a layered transmission of Net-Flow data that gracefully degrades the accuracy of traffic reports in response to network congestion on the reporting path.

However, the drawbacks of Adaptive Net-flow are as follows.

(1) Sampling rate is only to descend in one measurement segment, even though the space of flow cache is sufficient. This will impact the veracity of traffic measurement.

(2) Renormalization and inspecting packets are working synchronously. Forever, the proposed sketch must assure that the rate of releasing flow records is higher than that of creating flow records. This will increase the implement complexity.

Combined with the idea of stratified sampling, an algorithm called adaptive random sampling based on flow statistics is proposed. The main purpose of the sketch is to acquire detailed information of heavy hitters in massive network traffic. The easy-implemented method of stratified sampling can not only control resource consumption, but also realize self-adjust sampling rate bounty to flow statistics. Meanwhile, the memory of measurement system is referred as an important parameter which can be regulated online by counting the number of traffic flows in order to protect the memory from being overwhelmed.

The rest of the paper is organized as follows. In Section II we illustrate the efficient algorithm that how the sampling rate can be adaptively adjusted to the memory usage. Theoretical analysis is described in Section III. Experiments using traffic traces data are conducted to reflect the performance of the sketch in section IV. The paper is summarized in section V.

Adaptive Random Sampling Based On Flow Statistics

The Idea of Time-stratified Sampling

Time-stratified sampling is a classical sampling technique which possesses many good qualities as follow. With this sampling method, sampled packets take on good uniformity overall the total traffic. Moreover, different sampling methods can be deployed in different strata. Consideration the above merits, this paper introduces the idea of time-stratified sampling in order to circumvent the deficiency of lacking of scalability.

Definition 1: Traffic measurement system divides the whole measurement time into equally-sized time segments which are not overlapped. We call each time segment as a measurement period.

Definition 2: Each measurement period is divided into equally-sized time sections. Every time section is referred as a time window.

In (Brownlee N, Mills C, Ruth G., 1999), RFC-2722 recommends that flow records are preserved for every flow in the flow cache. Each flow record is consisted of flow identifiers (source and destination IP address, protocol, source and destination port, and type of service byte) and flow statistics. Net-Flow also maintains a flow cache containing flow records that describe the traffic forwarded by the router. These flow records are then exported using unreliable UDP to a computer that collects, analyzes and archives them. The router inserts a new flow record into the flow cache if a packet does not belong to an existing flow. Net-Flow uses four rules to decide when a flow has ended which then allows the corresponding record to be exported (Estan C, Keys K, Moore D, Varghese G., 2004):

- 1) When indicated by TCP flags (FIN or RST),
- 2) 15 seconds (configurable) after seeing the last packet with a matching flow ID,
- 3) 30 minutes (configurable) after the record was created (to avoid staleness)
- 4) When the flow cache is full.

Based on the same consideration, the sketch is also using these four rules. However, the difference is that all flow recodes are forced to be exported when one measurement period is ended. Combined with the idea of time-stratified sampling, the proposed sketch implements simple random sampling. Namely, every packet in one time window is sampled by a definite probability.

Defining Variables

To depict conveniently, the variables used in this section are defined as follows.

T	The length of each measurement period
L	The number of time windows in one measurement period
M	The maximal number of flow recodes accommodated by the flow cache
ε	The restraining parameter
N_k	The real number of flows stored in the flow cache in the k th time window
\tilde{N}_k	The predicted number of flows in the flow cache in the k th time window
p_k	The probability of random sampling in the k th time window
R_k^f	The real number of packets which belong to the same flow f in the k th time window
R^f	The real number of packets which belong to the same flow f in the whole time period T
S_k^f	The number of sampled packets which belong to the same flow f in the k th time window
\tilde{S}_k^f	The estimated value of S_k^f
\tilde{S}^f	The estimated value of R^f

The Sketch

The real-time consumed memory resource is referred as a parameter to regulate the sampling rate in order to achieve resource constraints. The detailed process of the sketch is presented as follows.

Computing the Sampling Probability p_k in Each Time Window

Based on the idea of time-stratified sampling, the sketch divides the whole measurement period T into equally-sized time window (Du Zifang., 2005). Obviously, the length of each time window is T/L . As is mentioned above, the real number of flows in the k th time window N_k is regarded as an important parameter to regulate the sampling rate. So, the equation of the sampling rate p_k in the k th time window is defined as follows.

$$p_k = \min \left\{ 1, \frac{\varepsilon M}{N_k} \right\} \quad (1)$$

From equation (1), we can conclude that the sketch samples packets with probability 1 when the in-equation $N_k \leq \varepsilon M$ satisfies. On the contrary, when the in-equation $N_k > \varepsilon M$ satisfies, the sampling rate is adaptively declined to decrease the number of preserved flows in order to protect resource from being overwhelmed. Notice that ε ($0 < \varepsilon < 1$) is a resource constraints parameter which can control the sampling rate to limit the number of flow recodes to be exported to an expected level. The parameter ε can be designed based on actual network environment.

Computing N_k and Estimating \tilde{N}_k

Before sampling packets in the k th time window, the sketch should ascertain the sampling rate firstly. From equation (1), we notice that only if N_k is acquired can the sampling rate be computed. So, N_k can be predicted by the number of flows counted by previous time windows. Taking the real-time and easy-implemented characteristics of traffic measurement into account, the prediction should be so compact that it can not impact the system's performance. We employ an AR model for predicting the traffic parameters N_k , since it is easier to understand and computationally more efficient as compared to other time series models (Choi B Y, Park J, and Zhang Z L., 2004). In particular, using the AR model, the model parameters can be obtained by solving a set of simple linear equations, making it suitable for online traffic load estimation. Using AR (p) model, \tilde{N}_k can be expressed as follows (Choi B Y, Park J, and Zhang Z L., 2004).

$$\tilde{N}_k = f(N_{k-1}, N_{k-2}, \dots, N_{k-p}) = \sum_{i=1}^p a_i N_{k-i} + e_k \quad (2)$$

$a_i, i = 1, \dots, P$ Are the model parameters and e_k is the uncorrelated error (which we refer to as the prediction error). The error term e_k follows a normal distribution with mean 0. The model parameters $a_i, i = 1, \dots, P$ can be determined by solving a set of linear equations in terms of P past values of N_k . P is a configurable parameter independent of N_k , and is typically referred to as the memory size. Empirical studies we conducted, however, show that the AR (1) is sufficient for our purpose^[8]. Namely, the predicted number of traffic flows can be expressed by $\tilde{N}_k = N_{k-1}$. So substitute N_k with \tilde{N}_k , we can acquire the followed equation.

$$p_k = \min \left\{ 1, \frac{\varepsilon M}{\tilde{N}_k} \right\} = \min \left\{ 1, \frac{\varepsilon M}{N_{k-1}} \right\} \quad (3)$$

Theoretical Analysis

In traffic measurement, the aggregated flows and the proportion of theirs are often focused. In this section, we give the expression of \tilde{S}_k^f and the expression of \tilde{S}^f . Also, the unbiased characteristics of both are also proofed.

Computing \tilde{S}_k^f and \tilde{S}^f

Based on the theory of time-stratified sampling (Du Zifang., 2005), \tilde{S}_k^f and \tilde{S}^f can be expressed as follows.

In the k th time window, \tilde{S}_k^f satisfies the followed equation:

$$\tilde{S}_k^f = S_k^f / p_k \quad (4)$$

In the whole measurement period, \tilde{S}^f satisfies the followed equation:

$$\tilde{S}^f = \sum_{k=1}^L \tilde{S}_k^f = \sum_{k=1}^L S_k^f / p_k \quad (5)$$

Estimating The Size Of Each Flow

Based on the theory of adaptive random sampling, we can acquire the followed theorem.

