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INFORMATION REGARDING
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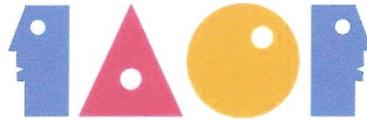
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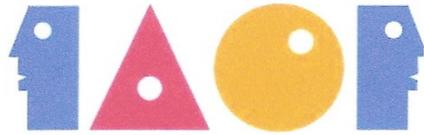
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CREATIVE TEACHING AND EFFECTIVE TEACHING
IN HIGHER EDUCATION

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Abstract

Students' and lecturers' perceptions of own effectiveness and creativity as teachers are compared, using a survey questionnaire with a sample of 854 students and 245 lecturers of a higher education institution, together with interviews and class observations of lecturers who were selected as examples of creative teaching. Results indicate that students concentrate more than faculty on creativity when imagining how they would perform as teachers; when effectiveness is considered, the opposite applies. In addition, the lecturers selected as creative score similar to students, as to the perception of their own creativity, and to their peers, as to effectiveness. Teaching creatively is seen by its agents as the search for doing things better, and if the communication process is successful, that attempt is perceived by the students as creative. This research demonstrates that creativity lies not in the teacher, nor in the student, but in the interaction between the two; and also suggests that it seems more important to understand what is involved in the construction of the role of teacher, and in the communication process with the students, rather than exploring creative ways to present the subject matter to students.

Keywords: Creative Teaching, Effective Teaching, Creativity, Kelly's Grids, Symbolic Interaction Theory, Role Theory

Introduction

Great teachers will have to live with the fate of being fired, discredited, isolated or their funds being withdrawn.

Paul Torrance, *Why Fly?* (1995, p. 113)

Paul Torrance's words have made me wonder why it is not precisely the opposite that happens, and whether it will always be like this. We tend to think that what happened to great teachers in the past would not fit in with today's western civilisation and its openness to creativity and innovation. Even admitting that schools, as in any other complex organisation, would tend to reject teachers who might unbalance the system by bringing in too many innovations, could a creative teacher be better accepted at least by the student population?

Trying to answer this and other questions requires a deep understanding of what is meant by creativity and creative teaching, how it fits in with the role and tendencies of today's university; and how one constructs and performs the role of a teacher, in such a way that it meets the requirements of the student, as well as the requirements of peers and superiors. This understanding can contribute to an easier acceptance of the truly creative teacher by a rather conservative organisation such as the school, and to help the creative teacher to balance more effectively the requirements of students and peers.

This article is therefore dedicated to teachers who would like to pursue creative approaches to teaching, and to be seen as effective by both students and staff. Let us begin by trying to understand the concept of creativity.

The Concept of Creativity

One of the first difficulties is that not everyone interprets and values creativity the same way. In fact, as Woodman & Schoenfeld (1990) recall, the term *creativity* can be seen either as a

social concept, expressed by people's implicit theories, or as a theoretical construct, developed by researchers in the field.

Considering the theoretical definitions, and after carefully analysing the propositions evidenced by Kasof (1995), it is possible to conclude that the construct of creativity was (and still is) used in the scientific literature to designate something perceived by others. Amabile (1983) states that *a product or response is creative to the extent that appropriate observers independently agree it is creative. ...and it can also be regarded as the process by which something so judged is produced.* Stein (1953; 1984; 1994) maintains that *creativity is a process that results in novelty which is accepted as useful, tenable, or satisfying by a significant group of others at some point in time.* These examples illustrate what can only be designated as creativity, after a successful *communication process.*

As the product of that communication process, creativity appears connected to what is perceived as new and useful by someone other than its originator, or as the *putting to use of an idea* (Kanter, 1983; West & Farr, 1990), in the domains of production, adoption, implementation, diffusion, or commercialisation of creations (Kaufmann, 1993; Rogers, 1983; Spence, 1994). In these cases, creativity is seen as *innovation.*

Others, like Baer (1997), Runco (1998), Kokot & Colman (1997) see creativity as a personal construct. Baer (1997), for example, considers creativity to be *anything that someone does in a way that is original to the creator and that is appropriate to the purpose or goal of the creator.* Recognising creativity as a personal concept, used by people to describe their acts at any moment, is in a sense using implicit theories of creativity. It lies in how each individual organises and incorporates the perception of reality in his or her own self. Striving for mastery and perfection, the expression of one's own individuality and sharing with others, become

essential parts of the core construct of creativity, which may, then, encompass a wider array of activities, products, processes and performances.

Creativity seems then to acquire its full meaning only after a successful process of communication between the creator (or the product) and the judges or audience, even though its essence lies in the communication between the creator and the product. Innovation seems to be more appropriate to designate the resulting attribution made by the audience apropos the product.

As a consequence, creativity can only be measured through socio-cultural judgements, and is therefore context-dependent. Quoting Csikszentmihalyi (1991), *creativity is located in neither the creator nor the creative product but rather in the interaction between the creator and the field's gatekeeper who selectively retains or rejects original products.*

This way, the theoretical construct of creativity relies on people's implicit theories of creativity, i.e. in the ways they consider a specific product, person or process as representative of their conceptions of creativity.

Concepts and Definitions of Creative Teaching

If it is almost impossible to reach agreement as to what “good” or “effective” teaching means, as authors tend to diverge between both poles - traditional and progressive, or teacher-centered and student-centered -, comparing the worst of one against the best of the other, mixing personality traits, teacher behaviors and styles, teaching methods and techniques, and classroom management tips. A more precise construction is then necessary, to provide for common understanding, and one possibility may be to use the concept of “creative teaching”.

One distinction that must be made is between the creative person who happens to be a teacher, and the act of teaching in a creative way. A painter, for example, may be a highly creative artist, but not necessarily a creative teacher, although he may exercise both professions.

Even the teacher who inspires students by a personal example of creativity may not be the person this text is dealing with. As Torrance (1962) mentions, the type of teacher who manipulates students through creative self-expression does not lead to their significant development. In fact, as Stein (1994, pg. 175) relates, few differences were found in students' creativity whether they had creative or uncreative teachers, while "those who were the pupils of teachers skilled in good relationships were more likely to be better off in using what they learned."

As happens with the concept of creativity, people tend to have their own images of the meaning of creative teaching, which do not necessarily coincide with the specialized literature. Fryer and Collings (1990; 1991), for example, reported that, in a study with more than 1,000 British teachers, from various educational levels, the vast majority tended to view creativity as "divergent thinking", and only a tenth recognized that it also involved convergent thinking; Fryer (1996) also points out that people tend to see creativity as arts related, not science related, and that if the respondents to the questionnaire had been provided with a definition of creativity, "the differences in the way the various groups of teachers perceive creativity would not have become apparent." (p. 34).

When looking in the literature for definitions of creative teaching, the majority of the authors who write about it avoid providing such a definition, preferring to list series of behaviors, approaches or strategies that characterize creative teaching. Paul Torrance, one of the main researchers in this field, never provided such a definition, but only of creative learning, which is not the same as creative teaching.

It is possible, though, when looking at the existent literature, to find examples connected with different approaches: one is the use of *creative methods and techniques*, as in the definition proposed by Mayer (1989) "creative teaching refers to instructional techniques that are intended

to help the students learn new material in ways that will enable them to transfer what they learned to new problems” (p. 205); another is *the development of students’ cognitive abilities*, as in Whitman’s (1994) definition, “teaching students to use strategies for representing and processing new information in ways that lead to problem solving transfer” (p. 5), or Osborn’s (1992), “the type of teaching which causes students to think as they learn” (p. 51); and one directed to *relational and emotional aspects*, as in the example of Slabbert (1994), “creative teaching is to be sensitive to the individual’s conception of himself and his role in the classroom” (p. 23); still another related to *classroom environment*, as in the definition proposed by Bozik (1990), “is to make classes contemporary and stimulant; innovation, variety and challenge must be apparent”; or the classical teacher-centered view of creative teaching as “inventive flexibility”, that is, to “be able to identify needs clearly, read a situation, preparedness to take risks and capability in monitoring and evaluating events”.

Even though expressed in different ways, they complement each other, so that some of them seem more directed to communication (relational and emotional aspects) with the students, or to the development of their cognitive abilities, while others stress the innovative aspects brought by the teacher, either by the use of new methods and techniques, or by managing the classroom environment. Even though both are highly connected, we can perhaps describe the former approaches (communicational; relationship aspects) as being more student-centered, and the latter (innovative; task centered) aimed mainly at the teacher.

If we look at the first approach - the use of creative teaching techniques - the literature provides a vast amount of examples of using specific materials, classroom arrangements, or programs, designed to increase the students’ cognitive abilities, as well as whole-person development, described further in this text in a model from Treffinger (1986). As Arnold (1992)

enumerates, a series of creative teaching techniques, derived from CPS (Creative Problem Solving) methods, have proved significant in changing the way teachers teach, as earlier discussed. Although this is probably the most popular association that people make with creative teaching - the use of specific techniques - they are just a means to provide for what is stated in the remaining definitions - cognitive and affective aspects in learning.

The definitions are then complementary, and if they are, their merging originates so inclusive a view that it has little value for providing an understanding of what is involved in creative teaching, as a specific kind of teaching.

The Movement Towards Creativity in Education

The movement towards creativity in education, born of the initial post-World War focus on gifted and talented children, was led by the United States; Stein (1986) enumerates people such as Paul Torrance, J. P. Guilford, Wallach and Kogan, Getzels and Jackson, Renzulli, Treffinger, and others. This movement has spread to other countries and has been adopted at further educational levels, in a sort of opposition to the so called traditional style, mainly around the development in the students of Guilford's original divergent functions: fluency, flexibility, originality and elaboration. As creativity theory evolved beyond divergent thinking techniques, so did its applications to education, which began to include all possible improvements of an education for the future, in opposition to the traditional approach, as in the Isaksen and Parnes' (1992, p. 427) comparison list, as follows in Figure 1.

As may be seen in this comparison, similar to the distinction that Entwistle & Marton (1989) make between *surface learning* and *deep learning*, the creative approach leads teaching and learning to a much broader perspective, "defeating" completely the traditional approach. Nevertheless it fails to provide the latter with a sense of purpose, or even to consider it,

sometimes, as a necessary step to arriving at further stages of development. As Berger & Luckman (1976) explain, if the traditional approach may be blamed for its apparent ideology (ideas serving as weapons for social interests), the creative one is probably too utopian (context-free knowledge, divorced from reality), and the best way lies probably in the middle, as Cropley (1992) advises.

As presented, creative teaching seems to have been recollecting elements from teaching movements that were trying to react against poor teaching practice. It may then be more easy to characterize it by what it is not, rather by what it is.

The comprehensive Treffinger (1980) creative learning model, here reproduced in Figure 2, also aims at higher levels of developmental goals than did the original divergent thinking and simple creative personality characteristics (Level I); it thus becomes liable to create a feeling of frustration in a teacher who does not feel able to get even part of it from the students.

Nevertheless, as mentioned earlier, what is shown in the model is aimed at learning, not teaching; it only becomes much more demanding upon the teacher, if one assumes that all of the learning is the teacher's responsibility, which is not the case, especially in higher education.

This danger of frustration in someone who tries to pursue creative teaching may also be expressed in the personal qualities approach to teaching, as described in the following section.

The Creative Teacher's Characteristics, Behaviors and Classroom Activities

Torrance and Safter (1990) start the list of a creative teacher's characteristics with "performs miracles" and "inspires the students", which is by no means within the reach of the vast majority of teachers. Referring to personality traits, Torrance (1962; 1968) mentions, "capacity to form good relationships with their creative students", "hard workers", "nonconforming", "childish at times", "does not work for status and power", "likes to be

<i>Traditional” assumptions</i>	<i>Creative assumptions</i>
<p>1. The student goes to school to acquire knowledge which has existed for a long time and is handed down on authority.</p> <p>2. Subject matter taken on authority is educative in itself.</p> <p>3. The best way to set out subject matter is in unassociated fragments or parcels.</p>	<p>1. The student goes to school to acquire skills which enable him/her to continue learning to deal with unknown/unpredicted events and challenges. Part of these skills involves the ability to acquire data (knowledge) necessary for the task in hand.</p> <p>2. Subject matter provides the raw material for learning but has value only when put to use in relevant and meaningful ways.</p> <p>3. The best way to attain knowledge is through active, experiential learning in a setting meaningful to the individual.</p>
<p>4. A fragment or parcel of subject matter is the same to the learner as to the teacher.</p> <p>5. Education is supplementary to and preparatory to life, not life itself.</p> <p>6. Since education is not present living, it has no social aspects.</p>	<p>4. What is relevant, meaningful and sensible to the learner varies according to each individual’s background, experience, characteristics and needs.</p> <p>5. Education involves growth, and is, therefore, a component of living.</p> <p>6. Personally meaningful learning involves interaction and effective communication with others.</p>
<p>7. The teacher can and should furnish the purpose needed for the acquiring of knowledge.</p> <p>8. Working on tasks devoid of purpose or interests is good discipline.</p> <p>9. The answer to the problem is more important than the process.</p>	<p>7. The learner’s needs and involvement provide the initial purpose for creative learning.</p> <p>8. It is important to involve the learner in choosing tasks which are interesting and have relevance for the learner, or to find ways of making given tasks interesting or purposeful to the learner.</p> <p>9. While solution to problems may have immediate importance, learning a problem-solving process has great long-range importance.</p>

10. It is more important to measure what has been learned than it is to learn.	10. It is both possible and important to document the impact (effect) and value of creative learning.”
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Figure 1. Comparison between “traditional” and “creative” approaches to teaching (Isaksen and Parnes,1992, p. 427)

<i>Cognitive</i> Independent inquiry Self-direction Resource management Product development “The practicing professional”	Level III Involvement in Real Challenges	<i>Affective</i> Internalization of values Commitment to productive living Toward self-actualization
<i>Cognitive</i> Application Analysis Synthesis Evaluation Methodological research and skills Transformations Metaphor and analogy	Level II Complex Thinking and Feeling Processes	<i>Affective</i> Awareness development Open to complex feelings Relaxation, growth Values development Psychological safety in creating Fantasy, imagery
<i>Cognitive</i> Fluency Flexibility Originality Elaboration Cognition and memory	Level I Divergent Functions	<i>Affective</i> Curiosity Willingness to respond Openness to experience Risk taking Problem sensitivity Tolerance of ambiguity Self-confidence

Figure 2. Treffinger’s (1980) comprehensive creative learning model

appreciated”, “adventurous”, “unpredictable”; and Cropley (1992) enumerates “inclined to be flexible and willing to ‘get off the beaten track’”, “resourceful in introducing new materials and

in finding ways to present knowledge to students”, “capable of enjoying good relations with all of their students but inclined to have particularly good relations with highly divergent ones”, “likely to be non-conforming and even critical and fault finding in their relationship with their colleagues”, “self-critical and frequently dissatisfied with themselves and the system in which they are operating”.

As to behaviors, Walberg (1991) mentions “encourages students to be independent”, “acts as a role model”, “assists students outside the class”, “accepts students as equals”, “rewards directly the student’s creativity or work”, “has an individualized approach”, and also enumerates the characteristics of those who do not “facilitate” creativity in the students: “rejects creative ideas from students”, “hypercritical”, “sarcastic”, “non-enthusiastic”, “insecure”, “dogmatic”, “non-actualized”, “non-available”. Alencar (1994), consider “cultivating the interest in discoveries and new knowledge”, “stimulating the students’ initiative, self-confidence, new ideas, curiosity, independence and critical ability”, “leading the student to understand divergent perceptions of a problem, allowing him to disagree with the teacher’s points of view”, “diversifying the teaching methodologies”, “treating students as valuable individuals”, “contacting them outside the classroom”; also “encouraging students to do things they have never done before”, “to write their own stories or poems”, “to protect creativity from criticism and ridicule”. Torrance (1997), in his test *Opinions on creative learning and teaching*, develops 50 items like “teachers should at times encourage pupils to think of wild ideas”, “the presence of a group stimulates many pupils to think of original ideas”, “it facilitates important learning for pupils to try to imagine or visualize things they cannot actually see”;

Instead of personality characteristics or teaching behaviors, and shifting the focus from the teacher to the student, we find all sorts of lists that try to select the most appropriate

classroom strategies and environments designed to promote creative learning. Torrance (1990), enumerates “confrontation with ambiguities and uncertainties”, “awareness of a problem”, “building onto existing knowledge”, “concern about problems”, “stimulating curiosity and wanting to know”, “familiar made strange or strange made familiar by analogy”, “freedom from inhibiting sets”, “looking at the same material from different viewpoints”, “ask provocative questions”, “predictions from limited information”, “purposefulness of activity made clear”, “structured only enough to give clues and directions”, “creative personality characteristics encouraged”, “visualization encouraged”, “time for incubation”, “the importance of praise and creative evaluation”. The same author, in his text *What makes a college of education creative?*, adds 146 items like “there are many opportunities for the ‘on-the-scene’ activities where the action is rather than a ‘classroom bound’ expectation”, “original research is encouraged throughout the undergraduate years”, “students feel free to ask questions, express ideas, etc.”, “there is time for the pursuit of creative achievements both in classrooms and out of class”, “there is a program of lectures and seminars which brings to the campus each year 10 to 15 of the greatest thinkers in the world”, “students participate in the planning of courses regarding goals, learning activities, methods of evaluation, etc.”, “course requirements make creative thinking necessary”, “there are special rewards and recognition for creative achievement for both faculty and students”, “instructors are respectful of the ideas of students”, “students take some work in a creative field such as music, art, writing, movement, drama, invention, etc.”, “individual differences are welcomed and used”.

The listings of personality characteristics, behaviours, and activities designed to promote creative learning are considerable, and so more doubts arise as to what really makes the difference between creative teaching and any other kind of effective teaching.

Creative Teaching Techniques

When searching for techniques, we can find possibilities that go beyond the “traditional creative” divergent thinking and problem solving techniques, but that belong to other fields of research besides creative teaching, as in the case of simulation and games (Greenblat, 1988), experiential learning (Pfeiffer & Jones, 1974), to name just two. If we search for other sources of literature, which came out of cognitive psychology and cognitive science, many more techniques can be obtained, as in the teaching of problem solving; and the teaching of thinking - creative and critical.

Still another source of confusion in understanding what creative teaching arises when authors in the field of creative teaching write about techniques outside divergent thinking and problem solving ones. Torrance, Murdock & Fletcher (1966), for example, in a text about the use of role playing in education, give notice of nine possibilities (Soliloquy, Double Technique, Audience Techniques, Multi Double Techniques, Mirror Techniques, Role Reversal Techniques, Magic Shop and Magic Net techniques, Future Projection and Future Soliloquy Techniques, Future Double Techniques) within role playing alone, apparently moving away from the initial divergent thinking programs, also listed by Torrance (1995). It happens frequently, also, that authors deal with concepts taken out of other movements in teaching, as Treffinger, Isaksen, & Firestien (1983) warn (i.e. experiential curricula, democratic instruction, humanistic and affective education, futures) and, as they are connected with the creative teaching movement, there is the possibility that people associate these concepts with creative teaching just because the author is related to research in creativity.

The frontier between creative teaching constructs and techniques and other kinds of constructs and techniques becomes more and more blurred, as the sciences of education develop.

These listings of personal characteristics, teaching behaviors, classroom strategies, and teaching techniques lead us to conclude that there exist various possible theoretical constructs of creative teaching, depending on the approaches analyzed (characteristics, behaviors, techniques, environments), and also that the danger of falling into the trap of the ideal teacher still persists, as the literature tends to include a vast array of material dealing with effectiveness in teaching. The conception of creative teaching becomes very broad then, and tends to include all that may be put under the umbrella of effective teaching, leading people to infer that creative teaching, as seen in the literature, is the same as effective teaching; and this effectiveness demands much more than is in fact possible.

The danger lies then in making a direct analogy between less-creative teaching and ineffective teaching, which may not be true. In fact effectiveness may be a characteristic of creative teaching, and less-creative teaching may also be effective, depending on the circumstances.

Creative Teaching as a Self-Attributed Concept

In the end, as Spector (1983) points out, a good teacher is simply one who has continued to grow; one who tries to improve in the job, which is the equivalent to creative behavior, as seen through the eyes of the individual, in such a specific way that, as Trow (1997) explains, not even originality is important, but only doing the job well and treating the students respectfully. Doing the job well may be represented by thinking through the key ideas in the text or lesson and identifying the alternative ways of presenting them to students. Seen as self-perception, creativity is directed towards improvement, or perfection (the goal of life, as explained by Sanford, 1998), and it acquires the meaning of creativity, effectiveness, or excellence according to those who evaluate the action of the individual, namely the students and the faculty.

Again, creativity appears as a hetero-attributed concept, and it may even be possible, as Fryer (1994) concludes, that teachers do not recognize themselves as creative, but only with possessing social attributes and willingness to work hard. Perceptions of creativity, and of effectiveness, are dependent upon the observer, and hetero-attributions of creativity are expected to occur among those who are sensitive to the communicational processes or the innovative products originated by the individual in question. If the student feels that, partially as a result of teaching, he or she has produced something creative, or has developed in that direction, then some of the reasons may be attributed to the teacher.

Besides considering the individual creative, the observers may or may not regard that individual as effective. And so, depending on the observer, it is likely that creative teaching is included in effective teaching, but the opposite may also be the case, where creative teaching is placed outside the effective teaching concept. Barros, Neto & Barros (1992), for example, in a study with 308 teachers, found they put creativity in fifth place, after scientific competence, fine method, authority, and freedom. It may even be possible, as Dawson, D'Andrea, Affinito, & Westby (1999) observe, that teachers have particular views of creativity, different from traditional ones; they found that teachers value good citizenship characteristics in their students (e.g., "is sincere", "is good natured"), besides the traditional ones (e.g., "is individualistic").

Hetero-Perceptions of Creative and Effective Teaching

From the previous considerations we reached the conclusion that creative teaching did not represent a kind of teaching easily identifiable in the present literature, because the use of teaching techniques, directed to the development of the students' thinking abilities, had gone far beyond divergent- thinking techniques; and, as the other teaching techniques were not born out of creative teaching theory, and also contribute to the development of thinking abilities, the

frontier between creative and non-creative techniques had become blurred. Not even the only thing that seemed to remain inviolate - the fact that creative teaching is student-centered and aims at maximizing the learning potential - can be assured, because it is dependent upon the observer and the way a person values creativity in teaching.

Creative teaching methodology does not even intend to present a completely new perspective, as it tends to search for its meaning in classical education, which Boone (1987) considers to be directed to invention and discovery; “back to basics”, as Craft (1999) concludes.

Getting back to where we started, as in the conception of Spector (1983), creative teaching is probably just to provide opportunities for the learners to improve their creativity, which means the building of a unique perception of something more, shareable with others. It is then, mainly, remembering Stein’s (1994) and Torrance’s (1962) conceptions of creative teaching, an emphasis on communication (relationship) between teachers and students, and so it seems quite appropriate as a means to evaluate how these two protagonists differ in their perceptions of teaching and learning.

Perception and Construction of the Teacher’s Role

Spelling out what it is in society that impacts particular aspects of the person, as well as what it is in the person that makes a difference to particular aspects of society, and just how these mutually determining processes take place, requires a theoretical framework to facilitate movement from the level of social structure to the level of the person and vice-versa; it also requires explanatory principles articulating the two levels that reflect the inherent complexity of both. This is the purpose of symbolic interaction theory and role theory.

As Stryker & Statham (1985) describe, role theory was developed through Social Anthropology and German Sociology, while social interaction theory appeared as the study of

the behaviour of people playing out roles shaped through evolutionary adaptation. Both theories depend on the concept of “role”, which articulates social structure as conceptualised around the way an individual becomes incorporated into organised patterns of interaction, conducted in terms of meanings persons develop in the course of their conduct - “symbols”. In fact, people learn to hold expectations of themselves and others according to the positions they occupy in the social structure, and as social systems tend to equilibrium and harmony between the parts, the individual is led to conform to collective habits, and to act according to other people’s expectations, which one becomes aware of through the process of communication. If a person wants to be accepted within a certain group, that person needs to learn to be “sympathetic” to the group, which means to learn to anticipate the possible reactions of others to one’s own behaviour.

The individual develops specific ways to respond to other people’s expectations, creating his own “self” between the control made by the attitudes of others and his spontaneous behaviours, by means of putting himself in the place of the other, and responding as the other would do - *role-taking* - and by anticipating the consequences of his own behaviour - *role-making*. As Munné (1989) explains, through the former the individual anticipates the other’s behaviour, which allows that individual to respond as the other would do; as to the latter it corresponds to the role which is really performed, and not to what the individual is expected to perform - *prescribed role*.

Roles are social in the specific sense that it is not possible to talk sensibly about a *position* (any recognised category of people) without at least implicit references to other positions. As in the words of Stryker & Statham (1985), “to use the term ‘role’ it is necessary to refer to interaction: there can be no ‘teacher’ without ‘pupils’, no ‘rebel’ without an

‘establishment’. Any position assumes a counter position; any role assumes a counter-role.” (p. 323). Through thinking, the person imagines being another, and tries to devise what kind of behaviours appear as most suitable, in a sort of anticipatory socialisation; this may bring conflict between the self-concept and the expectations of others, if the fit is not satisfactory. In the case of a teacher, for example, who fails to have his or her own role validated by the students, this will make it difficult for the person to maintain a sense of self that depends on that role; the response may be either to try to change, keeping the students as the “significant other”, or to create another self to respond to expectations of another target population, like peers or superiors.

According to Gabarro (1987), the construction of one’s own role may develop through several processes, like socialisation, role conflict, structure of role relationships and role transitions, all of which may take place in a “bargaining“ between people. The more people have their preferences and needs met in role relationships, the more satisfied they are in those relationships; and the more others share that person’s values, orientations and preferences, the more readily role arrangements can be devised that meet the needs of those involved.

If role partners can agree on preferred role arrangements, their satisfaction is likely to be high; this consensus is not automatic but achieved, and aspects like organisational distance and authority reduce the probability of role bargaining between people situated at different levels of the hierarchy. This process of bargaining is highly emotional, because it involves the person’s imagination of others’ feelings, when putting oneself in the place of the other, and taking that person’s perspective. Then, feelings like embarrassment, shame, or guilt, enter social control processes and produce the “socialisation of affect”, that is, the organisation of emotional expressions according to the person and the situation, in order to maintain established feelings.

The interesting view of Maslow (1968) contemplates a self-development transcending role definitions and allowing for self-actualisation, as a fundamental of human existence: the human capacity for autonomy from social circumstance. Self-control is an outgrowth of social control, and dependence on multiple others makes possible independence from the expectations of any given other(s), freeing the person to an important degree and making the choice possible. Even in a situation of maximal coercion, persons creatively seek and find means to assert their individuality, and so creativity and individuality may be seen as the product of the same social processes that produce constraint and conformity, as the search for individuality may lead the person to break with specific rights and duties, and thus, as Hinde (1997) explains, to become subjected to social sanctions.

To Petkus (1966), the construction of a creative role identity leads the individual to act in the way others will regard him or her as creative; a *role-performance* identity of “creative teacher”, for example, would imply such behaviours as using non-traditional texts, employing innovative class projects, etc. There is an inexorable synergy between role support from others and self role support, when both are significantly present; however, the individual may reject immediate role support if he or she is convinced that future generations, or other kind of audiences, will provide such support. Therefore, the support may either be real or imagined, but it needs to exist in order to feed the creative role.

Again, according to Stryker & Statham (1985), structural role theorists assume that institutionalised role expectations (e.g. mother and child, employer and employee, teacher and student) are the major constraint on a person’s behaviours and the internalisation of those role expectations proceeds almost automatically in the course of the socialisation process. Harrin (1993), for example, stresses the fact that the teachers’ initial professional development is

strongly influenced by images of previous teachers, which lead to immature and inflexible patterns of behaviour.

Let us see, then, how these concepts may be supported by empirical investigation, describing a study made by Sousa (1999).

Research

The subjects were 854 students and 245 teachers of undergraduate courses, in the seven polytechnic Schools of the *Instituto Politécnico de Lisboa* (IPL) [Lisbon Polytechnic Institute]. The IPL is made up of semi-independent, geographically separated Schools of Music, Drama and Cinema, Dance, Teacher Training (student teachers), Media Studies, Accountancy and Administration, and Engineering, representing a population of 8 068 students and 812 teachers.

A 16-item, two-factor structure (task/effectiveness; relation/creativity), 5-point Likert-type questionnaire, built using Kelly's grid procedures (Kelly, 1963), was used to collect quantitative data.

The instrument resulted from a series of transformations of an initial one with 56 opposite constructs (112 behavioural descriptions), related to creative/non-creative teaching behaviours, that were compared against theoretical descriptions to see if any important behaviour had been left out of the four general categories considered (1 - *scientific and pedagogic*, 2 - *ethics and relationship*, 3 - *student evaluation*, and 4 - *personal characteristics*). Each construct was rated in four elements: *The creative teacher*; *The non creative teacher*; *As I think I would be as a teacher* (students' questionnaire), or *As I think I am as a teacher* (teachers' questionnaire); and *How I would like to be as a teacher*.

From the validation studies described by Sousa (1999), it was possible to conclude of the instrument's good construct validity (e.g. ability to discriminate among groups; convergence in

varimax rotation of factors), as well as reliability (internal consistency and temporal stability above .75, in each factor). It also demonstrated good construct-related validity against three known instruments: two of them proposed by Jesuino (1987): the *Leader Behaviour Description Questionnaire - Form XII (LBDQ)*, and the *SYMLOG (Systematic Multiple Level Observation of Groups)*; and one concerning the evaluation of creative teaching in higher education - Eunice Alencar's Questionnaire (Alencar, 1994).

In every School each faculty member received a questionnaire together with a letter explaining its content and purpose. About 27% of the faculty (245) returned the questionnaire correctly filled in. As to the students, the questionnaires were administered either by teachers who volunteered to do so, at the end or in the beginning of their classes, or by members of the students' union. Using this procedure, it was possible to obtain 854 questionnaires correctly filled in, thus representing almost 11% of the student population. The questionnaires obtained allowed for representative samples in each school, below the .05 confidence interval.

Meanwhile, each students' union was approached in order to *draw up a list of teachers considered creative as teachers, about which it was possible to obtain a consensus among the students who were present at the meeting*. No definition of creativity or creative teaching was provided, nor a specific number of teachers demanded, and the lists were obtained after meetings with students of each course and year, so that all possible teachers could be taken into consideration.

From a total of 62 (out of 812) teachers selected by the students as examples of creative teaching, 23 were interviewed. The interview questions coincided with the questionnaire, and were: *Why do you think you were chosen as creative by the students?*, *How do you characterise a creative teacher?*, *And a non-creative one?*, *How do you see yourself as a lecturer?*, and *How*

would you like to be, as a lecturer?. After each interview, the performance in class of the interviewee was subjected to observation, and any event, act or interaction which could fit into the scope of the investigation registered. From these 23 interviews, six were submitted to a correspondence analysis, as well as six interviews to teachers not selected as examples of creativity, taken at random.

Results

Recalling that each item could be rated from 1 to 5, results showed the agreement of the subjects with the construction of the idea of creative and of effective teaching, since every item's mean score was below 3.00 (the closer the score was to 1.00, the closer it was to creativity or to effectiveness in teaching). Nevertheless, the mean scores that characterised the ideal image of the creative teacher, and that of the effective teacher, were not as close to the absolute creative and effective score (1.00) as expected. The widest differences between item means occurred in items describing behaviours more dependent on outside constraints (e.g. lack of time, too many students, poor facilities, poor materials) than on teacher's abilities.

Given the fact that it was necessary to appreciate the fit of the factor structure to each population (teachers and students) separately, a confirmation of the two-factor model was drawn up, using task (effectiveness) and relationship (creativity) subscales with the respective pool of items. The results of the confirmatory factor analyses, with two correlated factors, indicate that the two-factor model provides a stronger fit of the data to the students' sample, in both elements (GFI=.95; AGFI=.93; RMSEA= .06; Pop. Gamma Index=.96). As to the teachers' sample, the fit is not so good (GFI= .91; AGFI=.88; RMSEA=.06; Pop. Gamma Index=.95), which stresses the fact that the concepts are more difficult to clarify for the faculty rather than for the students.

According to standards defined by Hair, Anderson, Tatham & Black (1987), and Long (1983), the results indicate that the two-factor model provides a good fit of the data to the sample (GFI and AGFI greater than .90; RMSEA between .05 and .08; and Pop. Gamma Index higher than .95)

Differences Between Students and Teachers

Using both subscales (Task/Effectiveness and Relation/Creativity), various analyses of variance were done. Both means, of teachers and students, in each element, were compared, and the results are shown in Table 1.

Table 1. Mean differences in the element, *As I think I am (I would be) as a teacher*, between *Teachers, Students, and Creative Teachers*, in the *Relation and Task* Subscales.

Subjects	Subscale	<i>N</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i> ^a	
Teachers	Relation	854	2.72	.58	71.957	.000*	
Students		245	2.24	.55			
Creative Teachers		23	2.32	.37			
Teachers	Task	854	1.99	.46	11.553	.000*	
Students		245	2.16	.56			*
Creative Teachers		23	1.91	.34			

^a Tukey's Test for Unequal Samples

* Teachers differ from Students at $p < .000$, and from Creative Teachers at $p < .031$

** Teachers and Creative Teachers differ from Students at $p < .001$

As may be seen in the table, teachers and students differ in the way they see themselves as teachers, when referring to creativity (relation) in teaching, thus supporting the first proposition made [*Students think they would be more creative as teachers than their actual teachers think of themselves, in terms of creative teaching (relation oriented)*].

Considering the task subscale as a criterion variable, and the results shown in Table 1, it is possible to support the second proposition (*Teachers perceive themselves more effective as teachers, than students think they would be, if they were teachers*).

Orientations towards creativity and effectiveness, among faculty, appeared to be of a mutually exclusive nature, that is, an orientation to creative teaching was perceived as such at the expense of effectiveness, and vice versa. This mutually exclusive tendency was not visible among students.

The Teachers Considered as Creative

As described, 26 teachers interviewed filled in the questionnaire afterwards. As the results shown in Table 1 demonstrate, differences between scores of creative teachers and normal faculty support the third proposition. In fact, the teachers selected as examples of creative teaching seem to have a position closer to students, as to creativity in teaching, and to that of their colleagues, as to effectiveness.

This last finding supports the criterion validity of the instrument (accuracy of the test scores in predicting actual performance), as it proves itself able to identify subjects who are recognised as having a different attitude and behaviour. It also supports the conclusion that a creative teacher does not have to make an option to identify his or her role with the teachers' or students' expectations only; the former are probably more directed to effectiveness in teaching, while the latter prefer relationship. Thus a creative teacher seems to be just someone whose role has a better clarification than the less creative teacher does.

Qualitative Analysis.

In an attempt to provide a picture of the match between the statements (taken out of the interviews) of the teachers considered creative and their results in the questionnaire, a systematic approach to their discourse was developed, by submitting the interviews to the statistical method designated *correspondence analysis*, using SPAD-T (Lebart, Morineau, Bécue & Haeusler, 1993) and *Statistica* software packages.

Hair, et al. (1995), define correspondence analysis as an interdependence technique that facilitates dimensional reduction and conducts perceptual mapping, based on the association between objects and a set of descriptive characteristics or attributes specified by the researcher. According to these authors, the benefits of correspondence analysis lie in its unique abilities for representing rows and columns (e.g., subjects and categories) in a joint space. This method is normally used to match subjects and behaviours, or brands and attributes; in this case none of them applied, as there was no intention to differentiate between subjects, considering their discourse, but just to obtain a perceptual map of their own words and expressions, with the categories used in this research.

The first type of categories, designated as *research categories*, were obtained by submitting the interviews to successive simplifications of the wording used, and then factor analysed by correspondence analysis, using *SPAD-T* software, to draw up the main categories, used as columns. The interviews were also content analysed, and each unit of registry (words or sentence with a specific meaning) was registered and grouped in a *context category*. Then, each context unit was rated under as many research categories as it was related with (e.g., “I need more time to do research”, relates to *teacher*, *task*, and *creativity* research categories; “I keep myself distant from students”, relates to the *teacher*, *relation*, and *student* categories), and the frequency of each context category, under each research category, was calculated. The first type of categories were used as columns, and the second as rows in a final correspondence analysis, using *Statistica* software package, in order to draw up the perceptual map of the discourse.

As may be seen in the chart (Figure 1), the teacher considered creative places himself or herself in a central point of a space defined by two axes: the main one, horizontal (explaining 91% of the variance), with *relation* at one end (positive), and *creativity* at the other (negative);

the other axis, vertical (explaining 5% of the variance), with *task* at the positive end, and *creativity* at the negative.

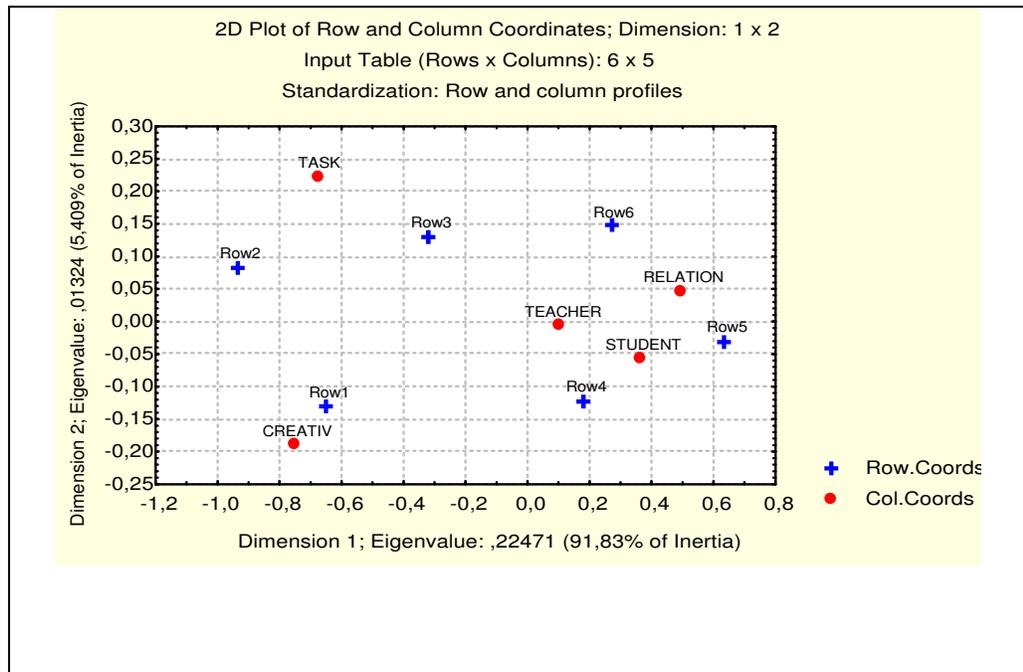


Figure 1. *Creative Teachers’* perceptual map: Projection of *context* (row) and *research* categories (column) in a two-axis space.

Legend of rows: 1 = creation; 2 = job outside (the School); 3 = job inside (the School); 4 = different students (implications of); 5 = relationship; 6 = participation (of the students).

This distribution of space provides a clear picture of how the subjects see themselves in the whole spectrum, in accordance with the findings reported in the previous section.

Figure 1 allow us to visualise how task and relation oppose each other in this perceptual map, as happened with the quantitative analysis, in the previous section; while creativity occupies a dominant position in half of the space defined by the two axes, revealing its importance in the conception of the whole dimension of teaching.

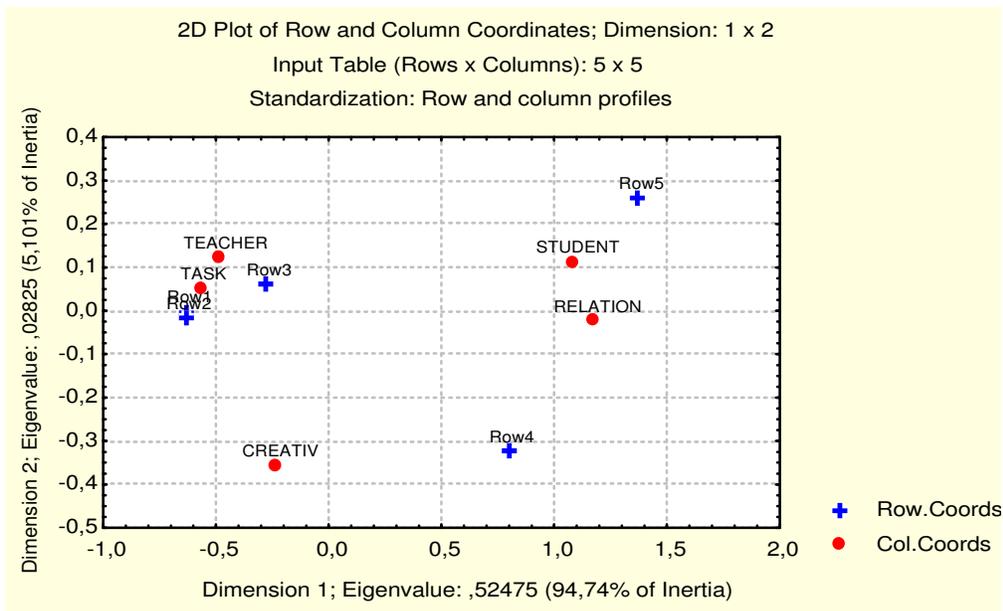


Figure 2. *Less Creative Teacher's* perceptual map: Projection of *context* (row) and *research* categories (column) in a two-axis space.

Legend of rows: 1 = creation; 2 = job outside (the School); 3 = job inside (the School); 4 = different students (implications of); 5 = relationship; 6 = participation (of the students).

Using the discourse of six *less creative teachers*, taken at random (see Figure 2), we may see a perceptual map where *task* and *teacher* appear close together. Here, the teacher leaves the central position, near the students and the relationship, and gets closer to a role where the definition made by peers and superiors is more important.

Implicit Theories

The Creative Teacher's Profile

From the interviews, and as described in Sousa (1999), it was possible to conclude that, at the polytechnic, creative teachers:

Are “workaholics”, with a teaching experience of more than ten years, unique and different from each other in such a way that it is difficult to find patterns, but in the fact that all love what they do, and all of them love their students.

They do not recognize themselves as creative, and tend to attribute that assessment to external factors (e.g. nature of the subject matter taught, reputation as a professional outside the educational environment), or to the kind of relationship that they maintain with their students. They tend to see themselves as “good teachers” and “actors on stage”, or as “negotiators” with their students, frequently available outside class, flexible as to students’ deviant behaviors (e.g. late arrivals), close (friendly) and distant (not a “comrade”) at the same time; knowing their names, participating in their initiatives and standing up for them when needed. Popular among students and respected (and probably envied) by their peers, they sometimes fear that being too nice can also be a bad thing for the students, preventing them from giving appropriate feedback, or leading them to fail later, when they will not have the extra support that they get from these teachers.

They prefer not to go in for too detailed a preparation of their classes, leaving something to be constructed with the students, as a sort of “hazardous class adventure”, so that it may become a surprise to themselves, as well as to their students. They hardly repeat a class, exercise, or semester exactly in the same way.

Good professionals in their own fields, they often carry out both activities (work and teaching) simultaneously, especially in the arts, accountancy and engineering fields, as this gives them the possibility of becoming experts in making analogies between academic and real life. Preferring to demystify science in its application to real-life problems, emphasizing communication instead of content, and alerting the students to everything that surrounds them, in their classes they try to create a climate favorable to the sharing of experiences.

Some of them may be more “task-oriented”, corresponding to the “actor on stage”, or “seducer” type; others may be more “relationship-oriented”, corresponding to the “supportive” approach, aimed at establishing close relationships and providing social support. The former type may also be designated as “masculine”, or ‘transformational’; and the latter “feminine”, or “facilitating”.

As to their ideal of perfection, they feel they are in equilibrium with their students, and that they must change as the students change, and all they wish is to have more time for themselves and for their students, and need less time to get to know them well.

And last, but not least, they tend to be subject-matter experts, with a constant worry for keeping themselves up-to-date. (p 362)

Definitions of creative teaching were chosen as examples of implicit theories of creative teaching:

The innovative, task-oriented teacher:

To be half way to being a good teacher
A communicator first
Someone who leaves his or her mark
A seducer, who 'inflames', 'infects', turns the students into subject matter 'addicts'

Others corresponded to the "facilitator" type of teacher:

Something that comes from the humility of creating our practice out of our self-assessment, presenting a model that does not have to be perfect (i.e. is not necessarily a role-model) and that must not try to impose itself
Is to live between light and darkness; to have an idea and not to have the image of that idea
To try to understand whether what each student takes out of school has to do with his or her wishes
Being ethical (relationship), before being aesthetic (task)
To be able to discover what the student has to say; what he or she is able to do; how his or her expressiveness reveals itself

Finally, the typical uncreative teacher seems to be:

Just someone who delivers the subject matter always the same way, not taking the students' reactions into consideration; who leads them to concentrate on facts and concepts, instead of questioning themselves and the subject matter
A predictable person

Conclusions

This study provided strong evidence to support a positive answer to the research problem ("Do students and faculty perceive their own creativity and effectiveness in teaching in different ways?").

In fact, students and faculty of the Lisbon Polytechnic Institute seemed to concentrate on different aspects of teaching and to provide different orientations as to what makes the core of the activity: creativity, seen as the outcome of a successful communication between students and teachers, where each player has the opportunity to express freely its own creativity; and effectiveness, seen as the task aspects of teaching where the student does not play an active part,

or has just to respond to the teacher's requirements, e.g. the teacher's actions aimed at preparing, organising and delivering the content materials, and evaluating the learning that has taken place. Students seemed to concentrate more on the relationship aspects of teaching (creativity), while imagining how they would be (real) as teachers, and how they would like to be (ideal), while the opposite happened as to how effective they would be as teachers (real), and attributing less importance to that effectiveness in the definition of the ideal.

This separation of conceptions of teaching, in accordance with the role performed, was supported by another finding, related to the last proposition made ("Creative teachers will tend to score close to students, in the way they value creativity in teaching, and close to faculty in effectiveness"), where it became clear that the teachers who were selected as examples of creative teaching did not differ from students, in their conceptions of creativity in teaching, neither from their peers, in effectiveness. Even though they represented a small group, in comparison with the whole sample of teachers, the differences were significant enough to support the proposition, reinforcing the finding that creative teachers tend to have a better role clarification than their less creative colleagues, and that they succeeded in balancing both factors (creativity and effectiveness) in a more effective way than their colleagues do. In fact, orientation towards creativity and effectiveness, among faculty, seemed to be of an exclusive nature, that is, when a lecturer had an orientation to creativity in teaching, he or she seemed to do that at the expense of effectiveness, and vice-versa. This tendency was not visible among students, when imagining themselves as teachers.

The correspondence analysis made to the mentioned interviews allowed us to visualize how task and relation aspects of teaching oppose each other in their perceptual map, as happened with the quantitative analysis. The teacher, occupying a central position in the perceptual map

(Figure 1), reflected the results obtained in the questionnaire by the lecturers considered creative, where they scored similarly to the students, as to the relationship aspect of teaching, and to their peers, as to the task aspect. This configuration also revealed the way these lecturers separate creativity from their relation with the students, but also from their task as teachers, considering it as an opposing direction of each dimension. This does not mean, to them, that creativity opposes teaching but rather that it is its main aspect. To them, creativity must be seen as an isolated aspect of teaching, and as a kind of target, that neither the teacher nor the students should pursue for its own sake: moving the teacher towards creativity might imply his or her separation from the students and from teaching, while moving to the task would divert the teacher from creativity, connecting him or her with the task aspect of teaching only.

This trend was confirmed by the analysis made to a similar discourse of a teacher not selected as example of creative teaching, in which it was clear that although representing the teaching universe in the same way as their more creative colleagues did, he placed himself not at the center of that universe, but near the task aspects of teaching (their “official” role as teachers), and away from his students.

From these findings it is possible to appreciate the general framework in which the construction of the role may take place. They also make possible to develop a better understanding of the teaching situation, especially when dealing with the extra effort that a teacher has to make in the attempt to draw his or her role out of an ever changing student population, instead of doing it from other teachers, only, or just from a school’s conception of the student’s prototype. A teacher may consider other teachers as the “significant other”, and “take their role” accordingly, or place the students in that position; if so, the effort of imagination that has to be made is much stronger, in this latter case, due both to role distance and to the

diversity and changing character of the student population. As the bargaining that has to be done between teacher and student, so that teaching actions become validated, is highly emotional, it is possible that what happens during role making lies far beyond consciousness and rationality, and mainly in the will and effort to maintain a constant update of the perception of the other's reactions to one's actions, so that role support may be achieved.

The role making of a teacher, keeping the students as the "significant other", and without rejecting other teachers as role models, seems to be achieved, then, by just a small proportion of professionals, and its perhaps this reality that will be possible to change, either by reviewing the professional assumptions about a teacher's role, or the present training systems that prepare future professionals. Only by reducing the distance that separates teachers' and students' requirements for education will it be possible to increase the proportion of professionals who are capable of balancing both types of requirements.

Another interesting finding was the possibility that there exists some kind of identification between students and lecturers, and that the former tend to converge with the latter in their preferences for creativity or effectiveness in teaching, as they progress in their courses. This way, students seem to follow the teachers' orientation, in a sort of role making conforming to faculty's preferences.

Besides the independent variable "Role", which proved to be the best predictor of all controlled variables, "School" also appeared as an important variable in defining differences among the criterion variables used. In fact, the study presented evidence that different students choose different Schools and courses, and that the students change their conceptions of teaching over the years, in the direction of those of their teachers, as stated above. Even with some exceptions, students seem to enter higher education with certain expectations about creativity

and effectiveness in teaching, which tend to become reduced as they progress, in such a way that we may speak of a sort of “standardisation” factor, strong enough to appear in the results of a simple measurement instrument such as the one used in this research.