Theorem 1 $\forall f \in F$, \tilde{S}_k^f and \tilde{S}^f satisfy:

(i) \tilde{S}_k^f Is an unbiased estimator of R_k^f , i.e. $E(\tilde{S}_k^f) = R_k^f$.

(ii) \tilde{S}^f Is an unbiased estimator of R^f , i.e. $E(\tilde{S}^f) = R^f$.

Proof:

(i) With a fixed probability p_k , S_k^f represents the number of sampled packets in the k th time window. Based on the theory of simple random sampling, we can conclude that $S_k^f \square B(R_k^f, p_k)$.

So, the expected value of S_k^f satisfies $E(S_k^f) = R_k^f p_k$. From equation (4), the first conclusion can be proofed as follows.

$$E(\tilde{S}_k^f) = E\left(\frac{S_k^f}{p_k}\right) = \frac{1}{p_k} E(S_k^f) = \frac{1}{p_k} \cdot R_k^f p_k = R_k^f$$

(ii) Since the whole measurement period is divided into equally-sized time widows,

\tilde{S}^f satisfies $\tilde{S}^f = \sum_{k=1}^L \tilde{S}_k^f$. So the second conclusion can be proofed as follows.

$$E(\tilde{S}^f) = E\left(\sum_{k=1}^L \tilde{S}_k^f\right) = \sum_{k=1}^L E(\tilde{S}_k^f) = \sum_{k=1}^L R_k^f = R^f$$

Experiment

In this section we empirically evaluate the performance of our adaptive random sampling technique using the real network traces. The traces used in this study are obtained from NLANR IPLS->CLEV 2.5G (NLANR, 2006). The experiments compare the sketch proposed in this paper

with Static Sampling and Adaptive Net Flow. To depict conveniently, we named the sketch proposed in this paper as adaptive random sampling.

Configuring Relevant Parameters

The length of one measurement period should be appropriate. If it is too long, the number of flow recodes may be so great that overwhelming resource is consumed. In the experiment, we chose $T = 60s$ and $L = 10$. Obviously, the length of each time window is $6s$. The sampling rate is initialized by $p_0 = 0.9$.

Simulation of the Measurement Error

Computing the packets data from the real network trace, we can acquire five familiar aggregated flows such as HTTP, P2P, FTP, SMTP and DNS. Table 1 gives the detailed proportion of each aggregated flow.

Table 1 The Proportion Of Each Aggregated Flow

Aggregate flows	HTTP	P2P	FTP	SMTP	DNS
Percent(%)	36.11	27.17	16.54	8.05	1.50

Table 2 gives the relative error of the above three algorithms. In order to compare fairly, three sketches utilize the same size of flow cache whose size is 16k. From table 2, we can conclude that the sketch proposed in this paper is not bringing additional measurement error.

Table 2 The Relative Error Of Each Aggregated Flow

Aggregate flows	HTTP	P2P	FTP	SMTP	DNS
--------------------	------	-----	-----	------	-----

Static Sample	0.009	0.013	0.047	0.097	0.147
Adaptive NetFlow	0.011	0.002	0.051	0.132	0.156
RCAPSBFC	0.009	0.014	0.055	0.099	0.149

Simulation Of The Consumed Memory

In this experiment, we configure the maximal number of flow recodes $M = 64K$ and the restraining parameter $\varepsilon = 0.6$. Figure 1 simulates the consumed memory in one measurement period. The size of the consumed memory is depicted by the number of flow records. At the end of the time window, the sketch records the number of the sampled flows. From figure 1, we can draw conclusion that static sampling will run out of all of the memory. However, adaptive random sampling will control the consumed memory by introducing the parameters N_k and ε . Namely, when the number of sampled flows is increasing, the corresponding sampling is declined to constrain the consumed memory resource.

Figure 2 simulates the consumed memory during ten measurement periods. At the end of each measurement period, the number of sampled flows is recorded. From figure 2, we can see that Adaptive Net-Flow can limit the consumed to an expected level through decreasing sampling rate and renormalization of flow entries. Adaptive random sampling can not only restrain the consumed memory into a fluctuated range, but also avoid the complicated operation of renormalization.

Conclusion

Aiming at the deficiency of the static sampling, the paper proposed a sketch called adaptive random sampling based on flow statistics. Firstly, the sketch divides the whole measurement period into equally-sized time windows. In each time window, simple random sampling is

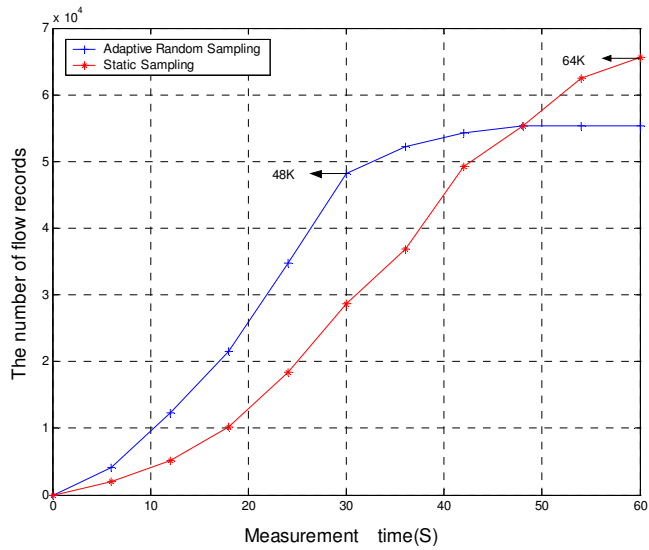


Figure 1 The Consumed Memory In One Measurement Period

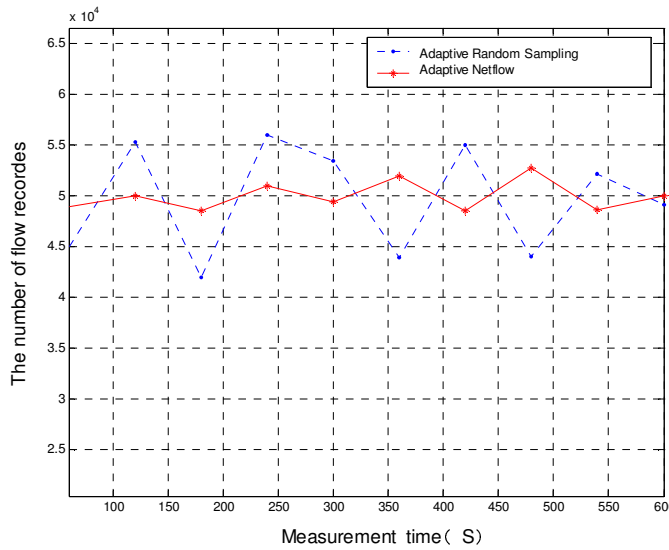


Figure 2 The Consumed Memory During Ten Measurement Periods

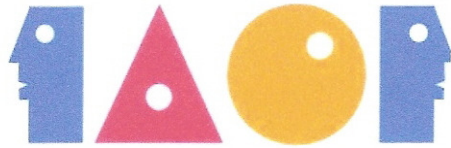
implemented. This sampling method is not only simple and easy-implemented, but also resolving the problem which is the complicated operation of renormalization. Secondly, the memory of measurement system is referred as an important parameter which regulates the sampling rate online in order to protect the memory from being overwhelmed. Meanwhile, the unbiased estimator of the size of the sampled flows is given. At the end of the paper, experiments are

conducted based on the real data to mainly validate veracity, adaptability and controllability of the sketch.

The ideas in this paper can be further developed by introducing a novel summarized data structure such as Bloom Filter. Bloom Filter can support per-flow measurement without sacrificing accuracy which is demonstrated in (Kumar A, Xu J, Wang J, Spatschek O, Li L., 2004).

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Characteristics of the Higher Education in
Mainland China and Taiwan

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Abstract

This study was to find the structural differences of higher education of the two sides through a status quo analysis. At the same time, it also tried to investigate the influences that the political, economic, technological, and cultural factors of both society and environment have had on higher education.

This study aims at comparing higher education in Mainland China and Taiwan, focusing on the similarities and differences. This study analyzed their virtues and flaws, and the status quo based on the political, economic, technological and social aspects, and provided suggestions to the future development of the higher education on both sides of the Strait.

Keywords: Both Sides, Higher Education, Economic, Technological, Political

Introduction

Taiwan has been alienated from Mainland China for so long that discrepancies now exist in many areas. Two major differences lie within economics and mindsets. With different social environments, the higher education on the two sides has become different from each other.

Both sides of the Strait value education highly. Folk sayings, such as “nothing is noble except reading,” and “there lies a fairy beauty Yan Ruyu and golden house in the books,” are true reflections of how the common folk regard education. It is necessary to promote the awareness that Mainland China and Taiwan both have need for higher educational development, which can result in massive returns on investments.

Literature Review

Hua (1999) believed that due to the need for the economic development, Taiwan continuously adjusted education policies, which brought education and higher education on to the fast track of development. As a result, it promoted the economic development and achieved distinctive effects. Li (2006) held that the development of higher education in Mainland China was inconsistent, but after the 1980's, with the establishment of a series of correct route, guideline, and policies, she adjusted and reformed higher education policies and practices, and also gained compelling achievements.

The scholars in higher education on the two sides of the Taiwan Strait have different views on the issue of higher education development, such as scope of development in higher education and other issues.

The scholars of higher education in Mainland China have different views regarding the scope of development of higher education. Some think that higher education in Mainland China

has and is capable of precipitating development; otherwise, it would restrict the economic development of Mainland China. Zhang (2005) summarized the major arguments as shown below:

The demand for and purchasing ability of the people for education also increased after the reform and opening up. Mainland China faces great unemployment pressure. Developing higher education and postponing the search for employment would be quite helpful in releasing the pressure of unemployment. Simultaneously, Mainland China is facing the challenge of the knowledge economy and the trend of the economic and social development certainly will require higher education to play a more important role. Although there is still a disparity between the scale of higher education in Mainland China and in the countries of the same developmental level, Mainland China can get the same number of university graduates from a much smaller scale of students studying in universities.

From the perspective of social demand and supply for higher education, Mainland China still faces prominent problems. On one hand, according to the aim of development of the national economy of Mainland China, the GNP should grow by 7% annually, while the role high-technology plays in economic growth will be more evident. All these form the huge demand for higher education. On the other hand, the possible investment to higher education in Mainland China might become severely insufficient. Mainland China has begun national construction in an all-round way in the 21st century (Wu, 2006). President Jiang Zemin put forward the following in the 16th Congress of the Communist Party of China (2002): The first 20 years of 21st century, China will build up a well-off society in an all-round way, which will benefit more than 1 billion people. Wu (2006) stated that this grand goal needs gross investment of capital. On educational investment, the priority should allocate funds for nine-

year compulsory education and reasonable arrangement of education of various kinds and levels henceforward. Higher education in Mainland China should keep an appropriate scale in the process of its development.

It is also a controversial issue in Taiwan, especially in recent years. Some educational workers hold doubts as to whether the expansion of higher education should still proceed, due to the condition of insufficient recruitment of students of colleges in Taiwan. Lin and Huang (2001) found the yearly capacity of higher education in Taiwan is approaching the total number of high school graduates each year. In other words, the development of higher education in Taiwan has nearly reached saturation. He also worried that the student recruitment of higher education in Taiwan would encounter a serious predicament in the future, due to Taiwan's entering WTO, expanding educational businesses, expanding schools, and the decline of the total number of high school graduates per year. Zhu (2007) said, "The higher education in Taiwan is abused nowadays. It is more difficult to fail it than to pass the entrance examination."

Even the president of Academia Sinica of Taiwan, Li Yuanzhe said, "We cannot help being suspicious of the necessity of building so many colleges and universities in Taiwan." (Shiu & Guei, 2001). Nevertheless, Iv and Peng (2001) stated that there is a positive correlation existing between the fast expansion of higher education and the whole economic development in Taiwan. He believes that there is an absolute need for expanding higher education, because Taiwan asks for more human resources of high quality in order to meet the needs of industries of high technology and promote the level of international competitiveness.

Research Design

Focusing on contents and questions of research, this study, from the macroscopic perspective of higher educational systems, objectively investigated the history and the current

situation of higher educational systems in Mainland China and Taiwan. Simultaneously, this study analyzed the factors which influence both the current situation and the future development of higher educational systems on both sides, including similarities and dissimilarities.

This study was designed in the following way because it was a unique historical phenomenon for Taiwan to separate from Mainland China. Mainland China and Taiwan originally were a unified country, using the same language and same alphabet characters. There are similarities in many various aspects. Therefore, it was necessary to depart from history, and find the common features of higher educational systems on the two sides. Moreover, Mainland China and Taiwan have been separated since 1949. In different social backgrounds, the higher educational systems of the two sides have gradually become different from each other. This study sought to find the structural differences of the two higher educational systems through the status quo analysis, and investigation of the influences that the political, economic, technological, and cultural factors of both society and environment have on the educational system.

Due to the difference of the geographic condition and the political and social nature between the two sides, it was impossible to determine a clear-cut criterion for comparison, so the comparison here was only a relative and approximate one from a macroscopic perspective. The starting time of the history of the higher educational systems on both sides mentioned here was set in 1949, for this year sets the timeline for higher education in Mainland China and Taiwan. The starting time for giving accounts of the status quo of higher educational systems in Taiwan was set in 1987. The starting time for Mainland China was set in 1977.

The materials for this study came from many diverse sources. Materials from all perspectives (positive and negative, historical and practical, official and popular) were included. First hand information was used as much as possible. Of course, on-site surveys and interviews

were necessary to acquaint one with the facts that cannot be found in literature, books and periodicals. Materials collected were representative, convincing and reliable. Statistics were accurate, without any uncertainty or bias. After collection of materials in a multi-angle and multi-sided manner, material was synthesized, classified, arranged, identified and analyzed.

Results and Discussions

Higher Education in Taiwan After 1949

Continuously Adjusting the Educational Structure to Meet the Needs of Economic Construction

When the 1970's came, Taiwan's economy was twice struck by oil crises. The traditional vocational education was no longer suited for the rapid economic growth; consequently, Taiwan had to vigorously develop its junior college and college educational systems. In 1985, Taiwan reopened its private schools which offered a junior college education or a college education. The number of universities and research institutes began to proliferate. According to statistics, there were 343, 000 students in 104 institutes of higher education in 1980, among which 187, 000 were from 77 junior colleges and 156, 000 were from 27 colleges or universities. In 1994, the number of institutes of higher education increased to 130, and there were about 720, 000 students studying there; but, among these 130 institutes, the number of junior colleges decreased to 72, while that of colleges or universities increased to 58 with more than 340, 000 students on campus. (Wang, 2002)

According to statistics, in 2002, the number of institutes of higher education increased to 152, and there were about 1,240,000 students studying there; colleges and universities increased to 148 with more than 890, 000 students on campus. (Ministry of Education, Taiwan, 2003).