As to the lecturers, only the variable “School” produced some variation in their conceptions of creativity and of effectiveness in teaching. Nevertheless, it seems that it is not the organisational environment, nor its correspondent scientific domain, which originates differences among faculty, but a convergence of factors that cluster around the predictor “School”. For example, the variable “Teaching Experience”, used as co-variate, did not reveal enough statistically significant influence, but its visible tendency supported what may be one of the reasons why the scores at the Media School appear higher than at the Teacher Training School. In fact, the average teaching experience of faculty was shorter at the former (9 years), while at the latter, faculty had the longest average teaching experience (19 years); also, while the nature of that experience was connected to primary and secondary level teaching, at the Teacher Training School, at the Media School the experience was more as a corporate professional. The Teacher Training School had also the cumulative effect of “Gender” (more women as teachers) and “Academic Qualifications” (higher proportion of M.A. and Ph.D.), as reasons to show more proximity to the image of creative teaching.

This way, it is probably for personal reasons (age, experience, gender, qualifications), not organisational (context or culture) ones (organisational environment, scientific domain), that lecturers showed some differences in their own perceptions as teachers, when referring to the creative teaching concept. As to effectiveness no differences were found.

The Art Schools did not reveal a defined pattern of perception different from the other Schools. Even with comparatively reduced numbers of subjects, the analyses made provided

enough evidence to detect differences among their students, with the dance students favouring creativity, and music students closer to effectiveness.

Final Comments

The opportunity to meet, interview, analyse the discourse, and attend the classes of such interesting subjects as those selected as examples of creative teaching, provided the final touch to this research: the possibility to understand people's concepts of creativity and creative teaching, as seen by those who are its living examples. Up to a point, these subjects provided the necessary links between theory and reality, between scientific constructs and people's concepts, adding some more definitions and descriptions of creative teaching.

As to class observation it was not possible to detect patterns or to learn much from the lecturers, given the experience of the observer with creative teaching techniques. It became clear that none of these lecturers used any specific method or technique, nor a constant and thoughtful approach to teaching and learning. Some, more than others, exhibited a personal style where communication with the students seemed to be a constant worry, even though it was not always a verbal interactive communication. In fact, many of them seemed to have made an option for the lecture type of lesson, while using all possible skills to detect the students' reactions to the talk, in a sort of player-public rapport.

Through them it was possible to confirm that teaching creatively is seen by its agents as the search for doing things better (effectiveness), within the framework of a professional role definition, while keeping the students as the main target. And that if the communication process is successful, that attempt is perceived by the students as novel and valuable, in helping them to develop and to be ready to face new challenges. Both players - students and lecturers - tend to attribute to each other the reasons why creative products result from their interaction.

That is why the teacher's perspective of effectiveness transforms itself into creativity when the student is considered as an active player, and as the *raison d'être* of the search for that effectiveness. Creativity, though, lies not in the teacher, nor in the student, but in the interaction between the two, therefore demonstrating the validity of Csikszentmihalyi's conception that *creativity is located in neither the creator nor the creative product but rather in the interaction between the creator and the field's gatekeeper who selectively retains or rejects original products*. This research suggested that it seems more important to understand what is involved in the construction of the role of teacher, and in the communication process with the students, rather than exploring creative ways to present subject matter to students.

As to Paul Torrance's (1995) observation, which opened this dissertation "Great teachers will have to live with the fate of being fired, discredited, isolated or their funds being withdrawn", and to the questions that followed, we hope that this research can be used as a contribution to changing that fate in the future. In fact, the creative teachers selected by the students in this research, did not correspond to the image of eccentricity as, for example, the one that Robin Williams plays in the film *The Dead Poets' Society*. And even though the aspect of organisational integration and acceptance was not fully analysed, it became clear that they fitted in perfectly in the ways a higher education teacher is expected to "behave" by peers and administration. They could eventually be envied by their peers, but not rejected because of incompetence or lack of conformity to a teacher's role.

If rejection may also occur because of the mechanisms underlying human envy, it will become more difficult to use them effectively if creativity in teaching is demystified, recognised and praised by the educational system, as this research tries to justify.

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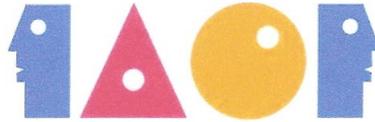
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THE INFLUENCE OF INNOVATION STRATEGY AND ORGANIZATIONAL INNOVATION ON INNOVATION QUALITY AND PERFORMANCE

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Abstract

This study utilizes the 1000 largest corporations that surveyed at 2009 by Common Wealth Magazine in Taiwan to explore the correlations and strengths between innovation strategies, organizational innovation, innovation quality, and innovation performance of a corporation. Through the investigation of managers and employees in various industries, 406 valid responses were collected and further explored and verified through comparison and analysis of structural equation modeling.

The study found that innovation strategy of corporations will positively influence on innovation quality and further influence on innovation performance. Meanwhile, organizational innovation also has a positive effect on innovation quality, thereby further affecting innovation performance. However, innovation strategy and organizational innovation all had no direct impact on innovation performance.

When comparison two relationship models between manufacturing industry and service industry that indicated significant variations existed in how the path strength of organizational innovation impact could affect on both of innovation quality and innovation performance. Therefore, that showed significant difference existed between manufacturing industries and service industries on influence path of innovation performance.

Keywords: Innovation Strategy, Organizational Innovation, Innovation Quality, Innovation Performance.

Introduction

Innovation is an important corporate strategy. Many scholars have defined it as the adoption of new concepts or behavior. Therefore, it can be a new product, new service, new technology, or a new management approach. The positive effect of innovation on performance has been proven true in a large number of empirical studies (Damanpour & Evan, 1984; Zahra, Belardino & Boxx, 1988; Khan & Manopichetwattana, 1998). Caught in an increasingly uncertain environment with tough competition, an organization has to value various types of innovation even more in order to survive and grow (Bir, Schacht, & Kaufmann, 1988). Every enterprise must be able to develop unique innovation strategies and actions to sustain competitive edges and improve its business performance, so that it can come out on top from fierce market competition.

Corporate innovation strategies include product innovation, process innovation, marketing innovation and management innovation; such as creating new products, new services, new production methods (production/technology innovation), new markets, new supply sources and new organization approaches, and so on (Johannessen, Olsen & Lumpkin, 2001). In addition, organizational innovation is also an important factor of influence on innovation quality and performance. It includes new leadership styles, organizational culture and commitments that can direct impact on employees' willingness to contribute (Belassi & Fadlalla, 1998; Hooff & Weenen, 2004; Jaramillo, 2005).

While one after another enterprise is applying innovation strategies to increase its competitiveness, it is in fact even more important to identify which innovation strategy can lead to performance growth and what innovative actions can effectively boost the company's competitive advantages. Since innovation is one of the main competitive strategies in every type

of industrial development and yet there have been few studies focused on examination of results of innovative efforts, this study therefore is aimed to investigate the influence of innovation strategies and organizational innovation of various Taiwanese industries on their performance, in the hope of providing certain information useful to the academic and business sectors.

The top 1000 manufacturing and service businesses rated by the Common Wealth Magazine in 2009 are adopted as the subjects of investigation in this study to examine the impact of innovation strategies and organizational innovation on enterprise performance. Literature analysis and empirical research are both conducted. The objectives of the study are as follows: 1) to explore the influence of innovation strategies on innovation quality and innovation performance, 2) to explore the influence of organizational innovation on innovation quality and innovation performance, 3) to explore the influence of innovation quality on innovation performance, 4) to compare the differences between two types of industries in relationship paths among innovation strategy, organizational innovation, innovation quality and innovation performance.

Literature Review

Innovation

Robbins (1996) suggested that “innovation” means application of a new idea to develop or modify a product, process or service. In other words, anything different from an existent method or content can be regarded as innovation (Porter, 1990). An organization has to continue to innovate to demonstrate its uniqueness in order to maintain its competitive advantages (Wernerfelt, 1984; Berry, 1991).

Glynn (1996) and Carter (2002) both asserted that corporate innovation can result in new R&D, production and marketing approaches, and eventually lead to commercialization of this

innovation. In other words, Innovation is the process of materializing a brand new idea, different past ones, by way of production or by making it become tangible. It is a process of realization of a new method, product or service (Thompson, 1965). Zaltman & Holbek (1973) believed that innovation includes generation of a new concept, evaluation and implementation. It is the use of new and different methods or technologies to improve quality or lower costs, to meet or surpass corporate targets.

Innovation is one of the options a corporation has to confront market competition and achieve sustainable management. Freeman (1997) regarded innovation as the effort of an enterprise through use of technology and information to develop, manufacture and market products that are new to the industry. It includes invention and commercialization. Tushman & Nadler (1986) considered innovation as creation of a new product, service or production process by a business. Frankle (1990) thought innovation is modification or invention of ideas to, through continuous improvement and development, meet customer demands. Demanpour and Gopalakrishnan (1998), on the other hand, took a further step and defined innovation as: “The process of coming up with new concepts, methods, equipment or products.”

From all the above, it is clear that innovation can be manifested in various aspects of an enterprise such as product R&D, production, marketing, services and operating processes, and so on.

Innovation Strategies

An innovative strategy is a new corporate concept in relation to products, production procedures or organizational structure. It has to be realizable and, hopefully, bring high added value or improve management performance for the corporation. Porter (1985) indicated that innovation strategies are an important means in corporate development. When an enterprise

formulates an innovation strategy, it must consider the current industrial condition, company capacity and the feasibility of integrating the strategy with the company's fundamental competition tactics. This makes innovation strategies an intrinsic element in a corporation's overall competition tactics.

Daft (1978) divided innovation strategies into "technology innovation" and "management innovation." Betz (1993, 2003) further separated technology innovation into product innovation, procedure innovation and service innovation. Innovation strategies can also be categorized in accordance with the scale involved. Depending on the reach of the innovation, gradual innovation normally is targeted at small-scale changes. Breakthrough innovation, however, can lead to a major overhaul; it may come from invention and creation of a new business can be possible (Henderson & Kim, 1990). Garcia & Calantone (2002) classified innovation into three types: breakthrough, original and gradual. Later scholars again divided breakthrough product innovation into technical breakthrough and market breakthrough innovation (Benner & Tushman, 2003).

If innovation strategies are sorted according to their patterns: Johne (1999) suggested innovation can be divided in accordance with the product (new material, new product,) market (new market, new application,) and process (management process, administrative process.) Johannessen et al. (2001), on the other hand, believed, pattern-wise, innovation may include new products, new services, new methodology or production, new markets, new supply sources and new organization approaches. Holt (1983) concluded that innovation must begin with technological innovation, before organizational innovation and marketing innovation. Technological innovation is carried out through use of knowledge to create and implement new technologies and it can result in "product innovation" or "process innovation." Holt also asserted

that management innovation ought to be included, meaning application of new management approaches and systems, in other words. Social or organizational innovation, financial and marketing innovation, and so forth, are also not to be left out.

In line with the above classification arrangements by different scholars, this study divides innovation strategies as follows:

a. Product innovation:

Use of new technology and design and development of new products and functions.

b. Process innovation:

Adoption of new production procedures or service process.

c. Management innovation:

Application of new organizational structure, management skills, methodology and systems.

d. Marketing innovation:

Establishment of new approaches of product or service marketing, new channels, and new market targets.

Organizational Innovation

Execution of innovation strategies requires coordination throughout the entire organization. No innovation strategy can be enforced without an innovative culture and leadership. Therefore, organizational innovation is another key factor that has an effect on innovation performance. Organizational innovation must go through the process of adoption, adaptation, acceptance, systemization and fusion before any result can be seen. Zmud & Apple (1992) measured the degree of enforcement of organizational innovation according to the degree of routinization. The evaluation items include coordination, policy implementation, budget and training.

Hurley & Hult (1998) pointed out that the degree of enforcement of organizational innovation ought to include the extent of systemization and establishment of consensus. Linton (2002) suggested that the factor behind successful introduction of organization innovation is communication. Tang (1999) thought organizational innovation has to include clear-cut organizational sense of mission and faith to support the innovation. This requires innovative instruments and skills to carry out work, while the employees have to value teamwork and cross-department coordination, perform their duties, as well as share creative ideas and energy, and are allowed to openly and actively make proposals. All such communication, sharing, convictions and attitudes are important elements in establishment of consensus.

Belassi and Fadlalla (1998) proposed an integrated organizational innovation diffusion model in which management style and organizational culture are factors of influence on adoption of innovation and these two factors are related to both the systemization and consensus establishment aspects. Malhotra & Drazin (1996) concurred that support from high-ranking administrators is key to successful innovation and development of organizational. Jaramillo (2005) came up with the idea that organizational commitment is a critical element in organizational innovation. Organizational commitment can be defined in two ways: 1) employees' willingness to remain in the organization to work, and 2) employees' loyalty to the organization (Porter, Steers & Boulian, 1974).

Based on the above definitions and classification of organizational innovation, the following three elements are applied in this study to evaluate organizational innovation:

a. Leadership Style:

The leaders value innovativeness and apply adjustment, management and incentive measures to achieve the goal of organizational innovation.

b. Organizational culture:

All the members of the organization follow same innovative approaches of implementation and share the same sense of value, while the administrators and employees also hold common innovation faith.

c. Organizational commitment:

The members of the organization are deeply convinced in the goal of organizational innovation and identify with the sense of value thereof derived. They are willing to make extra effort for the benefit of the organization and desire strongly to remain as part of the organization and help achieve the goal of organizational innovation.

Innovation Quality

Haner (2002) pointed out that innovation quality in fact is the aggregate of all the innovation results. It includes the quality of the products and services, the quality of the process of actual corporate operations, as well as the quality of management at the highest corporate level. Innovation quality indicates when an enterprise endeavors in the pursuit of innovation through creation of new products, processes or management modes, whether the innovation can satisfy the parties of interest such as the customers, the employees and the suppliers. If the answer is yes, then it means the innovation does have “quality”.

Innovation quality can be assessed in accordance with the corporate goal and the results of organizational activities. For instance, new product R&D, value chain renewal and modernized work approaches are all areas an innovative enterprise must value today. Ahmed & Zairi (2000) proposed that assessment of innovation quality should include 1) product/service quality: increase of customers’ perceived value, reduction of target costs, stability of new design, improvement of return on product investment, and product performance; 2) operation process

quality: correct release time, productivity upgrades, effective personnel arrangement and product development, and target control and flexibility; 3) management quality: employees' acceptance, understanding of customer needs, sales of innovative products, ratio of patents, and success rates of innovation.

From the above, it can be reckoned that while carrying out innovation, corporate managers must take quality into consideration. It can be evaluated from three chief aspects, namely product or service, process and management:

a. Product or service quality:

The level of quality of new products or services an enterprise develops through application of new technologies.

b. Process quality:

Productivity is effectively upgraded and a certain degree of cost reduction is achieved in the production process.

c. Management quality:

The leadership, management concepts, innovation and strategy control have a certain degree of direct and significant effect on business management.

Innovation Performance

Damanpour (1991) suggested that innovation performance can be evaluated in accordance with the ratio and speed of innovative measures adopted throughout an organization. Blau & McKinley (1979) on the contrary upheld that innovation performance can be assessed according to the number of awards the company wins. Hull & Hage (1982) had a different idea and thought that innovation performance should be measured in line with the quantity of patents a company is granted. Damanpour (1996) took a further step and pointed out that the results of

organizational innovation must be weighed based on the number of innovative measures carried out within a specific time period. Moreover, businesses often appraise the results of innovation by calculating the time span between two innovative measures adopted in an organization. Such appraisal reflects an organization's readiness and propensity toward innovation and its speed and ability to adopt innovation.

Hopkins and Bailey (1981) believed that evaluation of the effects of innovation products should be conducted with five indicators, namely financial assessment, target assessment, ratio of new products in overall sales, percentage of new product development success, and overall subjective satisfaction with new product development. Sbragia (1984), on the other hand, adopted four aspects to evaluate the results of an innovation: the rate of achievement in the progress of the innovation project, the cost control of the innovation project, the rate of satisfaction with the technology performance of the innovation project, and the company's overall satisfaction with the innovation project, including quality, costs and progress.

Walker & Ruekert (1987) used three aspects to assess the innovation performance. The first is effect - meaning the success rate, growth rate and change of market share. The next is efficiency - referring to the profit rate and return on investment. The third is adaptability - the success rate of the innovation on the market and the percentage of its profit in the company's total profits over the past five years.

Cooper (1985) established eight variables in innovation performance measurement, including the percentage of new products developed over the past five years in the company's current sales, the percentage of successful product development in the past five years, the percentage of unsuccessful and aborted product development in the past five years, the percentage of product development plans that have achieved established targets in the past five

years, the significance of the said plans in sales and profit increase for the company, the amount of profit exceeding invested costs, the degree of success in comparison with that of competitors, and the overall success rate.

By combining the above literature, three items of evaluation of innovation performances are established in this study:

a. Innovation success rate:

The success percentage of innovative product or service within a specific time period.

b. Market share:

The ratio or percentage of a company's innovation product or service sold on the market of the similar products within a specific time period.

c. Innovation profit rate:

The ratio between income and costs from innovation investment within a specific time period.

Research Hypotheses

Influence of Innovation Strategies on Innovation Quality

As many enterprises have greatly increased their profit and market share through innovation, innovation has consequently been deemed as a chief source of competitive advantages (Prajogo & Sohal, 2006). In order to acquire a deeper understanding of the key elements of corporate success, the relation between two major issues of "innovation" and "quality" has become important and worthy of investigation (Keogh & Bower, 1997).

Betz (1993, 2003) pointed out that enterprises can upgrade their efficiency and establish differentiated services that surpass customer expectation through process reformation or innovative management modes. In other words, innovation has been regarded a driving force for

boosting quality to higher levels. This also exhibits the close relationship between innovation and quality (Lyu & Chen, 2005).

Management innovation (such as innovation of organization structure and management skills) and technological innovation (such as product, service, production process and marketing innovation) are equally important in their impacts on innovation quality. In other words, these two types of innovation will affect each other and bring multiplied effects on innovation quality (Damanpour & Evan, 1984).

Trist (1981) recommended that application of management and technical innovation at the same time will help a company maintain equilibrium between its internal technical system and social structure then improving overall quality effect.

Based on the above arguments, the following hypothesis is established in this study:

H1: Innovation strategies have positive influence on innovation quality.

Influence of Innovation Strategies on Innovation Performance

Many studies have proven that innovation can lead to better performance in any industry. For example, Zahra, Belardine & Boxx (1988) discovered that innovation on industrial products and consumer goods can always elevate corporate performance. Subramanian & Nilakanta (1996) examined the service industries and advocated that innovation in service businesses can effectively boost performance. Damanpour & Evan (1984) applied the dual core model of “management innovation” and “technological innovation” to verify the influence of innovation on performance. The outcome reveals that both management innovation and technological innovation have positive influence on innovation performance and the two types of innovation also have influence on each other and, as a consequence, generate a positive synergistic effect on business performance. Zahra & Bogner (2000) conducted a study on the relation between the

influence of industrial environment on technological innovation strategies and performance in American software businesses. The results show that radical innovation is significantly positively related to return on equity (ROE) and growth of market share (GMS). The above findings proved the significance of innovation strategies to corporate innovation performance. Therefore, enterprises apparently ought to value innovation strategies to achieve better performance and competitive advantages.

Based on the above arguments, the following hypothesis is established in this study:

H2: Innovation strategies have positive influence on innovation performance.

Influence of Organization Innovation on Innovation Quality

Organizational innovation is an activity that takes form through the joint effort and operation of individuals and the entire organization by adopting new knowledge and achieving pertaining consensus (Holt, 1983). In the complicated and ever-changing competitive environment today, all personnel in an organization need to be innovative and an R&D team that is entrusted with the responsibility for product competitiveness has to be even more innovative (West & Naderson, 1996). Amabile (1988) pointed out that an organization with an innovative climate will have the benefits of establishing cooperation, soliciting support for innovation projects and achieving reasonable competitiveness. Climates that encourage innovativeness and cultures that support innovativeness are more likely to stimulate the creativity of employees (Glassman, 1986).

West & Anderson (1996) believed that whether organizational innovation is carried out within a team, an organization or a society or whether it is applied to initiate new processes, manufacture new products or renew methodology to increase profits for the whole entity, from a broader angle, the results of innovation should also encompass employee growth, increase of

satisfaction, concentration of group identification, better internal communication, improved productivity, as well as continual upgrades in other economic indexes. As a matter of fact, it is quality elevation across the board.

Based on the above, the following hypothesis is established in this study:

H3: Organizational innovation has positive influence on innovation quality.

Influence of Organizational Innovation on Innovation Performance

Su, Li, & Su (2003) discovered that organizational innovation and strategy control can generate direct and significant influence on the business performance of an enterprise. Therefore, whether corporate leaders are capable of making the right judgment, supporting the direction of innovation, and having the insight into new markets and customer needs is an important factor of influence on the business performance of the enterprise.

Chien (2004) indicated that application of the concept of organizational innovation in the policies for the stimulation mode, leadership style, organization culture and environment, job design and human resources can have an impact on organizational innovation performance. Mehia, Dixon, Brass & Robertson (2006) suggested that the innovativeness of leaders can have positive influence on the work performance of the employees and subsequently affect the performance of the entire organization. Chen (2004) examined the manufacturing and service industries in Taiwan and discovered that organizational commitment to innovation can improve innovation performance.

Lopez and Crawford (2004) found that a culture that values innovativeness has positive influence on organizational learning, and corporate innovative culture also has a significant effect on organizational innovative performance. This proves innovative organizational cultures do have a certain impact on innovation performance.

Based on the above, the following hypothesis on the relationship between organization innovation and innovation performance is established in this study:

H4: Organizational innovation has positive influence on innovation performance.

Influence of Innovation Quality on Innovation Performance

The quality of innovative activities includes complete preparations, quick and precise product definition, strong market orientation, strict decision process, full execution of quality control, thorough implementation of the new process, flexible procedures, and so on (Cooper, 1996).

Many studies have proven that innovation quality has significant influence on innovation performance (e.g. Cooper, 1996; Song & Perry, 1997; Millson & Wilemon, 2002, 2006). Millson & Wilemon (2006) discovered that the quality of innovation process will lead for certain activities, such as marketing plan execution, product reformation and new product use, and eventually improve the performances of innovation. Millson & Wilemon (2002) concluded that a high-quality innovation can speed up the release of new products, as well as help achieve performances of market success, profitability and technical accomplishments (Cooper & Kleinschmidt, 1995).

Based on the above, the following hypothesis on the relationship between innovation quality and innovation performance is established in this study:

H5: Innovation quality has positive influence on innovation performance.

The Differences Between Two Types Of Industry

The subjects of research in this study are divided into manufacturing and service industries according to the Standard Industrial Classification of ROC. The former includes regular manufacturers and hi-tech industries, whereas the latter covers ordinary service industries

and financial businesses. Therefore, the management style difference between these two categories is adopted as the segmentation variable in this study to investigate whether differentiation between industries of varied management styles exists in the relation model proposed in this study. Subsequently, hypothesis 6 is established:

H6: Industries of various categories differ significantly in the relationships among innovation strategy, organizational innovation, innovation quality, and innovation performance.

Design of Study

Research Framework

With the above literature review and hypothesis combined, a research model and the framework as shown in Figure 1 are established in this study. The chief objective is to examine the influence of innovation strategy and organizational innovation on innovation quality and innovation performance. The top 1,000 manufacturing and service enterprises rated by the Common Wealth Magazine in 2009 are applied to conduct empirical study and compare the differences between businesses of various categories.

Questionnaire Design

Related literature was adopted as references for the design of the questionnaire. An initial draft was first established and pretests were administered for necessary modification. Five enterprises were selected through convenience sampling. Each of these enterprises randomly chose six supervisors from different departments to be interviewed. The results showed some of the questions were ambiguous and revisions were made.

After modification, convenience sampling was again applied to pick out 10 businesses. 50 interviewees in total were randomly selected to establish pilot test samples. The questions were answered and reliability and validity were analyzed. The results revealed that the Cronbach's α value of each of the evaluation aspect exceeded 0.7, the factor loading of each

question was larger than 0.6, and the cumulative explained variance of each factor was higher than 0.6 and complied with established criteria (Nunnally, 1978). Therefore, this questionnaire was adopted as the official questionnaire to conduct the survey (as shown in Table 1). The questionnaire was divided into six sections. Innovation strategy, organizational innovation, innovation quality and innovation performance were evaluated with a 7-point Likert scale – the higher the score, the stronger the agreement. The other two sections, interviewee and company information, were rated in line with a nominal scale.

Sampling

Three copies of the aforesaid questionnaire were mailed to various supervisors of each of the top 1,000 enterprises in the manufacturing and service industries as rated by the Common Wealth Magazine in 2009. After three-time promptings during five months, 406 valid copies retrieved; 238 were from manufacturing businesses and 168 from service businesses.

Sample Structure Analysis

a. Interviewees' Background

Sample analysis reveals that among the interviewees males accounted for 52.8% and females 47.2%. People ranging between 31 and 40 years of age take up 42.3%, followed by the

Table 1. The measurement variables

Questionnaire dimensions	Measure project	Measure	References
Innovation strategy	Product innovation	Likert Scales	Zahra & Bogner (2002) Johne (1999) Holt (1983)
	Process innovation		
	Marketing innovation		
	Management innovation		
Organizational innovation	Leadership style	Linton (2002) Jaramillo (2005) Tan (1999)	
	Organizational commitment		
	Organizational culture		
Innovation quality	Products or services	Betz (1993, 2003) Tether (2002)	
	Operation process		

	Quality management		Haner (2002)
Innovation performance	Success rate		Miller & Dess (1993)
	Market share		
	Profitability		
Respondent background	Sex, age, educational level, sector and job title and years of work	Nominal scale	Wu & Hung (2007)
Enterprise information	Types of industry, number of employee, capital, age of leader	Nominal scale	Wu & Hung (2007)

30.1% of 25~30 year-olds. Those with a university degree comprise an absolute majority of 72.4%, while the ones with a master's or higher degree occupy 18.1%. 55.5% of the interviewees have a monthly income between 800 and 1,600 US dollars, while the ones making between 1,601 and 2,400 total 20.6%. People who work in marketing departments form the largest group at 29.4%, followed by the 23.6% of production department workers. 60.7% of the people are basic supervisors, 22.1% of them are in mid-level managers, and high-level executives make up 17.2%. People who have worked in the company for less than 5 years constitute 44.2%, followed by the 33.7% and 10.7% respectively of those having served in the company for 6~10 years and 11~15 years.

b. Enterprises' information

Among the enterprises, service businesses account for 41.4% and manufacturing businesses 58.6%. Enterprises with less than 500 employees form the largest portion of 41.7%, followed by companies with 1001~3000 employees at 24.5%. Capital-wise, companies with less than USD 33 million are the biggest group and stand for 37.4%, while those with a capital between 33 million and 160 million come next with 35.3%. The ones that have been in business for less than 15 years take up 30.7%, ahead of those having been around for 21~30 years take up

21.5%. Companies with leaders aging between 51 and 60 years old constitute 42.6%, and the ones with leaders ranging between 41 and 50 years of age form 30.1%.

Study Results and Discussion

Reliability and Validity Analysis of the Official Survey

The Cronbach's α value, correlation and factor analysis were applied to evaluate the reliability and validity of the valid questionnaires retrieved from the official survey. The results revealed that every aspect of this study complied with the definition by Nunnally (1978) that outcomes with the Cronbach's α value exceeding 0.7 are high in reliability and the principle established by Kerlinger (1978) that the item-to-total correlations must be larger than 0.5. Therefore, the overall reliability of the questionnaire was decent.

Following, factor analysis was used to test the convergent validity of the questionnaire. As the numeric values of all the aspects of this study proved to be higher than the criteria proposed by Kaiser (1958) that the eigenvalue of the factors must be over 1, the factor loading of each variable in every aspect larger than 0.5, and the cumulative variance explained no less than 0.5, the convergent validity of the questionnaire was therefore also decent (as shown in Table 2).

Initially, reference to related studies was made to formulate a draft of the questionnaire. Then, after discussion with scholars, specialists and businesses, it was modified and the pretest questions were concluded. In the end, a pilot test was administered to determine the official measuring scale. This due process shows the questionnaire indeed had its content validity. In addition, theories and empirical studies by various specialists and scholars were adopted as the basis of development of the study framework and the questionnaire evaluation aspects.

Table 2. The reliability and validity analysis of questionnaire

Factor	Item-total correlation coefficients	Factor loading	Eigenvalue	Cumulative explained variance %	Cronbach's α
Innovation Strategy			10.889	54.445	0.944
Innovation Strategy - Product Innovation					
Product improvement	0.739	0.835			
Acquisition of advanced technologies	0.748	0.842			
Improved production efficiency	0.762	0.851	3.613	72.264	0.904
New efforts in production approaches	0.780	0.865			
Upgraded product development ability	0.768	0.857			
Innovation Strategy - Process Innovation					
Continuous creating R&D and new products	0.766	0.841			
Continuous improving production function	0.808	0.872			
Continuous improving product appearance	0.775	0.847	4.386	73.094	0.926
Continuous upgrade product quality	0.815	0.877			
Significant changes on existed products	0.769	0.841			
Creating various products	0.783	0.852			
Innovation Strategy - Marketing Innovation					
Keeping track of new market information	0.682	0.825			
Updating marketing strategies	0.755	0.875	2.882	72.059	0.870
Establishment of new marketing channels	0.757	0.866			
Use of new approaches to promote sales	0.698	0.828			
Innovation Strategy - Management Innovation					
Joint efforts in work target renewal	0.786	0.867	3.678	73.570	0.910
Employee commendation in public	0.782	0.865			

Factor	Item-total correlation coefficients	Factor loading	Eigenvalue	Cumulative explained variance %	Cronbach's α
Emphasis on renewal and improvement of management process	0.797	0.875			
Acceptance of employee suggestions and execution of improvements accordingly	0.789	0.871			
Change of environment for structural adjustment	0.707	0.808			
Organizational Innovation					
Constant new ideas from the leaders	0.722	0.819	10.079	67.195	0.965
Encouragement for employees to solve problems from different aspects	0.839	0.902			
Employee potential stimulation	0.820	0.891			
Willingness to train employees	0.806	0.880			
Employees' full understanding of company objectives	0.763	0.849			
Work environment allowing employees to exercise their potential	0.802	0.876			
Being proud of being part of the company	0.853	0.911			
Willingness to make more effort to help the company	0.848	0.907			
Strong identification with the company goal	0.846	0.905			
Strong desire to remain and work for the company	0.760	0.842			
Valuing employee creativity	0.803	0.877			
Work full of challenge	0.774	0.860			
Encouragement between members	0.837	0.901			
Employees' sense of accomplishment	0.839	0.902			

Factor	Item-total correlation coefficients	Factor loading	Eigenvalue	Cumulative explained variance %	Cronbach's α
Valuing employees' personal freedom	0.725	0.818			
Innovation quality					
New products of fine quality	0.820	0.885			
Satisfaction of customer demands	0.836	0.897			
High customer acceptance	0.821	0.887			
Increased perceived value for customers	0.801	0.868			
Creation of a dedicated R&D unit	0.690	0.771			
Efficient R&D procedures	0.772	0.837			
Visible improvement in production process	0.772	0.860			
Continuous improvements on management process	0.826	0.897			
Effective communication upgrades	0.810	0.886			
Continued improvement of business-customer relations	0.778	0.860	11.935	66.305	0.970
Good relations with collaborating subjects	0.680	0.785			
Continuous business performance improvement	0.763	0.825			
Innovativeness	0.811	0.865			
Innovations capable of upgrading employee performance	0.876	0.914			
Innovations capable of attracting more customers	0.841	0.888			
Innovation and R&D capable of upgrading management results.	0.847	0.892			
Acceptance of all products by customers	0.768	0.828			
Company recommended by customers to fellow businesses	0.741	0.807			

Factor	Item-total correlation coefficients	Factor loading	Eigenvalue	Cumulative explained variance %	Cronbach's α
Innovation Performance					
Visible annual sales growth as a result of innovation	0.864	0.924			
Increase of R&D success rates	0.913	0.953	3.504	87.606	0.953
Increase of market share as a result of innovation	0.890	0.938			
Increase of return on innovation investment	0.873	0.928			

Therefore, the nomological validity was sufficient.

After classification of the evaluation questions through factor analysis, four factors in the innovation strategy aspect were confirmed: 1) Process innovation – 5 questions with the α reliability of 0.904, 2) Product innovation – 6 questions with the α reliability of 0.926, 3) Marketing innovation – 4 questions with the α reliability of 0.870, 4) Management innovation – 5 questions with the α reliability of 0.910.

Factor analysis also revealed there was one factor in the organizational innovation aspect – 15 questions with α reliability of 0.965; one factor in the innovation quality aspect – 18 questions, with the α reliability of 0.970; and one factor in the innovation performance aspect – 4 questions with the α reliability of 0.953 (as shown in Table 2).

Furthermore, based on the suggestion of Gaski and Nevin (1985) that the correlation coefficients of any two factors or aspects must be smaller than the Cronbach's α value of each individual factor or aspect, correlation analysis was applied to assess the discriminant validity of each factor or aspect in the questionnaire. The results showed that the correlation coefficient of every two factors or aspects complied with the criterion (as shown in Table 3). Therefore, the discriminant validity between the factors or aspects was adequate.

Table 3. Correlation coefficients between factors or aspects

Variable (Cronbach α Value)	Product Innovation (0.904)	Process Innovation (0.926)	Marketing Innovation (0.870)	Management Innovation (0.910)	Organiza- tional Innovation (0.965)	Innova- tion Quality (0.970)	Innovation Performanc e (0.953)
Product Innovation (0.904)	1						
Process Innovation (0.926)	0.763**	1					
Marketing Innovation (0.870)	0.621**	0.605**	1				
Managemen t Innovation (0.910)	0.696**	0.600**	0.643**	1			
Organizatio nal Innovation (0.965)	0.658**	0.575**	0.588**	0.784**	1		
Innovation Quality (0.970)	0.732**	0.670**	0.696**	0.814**	0.871**	1	
Innovation Performanc e(0.953)	0.595**	0.593**	0.600**	0.688**	0.733**	0.800* *	1

* : $P < 0.05$, ** : $P < 0.01$, *** : $P < 0.001$

Full Model Analysis

The AMOS software was adopted for structural equation modeling (SEM) analysis to understand the interrelated dependence relationships among multiple variables and its intensity. Model fit was examined in accordance with the proposal from Joreskog & Sorbom (1989) that the GFI, AGFI, NFI, RFI and CFI indices must be over 0.9 and the RMSEA and RMR not any smaller than 0.05 as well as the suggestion of McIver & Camines (1981) that the ratio between the Chi-square value and the degree of freedom must not exceed 3. The results of SEM analysis showed that the full model fitness met or was close to the criteria, so the model was acceptable (as shown in Table 4).

The standardized estimated parameters from path analysis (as shown in Figure 2) indicated that innovation strategy had significantly positive influence on innovation quality ($\gamma_1 = 0.594$, $P = 0.000$), meaning that H1 was supported, but had no significant influence on innovation performance ($\gamma_2=0.057$, $P=0.660$), implying that H2 was not supported.

At the same time, organizational innovation also had significant positive influence on innovation quality ($\gamma_3 = 0.395$, $P =0.000$), and H3 was supported; but had no significant influence on innovation performance ($\gamma_4=0.088$, $P =0.303$), H4 therefore was not supported. While innovation quality had significant positive influence on innovation performance ($\beta_5=0.709$, $P =0.000$), connoting that H5 was also supported.

Table 4. The fitness analysis of full model

Fit Measure	Value
χ^2	2519.792
df	1459
χ^2/df	1.727
P Value	0.000
RMR	0.053
GFI	0.825
AGFI	0.802
NFI	0.899
RFI	0.890
CFI	0.955
RMSEA	0.042

Competing model analysis

The AMOS software was further applied to compare the two models of management styles of manufacturing and service industries in order to examine

whether there were significant difference from the various management styles on the relations between the variables. As shown in Table 5, the fitness indices of this competing model all met or came close to the criteria defined by Jorekog and Sorbom (1989) and McIver and Camines (1981). This means the model was

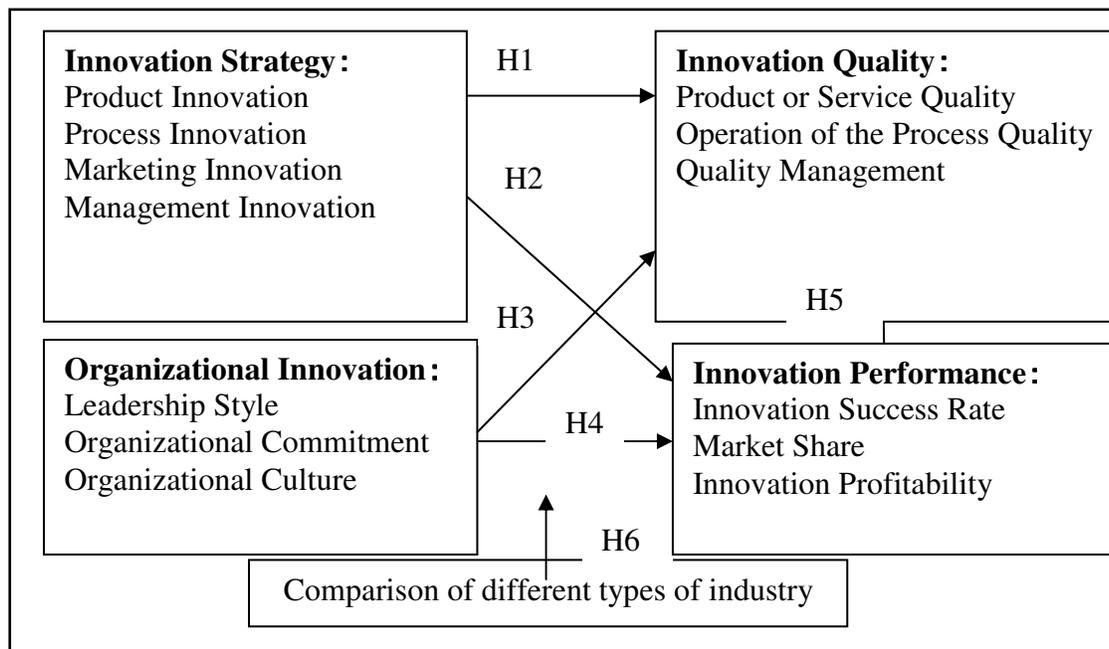


Figure 1. Research framework

acceptable. Findings from the analysis with the competing model have proven the following:

- 1) The degree of influence of innovation strategy on innovation quality indicates both the manufacturing and the service industries had significant influence on this relationship path. While the t-test results proved that manufacturing and service industries did not differ significantly in intensity of influence on this relationship path. The degree of influence on the relations in both was strongly significant, making it obvious that this path was important for both

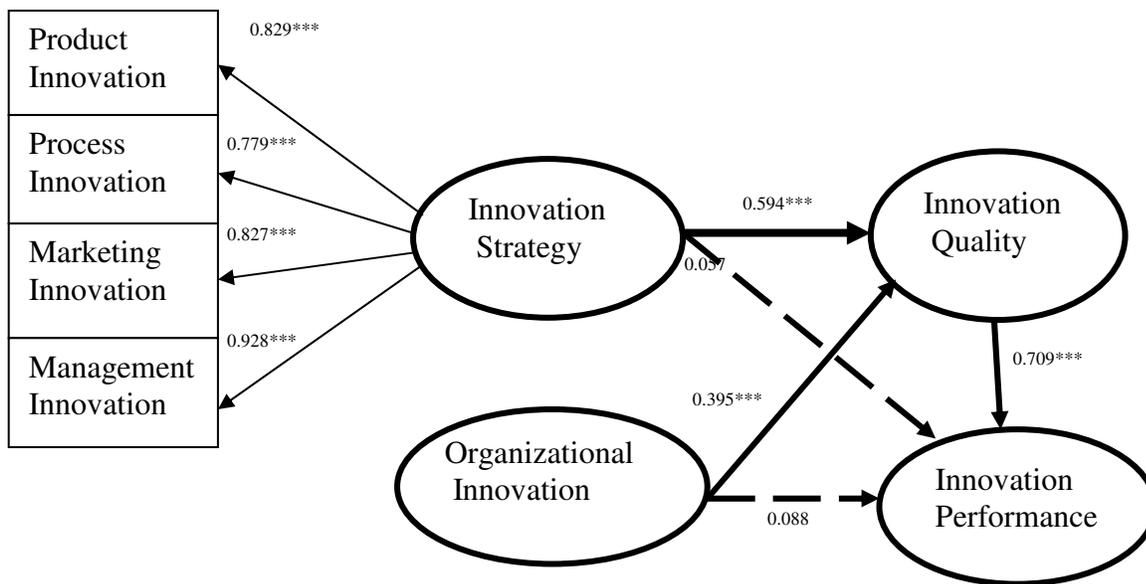


Figure 2. Relationship Model

types of industries. 2) Analysis of the influence of innovation strategy on innovation performance shows both types of industries had no significant influence on this relationship path, while the t-test results proved that manufacturing and service industries did not differ significantly in intensity of influence on this relationship path, either. In other words, the influence of both types of industries on this relationship path was weak.

3) Analysis of the influence of organizational innovation on innovation quality demonstrates both types of industries had significant influence on this relationship path. However, the t-test results proved that manufacturing and service industries differed significantly in intensity of their influence on this relationship path. The result showed that manufacturing industries in Taiwan have stronger influence on this relationship path, and organizational innovation

Table 5. Competing model

Model path	Standardized parameter estimates		Comparison		
	Manufacturing	Services	T-test		
Innovation Strategy→ Innovation Quality	0.518***	0.677***	-1.924		
Innovation Strategy→ Innovation Performance	0.050	0.131	0.094		
Organizational Innovation→ Innovation Quality	0.462***	0.316**	2.231**		
Organizational Innovation→ Innovation Performance	0.204*	-0.122	2.595**		
Innovation Quality→ Innovation Performance	0.573***	0.857**	0.731		
χ^2	df	χ^2/df	P Value	RMR	GFI
4973.032	2918	1.704	0.000	0.081	0.709
AGFI	NFI	CFI	RMSEA		
0.670	0.811	0.911	0.042		

*:P<0.05, **:P<0.01, ***:P<0.001

4) Analysis of the influence of organizational innovation on innovation performance shows that the manufacturing industries had significant influence on this relationship path, however, the service industries did not. The t-test results proved that manufacturing and service industries differed significantly in intensity of influence on this relationship path. In comparison, manufacturing industries were significantly higher than the service industries in intensity of influence on this path. In other words, organizational innovation is more likely to bring upgrades in innovation performance in manufacturing industries.

Analysis of the influence of innovation quality on innovation performance indicates both the manufacturing and the service industries had significant influence on this relationship path and the t-test results proved that different types of industries did not differ significantly in intensity of influence on this relationship path. The result showed that both types of industries have strong influence on this path.

With the above combined, when compared under the manufacturing-service industry relation model, the path intensity from organizational

innovation to innovation quality could differ significantly depending on the type of business and the same happened with the path intensity between organizational innovation and innovation performance. Therefore, H6 was supported partly.

Conclusions and Suggestions

Conclusion and Findings

In this study, Taiwanese firms as the research object to explore the influence of innovative strategic and organizational innovation on the quality and performance of innovation. This study established the relationship model among innovation strategy, organizational innovation, innovation quality and innovation performance, and also established a measurement scale of efficiency variables, which offers useful research tools and related concepts should be with academic and practical value.

Through SEM analysis, this study found that:

- 1) Innovation strategy has a positive impact on the quality of innovation. This meet the results of Keogh & Bower (1997) and Damanpour & Evan (1984), who proposed the concept in line with the implementation of innovative strategies that directly enhance the quality of innovation. Thus enterprises should continue to implement innovative strategies to effectively enhance the quality of innovation.
- 2) Organizational innovation has a positive impact on the quality of innovation, the results of West & Anderson (1996), Glassman (1986) and others, proposed the concept of line. From this, enterprise can be supported by innovative leadership style, an open organizational culture and organizational commitment to more effectively enhance the quality of innovation.

3) Innovative quality has positive effects on innovation performance, this result meet the concepts proposed by Millson & Wilemon (2006) and Cooper & Kleinschmidt (1995), the high innovation quality the high innovation performance.

4) Innovative strategies have no significant effect on innovation performance. Although this result can not to support research hypothesis, however, innovative strategies will indirectly impact on innovation performance through innovation quality. In addition, the organizational innovation also impact on innovation performance indirectly, through the innovation quality. Therefore, these results meet the concepts of Millson & Wilemon (2006) and Song & Parry (1997) partly. These show that innovation strategies and organizational innovation will increase innovation quality and further enhance positive effects of innovation performance.

According the above, innovation strategy will affect the innovation quality and indirectly affect the innovation performance; also organizational innovation will directly affect the innovation quality and indirectly affect the innovation performance. Therefore, both of the innovative strategy and organizational innovation are important antecedents to affect the business performance for all enterprises.

Through comparison of two industry categories, this study found that:

1) According to the parameter estimates of manufacturing industry model, it showed that innovative strategies will direct affect on the innovation quality then indirect affect on the innovation performance. On the other hand, organizational innovation will direct impact on the innovation quality and innovation performance. Therefore, manufacturing industry can use innovative strategies and organizational innovation to enhance innovation quality directly and increase the innovation performance directly or indirectly. Thus the influence exists in both of direct and indirect effects.

2) According to the parameter estimates of service industry model, it showed that both of innovative strategies and organizational innovation will affect on the innovation quality directly, and then affect on the innovation performance indirectly. Thus, the relationship effects of innovation performance of service industry existed only through indirect paths.

3) The research results showed that the implementation effect of organizational innovation on manufacturing industries will significant greater than the service industries. It means that the innovative leadership style, organizational commitment and organizational culture adopted by manufacturing industries will more significant improve their innovation quality and performance than the service industries.

Managerial Implications

This study found the interrelated dependence relationships among innovative strategies, organizational innovation, innovation quality and performance. The results showed that Taiwan's industries to implement innovative strategies and implementation of organizational innovation can directly improve the quality of enterprise innovation and, indirectly, to strengthen innovation performance. Thus,

An enterprise should pay attention not only on the innovative strategies of business such as product innovation, process innovation, marketing innovation, and management innovation; but also should implements organizational innovation such as adopting innovative leadership style, innovative organizational commitment, and innovative organizational culture, so that to reach a mutual cooperation and to promote the synergy of innovation quality and innovation performance.

In terms of different industry types, except the product manufacturing, processing, marketing and management innovation, manufacturing industries should pay attention to

organizational innovation culture and to establish an innovative atmosphere that can get the result of enforcement effect of innovation policy. Contrast to service industries; it should enhance its' innovation strategy effect through pragmatic approach of innovation of product, process, marketing and management, to promote the demonstrated synergy of innovation quality and performance.

Study Limitations and Suggestions

- 1) This study's sample only select from 1000 largest corporations that surveyed at 2009 by Common Wealth Magazine in Taiwan, however, it cannot cover all enterprises of Taiwan. Therefore, the future study could expand the sampling scope to further improve the reliability of the study results.
- 2) This study uses the manufacturing and service industries as an example to perform comparisons. However, the manufacturing and service can be further divided into different types, such as the traditional manufactory, the high-tech manufactory, ordinary service or financial service. Subsequent researchers can further compare performance focus on different types to better understand the characteristics of specific industry types.
- 3) This study used the in-depth interview, the focus group, and the survey to perform qualitative and quantitative studies and evidenced the reliability and validity of these measurement indicators. Future researchers can use these indicators to evaluate an organization's innovation variables to further evidence this scale's efficiency, making this measurement scale more reliable and useful.

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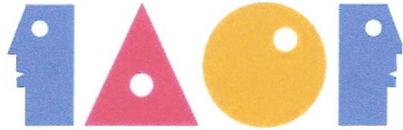
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A MODEL FOR KNOWLEDGE SHARING IN WEB-BASED LEARNING ENVIRONMENTS

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Abstract

In this study, a framework based on the theory of planned behavior was proposed to determine the major factors which influence learners' knowledge sharing attitude in web-based learning environments. A field survey has been conducted with 150 learners who had experiences in web-based learning. The proposed hypotheses were examined by structural equation modeling.

According to the analysis of the results, we have found that the knowledge sharing attitude is influenced by subjective norms, expected contribution, expected loss, disincentives and altruism. However, positive reinforcement, expected relationship, and sharing interference have no significant influences on knowledge sharing attitude.

We hope this study is helpful to instructors for designing good teaching strategies to improve knowledge sharing among learners in web-based learning.

Keywords: Web-Based Learning; Knowledge Sharing; Theory of Planned Behavior; Structural Equation Modeling

Introduction

Due to the rapid development of information technology in recent years, web-based learning has become an important trend in education. Moore and Kearsley [1] argued that distance is not determined by geography, but by the way and to what extent instructors, learners and the learning environment interact with one another. Transactional distance is the psychological and communication gap that results from the geographical separation among the participants of online courses. There are three necessary interactions in web-based learning environments, learner-content, learner-instructor, and learner-learner interactions. Therefore, the online chat room, electronic whiteboard, video conferencing, instant message, discussing forum, and email are popularly applied in web-based learning environments. Learners can engage in both asynchronous and synchronous interactions in order to participate in various learning activities. Interaction is important for advancing the learning process and is also essential for internalizing the learning.

Knowledge sharing is a critical part of the learning process and benefits the learning performance. In the web-based learning environment, any desired information must transform it into the readable display form from the information or knowledge providers, for examples, the text, the sound, the picture or the video image. Learners must have certain abilities to share their knowledge with the application of information technologies. If the learners are not willing to share their knowledge, then it is difficult to achieve the main purpose of web-based learning. Therefore, how to enhance knowledge sharing intentions of learners is an important issue for web-based learning.