Stressing Educational Investment.

During the second half of the 1980's, Taiwan authorities accelerated the upgrading of technology and industry to improve industrial structure and productivity to strengthen its competitive edge against foreign rivals. Higher education investments rapidly increased and held 20 percent of all the government education investment. The establishment of various kinds of rules of law on education was highly beneficial to the standardization of education and the healthy development of the whole education business.

Developing Vocational and Technological Education For Applicable Personnel.

With the increasing growth of Taiwan's economy, its economic structure changed from internal to external labor-intensive export processing, which turned an agricultural society into an industrial one. At present, general universities in Taiwan attach more and more importance to research of applied science and technology (practical technology) and to technological education. Both traditional specialties and courses present the characteristics of vocational education. Meanwhile, institutes of higher vocational education constantly improve education and research levels on scientific and technological theories and overall quality of students. Institutes of higher vocational education are more and more similar to general universities. (Yang & Han, 2002)

Higher Education in Mainland China after 1949

In 1949, the Chinese Communist Party (CPC) came into power and started the modernization of socialistic higher education, learning from the Soviet Union.

Exploring the New Way Of Higher Education.

The period from 1956 to 1966 was called by Mainland China the "decade of socialistic construction", and this was an important period in which Mainland China actively sought and developed its own way of higher education. In the course of opposing USSR, CPC totally negated the experience of higher education in the USSR and began to explore new ways of

developing higher education in China. From 1958 to 1964, Mainland China successively started two “education revolutions”, hoping to overcome the defects from the Soviet pattern of higher education. Due to the political environment of the time, the two reforms were heavily tinted with irrationality and finally failed. To the contrary, the failing of reforms reinforced the Soviet style teaching system (Yu, 2002.)

During the Cultural Revolution, institutes of higher education were seriously devastated. The consequences of the Cultural Revolution brought to higher education were calamitous, which caused a halt in the education modernization in Mainland China (Wu & Yian, 1997).

Current Higher Educational System in Taiwan

The start time for describing the current higher educational system in Taiwan is 1987. The current educational system in Taiwan is divided into standard education and vocational education. Standard education contains three phases: civil education, senior secondary education, and higher education. Vocational education includes primary vocational education and higher vocational education (Wang, 2001). Length of schooling in standard institutes of higher education is four years, but at normal universities, law and construction specialties are five years, and medicine is six to seven years (Social Exchanges across the Strait, 2000).

Management Mechanisms.

Both public and private universities have been administered according to the regulations and rules of law enacted by the “Ministry of Education” of Taiwan for college administration. To some extent, this facilitated standardization and institutionalization of managing institutes of higher education in Taiwan and kept higher education developing in an orderly way. But the extremity of this kind of administration often led to the loss of independence of universities. The new university laws, promulgated in 1994, definitely prescribed to grant self-rule to universities.

That situation began to improve. Institutes of higher education began to develop in the direction of administration independently under macro control. (Lin, 1995)

Student Recruitment System.

From 1994, Taiwan began to study and try out a diverse entrance scheme, which fully replaced the joint college examination in 2002. The tenet of this new scheme is “to select befitting students to enter proper colleges for suitable development through advisable ways” (Xu, 2002).

Yu (2001) introduced the idea of the diverse entrance scheme have two types: “selection scheme” and “respective distribution of examination scheme”. Selection scheme is developed through combining current the application system and recommendation system; respective distribution of examination scheme recruits students according to their subject aptitude test and the grade of examination on a given subject. The diverse entrance scheme aims at that those students with different aptitudes, potentials, and specialties, and all have the chance to be selected for institutes of higher education for further studies through diverse entrance channels.

Education Policy.

The rapid economic development of Taiwan is to some extent attributed to the strong support of higher education, while the development of higher education is in some degree benefited from policies which standardize the development of higher education. Peng (2001) reported that the reason why Taiwan can create such a well-known economic miracle with limited territory and natural resources lies in its favorable education policy, which is critical in manpower cultivation. “White Paper on Taiwan College Education Policy” promulgated in December 2001, pointed out the development strategy of current college education in Taiwan:

(a) medium and long development project of college education which is now in research; (b) to impel universities to position themselves through offering reasonable flexibility; (c) to improve both capacity and quality of college education; and (d) to rationalize fund-raising and distribution of college education. In general, the direction of reform for education in Taiwan is “to loosen the bondage on education, foster every student, open entrance channels, improve education quality, and build up a life-long learning” (Yu, 2001).

Current Higher Education in Mainland China

The start time for describing the current higher educational system in Mainland China is 1977. A higher educational system in Mainland China has been developed. The characteristics of the system are as follows: an established scale, diversified forms, various levels, a complete set of branches of study, ever-increasingly reasonable overall arrangement. (Xu, 1999) Xiao (2000) divided institutes of higher education in Mainland China into four types according to subject setting: comprehensive subject university (with more than 7 first-level subjects including society, human culture, nature, and engineering), general subject university (with more than five first-level subjects including economics, law, literature, science, engineering), multi-subject university (with more than three first-level subjects, chiefly science, engineering and society with other subjects in a supporting role) and single subject university (only one main subject).

Management Mechanisms.

In 1993, Mainland China was bold to push forward the gradual reform on administrative system of higher education and put forward a “co-build, adjust, cooperate, and combine” policy. It changed department school administration system formed under planned economy into another in which the administration of a majority of institutes of higher education was transferred to the lower level of each province, city, and autonomous region. As Zhou (2002) stated, there were

altogether 367 institutes of higher education directly administered by the State Council. After reform, there were about 110 left. Reform of the administrative system of higher education in Mainland China transfers the examining-and-approval right of higher vocational colleges and junior colleges, and the recruitment planning right of junior college education to provincial governments to improve the independence of institutes of higher education. Therefore, it has a strategic significance for the development of higher educational business in Mainland China (Zhou, 2002).

Student Recruitment System.

Recruitment expansion starting in 1998 is in complete accordance with the collective demand for higher education caused by the social development of Mainland China. In order to keep quality from falling after expansion, on one hand, Mainland China increases its investment on higher education to provide hardware guarantee for improvement of teaching quality. On the other hand, it makes new policy, deepens teaching reform, adopts advanced teaching method, reform teaching contents, and makes further efforts to ensure education quality. (Institute of Shanghai City Education & Science, 2008).

Development of Privately-Owned Institutes of Higher Learning.

In 1992, the 14th CPC Congress pointed out to “encourage social fund-raising administration and local administration of schools through various channels and in various forms in order to change the practice of all state-administration of education.” In 1999, the third national education meeting of Mainland China further brought forward the policy to “establish the pattern of co-development of public and private schools with government-run schools as the principal part.” After that, private education stepped into the phase of accelerated development.

Findings and Conclusions

Through the investigation, this study found:

1. Common features of higher educational systems on both sides of the Taiwan Strait exceed differences.
2. Attaching importance to and developing higher education are long time policies that two sides adhere to.
3. The political factors still have an impact on the exchanges and cooperation in the educational fields between the two sides.
4. The reform of higher educational systems of the two sides brings about more opportunities for countries with more developed higher education to participate and invest in both sides.
5. The situation of the higher educational reform of both sides is different.
6. Increasing exchanges and improving cooperation are indispensable for the future better development of higher education between the two sides.