This study attempted to explore what factors have influences on knowledge sharing in order to help instructors plan compatible teaching strategies to encourage learners' knowledge sharing behaviors. The theory of planned behavior [2] was used as the theoretical foundation. The purposes of this study are as follows:

- 1) What are the exogenous variables which could affect learner's knowledge sharing attitude?
- 2) What are the endogenous variables which could affect learners' knowledge sharing intentions from the theory of planned behavior?
- 3) Providing some suggestions for instructors to promote learners' knowledge sharing behaviors.

RESEARCH METHODS

The behavioral occurrence and its accomplishment need both external and internal factors. Individual wants to establish the intended behavior is only a way to achieve one's goal, however this intended behavior can be seen as plans of action. In the plans of action, it shows that the intention is affected by three major elements, the attitude, subjective norms, and perceived behavioral control. When individual's intention is strong, in reality the opportunity to accomplish the behavior is higher.

Eleven hypotheses were proposed in this study. The detail description is shown as follows.

Hypothesis 1: In web-based learning, if a learner's altruistic characteristic is stronger, as the result it brings the positive influence upon knowledge sharing attitude.

Hypothesis 2: In web-based learning, positive encouragement is stronger that shows to bring more positive knowledge sharing attitude.

Hypothesis 3: In web-based learning, when the disincentive is stronger, it is positively influence upon knowledge sharing attitude.

Hypothesis 4: In web-based learning, when the learner's expectation for interpersonal relationship is higher, the positive influence for knowledge sharing attitude is higher.

Hypothesis 5: In web-based learning, learner's contribution expectation is higher, as the result, it is more likely to have positive knowledge sharing attitude.

Hypothesis 6: In web-based learning, when learners' expectation loss is higher, as the result, it will influence knowledge sharing attitude negatively.

Hypothesis 7: In web-based learning, when the sharing interference is higher between learners, it will bring negative influence upon knowledge sharing attitude.

Hypothesis 8: In web-based learning, when the subjective norm of knowledge sharing is stronger, the positive knowledge sharing attitude is more positive.

Hypothesis 9: In web-based learning, more positive knowledge sharing attitude, it is more positive to influence knowledge sharing intentions.

Hypothesis 10: In web-based learning, when the subjective norm of knowledge sharing is stronger, the knowledge sharing intention is more positive.

Hypothesis 11: In web-based learning, when perceived behavioral control of knowledge sharing is stronger, it is more positive to bring a positive knowledge sharing intention.

The operational definition of each construct for questionnaire design is shown as Table 1.

Table 1. Operational Definitions in this Study

Construct	Operational definition
Altruism	The behavior of learners who are willingly to help out others without any expected rewards.
Positive reinforcement	Learners expect that knowledge sharing behaviors must be rewarded.
Disincentives	Learners expect that refuse to proceed knowledge sharing must receive punishment.
Expected relationship	Learners believe that knowledge sharing behaviors would gain the interpersonal relationship between peers.
Expected contribution	Learners believe that knowledge sharing behaviors are helpful to encourage the group learning atmosphere and to ensure their own contribution.
Expected loss	Learners believe that knowledge sharing behaviors may cause the loss of competitive advantage.
Sharing interference	Learners believe that when one group of peers have proposed one topic for discussion and are already been commented by many, it may cause the decrease of contributing one's opinion.
Subjective norm of knowledge sharing	When learners precede knowledge sharing behaviors, one may feel the influence from both peers and instructors.
Perceived behavioral control of knowledge	When learners precede knowledge sharing behaviors, one must be familiar with the operational tools and skills for transferring one's knowledge into computerized presentation.

sharing	
Knowledge sharing attitude	Learners' positive and negative perspective and attitude toward knowledge sharing behaviors.
Knowledge sharing intention	The subjective perception of knowledge sharing percentage by the learners.

DATA ANALYSIS

The participators who had previous web-based learning experiences were from four universities in Taiwan. The total number of the participators was 159. Because 9 learners did not complete the questionnaire, the valid number of cases used in the analysis was 150.

Learners can learn without time and distance barriers in web-based learning environments. These kinds of environments enable learners to access materials, share ideas, and discuss with instructors and other peers online. Therefore, it attracts many learners in their professions who have the urge for self-growth needs to attend the online courses, thus the age about 30 has 60%. In addition, 40% of them are graduate students. From the total hours of using Internet for each day, it is clear that most of participators have very good skills in using Internet and other information technologies.

This study originally constructed 50 items for the questionnaire. Exploratory factor analysis was used to determine the minimum number of latent variables that can adequately describe the correlations among a set of measured items. Only the factor with an eigenvalue greater than 1.0 was retained for the subsequent statistical analysis [3]. The factor loading of each item greater or equal to .50 is considered as practically significant [3]. After exploratory factor analysis, there were 5 items which cannot be classified into any construct were dropped. In the end, 45 items which belonged to 11 constructs were used for data collection. The total explained variance reached 76.08%. The Cronbach's Alpha of each construct was above .82 which was

greater than the recommended value of .70 [4]. It shows that the particular questionnaire is good enough to support its reliability.

A confirmatory factor analysis (CFA) was used to assess the number of factors, factor loadings, construct reliability, convergent validity, and discriminant validity. There are total 45 items, in contrast the collected samples are only 150. Therefore, it is impossible to include all the tests into one measurement model for the analysis. According to Sethi and Carraher's suggestion [5], the limited information method can be used to maintain the tested model to keep its integrity.

The constructs were divided into two parts for examination, the first part was the seven exogenous variables of knowledge sharing attitude, and for the second part, it included the subjective norm of knowledge sharing, perceived behavioral control of knowledge sharing, knowledge sharing attitude, and knowledge sharing intention. The factor loading of each construct was above .56. All items were expressed and restrained in their own construct.

Both convergence and discriminability are particularly important for testing the construct validation. The average variance extracted (AVE) of all constructs exceed the recommended level of .50. The results indicate that the constructs had good convergent validity. Discriminant validity can be assessed by the AVE method. Constructs are different if the AVE for one's construct is greater than their shared variance. The results indicate that the measurement model has good discriminant validity.

A number of goodness-of-fit measures were used to assess the overall fit of the proposed model. The chi-square fit index is the most important test of fitness for structural equation modeling (SEM). The indexes and criteria of goodness-of-fit [6] were used in this study as shown in Table 2. Most of the statistics corresponded with the requirements of goodness-of-fit indexes.

Table 2. Goodness-of-fit Summary

Index	Exogenous variable	Structural Model	Suggested Value
χ^2 (d.f.)	544.5 (377)	275.7 (122)	—
$\chi^2 / \text{d.f.}$	1.44	2.26	< 2
NFI	.81	.88	> .90
GFI	.81	.83	> .90
AGFI	.76	.76	> .90
CFI	.91	.92	> .95
RMSEA	.054	.091	< .05
SRMR	.062	.079	< .08

Figure 1. displays the results of the SEM examination for the proposed research framework.

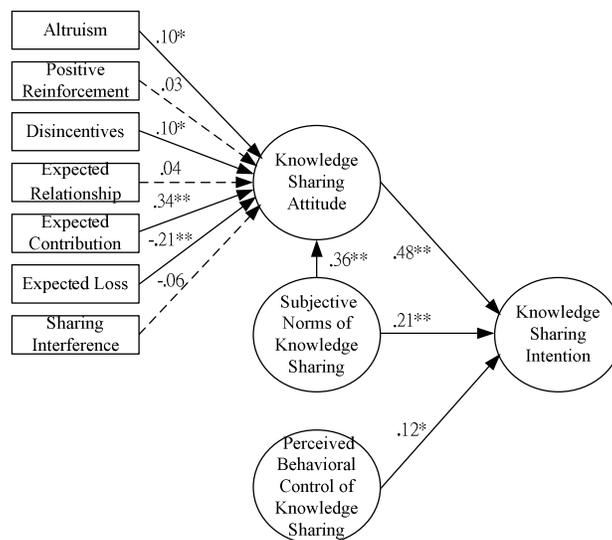


Figure 1. Path coefficients in the research framework
 ** p -value < 0.01, * p -value < 0.05

The positive reinforcement, expected relationship, and sharing interference are not yet to reach the significance level of .005. The expected contribution and the subjective norm of knowledge sharing have positive effects on knowledge sharing attitude, in contrary that the

expected loss has negative effects on knowledge sharing attitude. In addition, knowledge sharing attitude, subjective norm of knowledge sharing, perceived behavioral control of knowledge sharing have great effects on knowledge sharing intention. The results show that all the hypotheses were supported except hypotheses 2, 4, and 7.

RESULTS AND DISCUSSION

The web-based learning provides a good interactive environment for both instructors and learners [7]. It allows the learners use asynchronous and synchronous methods to achieve learning goals. Interaction encourages deep learning processes which take place when learners translate new information into engraved concepts and relate it to their life experiences

The relevant findings are shown and described as follows.

1) The knowledge sharing attitude is influenced by the subjective norm, expected contribution, and expected loss.

Instructors intent is to perform the key role for the success or failure of online courses [8]. If instructors were devoted to web-based learning management and were able to encourage learners to participate in actively discussing and sharing would be positively expected. Therefore, the main factors for knowledge sharing attitude is the subjective norm which is derived from the instructors' expectation.

In this study, there are above 40% of graduate students, this may result in no needs of extra rewards. Most of them value more on a sense of self-achievement. Therefore, if learners were in the participating process of the discussion and after realizing that his or her contribution was valuable to the general public, they would enjoy sharing knowledge more. However, there were still competition pressure and behavior occurring. Some believe that when they share an important information or knowledge, they may lose their competition credibility and advantage to

others, in that it causes many refuse to share for self protection. Other possibility is that most of the participators are the part-time students, some of them bring their professional ethnic to the school, however, how realistically correct that is still waiting to be proven through farther examination.

2) The secondary factors affecting knowledge sharing attitude are disincentives and altruism.

Although students may not care much about the reward, they are afraid of the punishment, especially for those whose self-esteem is high. Adult who have higher sense of self-achievement, despite of public or private accusation, those for them were neither difficult for their characters. If instructors use the negative reinforcement to increase sharing behaviors, may be in a short time it is efficient. However, in a long run, the negative emotion and the rejection may raise and bring more damage toward the learning efficiency.

Altruism is to describe the behavior that is under the expectation of non-reward anticipation for helping others. Learners who enjoy helping other may also enjoy helping other classmates who have troubles in the learning process.

3) The positive reinforcement, expected relationship, and sharing interference have no significant influences on knowledge sharing attitude.

The research generally thought that the positive reinforcement is helpful in promoting the organization members toward the direction of their personal development; however it is not remarkable in this study. The possible reason can be that the web-based learning is rather unique, because of the positive reinforcement method is just playing the rewarding marks game and encouraging praise upon those learners. The learners' time investment is far beyond what they have received, thus the temptation is not high enough for those learners. Therefore more often that the learners keep having the passing grade attitude as long as they do not fail this program, a little

less of grade result is fairly enough for those learners who have this kind of attitude can be many. From the expectation of contribution angle to see this perspective, if the instructor was able to make one feels promoted and achieving for most of adult, the result can be resolved higher than just giving out grade reward.

According to the practice experience, knowledge sharing is a good promotion method of brining interpersonal relationship, especially in various industries of part-time students, personal connections at work is helpful in one's profession and it is an advantage for each other. However, expected relationship has no significant effects on knowledge sharing attitude in this study. It is necessary to have more studies on this issue in the future.

In sharing interference to knowledge sharing attitude is not significant effective, it can be that among the peers, there has no extreme powerful will of the learners themselves in order to contribute their comments, or if there were more people to participate in the discussion it is easier to bring up the heat, then it will create a new discussion topic itself naturally or inspire a new thought, in that it will help the sharing behaviors.

4) The subjective norm of knowledge sharing mainly derives from the expectation of the instructors.

In the items of subjective norms include the expectation from both instructors and peer learners. The subjective regulation and its secondary confirmation factor analysis, from which it is not difficult to find that this construal concept is related to the instructors' expectation, and that can explain the instructors' expectation of its total amount of variation is 94% higher than 62% of the same generation learners. Thus, in online courses, instructors to the knowledge sharing environment's class management and creating its atmosphere perform a very important key role [9].

5) The perceived behavioral control of knowledge sharing is the major information technology utility.

In the knowledge sharing process, the knowledge owners must have the ability to transform their knowledge into the form of writing, sound, digital images or pictures that is convertible through the computer. The web-based learning environment also must have the proper application internet skills in order to represent their knowledge [10]. The basic information analysis through the samples, such as 4-year above, 4-hour above internet users and their daily on-line hour, to those they most likely working for information technology industry as their professions, and the ratio is very high. Therefore, it is obviously to know that the questionnaire was filled by the learners who have great internet tool application skills and is confident to use and deliver one's knowledge. In contrast, to those who have high internet tool skill but low desire to represent their knowledge can possibly be due to the poor ability in transforming their knowledge.

6) Knowledge sharing intention is influenced by the attitude, subjective norm, and perceived behavioral control.

From the structural model analysis, the learners' knowledge sharing intentions are affected by the knowledge sharing attitude, subjective norm, and perceived behavioral control. Therefore, the instructors must spend more time to invest in the instructors' influential power and improve students' knowledge sharing attitude in order to be effectively promoting and encouraging the learners' knowledge sharing intentions and knowledge sharing behaviors.

There are some suggestions for further studies. In fact, that the instructors' preference may be interested in finding out how to promote the low-desire knowledge sharing behavior from the learners in web-based learning environments. In the future, the difference between the

enthusiastic knowledge sharing learners and the low-desire knowledge sharing learners to supply the reference for teaching strategies.

Knowledge is a reconstructive and communicative process, the interaction between learners are very important during the process, but at present, most of the studies are cross-session, it is a must to include the time factor, in order to understand different levels of their knowledge sharing behaviors.

The part of the discussion was rely on the practice of the researchers' experiences for the final analysis. In the future, a deep interview based upon the important factors can be employed to ensure the real reason behind the factors.

The growing of using the web-based learning by the organization is gradually increased. At present, the knowledge sharing and its research are mainly used by the organization members, it is an issue to exam the difference of knowledge sharing behaviors between web-based learning and non web-based learning, in order to bring efficiency to the organizational training programs.

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THE INTERNATIONALIZATION OF HIGHER EDUCATION IN TAIWAN: ARE WE ON THE RIGHT TRACK?

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Abstract

The purpose of this qualitative study is to investigate international students' perspectives on the challenges of internationalization of higher education in Taiwan - reasons for attending schools, perceived barriers to the learning environment, and support provided by the communities. Structured interviews were conducted with 24 international students from various universities in Taiwan. Qualitative data (i.e. field notes and interview transcripts) were collected from in-depth interviews. Thematic analysis was adopted for data analysis. Four main themes emerged from the analyses of the interview transcripts: (1) political and security concerns, (2) economic enhancement and concerns, (3) academic quality assurance, and (4) cultural and social understanding. The findings indicate that the perceived barriers to the learning environment in Taiwan are cultural differences, teaching pedagogies, improper curriculum design, insufficient information and communication between the school and the students, and the language barrier among learners which strongly impact student engagement and collaboration. The findings suggest several implications and opportunities to improve the content and context of the international program in order to enable more effective learning outcomes in this era of mandatory educational reform.

Key words: Internationalization, International Education, Higher Education.

Introduction

To date, there has been growing interest in internationalization in higher education sector; however, the majority of studies and comments focus on traditional destinations of foreign students such as the USA, the UK, and Australia; few studies have focused on the issue of the internationalization of higher education in Asia-Pacific region (Kondakci, Van den Broeck, & Yildirim, 2008). One of the primary reasons is that the US, UK, and Australia are countries that have the highest number of international students. The US, particularly, has the largest international student population, i.e., approximately 690,923 foreign enrollment in the 2009/2010 academic year (Institute for International Education, 2010). According to the Ministry of Education (MOE), foreign student enrollment in Taiwanese universities has grown 20 to 30 percent per annum over the last three years. Approximately 7,764 full-time foreign students were enrolled at more than 100 universities throughout Taiwan in the 2009/2010 academic year (Ministry of Education, 2010.). Taiwanese President Ma Ying-jeou explains that Taiwan will become a higher education center for Asian-Pacific students within the next few years. There are approximately 19,379 foreign students (i.e., including full-time and language learning students) in Taiwan in the 2009/2010 academic year (The Foundation for International Cooperation in Higher Education of Taiwan, 2010). One of the goals of the MOE is to attract more Southeast Asian and Asian Pacific students and turn Taiwan into a higher-education hub in the region. There are currently around 10,000 students from Southeast Asia in Taiwan, making up 55 percent of all foreign students. The government plans to increase the enrollment to 15,000 by 2012, and reaching 17,000 by 2014 (“Taiwan will become,” 2011).

Internationalization, accordingly, becomes an essential element for the future development of universities in Taiwan. However, little is known about the internationalization of

higher education in Taiwan; especially, nor has it addressed the international students' views of internationalization in Taiwan. The purpose of this study, hence, is to investigate international students' perspectives on the challenges of internationalization of higher education in Taiwan.

The research questions that guide the study are as follows:

1. What are the reasons for attending schools in Taiwan?
2. What are the perceived barriers to the learning environment in Taiwan?
3. What are the supports provided by the communities in Taiwan?
4. How does the studying abroad experience affect their life and career development?

This research presents a detailed description of the subjective experiences of a group of international students, using their own words and concepts.

Method

Participants

The research participants were 24 international students (i.e., 15 males and nine females) from eight universities in Taiwan. They were from different countries in Asia, Africa, Latin America, Europe, and North America. Twelve of them were undergraduate students and the others were graduate students. Their length of stay in Taiwan ranged from six months to three years.

Research Design

The objective of this study is to understand a new phenomenon of interest; therefore, large sample multivariate statistical studies were not used to investigate the research questions. Qualitative methodology was used in order to explore international students' perspectives. A series of structured interviews were conducted via face-to-face interviews or Skype internet communications. Both one-on-one and focus group interviews were utilized. The researchers

moderated the focus group sessions which lasted approximately 1 hour. The questions took the research participants through the history of their subjective experience with the phenomenon being studied. The interviews were taped and then transcribed into textual data.

The six open ended questions, determined by the literature review and research concerns, were asked as follows: (1) When was the first time that you thought about coming to Taiwan, and what did you think it would be like? (2) How did you go through the process of deciding to study in Taiwan? (3) What is your relationship with your school, faculty members, and international/domestic students and how has it affected your learning? (4) What is being an international student like? How has it changed your sense of who you are, and what life is about? (5) What are you most proud/happy of, and what do you most regret during your study in Taiwan? (6) How has being an international student affected your career? After being asked these six questions, the students were invited to share any other thoughts or ideas not covered by their responses to the questions.

Data Analysis

Qualitative data (i.e. filed notes and interview transcripts) were collected from in-depth interviews. Data was obtained mainly from structured interviews with participants and field notes. The interviews were video-recorded and subsequently transcribed verbatim. A transcription process known as thematic analysis, that coded raw-text into categories in order to identify common themes, was used for data analysis (Merriam, 2009). The first level of data analysis involved data reduction to identify major clusters labeled as categories; therefore, related passages of relevant text were grouped together to form a category. Coherent categories were grouped together to form a theme, i.e., common concepts, which emerged in the transcripts, were identified as themes. Two researchers coded each transcript into text-based categories and a

list of themes. The organization of the data were compared and contrasted. The themes, given their final analytical form and definition, were refined further through systematic examination by the authors. The sample transcripts and research results were sent to an outside consultant who is an administrator of the international office at one of the universities that we studied. The ensuing discussion notably improves our understanding of the data. The searching, coding, and labeling of themes were done by the use of QSR NVivo 7- an entrenched qualitative data analysis program which is designed to code and analyze rich text-based transcripts.

Results

Four main themes emerged from the analyses of the interview transcripts: (1) political and security concerns, (2) economic enhancement and concerns, (3) academic quality assurance, and (4) cultural and social understanding. In the ensuing sections, the major themes are discussed.

Theme one: Political and security concerns

The subjects were concerned with the national/personal security and political atmosphere. The extracts of the interview transcripts are as follows:

Extract 1: “Taiwan is a free country. It is a safe place.” (Interviewee No. 10)

Extract 2: “I appreciate the democracy and human rights in Taiwan. I never thought of going to China.” (Interviewee No. 20)

Extract 3: “One foreign student had a physical fight with some Taiwanese students and felt depressed [afterward.] The department suggested he seek counseling, but there was no counselor available for international students at the university’s counseling center. I was worried that he would attempt suicide.” (Interviewee No. 18)

Theme two: Economic enhancement and concerns

The earliest waves of foreign students came as a result of a promotion offered by government in 2004. Scholarships offered by the Ministry of Foreign Affairs, the Ministry of Education, the Ministry of Economic Affairs, and the National Science Council, have attracted talented foreign students from nations with/without diplomatic relations with Taiwan. The development enhanced the economic growth and diplomatic cooperation within the international community. The extracts of the interview transcripts are as follows:

Extract 4: “I came to Taiwan to study because of the generous scholarships for foreign students. It made a big difference in my decision to come to Taiwan to study.” (Interviewee No. 4)

Extract 5: “It’s only one-fifth the cost of studying in America. The scholarship is three years long. Some of my friends even have five-year-long scholarships for pursuing bachelor’s degrees. The tuition is relatively affordable.” (Interviewee No. 1)

Extract 6: “Apart from the scholarships, the rapid economic growth in the Greater China area has created promising working opportunities. I want to attend Chinese programs.” (Interviewee No. 21)

Extract 7: “Not all of the foreign students here have received scholarships. Nearly two-thirds of my friends don’t have the scholarships. Some of them work here as English teachers. The payment is really good here. They can work and attend school at the same time.” (Interviewee No. 13)

Theme three: Academic quality assurance

Here’s what the subjects said concerning the assurance of teaching and learning in higher education institutions. The extracts of the interview transcripts are as follows:

Extract 8: “Our business school tries to accommodate foreign students’ needs by teaching courses in English. We use English textbooks and English-language curriculum. We read

business cases in English. I want to know more about Chinese business experience. I think the use of English constantly puts limits on the quality of instruction. Some professors cannot speak as precisely in English as in Chinese.” (Interviewee No. 3)

Extract 9: “Some professors seldom have discussion with the students and Taiwanese students seldom ask questions in the class. It’s a very difficult learning experience. I want have more interactions in the class. I feel those Taiwanese students are like high school students. We are more independent....we are more like university students.” (Interviewee No. 13)

Extract 10: “One of the foreign students just skipped the class and told the professor that he has to go to work. The professor let him leave the class. At the end of the semester, the professor let him pass the course. Another case is that one foreign student sometimes listens to his MP3 music during the class since he doesn’t understand the instruction in Chinese. That professor let him pass the course, too.” (Interviewee No. 9)

Extract 11: “Even though the tuition in Taiwan is lower than in the US or Britain, I think studying in China or Singapore is better for the post-school job search. Many foreign students came here because they plan to work with Chinese or live in the Greater China area.” (Interviewee No. 20)

Extract 12: “I often have difficulties using the online course registration system because I can’t read Chinese. I don’t know what required or elective courses I should take.” (Interviewee No. 18)

Extract 13: “I had culture shock when I saw some domestic students fall asleep, send text messages in class, eat food, or arrive late for class. Some of the professors seem to allow them to do so.” (Interviewee No. 9)

Theme four: Cultural and social understanding

The subjects were concerned with the role and the importance of the culture and language related to the aims of higher education. The extracts of the interview transcripts are as follows:

Extract 14: “It is not easy to make friends with local students. Although we are classmates, some local students don’t want sit next to international students. I asked other foreign student and he/she had similar experiences. I sometimes felt isolated from the local students. I’ve heard that some schools have the “buddy system” and they team up local and foreign students. I think this would help.” (Interviewee No. 11)

Extract 15: “Taiwanese people are very friendly and sincere. They are friendly to foreigners. The faculty and staff are very supportive. I like Chinese culture. I came to Taiwan to learn traditional Chinese characters so I can explore and study historical Chinese classics. The recruiters told me if I learn the traditional Chinese characters, then it will be very easy for me to learn the simplified Chinese.” (Interviewee No. 23)

Extract 16: “Language is a big problem. Some international students speak very little English and they cannot speak Chinese, either. They sometimes skip classes. It’s very hard for the faculty and students to interact with them. International students always hang out together with other foreign students here. My classmates are from South America, Europe, Africa, and Asia. I got to know different cultures. Some of my classmates are Muslim and I’ve learned to appreciate different cultures and religions. I think the school should provide cross-culture training courses.” (Interviewee No. 11)

Extract 17: “I like [it] here but I don’t like the weather. It is too humid and the summer is too hot. I felt very uncomfortable when I first arrived in Taiwan.” (Interviewee No. 9)

Discussion, Conclusion, and Recommendations

The research findings suggest that many international students choose to study in Taiwan not only for pursuing academic degrees, but also for enhancing Chinese language abilities. Poor Chinese and English language proficiency, especially, limits the ability of international students to be fully involved in academic learning. The study, additionally, indicates many of the international students plan to work with Chinese or work in the Greater China Region after graduation. The findings also suggest that students felt they are welcomed and supported by the local communities; on the other hand, the perceived barriers to the learning environment in Taiwan are cultural differences, teaching pedagogies, improper curriculum design, insufficient information and communication between/among the school and the students, and language barriers among learners which strongly impact student engagement and collaboration. The results of this study are consistent with the findings of Poyrazli and Grahame (2007) concerning international students experiencing challenges adjusting to weather, local language, social interaction, and academic life. This result parallels the finding of a recent study (Green, 2005), in which he identified that faculty involvement is the key to internationalization. It was concluded that higher education institutions must recognize that the success of any internationalization program not only involves physical infrastructure of an institution, but also involves the “human” infrastructure.

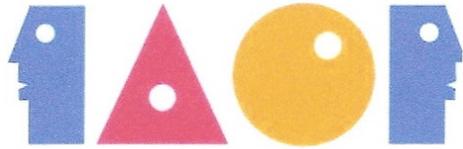
While noting the international students’ learning experiences in Taiwan, this research suggests four fundamental challenges of internationalization in higher education which are as follows: (1) the ‘clone’ phenomenon of curriculum design (viz., using the same curriculum design, courses and textbook as the US or the UK), (2) the language deficiency of the faculty and domestic/international students, (3) traditional teaching method for students from diverse cultural

background (viz., ignore individual and cultural differences), and (4) lack of the well-designed assessment and evaluation system for both domestic and international students.

Therefore, it is recommended that higher education should continuously promote cooperation with international society, implement strategy alliance programs with universities in the Greater China region (viz., assist students to achieve their career goals to work in the Greater China region), promote “internal internationalization” (viz., establish human resources policies and training programs for faculty, staff, and students in order to communicate efficiently), establish curriculum design that demonstrates Chinese cultural values and Taiwan’s experience, use diverse pedagogies for teaching, and ensure the quality of learning (i.e., establish clear learning goals, curriculum map, and e-portfolio systems). The findings suggest several implications and opportunities to improve the content and context of the international program in order to enable more effective learning outcomes in this era of mandatory educational reform. Hence, it is recommended that much attention be paid to management attention, faculty and staff training, and organizational reengineering.

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KNOWLEDGE DISCOVERY THROUGH BIBLIOMETRICS AND
DATA MINING: AN EXAMPLE ON MARKETING ETHICS

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Abstract

This study attempts to systematically examine the intellectual structure and thematic evolution of marketing ethics literature through bibliometrics analyses and co-word analysis. The database comprises of 474 published works and their accompanied 23,029 citations found in SSCI and SCI database between 1990 and 2009. Co-word analysis, a technique of data mining, revealed the comprising elements of knowledge structure and determined their connectivity to marketing ethics. Bibliometrics techniques identified the most influential articles/books and journals, and visualized the evolution of research interests and maturity of marketing ethics literature in marketing ethics. Four major research themes in marketing ethics in the period of 1990-1999 was found to be models proposition/testing, survey-based studies, business/marketing ethics theories, and early marketing ethics works. In the period of 2000-2009, the research themes were condensed into more specific topics: ethical decision making, personal moral values, and ethical behavior and judgments. The results of this study help future researchers to quickly access marketing ethics literature, and provide efficient ways to browse and understand other fields.

Keywords: Marketing Ethics, Knowledge Discovery in Database (KDD), Bibliometrics, Data Mining, Co-word Analysis.

Introduction

Marketing ethics as a sub-discipline of business ethics came of age in the 1990's. It is the systematic study of how moral standards are applied to marketing decisions, behaviors and institutions (Murphy et al, 2005). Murphy stated in the book *Business Ethics* that 'the field moved from what was earlier believed as the oxymoron stage to one of academic legitimacy' (Murphy 1990). The first literature review on marketing ethics was done by Murphy & Laczniak (1981) in the book *Review of Marketing*. Hunt & Vitell (1986) outlined the two ethical theories in which the marketers follow when facing problem situations with ethical content. The pioneer works of Hunt and Vitell defines the field of marketing ethics. Hunt & Vitell (2006) in later works revised the theories and further posed three questions to the theories proposed. It is through modifying, elaborating, and debating, that a field grows. In the last decade, many researchers have attempted to review and reflect on the development of marketing ethics, but a systematic analysis of articles published in the marketing ethics literature is still lacking. Filling this gap, this study uses bibliometrics as well as data mining techniques to gain an impression of marketing ethics research and its shift in research themes through time.

The objective of the study is to investigate the research paradigms of marketing ethics literature by analyzing documents and their accompanying citations in Social Science Citation Index (SSCI) from 1990 to 2009. More specifically, the goals of this study are to (1) Identify the most important and influential published works in the marketing ethics area; (2) Outline the proximities of these works and define the change in research interests through time; (3) Using techniques of co-word analysis to identify research themes within marketing ethics and their interaction; (4) Compare and evaluate the results from bibliometrics and co-word analysis. Co-word analysis objectively reveals the clusters of research themes and how the components of

these clusters relate to each other. With the use of citation analysis, the most influential journal titles and the field-defining works are identified. Article co-citation analysis is conducted to effectively utilize the social network analysis in mapping the research paradigms of marketing ethics studies and their possible evolutionary patterns.

Literature review

Data Mining & Co-Word Analysis

Data mining enables the researcher to extract valuable correlations and meanings from a simple set of data. This technique is widely used in academic disciplines, and is described by Bigus (1996) as ‘the efficient discovery of valuable, non-obvious information from a large collection of data’. Data mining can perform tasks such as classification, estimation, prediction, affinity grouping, clustering, and description (Labib & Malek 2005). The last two are termed ‘undirected knowledge discovery’ because it aims at finding patterns or similarities among groups of records without the use of a particular target field or collection of predefined classes (Labib & Malek 2005). Our study focuses on these 2 mentioned properties of data mining, as represented by co-word analysis, to identify main research themes in the field of marketing ethics. Fayyad (1996) in his study provided real world applications to data mining and its broader concept of ‘knowledge discovery in database’. Software programmed to compute data mining algorithms were introduced in recent years. Larose (2005) suggested that only black-box method (software) is not enough, we need the white-box method where the analyst understands the mechanisms of data mining. So in 2005, he published a paper providing readers with insight into how data mining algorithms work. Kostoff (1997) reviewed the applications of database tomography, which is a method for information retrieval from large textual databases. The goal of database tomography is very similar to data mining and bibliometrics. In a study evaluating

the bibliometrics and data mining, Kostoff (2001) found that ‘the combination of citation bibliometrics and text mining provides a synergy unavailable with each approach taken independently’, and that ‘text mining is a REQUIREMENT for a feasible comprehensive research impact determination’.

Realizing that co-citation links are, in the end, a route to the *content* of the articles, one may proceed in a more direct way and use content analysis (Rip & Courtial 1984). One example of such analysis is the Co-word analysis pioneered by Callon et al (1983), which uses key-words or single-words to overcome some of the limitations of citation and co-citation analysis. Much like co-citation analysis, co-word analysis is based on the co-occurrence frequency of pairs of words or phrases. It is used to discover linkages among subjects in a research field and trace the development of the given field. Indices based on the co-occurrence frequency of words/phrases, such as inclusion index and proximity index, are used to measure the strength of relationship between those words/phrases. Using these indices, items can be clustered into groups and displayed in network maps. Inclusion map is used to identify the main research themes in a domain, whereas proximity map reveals the connections between minor themes. The theoretical foundation to co-word analysis is based on an important concept proposed by Callon et al (1986), the “actor network”. Callon et al (1986) published a book titled ‘Mapping the Dynamics of Science and Technology’, which is one of the pioneering studies that presented the power of words and the applications of co-word analysis. Another example was Bauin (1986)’s study, which mapped the dynamics of aquaculture and created both inclusion map and proximity map. Law et al (1988) in a co-word study on environmental acidification presented a useful ‘strategic diagram’ that reveal the strength of local links and global links for research themes. Inclusion and proximity index were introduced by Callon et al (1886) to explore respectively the

hierarchies among the areas of a research problem and to detect minor but potentially growing areas. As summarized by He (1999), the inclusion index (I_{ij}) is defined as:

$$I_{ij} = C_{ij} / \min(C_i, C_j)$$

where C_{ij} is the number of documents in which the keyword pair (M_i and M_j);

C_i is the occurrence frequency of keyword M_i in the set of articles;

C_j is the occurrence frequency of keyword M_j in the set of articles;

$\min(C_i, C_j)$ is the minimum of the two frequencies C_i and C_j

And the proximity index (P_{ij}) is defined as:

$$P_{ij} = (C_{ij} / C_i C_j) * N$$

where C_i , C_j , and C_{ij} have the same meaning as the previous formula;

N is the number of articles in the collection

Citation Analysis

Shaw (1979) stated that citation “establishes a relation among authors which is a measure of the extent to which they communicate through literature. Egghe & Rousseau (1990) defined the application areas of citation analysis as i) quantitative and qualitative analysis of scholars, publication outlets and scientific institutions, ii) modeling the historical development of science and technology, and iii) information search and retrieval. Citation analysis enables the researcher to identify the contributions of key authors and their works to a specific field. This is achieved by combining descriptive analyses of most-cited first authors, most-cited texts (books and articles), temporal pattern of articles cited, and publication outlet patter of articles cited (Parvinen 2003).

Co-citation analysis

Generally speaking, the formal and informal communications that authors engage in are systematically chronicled in journals that publish their works. Authors working in a stream of

research often cite one another as well as draw on common sources of knowledge. Further, their works are likely to be frequently co-cited by other studies working on intellectually similar themes. The upshot of this process is an intricate web of relationships between these works established through the creation and dissemination of knowledge. As Small (1973, p265) documented, “the pattern of linkages among key papers establishes a structure or map for the specialty, which may then be observed to change over time. Through the study of these changing structures, co-citation provides a tool for monitoring the development of scientific fields and for assessing the degree of interrelationship among specialties”. Thus, co-citations of these published works provide a basis for unraveling the complex patterns of associations that exist among them as well as trace the changes in intellectual currents taking place over time.

Co-citation analysis has proven useful to describe, from an empirical standpoint, the intellectual structure of one academic discipline using an objective method. It has therefore been applied in many academic areas such as management (Acedo et al, 2001), marketing (Heischmidt & Gorden 1993), organizational behavior (Culnan et al, 1990), conflict management (Ma et al, 2008), small enterprise (Ratnatunga & Romano 1997), management information systems (Culnan 1986, 1987, McCain 1990, White 2003, and among others), strategic management (Acedo et al, 2006, Nerur et al, 2008), international management (Acedo & Casillas 2005), knowledge management (Ponzi 2002), and family business (Casillas & Acedo 2007). In those disciplines, this methodology contributes to the identification of research gaps and orienting future lines of study. This study also aims to be a quick reference for new researchers to become familiar with the marketing ethics field of study.

Social Network Analysis

Network analysis was first used by sociologists to explore the relationships between groups and individuals (Scott 1991). Over the years, a series of tools and techniques have been developed which are useful in producing graphic representations of the relative distances between information/knowledge processing entities. Some techniques explore structural patterns and the differing roles of certain positions within the network, thus allowing easier understanding of complex patterns of interaction. Its applications reveal the number of interactions and the closeness of relationships between nodes within a network. In other words, the nodes in the network are the people and groups while the links show relationships or flows between the nodes. Social Network Analysis (SNA) is a powerful diagnostic method used to analyze the nature and pattern of relationships among members of a particular domain. Liebowitz (2005) in his article described and briefly compared the 3 major methods of SNA which includes “full network analysis, the “snowball methods, and the use of egocentric network. SNA provides mathematical definitions of certain characteristics of the actors and the network itself: power of actors, range of influence, cohesion, equivalence, and brokerage (Bonacich 1987) (Burt 1992). These characteristics are expressed in terms of corresponding network-structure parameters derived from the relations among the actors.

SNA involves actors (seeing how actors are located or “embedded” in the overall network) and relations (seeing how the whole pattern of individual choices gives rise to more holistic patterns) (Liebowitz 2005). Actors can be persons, organizations, or groups, or other set of related entities. Relations between actors are depicted as links between the corresponding nodes. A co-citation matrix is inherently very similar to the social networks, a network linked authors (Pilkington & Teichert 2006, Pilkington & Chai 2008). The core division of the co-

citation matrix representing the key nodes from one academic field can be shown diagrammatically as a network with locations determined using Geodesic distances (Pilkington & Teichert 2006) (Pilkington & Chai 2008). The use of such method has received increased interests from scholars or articles in other disciplines (Casey & McMillan 2008, Ma et al, 2008, Ma 2010, Pilkington & Fitzgerald 2006, and among others). This study proposes that SNA techniques would help researchers to examine networks of knowledge and find correlations between them.

Methodology

Based on the objective of this study, I explored the research paradigms of marketing ethics between 1990 and 2009. This study chose such time periods because the field of marketing ethics arose from business ethics in the early 1990's. The past two decades contains the most valuable and the most updated researches in marketing ethics. Bibliometrics and co-word analysis are the main methods for this study. Bibliometrics focuses on finding patterns from a series of 'cited' articles or books while co-word analysis is based on find patterns from a source of 'citing' works.

Co-Word Analysis

For this part of study, the original 474 documents from SSCI database in the given time frame were collected and analyzed. Unfortunately, only 435 abstracts were available during extraction. From these 435 sources, a total of 1172 keywords were retrieved. The occurrence of each different keyword is then tabulated. Based on the frequency, I selected the top 21 keywords for co-word analysis. The co-occurrence counts of these 21 keywords in the abstracts were tabulated and a co-word matrix was constructed. The matrix developed allows further analysis using STATISTICA, including clustering of the keywords into research themes and the

visualization of the knowledge structure of marketing ethics. The course of co-word analysis is displayed in Figure 1.

Bibliometrics

This part of research was carried out in three stages, each stage required different analytic tools to examine the knowledge network of marketing ethics studies and its evolution. Citation and document co-citation analysis were the main research methods.

First, the databases were established from a source of marketing ethics publications. Then data collection and analysis techniques were designed to collect the desired information about the topics, authors, and journal titles from the database. This study used Social Science Citation Index (SSCI) as the database due to its wide acceptance and inclusion of citations published in about 2000 refereed journals. Using SSCI would provide the most comprehensive and widely accepted databases of marketing ethics publications. In this study, we collected all documents (books and articles) in the database that contains both of the keywords “Marketing” and “Ethics” between the years 1990-2009.

In the second stage, citation counts were tabulated for each of the source document using the Microsoft Excel package. After a series of operation, key nodes of the knowledge network in marketing ethics research were identified and the structure developed. The dataset in this study was divided into 2 separate timeframes – 1990-1999 and 2000-2009, to observe the changes over the past 2 decades. In the final stage, document co-citation analysis is conducted which utilizes the social network analysis and factor analysis (as depicted in Figure 1). The citation analysis

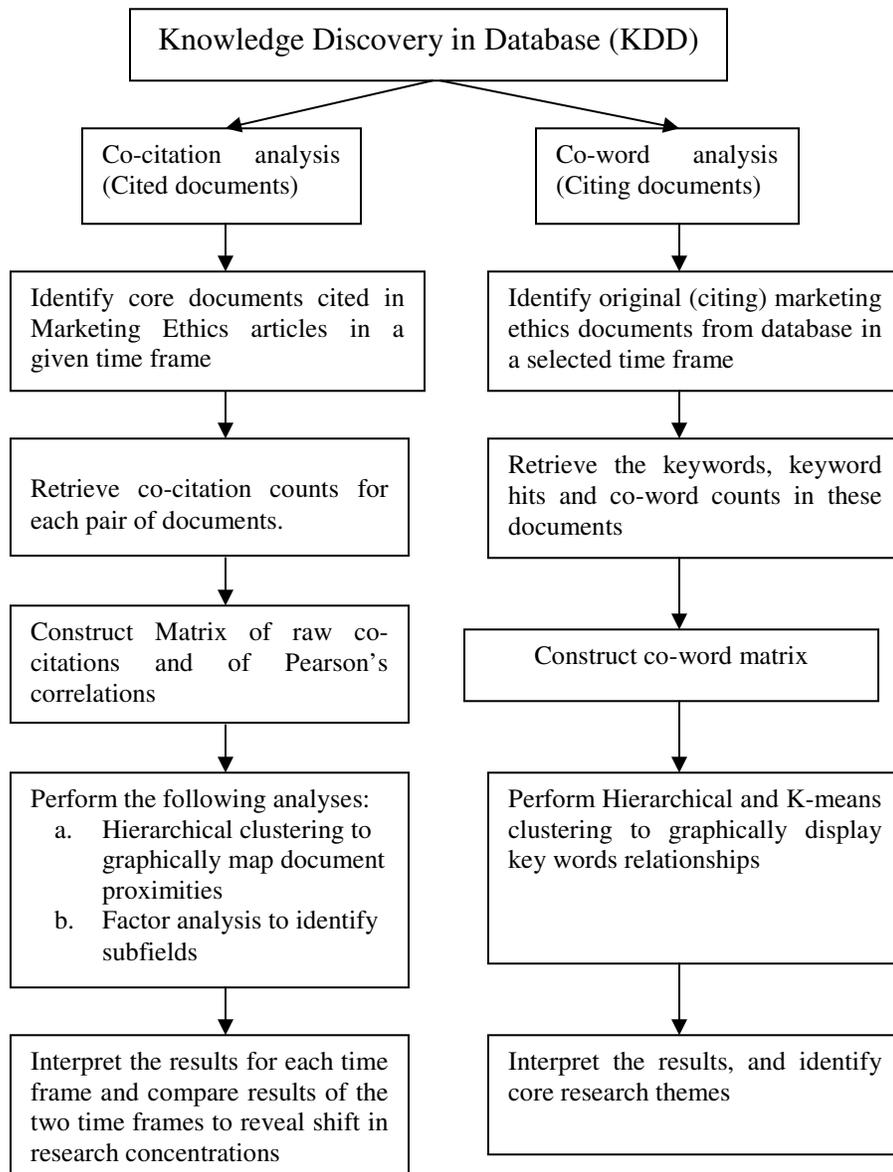


Figure 1. Method of co-citation analysis and co-word analysis in this study identifies the knowledge nodes that contributed most to the field, while co-citation analysis maps the research paradigms and at the same time reveals evolutionary patterns in marketing ethics studies.

items such as “ethics”, “business ethics”, “marketing, and “marketing ethics”, because they are the underlying topic of all collected works and are rendered meaningless. Note that “decision-making”, “behavior”, “organizations”, and “models” are among the most frequently used key

words. These meaningful key words correspond to the current trends of marketing ethics research, but are only preliminary results. To determine the major themes of research more precisely, further data processing is needed.

We used the top 21 highest frequency phrases to construct a 21X21 co-word matrix based on the co-occurrence in the document abstracts. Co-word analysis is applied to this matrix using STATISTICA software. Through K-means clustering, the strategic diagram of research themes was constructed (Figure 2). 5 clusters were identified as the potential research themes representing this field according to their relevance to marketing ethics in a global context. The clusters were assigned names that are congruent with the keywords belonging to each cluster. I. Consumer ethics and social responsibilities in marketing. II. Conflict resolution and ethical decision making. III. Marketers and Consumer Values. IV. Marketers' perception. V. Models – behavioral and decision making. Comparing to the first four clusters, cluster 5 is better in

Table 1. Frequency of Key word 'hit' in database abstracts

Key word / phrase	Frequency	Key word / phrase	Frequency
Decision-Making	43	Marketing-Research	10
Behavior	27	Management	9
Organizations	26	Trust	8
Model	24	Unethical Behavior	8
Managers	22	Framework	7
Perceptions	17	Business	7
Attitudes	17	Consumers	7
Corporate Social Responsibility	16	Gender	7
Consumer Ethics	13	Consumer Behavior	6
Professionals	13	Education	6
Social Responsibility	12	Industry	6
International Marketing	11	Culture	6
Values	11	Organizational Commitment	6
Judgments	11	Unethical Decision Behavior	6
Students	11	Privacy	6
Beliefs	11	Ethical Decision Making	5
Issues	10	Stakeholder Theory	5
Ethical Decision-Making	10	Consumption	5
Relationship Marketing	10	Salespeople	5

explaining the broad focus of the field, but the concepts within the cluster are not fully mature and do not share strong local links to each other.

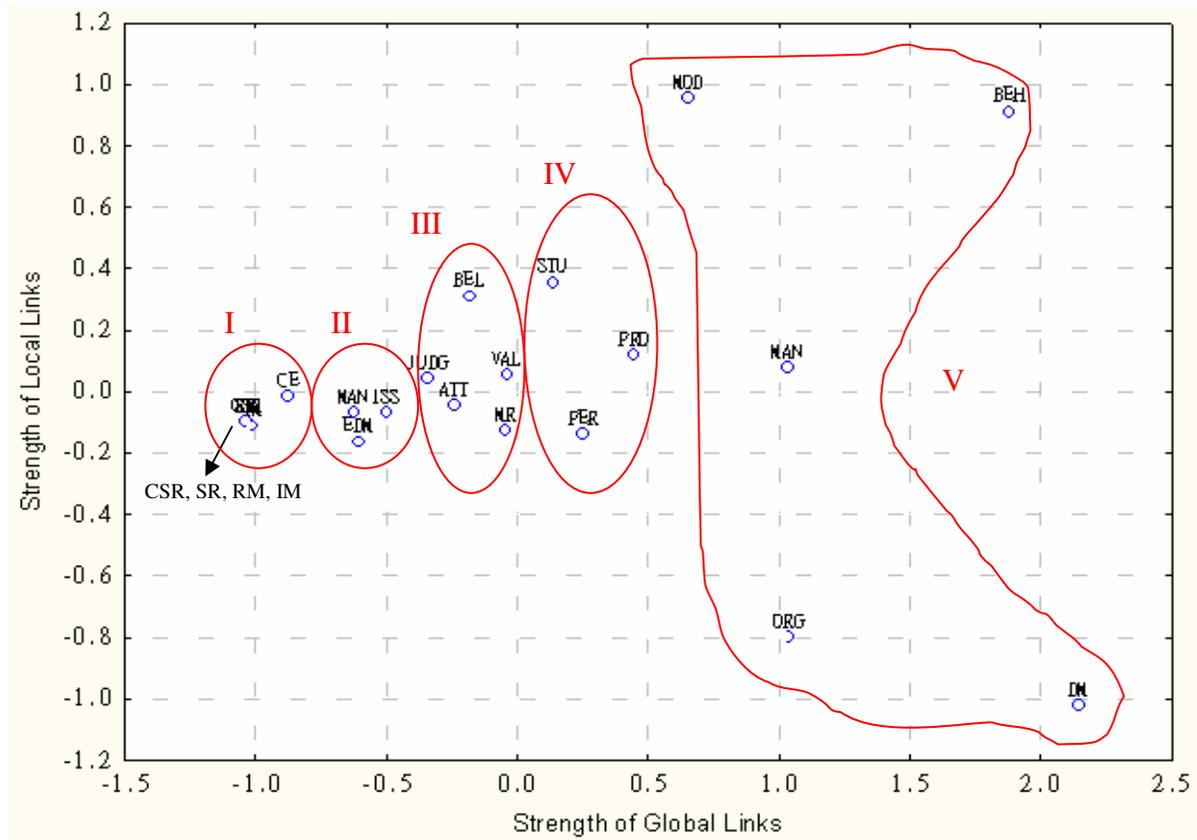


Figure 2. Strategic Diagram of Marketing Ethics research themes (1990-2009, n=21). 5 major clusters were identified in red by their strength of global links. Cluster I - Consumer ethics and social responsibilities in marketing. Cluster II - Conflict resolution and ethical decision making. Cluster III - Marketers and Consumer Values. Cluster IV - Marketers' perception. Cluster V - Models – behavioral and decision making. The abbreviations from left to right are as follows: Corporate Social Responsibility (CSR), Social Responsibility (SR), International Marketing (IM), Relationship Marketing (RM), Consumer Ethics (CE), Management (MAN), Ethical Decision Making (EDM), Issues (ISS), Judgments (JUDG), Attitudes (ATT), Beliefs (BEL), Values (VAL), Marketing Research (MR), Students (STU), Perceptions (PER), Professionals (PRO), Management (MAN), Organization (ORG), Behavior (BEH), Decision Making (DM)

With hierarchical clustering, this study further mapped the knowledge structure of marketing ethics (Figure 3) by revealing the closeness of these keywords according to how common these concepts are brought up together in a document. It is also evident in the figure

that certain thematic clusters exist. Three major clusters were identified and assigned names in the same way as previously done. I. Consumer ethics and social responsibilities in marketing. II. Marketers / Consumer Values and ethical decision making. III. Models – behavioral and decision making. The research themes identified with hierarchical clustering is comparable to the ones from K-means clustering. The result suggests that consumer ethics, social responsibilities, ethical decision making, and model presentation are the core research areas of marketing ethics in the past 2 decades.