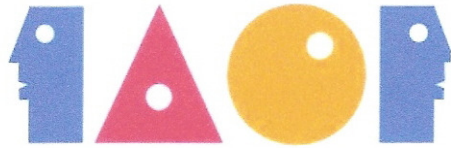
Recommendations for Further Research

It is a big topic to talk about the higher educational system in Mainland China and Taiwan, for it involves aspects of higher education of the both sides, and it is not easy to cover it in details in one article. Restricted by the coverage of an article, this study left far from complete the history of higher education previous to the year of 1949 in China. At the same time, due to the restrictions of conditions, the illustration of higher education of Mainland China in the Cultural Revolution is far from complete, as is the research on how higher education of the both sides develops under edification of the long-standing culture of the Chinese nation.

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A STUDY ON THE DESCRIPTIVE SCALE OF GLOBAL VIEW FOR
SHAPE CONCEPTION FEATURE

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Abstract

In this paper, we approached the issue of global shaped factors, which conceptualize the “egg-shaped”, according to the egg-shape conception of people using quantitative process. First, a research sample of 30 simple outlines was examined, and 30 students participated. In order to define the “strength of the egg-shaped conception”, the shape samples were evaluated according to the participants’ feel on similarity of degree between samples and egg-shape conceptions, and the most typical egg-shape was selected. The shape samples were transformed into quantitative data using ODSR (One Dimension Sequence Representation), and 4 statistics were used to describe the feature factors of the egg-shapes; Average, Coefficient of Variation, Coefficient of Skewness, Coefficient of Kurtosis. The capability of these 4 statistics was used to explain the “strength of the egg-shaped conception”.

Keywords: Shaped Conception, Shaped Feature

Introduction

Shape performs a very important role in the interaction between products and consumers, whether for an aesthetic purpose or a functional purpose. But the interaction between shape and consumer's recognition is very complex. In the past, designers created a style or coherence of product shape according to his subjective opinion, called "the black box operation". It is difficult to understand the interaction between shape and recognition in this process. From a scientific viewpoint, we couldn't infer or predict the shape which is demanded or favored by consumers if the relationship was not defined. Thus, it is necessary to research the relationship between shape and consumer's recognition by using systematic quantitative methods. Two key points are discussed, "shape conception" and "shape descriptive on global view".

"Conception" could be formed as a constituent unit of a knowledge system on cognition psychology (Bruner, JS et al. 1956). It has a powerful impact in the action of cognition. The conception is a symbolic structure. It typifies the commonality of externals. The conception is transformed by people's categorization, though the progress of categorization to structure a variety of conception, where the more similar things are, the more homology de-excited¹.

The meaning of "quantitative description in shape" transforms from an actual shape into a quantity format. It conduces to definition, explanation, analysis, comparison of shape questions. In the typical study of Kansei Engineering (Nagamachi, M. 1995), shape is always described by several attributions formed by qualitative methods. However, it has many restrictions in the exploration of the relationship between shape and recognition, as follow.

- (1) According to the Structure Mode Theory of Gestalt Psychology (Garner, WR. 1978), the conception could not be formed by single individuality and it mostly thought the analysis of commonality of shapes, so it is difficult to define the impact of single attribute on whole

recognition process.

- (2) If we define a conception of shape by several common attributions, the interaction will become a problem when the statistical tool is used.
- (3) The shape attribute is always biased by the researcher's subjective opinion.

Another type of shape description is the re-presentation based on mathematical format, such as curve fitting techniques (Vera, B. 1993). The advantage of mathematical representation is accuracy of representation. The data structure of this kind of representation is quite complex and lacking in commonality. It is hard to construct a relationship between shape and cognition.

It not only exists in cognition psychology and design fields to find an applicable quantitative method in description of shape. A lot of researchers are developing the description shape by quantitative approaches, such as CSM (The Continuous Symmetry Measure Method) (Zabrodsky, H. & Avnir, D. 1995) used to measure symmetry of prehistoric instruments in archaeology (Saragusti, I et al. 1998). Altogether, it is the research method used to determine the descriptive scale on global view and explore the ability of factors for explanation of shape conception.

Descriptive Scale of Global View

There is a major question in this paper: how to describe shape by suitable scales. Via those scales, the designer will be able to understand the relationship between shape and consumer's recognition effectively. We used the outline of the egg-shaped as an example. ODSR (One Dimension Sequence Representation) transforms the shape of the sample into quantitative data, and four statistics (Average, Coefficient of variation, Coefficient of skewness, Coefficient of kurtosis) are evaluated to identify the ability to explain recognition effect:

Set $v_i = \text{sequence } (i = 1, 2, \dots, n)$

(1) Average (F_1)

$$F_1 = m = \frac{\sum_{i=1}^n v_i}{n} \quad (1)$$

(2) Coefficient of variation (F_2)

$$F_2 = v = \frac{\left[\frac{1}{n} \sum_{i=1}^n (v_i - m)^2 \right]^{1/2}}{m} \quad (2)$$

(3) Coefficient of skewness (F_3)

$$F_3 = s = \frac{\frac{1}{n} \sum_{i=1}^n (v_i - m)^3}{\left[\frac{1}{n} \sum_{i=1}^n (v_i - m)^2 \right]^{3/2}} \quad (3)$$

$$F_4 = k = \frac{\frac{1}{n} \sum_{i=1}^n (v_i - m)^4}{\left[\frac{1}{n} \sum_{i=1}^n (v_i - m)^2 \right]^2} \quad (4)$$

Method

The framework of this research consists of 3 parts: (1) Participants evaluated the degree of similarity between sample shape and their conception of egg-shapes, and then selected the most typical egg-shaped of all samples. (2) Researchers calculated 4 statistics for all samples by ODSR and normalization. (3) The relationships between these statistics and the conception of egg-shaped were analyzed.

Selecting The Typical Egg-Shaped

Sample

In order to expand the range of the sample and restrain the number of samples, we draw a figure as a “desired typical egg-shaped” according real egg (sample No.6). (See all samples and figures at the end of the article.) Fig.1 shows the 30 samples in this research, No.1 is a round, No.2~5 are derive from No.1, No.7~15 are derive from No.6 variety of proportion, No.16~25 are derive from No.6 by irregularity, No.26~30 are derive from No.6 by rotation.

Experiment: Subjective Evaluations of Similar Degree

Every participator is asked to evaluate the similar degree between every sample and their conception on “egg-shaped” by a Likert rating scale. First of all, participants are asked to select two samples, one is the most score, the other is the less score. This was done to avoid variance is from the different of evaluation criterion among the participants.

Results of Experiment

Table 1 shows the average and standard deviation of score of all samples, No.6 have highest average in all sample (6.8), standard deviation is 0.4, that meaning the No.6 is the closest sample of egg-shaped between 15 participants, and the evaluation of all participants are very concurrent. Thus, No.6 was selected for the typical egg-shaped conception in this research.

Quantitative Representation of Shape:

The method which transforms boundary point of shape into several distances between boundary point and center of shape in sequence was used to represent a shape.

Calculation of Center Of Shape Outline

Calculation of center of shape outline

In order to Calculation the position of figure and area of shape, the sample figures were inserted into a grid (see Fig 2). In this grid, the units which be passed by outline was mark by gray. The center of sample figure was calculated by the coordinate of those gray units, as Eq. (5), (6), (7).

$$X_c = \frac{-\sum_{i=1}^n x_i^2 (y_{i-1} - y_i)}{2 \times Area} \quad (5)$$

$$Y_c = \frac{-\sum_{i=1}^n y_i^2 (x_{i-1} - x_i)}{2 \times Area} \quad (6)$$

$$Area = \sum_{i=1}^n [y_i(x_{i+1} - x_i) - x_i(y_{i+1} - y_i)] \quad (7)$$

where:

$C = (X_c, Y_c)$ center of figure

$n =$ number of gray units

$Area =$ area of figure (Gree rule)

Representation of Outline of Shape

The position of boundary points of the approximate polygon of sample shape is calculated using “Isometric angles method”. Fig.3 shows the approach of search the boundary point of shape by the method of Isometric angles. The Boundary points are searched toward the outline with C point as hub at an interval of 11.25° , the boundary of which longest distance which be measured between boundary point (T_i) and C are deputized starting to number the boundary point from 1 to 32 (T_1, T_2, \dots, T_{32}) in reversed clock direction. The outline of shapes are represented in Eq. (8)

$$S = \{T_i = (x_i, y_i)\} \quad i = 1, 2, \dots, n \quad (8)$$

where:

$S =$ outline of shape

$T_i =$ boundary point i

$(x_i, y_i) =$ the coordinate of boundary point i

$n =$ the number of boundary points

Transforming Outline into Sequence

The outline of shape transformed from the coordinate into sequence (r_i) which was represented in the distance between boundary and center as Eq. (9).

$$r_i = d(T_i, C) \quad i = 1, 2, \dots, n \quad (9)$$

Where:

$C = (x_c, y_c)$ coordinate of center

$T_i = (x_i, y_i)$ coordinate of boundary point i

$d(T_i, C)$ = the distance between T_i and C

Normalization

Find out the unit of which largest distance in sequence $V_{\max i}$, and sequence unit r_i is normalized into v_i follow Eq. (10). Normalization could drown the impact of difference of scale between samples. The number of sequence v_i intervenes between 0 to 1 (see Fig.4)

Analyses And Results

Calculation Of Feature Factors

Four feature factors of egg-shaped (Average F_1 , Coefficient of variation F_2 , Coefficient of skewness F_3 , Coefficient of kurtosis F_4) are calculated according to Eq. (1), (2), (3), (4) (see Fig.5).

Calculation Of Distance Between Sample And Typical Egg-Shaped

Follow the conception of this research, we assume the number of feature factors of typical egg-shaped equal to the sample which was the largest strength of egg-shaped in all ($F_1=0.71$, $F_2=0.08$, $F_3=0.78$, $F_4=0.05$). In order to verify the supposition, we calculate the distance between every sample and No.6 sample (the typical egg-shaped) on 4 feature factors. No.1 sample was not calculated, because it is around, the numbers are equality on 4 feature factors.

Multiple Regression Analysis

The regression analysis model consists of 4 feature factors as independent variable; it was constructed to test the statistical significance of those feature factors in explanation of egg-shaped conception. Table 3 shows the results of ANOVA, the relationship between independent

variable (a feature factors) and dependent variable (the strength of egg-shaped conception) are re presented. $P=0.05$, $F=6.26$, sig of $F=0.01$, meaning the relationship between feature factors and strength of egg-shaped are regression.

The $ADJ R^2$ value deters the ability which explains the strength of egg-shaped conception of 4 feature factors. In Table 4, $ADJ R^2=0.429$, meaning in the regression model 4 feature factors only reduced 43% variance of strength of strength of egg-shaped conception. Scilicet, 57% variance comes of undiscovered factors.

In order to check whether there are powerful feature factors which explain the strength of egg-shaped conception or not, stepwise regression is used. Average F_1 , Coefficient of variation F_2 , Coefficient of Kurtosis F_4 is excluded in this model (see table 5). Specifically, those feature factors have no significant to explain the strength of egg-shaped conception.

Through significance testing, only the Coefficient of skewness (F_3) is reserved in all feature factors (see table 6). The Coefficient of skewness (F_3) is performed to construct another regression analysis, and its ability which explains the strength of egg-shaped. $R^2=0.399$ (see table 7), and compares with first regression model the regression which consists by Coefficient of skewness (F_3) have a significant effect to explain the variance.

Conclusions

- (1) The capability of the 4 statistics in the explanation of the “strength of egg-shaped conception” is identified. The Coefficient of Skewness, which has a significant capability in explaining the " strength of egg-shaped conception" is 43%; in other words, 57% of variance comes form undiscovered factors.
- (2) The Average, Coefficient of Variation, Coefficient of Kurtosis have no significant impact in explaining the relationship of shape and egg-shaped conception.

(3) By putting the Coefficient of Skewness into practice, we could understand its meaning. When the Coefficient of Skewness is 0, the sequences would centralize near the average and more approximate a round. When the Coefficient of Skewness is greater than 0, the greater part of sequences would be less than average, meaning a slender shape. When the Coefficient of Skewness is 0.78, the egg-shaped conception reaches towards the top; the closer to the top, the more strong the conception.

Acknowledgements

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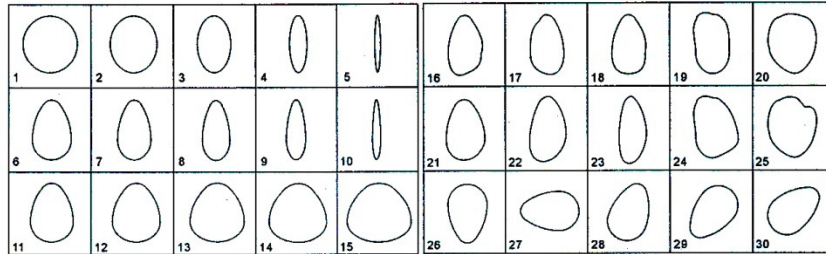