The use of co-word analysis provides a systematic approach to analyze vast amount of

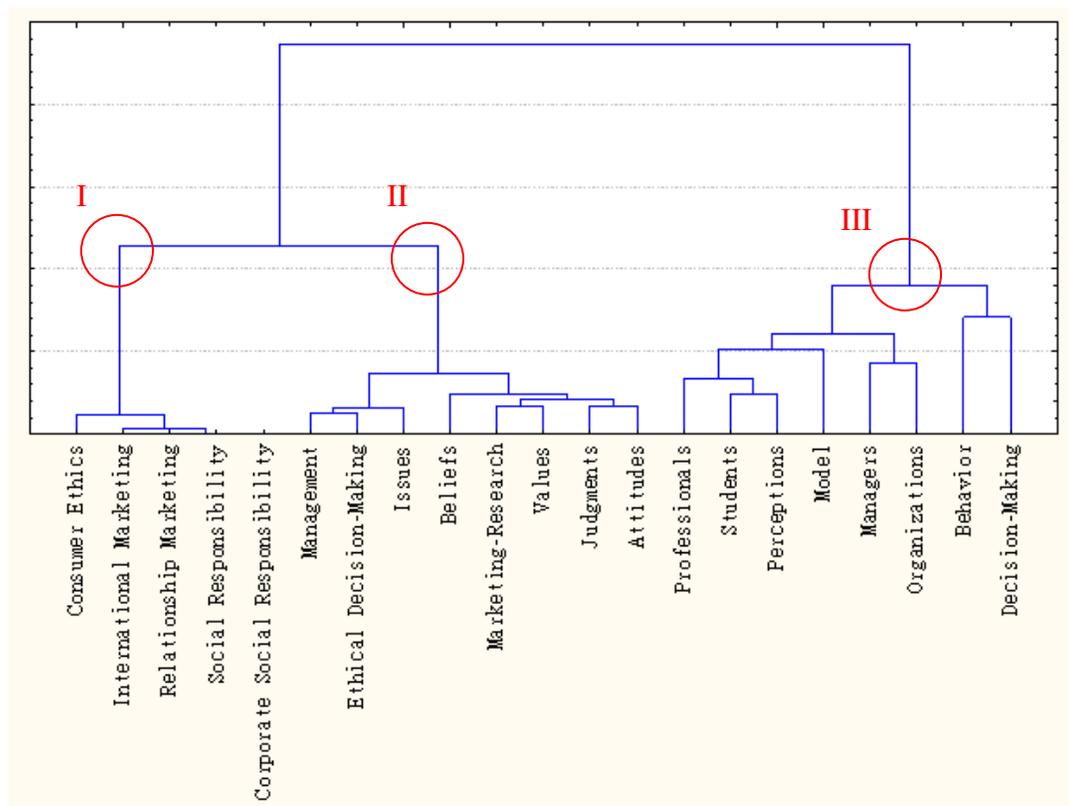


Figure 3. Knowledge Structure of Marketing Ethics, displaying the relationship between major keywords. The earlier the keywords meet the more common the keywords are being studied by scholars. Three major clusters were identified. Cluster I - Consumer ethics and social responsibilities in marketing. Cluster II - Marketers / Consumer Values and ethical decision making. Cluster III - Models – behavioral and decision making

literature objectively. It enables researchers to identify major research areas and themes, and at the same time presents a quick glance at the knowledge structure of a given field such as marketing ethics.

Citation Analysis

Citation analysis was tabulated for each of the source documents using the *Microsoft Excel* package. Preliminary analyses of the data produced valuable background statistics. The most influential journals and the most influential documents were then identified by the total citation counts they receive within the source journal articles. *Journal of Business Ethics*, *Journal of Marketing*, and *Journal of Marketing Research* were among the highest cited journal titles, especially *Journal of Business Ethics*, which received an enormous amount of citations comparing to the rest (Table 2). The most influential documents in marketing ethics between 1990~1999 were identified to be articles published by Ferrell, Hunt, and Trevino, and a book published by Murphy (Table 3). In the following decade, 2000~2009, many of the influential works from the previous decade still remained amongst the highest in citations, but articles by Forsyth and Jones also received such popularity (Table 4). These mentioned works are the foundations of the Marketing Ethics field and defines the field in the respective time frame.

Article Co-citation Analysis

In this stage, data mapping was conducted and the research paradigms of the marketing ethics studies were revealed by using article co-citation analysis. Co-citations were tabulated for all source documents using the *Microsoft Excel* package. Many of the works had very few co-citations and were either unlikely to have had a significant impact on the development of the field and/or were too recent to have had time to impact on the literature. Based on the total

number of citations in the selected documents, the top 30 works were identified, and then a co-citation matrix (30X30) was built before a pictorial map was drawn to describe the correlations

Table 2. The Most Frequently Cited Journals

Journal Title	Number of citation
Journal of Business Ethics	4220
Journal of Marketing	924
Journal of Marketing Research	472
Journal of the Academy of Marketing Science	348
Journal of Consumer Research	344
Journal of Business Research	302
Academy of Management Review	300
Journal of Macromarketing	298
European Journal of Marketing	213
Journal of Public Policy & Marketing	211
Harvard Business Review	182
Journal of the American Medical Informatics Association	164
Journal of Personal Selling & Sales Management	157
Journal of Personality and Social Psychology	145
Business Ethics Quarterly	138
Journal of Applied Psychology	132
Academy of Management Journal	130

among different works. In doing so, I was following the procedures recommended by White & Griffith (1981). I used r-Pearson as a measure of similarity between pairs of articles, because it registers the likeness in shape of their co-citation count profiles over all other works in the set (White & McCain 1998). The diagonals were considered missing data and applied the criterion of omitting the two cases (pair-wise delete) (McCain 1990).

Social network analysis tools can be used to graph the relations in the co-citation matrix and identify the strongest links and so the core areas of interest in marketing ethics (Pilkington & Teichert 2006). Figure 4 and Figure 5 demonstrates the knowledge trees where studies with common research interests are tied closely to each other. Examining from left to right, the earlier

Table 3. Highly Cited Documents (1990-1999) $N \geq 10$

Rank	Author	Year	Journal	Vol. & Page	Freq.
1	Ferrell, O. C.	1985	Journal of Marketing	V49, P87	46
2	Hunt, S. D.	1986	Journal of Macromarketing	V6, P5	35
3	Murphy, P. E.	1981	Review of Marketing	book, P251	25
4	Ferrell, O. C.	1989	Journal of Marketing	V9, P55	24
5	Trevino, L.	1986	Academy of Management Review	V11, P601	24
6	Chonko LB	1985	Journal of Business Research	V13, P339	23
7	Ferrell, O. C.	1988	Journal of Marketing Research	V25, P103	23
8	Akaah, I. P.	1989	Journal of Marketing Research	V26, P112	21
9	Tsalikis, J.	1989	Journal of Business Ethics	V8, P695	20
10	Hunt, S. D.	1984	Journal of Marketing Research	V21, P309	19
11	Jones, T. M.	1991	Academy of Management Review	V16, P366	19
12	Robin, D. P.	1987	Journal of Marketing	V51, P44	19
13	Ferrell, O. C.	1978	Journal of Marketing	V42, P69	18
14	Brenner, S. N.	1977	Harvard Business Review	V55, P57	17
15	Crawford, M. C.	1970	Journal of Marketing	V34, P46	16
16	Armstrong, J. S.	1977	Journal of Marketing Research	V14, P396	15
17	Bellizzi, J. A.	1989	Journal of Marketing	V53, P36	15
18	Kohlberg, L.	1969	Hdb Socialization Th	Book, P347	15
19	Laczniak, G. R.	1993	Ethical Marketing De	Book	15
20	Hunt, S. D.	1984	Journal of Marketing	V48, P30	14
21	Mayo, M. A.	1990	Journal of Academy Marketing	V18, P163	14
22	Baumhart, R.	1961	Harvard Business Review	V39, P6	12
23	Wotruba, T. R.	1990	J Personal Selling S	V10, P29	12
24	Forsyth, D. R.	1980	J Pers Soc Psychol	V39, P175	11
25	Hunt, S. D.	1989	Journal of Marketing	V53, P79	11
26	Reidenbach, R. E.	1991	Journal of Academy Marketing	V19, P83	11
27	Tybout, A. M.	1974	Journal of Marketing Research	V11, P357	11
28	Akaah, I. P.	1994	Journal of Business Ethics	V13, P417	10
29	Fritzsche, D. J.	1988	Journal of Macromarketing	V8, P29	10
30	Goolsby, J. R.	1992	Journal of Marketing	V56, P55	10

Table 4. Highly Cited Documents (2000-2009) $N \geq 3$

Rank	Author	Year	Journal	Vol. & Page	Freq.
1	Ferrell, O. C.	1985	Journal of Marketing	V49, P87	9
2	Trevino, L. K.	1986	Academy of Management Review	V11, P601	7
3	Forsyth, D. R.	1980	J Pers Soc Psychol	V39, P175	6
4	Jones, T. M.	1991	Academy of Management Review	V16, P366	6
5	Akaah, I. P.	1990	Journal of Business Ethics	V9, P45	5
6	Chonko, L. B.	1985	Journal of Business Research	V13, P339	5
7	Forsyth, D. R.	1992	Journal of Business Ethics	V11, P461	5
8	Fritzsche, D. J.	1991	Journal of Business Ethics	V10, P841	5
9	Akaah, I. P.	1989	Journal of Marketing Research	V26, P112	4
10	Armstrong, J. S.	1977	Journal of Marketing Research	V14, P396	4
11	Bommer, M.	1987	Journal of Business Ethics	V6, P265	4
12	Deconinck, J. B.	1997	Journal of Business Ethics	V16, P497	4
13	Hegarty, W. H.	1979	J Appl Psychol	V64, P331	4
14	Hunt, S. D.	1986	Journal of Marketing	V6, P5	4
15	Hunt, S. D.	1986	Journal of Macromarketing	V8, P5	4
16	Hunt, S. D.	1989	Journal of Marketing	V53, P79	4

17	Hunt, S. D.	1993	Journal of Marketing Research	V30, P78	4
18	Izraeli, D.	1988	Journal of Business Ethics	V7, P263	4
19	Laczniak, G. R.	1993	Ethical Marketing De	Book	4
20	Murphy, P. E.	1981	Rev Marketing,	Book, P251	4
21	Singhapakdi, A.	1991	J Personal Selling S	V11, P1	4
22	Singhapakdi, A.	1993	Journal of Business Ethics	V12, P525	4
23	Singhapakdi, A.	1995	J Acad Market Sci	V23, P49	4
24	Stead, W. E.	1990	Journal of Business Ethics	V9, P233	4
25	Vitell, S. J.	1993	J Acad Market Sci	V21, P331	4
26	Vitell, S. J.	1993	Journal of Business Ethics	V12, P753	4
27	Weaver, K. M.	1977	Cont Marketing Thoug	V41, P477	4
28	Akaah, I. P.	1994	Journal of Business Ethics	V13, P417	3
29	Akaah, I. P.	1996	Journal of Business Ethics	V15, P605	3
30	Bartels, R.	1967	Journal of Marketing	V31, P20	3

the 'knots' appear, the more connections in theme the studies share. This is based on the number of times that a pair of works is simultaneously cited in articles. These were produced using *UCINET 6.0* software (Borgatti et al, 2002) and shows graphically the core groupings of research interests by authors in marketing ethics.

The co-citation correlation matrix was factor analyzed using varimax rotation, a commonly used procedure, which attempts to fit (or load) the maximum number of authors on the minimum number of factors. Factor analysis of the 30X30 article co-citation matrices provided us the insights to the main research themes in the 2 time periods under study. 4 major factors (themes) were identified in the period of 1990-1999, and together they explain over 83% of the variance in the data (Table 5). Articles with factor loadings of more than 0.4 were considered and displayed in the table. As is usual in this type of analysis, items with less than a 0.4 loading were dropped from the final results (White & Griffith 1981). The first factor in the 1990-1999 periods comprises of many articles and accounts for 52.3% of variance. The general theme for this factor was found to be proposing and testing models to explain ethical decision process in marketing. Kohlberg (1969) described a cognitive moral development model in a chapter of a book.

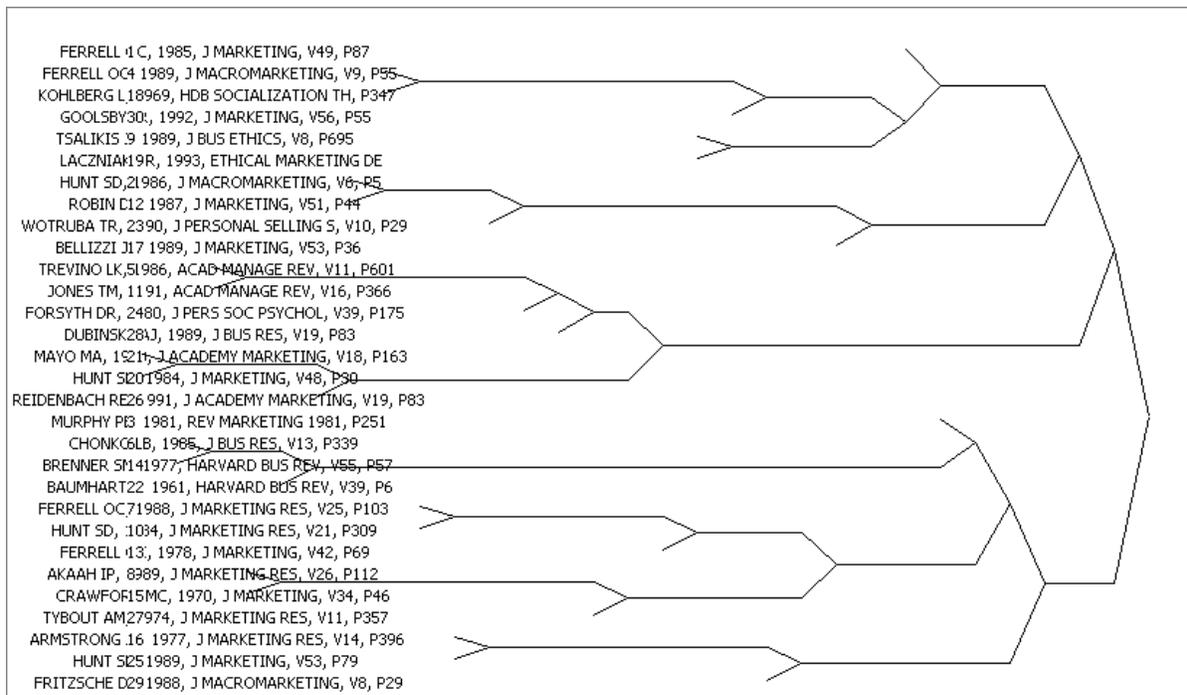


Figure 4. Knowledge Tree displaying similarities between research interests of 30 most cited works in 1990-1999. A co-citation clustering diagram using complete link method.

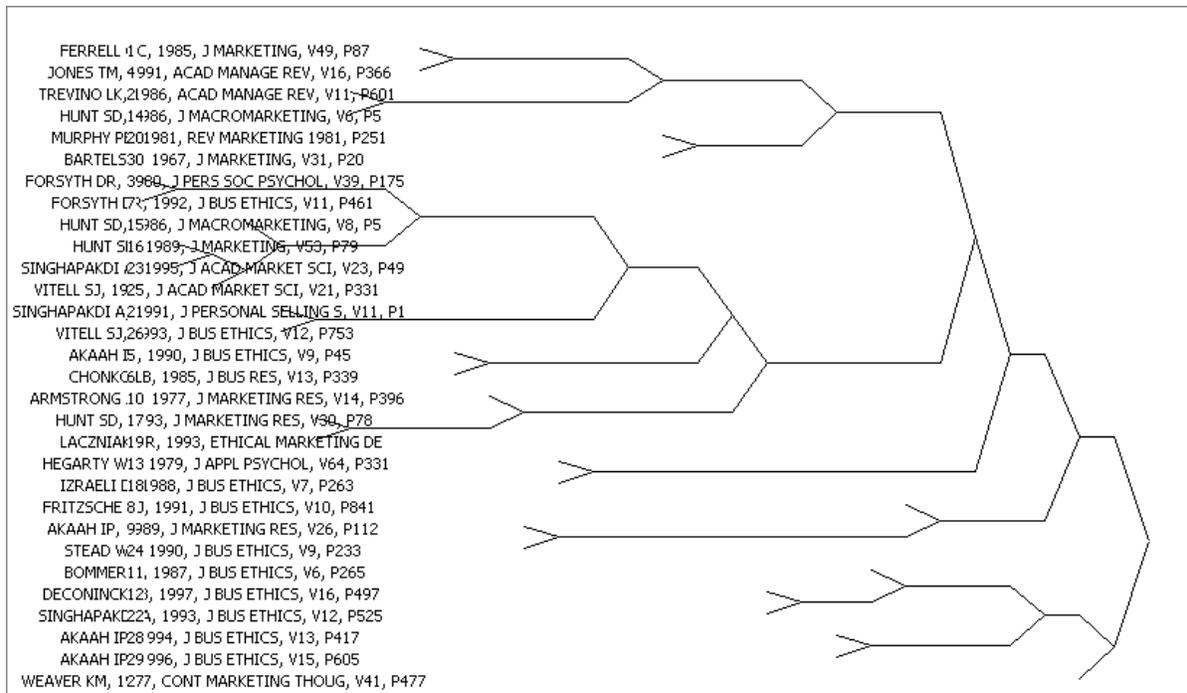


Figure 5. Knowledge Tree displaying similarities between research interests of 30 most cited works in 2000-2009. A co-citation clustering diagram using complete link method.

Trevino (1986) incorporated Kohlberg's model and proposed an interactionist model for ethical decision making in organizations. Goolsby & Hunt (1992) elaborated on cognitive moral development and presented an empirical survey-based study. The authors found that marketers with advanced moral reasoning properties tend to have socially responsible attitudes and behavior. Ferrell (1985) proposed a multistage contingency model that integrates key determinants of ethical/unethical behavior. The concept of moral intensity was introduced by Jones (1991) in his article. Jones argued that moral intensity influences every component of moral decision making and behavior. The author briefly described most major models at that time and synthesized into his own issue-contingent model. Ferrell (1989) compared contributions of several ethical decision making models and synthesize those frameworks to form an integrated model that combines both cognitive-effect and social-learning theory to produce a more complete perspective of the ethical decision process. Dubinski & Loken (1989) and Mayo & Marks (1990) both tested a specific model of ethical decision making with scenarios in their respective articles. Forsyth (1980) developed a well-known scale called "Ethics Position Questionnaire" that measures the extent to which individuals adopt one of the 4 ethical perspectives presented by him: Situationism, Absolutism, Subjectivism, and Exceptionism. All these works mentioned above very precisely define the primary theme in the first period under study.

The second factor covered 20.9% variance and includes studies that use surveys/questionnaires to marketing practitioners to test some hypothesis or to examine marketing ethics' current trends. Hunt (1984)'s empirical study examined the major ethical problems marketing researchers have and how professional codes of conduct address these problems. Crawford (1970) reported reactions of research directors and top marketing line

executives to 14 'situations' which occurs in the field of research. In his study, respondents disapproved the use of ultraviolet ink, hidden tape recorders, one-way mirrors, a particular price exchange program, an action relating to product misuse, the ignoring of executive distortions, conflict of interest, the refusal of assigning a man to a ghetto business project, and personnel situations involving racial and religious discriminations. Ferrell & Skinner (1988) found that bureaucratic structure of organization is related to ethical behavior and that respondents' sex is a significant predictor of ethical behavior in data subcontractors and research firms. In an earlier study, Ferrell et al (1978) discovered that respondents believe that they make decisions in an organizational environment where peers and top managers have lower ethical standards than their own. The existence and enforcement of corporate policy does not encourage more ethical conduct than their existing personal beliefs (Ferrell 1978). However, Hunt et al (1989) found evidence of a positive association between corporate ethical value and organizational commitment. Akaah (1989)'s study suggests that three organizational factors underlie differences in ethical judgments – extent of ethical problems within the organization, top management actions on ethics, and organizational role (researchers versus executives). Fritzsche (1988) surveyed marketing managers with 4 vignettes (Bribery, Lying, Conflict of Interest, and Whistle blowing) and found differences in response across vignettes which suggest that managers practice situational ethics. Questionnaire-based studies have their limitations. Tybout & Zaltman (1974) pointed out that violation of subject's right in marketing research may affect the quality of data obtained. In the case of non-response bias, Armstrong & Overton (1977) reviewed several methods for its estimation and provided benefits of such estimation.

The third factor covers only 5.7% of variance and the fourth covers only 4.5%. The third major theme in the 1990-1999 time periods in marketing ethics discusses business/marketing

ethics theories. In the field of moral philosophy, ethical theories have generally been classified into two major types, deontological and teleological (Murphy & Laczniak 1981). Hunt & Vitell (1986) in their article discussed and evaluated deontological and teleological theories, and further developed a positive theory to help explain some of the empirical researches that has been conducted in the area of marketing ethics. The authors argued that positive research should precede normative writings. 'If one wished to make normative prescriptions as to how other people should resolve their ethical conflicts, a useful starting point is to attempt to understand how these "others" do in fact arrive at their ethical judgments (Hunt & Vitell 1986). Tsalikis & Fritzsche (1989) in their article also reviewed studies on normative theories and studies leading to a positive theory. Robin & Reidenbach (1987) reviewed the concepts of social responsibility and business ethics, and proposed a positive, proactive approach to marketing ethics and social responsibility. In a book by Laczniak & Murphy (1993), the authors provided series of questions about the ethics of marketing practices that are based on different theories of moral philosophy. The authors suggested that any code of ethics should be communicated, specific, pertinent, enforced, and revised. These above mentioned works collectively defines the third theme of marketing ethics studies in the defined period.

The fourth factor contains only 3 works, but these are the early works of marketing ethics. Baumhart (1961) did a well-known questionnaires study on attitudes of executives towards business ethics. The author found that more than 75% of manager reported experiencing conflict between personal standards and what was expected of them as managers. Behavior of superiors was perceived by respondents as the number one factor influencing ethical/unethical decisions (Baumhart 1961). In an updated version to Baumhart's study, Brenner & Molander

Table 5. Marketing Ethics Studies Topic Clusters: 1900~1999

Factor 1: Models – Proposition and Testing	Variance 52.3%
FERRELL OC, 1985, J MARKETING, V49, P87	0.560
FERRELL OC, 1989, J MACROMARKETING, V9, P55	0.755
TREVINO LK, 1986, ACAD MANAGE REV, V11, P601	0.861
JONES TM, 1991, ACAD MANAGE REV, V16, P366	0.902
KOHLBERG L, 1969, HDB SOCIALIZATION TH, P347	0.762
HUNT SD, 1984, J MARKETING, V48, P30	0.921
MAYO MA, 1990, J ACADEMY MARKETING, V18, P163	0.856
WOTRUBA TR, 1990, J PERSONAL SELLING S, V10, P29	0.595
FORSYTH DR, 1980, J PERS SOC PSYCHOL, V39, P175	0.953
REIDENBACH RE, 1991, J ACADEMY MARKETING, V19, P83	0.845
DUBINSKY AJ, 1989, J BUS RES, V19, P83	0.899
GOOLSBY JR, 1992, J MARKETING, V56, P55	0.743
Factor 2: Survey-Based Empirical Studies	Variance 20.9%
FERRELL OC, 1988, J MARKETING RES, V25, P103	0.785
AKAAH IP, 1989, J MARKETING RES, V26, P112	0.704
HUNT SD, 1984, J MARKETING RES, V21, P309	0.884
FERRELL OC, 1978, J MARKETING, V42, P69	0.738
CRAWFORD MC, 1970, J MARKETING, V34, P46	0.671
ARMSTRONG JS, 1977, J MARKETING RES, V14, P396	0.765
BELLIZZI JA, 1989, J MARKETING, V53, P36	0.613
HUNT SD, 1989, J MARKETING, V53, P79	0.842
TYBOUT AM, 1974, J MARKETING RES, V11, P357	0.729
FRITZSCHE DJ, 1988, J MACROMARKETING, V8, P29	0.852
Factor 3: Business/Marketing Ethics Theories	Variance 5.7%
HUNT SD, 1986, J MACROMARKETING, V6, P5	0.655
MURPHY PE, 1981, REV MARKETING 1981, P251	0.513
TSALIKIS J, 1989, J BUS ETHICS, V8, P695	0.697
ROBIN DP, 1987, J MARKETING, V51, P44	0.653
LACZNIAK GR, 1993, ETHICAL MARKETING DE	0.583
Factor 4: Early Works	Variance 4.5%
CHONKO LB, 1985, J BUS RES, V13, P339	0.756
BRENNER SN, 1977, HARVARD BUS REV, V55, P57	0.804
BAUMHART R, 1961, HARVARD BUS REV, V39, P6	0.845

Table 6. Marketing Ethics Studies Topic Clusters: 2000~2009

Factor 1: Ethical decision making in marketing	Variance 57.5%
FERRELL OC, 1985, J MARKETING, V49, P87	0.790
TREVINO LK, 1986, ACAD MANAGE REV, V11, P601	0.627
FORSYTH DR, 1980, J PERS SOC PSYCHOL, V39, P175	0.900
JONES TM, 1991, ACAD MANAGE REV, V16, P366	0.839
AKAAH IP, 1990, J BUS ETHICS, V9, P45	0.739
CHONKO LB, 1985, J BUS RES, V13, P339	0.777
FORSYTH DR, 1992, J BUS ETHICS, V11, P461	0.919
ARMSTRONG JS, 1977, J MARKETING RES, V14, P396	0.826
HUNT SD, 1986, J MACROMARKETING, V6, P5	0.647
HUNT SD, 1986, J MACROMARKETING, V8, P5	0.944
HUNT SD, 1989, J MARKETING, V53, P79	0.948
HUNT SD, 1993, J MARKETING RES, V30, P78	0.902
LACZNIAK GR, 1993, ETHICAL MARKETING DE	0.908
SINGHAPAKDI A, 1991, J PERSONAL SELLING S, V11, P1	0.825
SINGHAPAKDI A, 1995, J ACAD MARKET SCI, V23, P49	0.944
VITELL SJ, 1993, J ACAD MARKET SCI, V21, P331	0.924
VITELL SJ, 1993, J ACAD MARKET SCI, V21, P331	0.886
Factor 2: Decision maker's personal moral values	Variance 13.4%
FRITZSCHE DJ, 1991, J BUS ETHICS, V10, P841	0.711
BOMMER M, 1987, J BUS ETHICS, V6, P265	0.589
DECONINCK JB, 1997, J BUS ETHICS, V16, P497	0.674
MURPHY PE, 1981, REV MARKETING 1981, P251	0.668
SINGHAPAKDI A, 1993, J BUS ETHICS, V12, P525	0.729
BARTELS R, 1967, J MARKETING, V31, P20	0.644
Factor 3: Ethical behaviors and judgments	Variance 6.6%
AKAAH IP, 1989, J MARKETING RES, V26, P112	0.867
HEGARTY WH, 1979, J APPL PSYCHOL, V64, P331	0.669
IZRAELI D, 1988, J BUS ETHICS, V7, P263	0.623
STEAD WE, 1990, J BUS ETHICS, V9, P233	0.895
Factor 4: Ethical behaviors and judgments	Variance 4.0%
AKAAH IP, 1994, J BUS ETHICS, V13, P417	0.798
AKAAH IP, 1996, J BUS ETHICS, V15, P605	0.705

(1977) in their questionnaires study also indicated similar role conflict situation in over half of the respondents. Furthermore, Brenner & Molander (1977) discovered that the existence of a code can raise the ethical level of business behavior because it clarifies what is meant by 'ethical conduct'. However, a survey-based empirical study done by Chonko & Hunt (1985) showed that recognized existence of such codes was not a significant factor in explaining individual perceptions of ethical problems. Their mere existence, without enforcement, is insufficient to effect ethical behavior (Chonko & Hunt 1985).importance of ethics and social responsibility. In an earlier study, Singhapakdi (1991) analyzed the ethical decision making of sales professionals through survey-based research, and found that ethical climate of an organization influences a salesperson's perceptions of an ethical problem and his/her perceptions of alternative course of action. Individual's personal moral philosophy also influences moral judgments of certain business practices and their decisions to engage in those practices (Forsyth 1992). In Jones' (1991) article, the author argued that moral intensity influences every component of moral decision making and behavior using concepts, theory, and evidence from social psychology.