Figure 1 Samples

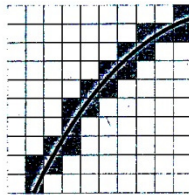


Figure 2 An outline of shape be represented by grid

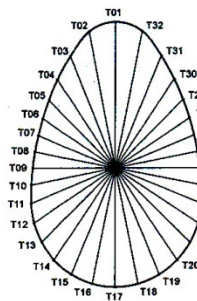


Figure 3 Calculation the approximate polygon of egg-shaped

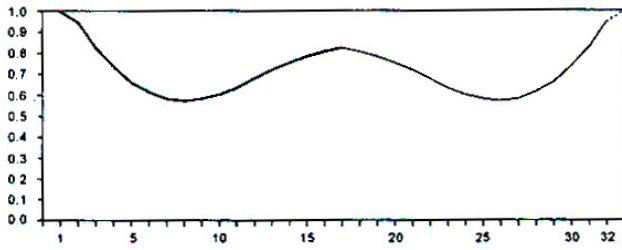


Figure 4 Sequence represent of shape

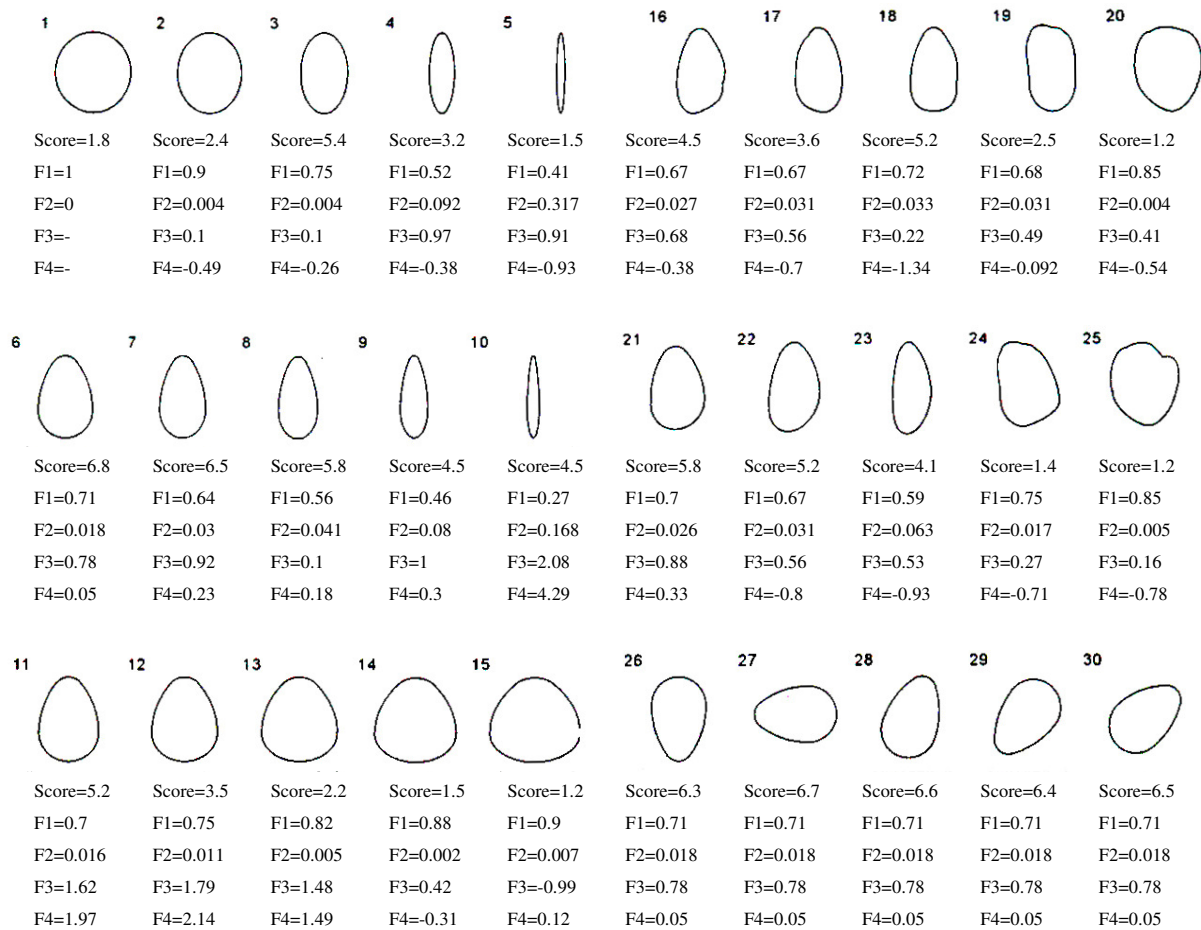


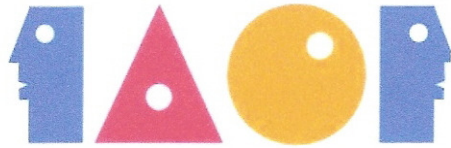
Figure 5 Result of calculation of 4 feature factors

Table 1 The result of evaluation

sample	average	SD	sample	average	SD
1	1.8	1.2	16	4.5	1.7
2	2.4	0.8	17	3.6	2.0
3	5.4	0.7	18	5.2	0.9
4	3.2	1.3	19	2.5	1.7
5	1.5	0.4	20	1.2	0.6
6	6.8	0.4	21	5.8	0.6
7	6.5	0.6	22	5.2	1.4
8	5.8	0.7	23	4.1	2.3
9	4.5	1.2	24	1.4	0.5
10	1.5	0.9	25	1.2	0.3
11	5.2	1.5	26	6.3	1.2
12	3.5	1.0	27	6.7	0.8
13	2.2	1.7	28	6.6	0.6
14	1.5	0.8	29	6.4	0.8
15	1.2	0.3	30	6.5	0.5

Table 2 Distance between sample and typical egg-shaped

sample	score	F_1	F_2	F_3	F_4
2	2.4	0.19	0.014	0.68	0.54
3	5.4	0.04	0.01	0.31	0.31
4	3.2	0.19	0.074	0.19	0.43
5	1.5	0.30	0.299	1.13	0.98
6	6.8	0.00	0.000	0.00	0.00
7	6.5	0.07	0.012	0.14	0.18
8	5.8	0.15	0.023	0.68	0.13
9	4.5	0.25	0.062	0.22	0.25
10	1.5	0.44	0.149	1.30	4.24
11	5.2	0.01	0.002	0.16	1.92
12	3.5	0.04	0.007	0.01	2.09
13	2.2	0.11	0.013	0.30	1.44
14	1.5	0.17	0.016	0.36	0.36
15	1.2	0.19	0.011	1.77	0.07
16	4.5	0.04	0.009	0.10	0.43
17	3.6	0.04	0.013	0.22	0.75
18	5.2	0.01	0.015	0.56	1.39
19	2.5	0.03	0.013	0.29	0.97
20	1.2	0.14	0.014	0.37	0.59
21	5.8	0.01	0.008	0.10	0.28
22	5.2	0.04	0.013	0.22	0.85
23	4.1	0.12	0.045	0.25	0.98
24	1.4	0.04	0.001	0.51	0.76
25	1.2	0.14	0.013	0.62	0.83
26	6.3	0.00	0.000	0.00	0.00
27	6.7	0.00	0.000	0.00	0.00
28	6.6	0.00	0.000	0.00	0.00
29	6.4	0.00	0.000	0.00	0.00
30	6.5	0.00	0.000	0.00	0.00



FAST FAILURE RECOVERY VIA PATH-COST INDICATING

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Abstract

The article presents the basic design of Path-Cost Indicating (PCI), a new routing framework to achieve fast failure recovery routing. Under PCI, each packet carries a short label to indicate the remaining path cost and failure nodes in network. A packet is routed to its destination based on the label without delay or drop even if there are link failures. The preliminary analysis suggests that PCI has small computation overhead with guaranteed reach ability.

Key Words: Network Failure, Fast Recovery, Loop Free

Introduction

The Internet has achieved goals of broader bandwidths, shorter delays, and better performance with the rapid development in past decades. The Internet has been more and more widely used and expected to be always available for both personal and business applications. Yet IP forwarding combined with the OSPF or IS-IS routing protocols in use today can easily produce noticeable disruption while in convergence procedures triggered by host down, link failure or other circumstance. Due to the inconsistent topology map in each node of the network, convergence procedures may bring problems such as route failure, route loop, and etc. Consequentially making data packets delay or even discard, and making performance degrades. In a network that contains thousands of nodes, a convergence procedures may last 30-40 seconds (P. Francois, C. Filsfils, J. Evans, and O, 2005), Though the convergence period is shortened by a series of methods, it still lasts several hundred milliseconds, long enough to degrade the performance of some delay sensitive applications such as IPTV, VoIP and etc.

The most direct approach is to accelerate the convergence procedure by adjusting parameters. However, it will influence the stability of the network. Another approach is overlay routing that makes packets bypass the failed nodes through a random intermediate node. Yet lacking of equity may cause congestion and worse the traffic engineering (D. G. Andersen 2001). Multi-path routing deals with failure by initiating several paths simultaneously to deliver packets. The main problem of multi-path routing is the blasting routing and forwarding table.

Note that the lasting time of convergence is determined by two factors, the transfer speed of information via link and the process speed of nodes, which are limited by current electronic technique. Every node in the network has to exchange fail or recover information and achieve consistency. On the other hand, links or nodes failures in network occur frequently and most of

which are instantaneous, and will resume in a short time. Statistics show that 70% of failure will resume within 5min, and only 10% of failure last more than 15min (Gianluca & Iannaccone, 2002), It enlightens us there may be other ways, such as restricting the spread range of fail information, to reduce the time or frequency of convergence, and to restrain the negative affection of convergence.

Karthik Lakshminarayanan *et al.* (2007) propose FCP protocol, in which packets carry information of links or nodes failure. Nodes route packets with failure information, thus guarantee every packets' arrival when facing with nodes or links failure. However, the high cost of route computation is main weakness of FCP. Ang Li *et al.*,(2008) present a mechanism of forwarding packets called CCP, which stamps a short label in a packet to indicate the remaining path cost to reach a destination. Downstream routers use path costs carried by packets and their locally computed path costs to detect inconsistent forwarding paths and repair the inconsistencies. The computing overhead is reduced in CCP. However, CCP may encounter several paths with the same path cost. Though the probability is restrained much smaller by introducing a random noise to the path cost, CCP still cannot guarantee loop-free routing.

This paper presents Path-Cost Indicating (PCI), a routing framework that minimizes forwarding disruption time while retaining efficient and loop-free routing. Communication is immediately resumed once the network failure is detected by its adjacent nodes. PCI can simultaneously achieve both low loss and low overhead.

Path Cost Indicating

To achieve fast failure recovery without modifying convergence, packets need to carry some information to help routers detect failure and take proper actions. In PCI, each packet carries a small label that contains the remaining path cost to its destination and a fail node list that

contains fail nodes detected.

Figure 1 shows the pseudo code of the basic PCI protocol. After a router computed a packet's next hop, the router will check corresponding port's status and forward it. If the port is not available, the router re-computes the path towards the destination with a new topology map that has deleted the failed link and nodes. Then adding the router ID into failed nodes list, and finally updating the path cost in packet label and forwarding it. If the corresponding port is available, the route updates the cost and forwards directly.

```
Initialization:  
  pkt. cost = 0  
  pkt. Fail nodes = NULL  
Packet Forwarding:  
  while (pkt. Fail flag)  
    path = Match Cost (pkt. cost)  
    if ( path. num == 1)  
      Check Forward (pkt, path. next_ hop)  
    else  
      path=Remove Fail (path. list, pkt. fail nodes)  
      Check Forward (pkt, path. next hop)  
  return  
Check Forward :  
  if (Check Port (path. next_ hop))  
    Update Cost (pkt, path. next_ hop. cost)  
    Forward (pkt, path. next_ hop)  
  else  
    Compute Path (M – path. next_ hop)  
    Insert Fail (pkt)  
    Up data Cost (pkt, path. next_ hop. cost)  
    Forward (pkt, path. next_ hop)
```

Figure 1: Basic PCI Protocol

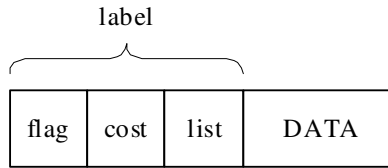


Figure 2 Label Format

Figure 2 shows the label format. It is composed by three parts: failed flag, path cost, and failed list. When a router receives a packet, it first checks the failed flag in label. If the flag is zero, which means the packet does not encounter any failed links or nodes, the packet's next hop will be computed according to the default route. Otherwise, the packet must have encountered a failed link or node, and the default route may not lead to the destination. In this circumstance, the router compares the cost of every path to the destination with the cost in packet label. The packet will be processed differently based on the compare result.

If there is only one matched result, the next hop will be chosen according to the matched path. If the matched result is more than one, paths those contain fail nodes are deleted, and one of them is chosen to forward. If there are no matched results, forward the packet according to the default route. However, the last possibility is not existed theoretically. Because every node in network has the same topology map, so the route one node computes must be valid for another node. To understand PCI better, the example is given with the topology described in Figure 3.

Figure 3- Forwarding using PCI

Assume node S sends a message to node D, and the link F-D is down. Since only nodes adjacent to the failed links know about the failure, the packet is forwarded along the shortest path in the original graph, (S, B, F, D), until it reaches the failed link F-D. At this point, F detects the default port towards to node D is failed, and computes a new shortest path to D based on the map minus link F-D. Assuming that this path is (F, B, S, A, E, D). F then changes the fail flag in label, updates the path cost 326, and includes the failed node F in fail nodes list. When the packet

reaches B, B detects the failure from the fail flag, and finds the path to D with a cost of 326. Obviously only the path (B, S, A, E, D) has a cost of 326, so B minus the cost of link S-B, updates the cost to 259, and forwards the packet to next hop S. When the packet reaches S, S

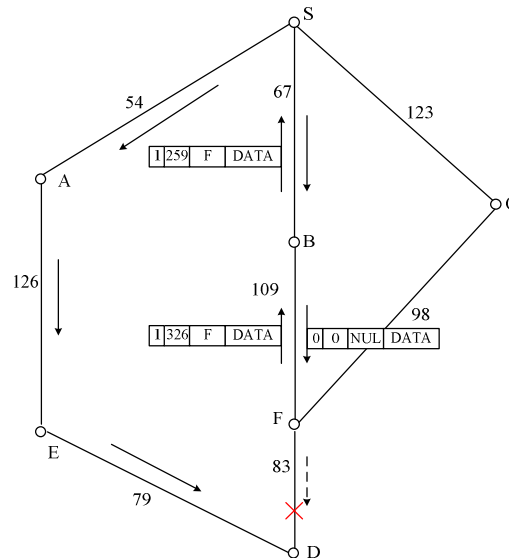


Figure 3 Forwarding using PCI

repeats the similar detection and comparison. But S finds that there are two path with cost of 259, path (S, B, F, D) and (S, A, E, D). So S finds the fail node F in two paths, and deletes the path (S, B, F, D), which contains a fail node. Then S updates the cost and forwards to A. Eventually the packet reaches the destination, D, along this path.

Analysis

Assume every node in network has a consistent topology map, and there are no packet losses due to network congestion.

A. *Guaranteed reachability*

The failure adjacent node re-computes a new path to destination after a link failure occurred. Its downstream nodes with consistent topology map certainly can compute the same path, along which packets are routed to destination. Furthermore, downstream nodes may compute other

available paths, and also reach ability is guaranteed along these paths.

That means, once the failure adjacent node has computed an available path, the packet can be transfer to its destination along the path or other paths computed by downstream nodes.

B. Loop free

To form a route loop, a packet must pass one node more than twice. In PCI, a packet will not pass a fail adjacent node twice, because the node's ID is inserted into the label, other nodes will not forward the packet to these fail nodes. For other nodes, because of the digression of path cost, a packet will not pass a node more than twice after a failure occurs.

C. Computation overhead

When a failure occurs, the main computation overhead of failure adjacent node happens during the process of computing a new path with the topology minus the fail link. To reduce per-packet computation at nodes where failures are encountered, nodes in our proposal will perform some pre-computation. Each node (in addition to the default forwarding table), for every adjacent link l , computes the forwarding table using the consistent map minus l ; this table is used when l is failed. However, in terms of actual forwarding state, such a pre-computation needs double memory requirement than old before: for each destination, in addition to the default path P computed using the map, we need to store the pre-computed path computed using map minus l , where l is first hop in P .

The main overhead of other nodes in network is to store the pre-computed paths. The pre-computed paths storage can be achieved by additional database. Another overhead is to search a matched path by cost, which is much smaller than re-computed a new path as FCP. The pre-computation could be done in low priority to avoid slowing down convergence related tasks.

Conclusion

We proposed Path-Cost Indicating (PCI), a new routing technique which greatly reduces convergence frequency endured by traditional routing protocols, and achieves disruption-free routing while link failures occur. PCI has smaller computation overhead compared with FCP, and has arrival guarantee in contrast with CCP.

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