Laczniak & Murphy (1993) wrote a book dedicated to ethical marketing decisions, and proposed a framework with series of questions about the ethics of marketing practices that are based on different theories of moral philosophy. The authors reviewed the Hunt-Vitell theory and concluded that reasoned action model never clearly specifies whether the evaluations are made from the standpoint of the self-interests of individual, the manger as representing the shareholders of the organization, or the manger taking into account all the various stakeholders (Laczniak & Murphy 1993). Hunt's (1993) finding in a questionnaire study suggests that manages' decisions to either discipline or reward the behavior of salespeople are guided

primarily by the inherent rightness or wrongness of the salespeople's behavior and only secondarily by the consequences of the behavior on the organization.

The second factor discusses the personal moral values of decision makers and covers 13.4% of variances. This factor appears to be a sub-theme of the first factor identified. Bartels (1967) presented a schematic plan for analyzing the variables inherent in the ethics of decision-making. Fritzsche (1991) included personal values of the decision maker as the dominant individual input in an ethical decision model presented. Singhapakdi & Vitell (1993) in a questionnaire study to American Marketing Association's professional members explored the relative influence influences of personal and professional values on ethical judgments. The authors found that marketer's ethical judgment is partially explained by his/her personal and professional values. These above mentioned authors represent the second factor of the 2000-2009 periods.

The third and the fourth factor collectively explain 10.6% of variances. Both factor were found to share a common theme, thus will be discussed together. The common research interest for authors in these two factors was identified as "marketer's ethical judgments and behaviors". Hegarty & Sims (1979) evaluated unethical decision behavior under different policy and environment conditions in their stimulated experiments. The authors concluded that foreign nationality, Machiavellianism, and economic value orientation were positively related to unethical decision behavior. Stead et al (1990) review literature related to ethical behavior and proposed a model for understanding ethical behavior in business organizations. Managing ethics in business organizations requires that managers engage in a concentrated effort which involves espousing ethics, behaving ethically, developing screen mechanisms, providing ethical training, creating ethics units and reinforcing ethical behavior (Stead et al, 1990). A cross-cultural study

by Izraeli (1988) revealed that the best predictor of marketer's ethical behavior is their beliefs and perceptions concerning their peer's behavior. Several studies by Akaah examined ethical behavior and ethical judgments and factors that influence them. Akaah & Lund (1994) studied the influence of personal and organizational values on marketing professionals' ethical behavior, and found that organizational values influences ethical behavior more than personal values. An earlier study suggests that the organizational factors underlying differences in ethical judgments are extent of ethical problem within the organization, top management actions on ethics, and organizational roles (Akaah & Riordan 1989). In 1996, Akaah published a survey-based paper examining the extent to which marketing professionals of different organizational ranks and roles differ in ethical judgments. The author concluded that no differences were found between organizational ranks and ethical judgment, but marketing professional of executive role has better ethical judgment than of research role.

It was noted that the main research interests in marketing ethics have evolved in the past 20 years in terms of research structure, direction, and form. Marketing ethics studies went from proposing models, analyzing surveys, and discussing ethics theories in the period of 1990-1999 to a more specific ethical decision making, personal moral values, and ethical behaviors and judgment in the period of 2000-2009.

Discussion and Conclusions

Using methods of bibliometrics and co-word analysis on data published in SSCI database between 1990 and 2009, this study investigates marketing ethics research and outlined the research interests in this field through the past 20 years. This study followed Kostoff's (2001) method of combining bibliometrics and data mining to identify the research paradigms of marketing ethics in a given time frame and at the same time identifying notable swift, expansion

and condensation of research interests. The methodology proposed can be applied to most academic discipline to investigate the literatures. Through evaluating the keywords and the pattern of their usage, we can objectively observe the major research interests in the marketing ethics field and the interaction between these clusters. The strategic diagram and the hierarchical clustering provide invaluable insight into the field. Three major clusters of research themes were identified as I. Consumer ethics and social responsibilities in marketing. II. Marketers / Consumer Values and ethical decision making. III. Models – behavioral and decision making. By examining articles in Table 3 and 4, the readers notice the high number of citations of what can be termed the backbone of marketing ethics, which lay the ground work for the understanding of marketing ethics as a distinct field and its advancement in research themes. *Journal of Business Ethics*, *Journal of Marketing*, and *Journal of Marketing Research* were among the most highly cited journals in marketing ethics as illustrated in Table 2. The article and journal listings serve as a quick reference for new researchers to become familiar with where the core of marketing ethics field resides. Co-citation and factor analysis revealed shift of research themes within the past 2 decades. The 1990-1999 period was more concerned with models proposition/testing, survey-based studies, business/marketing ethics theories, and early marketing ethics works. On the contrary, the 2000-2009 periods condenses and focuses on more specific topics such as ethical decision making, decision maker's personal moral values, and ethical behavior and judgments.

The findings from co-word analysis are congruent with the results from co-citation analysis as the major research themes were matched. Co-citation analysis provides a semi-systematic mean to approach literatures from a field. Author or Document co-citation only provides linkages between authors and documents respectively. It lacks the analysis of content,

which can only be achieved through manual reading of the articles in each factor group. Co-word analysis on the other hand offers near-complete objectivity and reveals the intellectual structure of a field by its research content. As such, co-word analysis seemed to be a quicker method of obtaining insights into a given field. The downside to co-word analysis is that it does not take into considering the authors or the journal involved, resulting in insufficient information if used alone. This undoubtedly suggest the need of applying both co-word and bibliometric analysis together to achieve a better understanding of a field.

Even though this study offers a valuable insight into the researches of marketing ethics, it has some limitations and areas that can be further refined. First, our search criteria may be incomplete, which may results in some valuable papers being excluded unintentionally. Wider inclusion of other important indices is suggested for future researchers. Secondly, co-word analysis is only a subset of many essential methods of data mining. Further evaluations can be performed to obtain a more detailed structure of marketing ethics. Thirdly, the substantial change in authors comprising each factor in co-citation analysis suggest that more time periods should be examined, and each time periods should be less than 10 years as presented in this study. By separating into several time frames, we can observe a slower and clearer evolution of research interests in this field. Techniques of bibliometrics and co-word analysis provide a feasible method to approach and understand a research field, but if accompanied by manual content analysis, a more informative and comprehensive picture of the knowledge structure and research concentrations are accessible.

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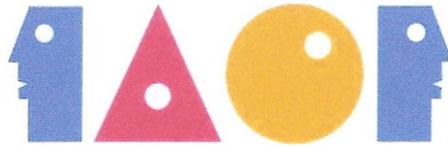
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EXPLORING THE INFLUENTIAL FACTORS TOWARD THE CONTINUANCE INTENTION OF ON-LINE BOOKS PURCHASE

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Abstract

Although trade costs for both sellers and buyers can be reduced through the usage of e-commerce, however low transfer costs and global competition cause that the e-bookstores to have to maintain their customer loyalty is more difficult than traditional shopping stores. The formations of the customer loyalty of e-bookstores have been explored by many researchers from different points of view, such as service quality, satisfaction and trust. Nevertheless, the current bottleneck of e-commerce operation is that customers are no longer continuing using e-bookstores. Based on the theory of Post-Acceptance Model, this study empirically tested using a field survey of e-bookstore customers. The results showed that satisfaction and perceived usefulness are significant predictors of continuance intention. The expectation-confirmation factors except the confirmation of system platform are significant predictor of satisfaction and perceived usefulness. The implications of these findings for e-bookstore continuance theory and practice are proposed in the final section.

Keywords: Post-Acceptance Model, Continuance Intention, e-Bookstore, Perceived Usefulness

Introduction

One of the commercial activities practiced by many Taiwanese is purchasing books online.– Take, for example, the sales volumes for books.com.tw are approximately 1.1 billion Taiwan Dollars (NT\$) per year. This shows that e-commerce has unlimited potential in Taiwan, and many enterprises are also considering to develop online stores in order to open up new digital route sales and new services to their customers. Since 1995, Amazon network shop (www.amazon.com), the initiator of e-bookstores, had been making good use of the information technology for its customers as well as building alliance for partnerships and the brand loyalty. Bill Gates, the founder of Microsoft, once pointed out in a magazine that all of his books are purchased online for he is very busy and it is a convenient way. With the providence of extremely broad options, this kind of website is also trustable.

Even though trade costs can be reduced both for sellers and buyers through the usage of e-commerce, the low cost and global competition makes it more difficult for network stores to maintain their customers' loyalty than (comparing to) the traditional shopping stores (Shim and Eastlick, 1998). Furthermore, the joining in of new customers and the maintenance of old customers' loyalty to the e-commerce are similar to the leaky bucket theory. This needs to be dealt with two facades at the same time; in other words, what network stores or operators are dealing with is a bucket with many holes. Therefore, through the elevating of the website quality and other various advertisements and promotions of the website, the attract of new customers to visiting the website is like unceasingly pouring running water into a leaking bucket. On the other hand, the maintenance of old customers' loyalties to the website is the same as striving to mend the holes in the bucket and reducing the leak as much as possible. As a result, the water level will be able to rise gradually.

There are differences between attracting new customers to accept the usage of online bookstores and maintaining the old customers' loyalty to use the online bookstore continually. Researchers have discussed this from the aspects of different viewpoints and factors as well as interpreted the leading factors for new customers to adopt and accept the online shopping, such as Technology Acceptance Model, Theory of Reasoned Action, and Innovation Diffusion Theory. However, some scholars regard that being adopted and attracted to the usage of online store do not equal the continuing usage of it (Li et al., 2006). In other words, attracting internet users to accept online shopping is only the beginning of success for e-commerce, a truly successful management for online stores depend on its members' continuing usage of the online stores. As a result, the maintenance of old customers' continuing usage of online stores is more important than the initial adoption of using online stores by new customers (Li et al., 2006; Karahanna et al., 1999; Reichheld and Schefter, 2000; Venkatesh and Davis, 2000; Bhattacharjee, (2001a; 2001b).

According to a recent website consumption investigation given by yam.com, it shows that the consumption of network shopping in Taiwan is mainly based on the purchase of books, magazines and other publications, which is approximately 35%, the highest among all purchases. Its market scale surpasses one billion NT dollars. There are still other more online publishing bookstores that allow customers to order professional books (e.g. computer books) online, which include San Min Book Company, Flag Publishing and Kings Publishing. Speaking of most network bookstores, book discounts (price reduction strategy) is the major way to maintain its customers' loyalty (Lin et al., 2004). The purpose of this research is to study whether those innovations are conducive to increase the continuance intention of the customers' usage of e-commerce and with a further approach to discover the crucial causes of the factors concerning its usage (e.g. user's satisfaction, value factor). The research will examine the correlation hypothesis

by using empirical researching technique, and then the proposal of several management opinions and suggestions will be based on the results of the hypothesis diagnoses.

Literature Review

This study explores Taiwan's online bookstore users' intention of continuing to purchase books online with the adoption of Post-Acceptance Model (Bhattacharjee, 2001a) as the base of the theory and using IS success model of DeLone and Mclean (2003) as the confirmation of it. Therefore, relating researches based on Post-Acceptance Model and IS success model will be reviewed.

Adopting Post-Acceptance Model

Bhattacharjee (2001a) regards that the expectation of a customer differs before and after the purchase of a product. With the consideration of this theory, this research modifies Expectation Confirmation Theory and adds in the factors of perceived usefulness from Technology Acceptance Model (Davis et al., 1989). Therefore, Post-Acceptance Model takes shape in Figure 1.

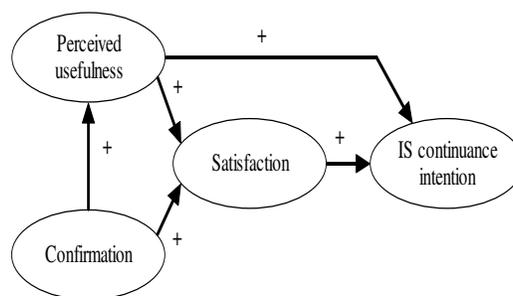


Figure 1. Post-Acceptance Model of IS Continuance (Bhattacharjee, 2001a)

The confirmation in Expectation Confirmation Theory comes from the comparison between the previous expectation (t1) and the present result (t2). Positive disconfirmation is a

term used when the actual result exceeds the previous expectation, while negative disconfirmation is a term used when the actual result falls shorter than the previous expectation. On the other hand, confirmation is a term used when the two factors (t1 and t2) are equally balanced.

Bhattacharjee (2001b) regards that confirmation is helpful in improving the rate of users' perceived usefulness and satisfaction. Davis et al.(1989) indicates that the higher the perceived usefulness of the user in perceiving a specific technology or system, the more positive attitude in using the technology or system will be, which will in turn enhance the intention of usage.-Many literatures have previously indicated that in the situation of e-commerce, perceived usefulness will positively influence the satisfaction rate and the attitude of network usage, as well as the intention and continuing intention of usage (Lin and Lu, 2000; Sarv et al., 2002; Koufaris, 2002; Chiou et al., 2002; Flavian et al., 2006; Huang et al., 2008). Bhattacharjee (2001a) regards that perceived usefulness is a recognition and concept of the information system, and it can be referred as the afterward expectation of Expectation Confirmation Theory. This enables the expectation that is difficult to define a concrete measurement. With the adoption of Post-Acceptance Model, this study holds the opinion that the reason why customers are willing to continually purchase books online is because the internet is regarded as a useful mean for purchasing books and it also brings a sense of satisfaction to its customers.

IS Success Model

Online bookstore is both a website platform and a retail store, so the way of measuring customers' confirmation of the website platform quality can be made through the adoption of information content quality, information system quality and website service quality (DeLone and Mclean, 2003; Li, 2003). In the measurement of the customers' satisfaction rates, McKinney et al.(2002) also indicates that the expectation and the comparison of the consciousness result of

information content quality and information system quality will turn out to be disconfirmation (IQ disconfirmation and SQ disconfirmation), and this will in turn affect the customer's satisfaction rate.

DeLone and Mclean (2003) integrated the effective viewpoint and process influence of the system and information to develop IS Success Model. Additionally, the six construction sides including system quality, information quality, information usage, user's satisfaction, personal impact and organization impact, was proposed. It is regarded that system quality and information quality will influence both the satisfaction rate of the user and the usage of the system. What's more, the usage rate will also positively or negatively influence the user's satisfaction rate, which will become a personal impact and will afterward influence the organization. DeLone and Mclean(2003) also renewed that the model should be added into the servicing quality, so as to become a more complete IS Success Model shown in Figure 2.

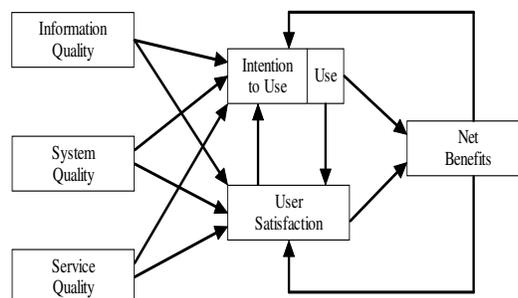


Figure 2. IS Success Model (DeLone and Mclean, 2003)

Information content quality refers to the relevance, instance, reliability, correctness and wholeness of the supplied information content (Venkatesh and Davis, 2000; DeLone and Mclean, 2003; Chiou et al., 2002; McKinney et al., 2002). Internet service quality includes the interaction quality of the staffs, substantial environmental quality and information quality gained from. (DeLone and Mclean, 2003; Pitt et al., 1995; Zeithaml, et al., 2002; Ahn et al., 2004).

The Research Models and Hypotheses

The goal of this research is to probe into the influencing elements of the continuance usage of purchasing books online. With the inheritance and adoption of Post-Acceptance Model as the base of the theory, and the adoption of information content quality, system quality and service quality from the confirmation in Post-Acceptance Model, as well as through the IS Success Model of DeLone and Mclean (2003), the satisfaction and perceived usefulness of the system are developed through the influence of these three qualities. According to the previous relating literature reviews, this research develops a model that is given in Figure 3 and the following nine researching hypotheses.

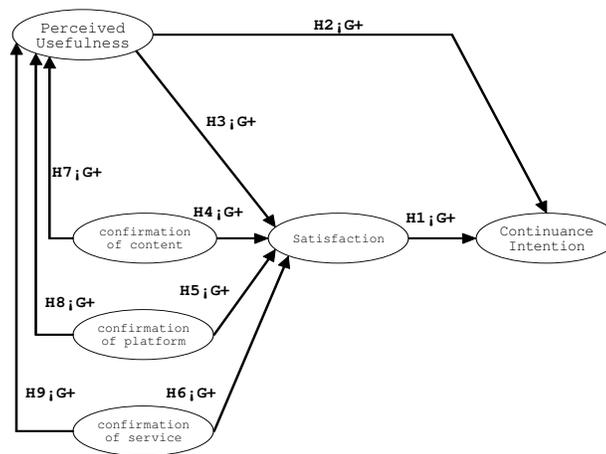


Figure 3. The Research Model

H1 Users' satisfaction positively influences the continuance intention of using e-bookstores.

H2 Perceived usefulness in purchasing books online positively influences the continuance intention of using e-bookstores.

H3 Perceived usefulness in purchasing books online positively influences users' satisfaction.

H4 Informational content confirmation in purchasing books online positively influences users' satisfaction.

H5 Website platform confirmation in purchasing books online positively influences users' satisfaction.

H6 Website service quality confirmation in purchasing books online positively influences users' satisfaction.

H7 Informational content confirmation in purchasing books online positively influences the perceived usefulness of using e-bookstores.

H8 Website platform confirmation in purchasing books online positively influences the perceived usefulness of using e-bookstores.

H9 Website service quality confirmation in purchasing books online positively influences the perceived usefulness of using e-bookstores.

Research Methodology

This paper investigates online customers' continuance intention of using online bookstores, and an empirical study will proceed by using questionnaire. Additionally, structure equation model (SEM) is adopted to verify the path relations of variables of the model. The research steps are to explain as follows.

Sampling Source and Data Collection Procedure

Empirical data for this study was collected via a convenience sampling survey, and the survey respondents were students of a polytechnic university in southern Taiwan. They were either full time or part time students. The students were inquired whether they had any experience of purchasing books or other products online before answering the questionnaire. The survey respondents are only those who have had the experiences of purchasing books or other products online. 240 questionnaires were collected and 150 of them are valid after weeding out those

incomplete or surveys through the visual examination. Of the 240 collected questionnaires, 90 surveys are invalid while 62.5% of surveys are valid samples.

The majority of the survey respondents are females (60%), who are between 20 to 24 years old. Using convenience sampling, the sampling sources are mainly university students. The difference of their residential areas and their educational are not big. Most of their income are between the range of 3,000~6,000 and 21,000~24,000 NT\$ per month due to the reason that the income differs between full time and part time students. The online bookstores that are often used by the 150 survey respondents are buy.yahoo.com.tw (51/150), 24h.pchome.com.tw (46/150), books.com.tw (37/150), eslite.com (6/150), and other online bookstores (10/150).

Measurement Constructs and Question Items

The constructing question items in this research are referred from Bhattacharjee (2001a; 2001b) and other related articles (Li, 2003) (Ahn, et al., 2004), they adopt their operational definition to develop measurement question items, all of which are given in the appendix. The previous survey of the questionnaires in this research had been held for three weeks before the formal survey. 20 customers who had experiences of using online bookstore were invited as survey respondents to fill the questionnaire. The result shows that composite reliability (CR), average variance extracted (AVE) and factor loading are higher than the suggested degree of rate.

The questions of the questionnaire have been examined one by one by 2 information management professors and 3 doctoral candidates. The questions that were involved with ambiguous meaning, easily confusing or repetitious sentences have been corrected or revised, in order to elevate the content validity of the questionnaire. Seven-point Likert scales are used to measure each question and 1 is labeled as highly disagree, 4 is labeled as neutral and 7 is labeled as highly agree.

Data Analysis

This research adopts Smart PLS version 2.0 M3 as the statistical analysis instrument. Smart PLS is a graphical software for structural equation statistics that is similar to LISEREL. Comparing with LISEREL, Smart PLS is less restrictive in the request that variables must be at normal and random distribution. Also, when estimating the path coefficient, Smart PLS has fewer requirements about the sample size. The sample size of this research is 150 therefore; it is appropriate to adopt Smart PLS as the statistical analysis software.

Measurement Model Analysis

Under the consideration of the overall model, the purpose of measurement model analysis is both to test whether all measured variables have correctly measured its latent variables and whether they correspond with the complex measured variables under different circumstances. This research uses convergence validity and discriminate validity to represent construct validity. Convergence validity means using different measuring methods to measure variables from related variables, and it will be the measurement of the same object when the correlation degree is high; thus, the score of the measurement and the result should be the same. In a certain construct, the variance of measured variables should either be highly interpreted or that the measured variables should possess convergence, and the factor loading used in this research is between 0.7~0.9 and it also uses average variance extracted, AVE, to represent it (see Table 1). The factor loading scale of all questions in this research is shown in Table 2. The scale is between 0.703~0.904, all of which are higher than the suggested scale 0.70. Therefore, the convergence validity of this research is within an acceptable range.

Discriminate validity means the measuring of two different concepts, which is that no matter the same or the different method the researcher uses, the relating analysis after the result of

measurement shows that the correlation degree is lower. This research table is shown in Table 1. AVE scale is between 0.62 and 0.75, and the radical expression of any two constructs of AVE is larger than the coefficient relationship of these two constructs. Therefore, the discriminate validity of this research is within an acceptable range.

Table 1. Correlation of Constructs and AVE

	AVE	Constructs					
		Continuance Intention	Satisfaction	Perceived Usefulness	Informational Quality Confirmation	System platform Confirmation	Service Quality Confirmation
Continuance Intention	0.74	0.86	-	-	-	-	-
Satisfaction	0.68	0.43	0.82	-	-	-	-
Perceived Usefulness	0.68	0.50	0.43	0.82	-	-	-
Informational Quality Confirmation	0.69	0.38	0.45	0.45	0.83	-	-
System platform Confirmation	0.75	0.54	0.15	0.27	0.10	0.87	-
Service Quality Confirmation.	0.62	0.34	0.54	0.39	0.43	0.16	0.79

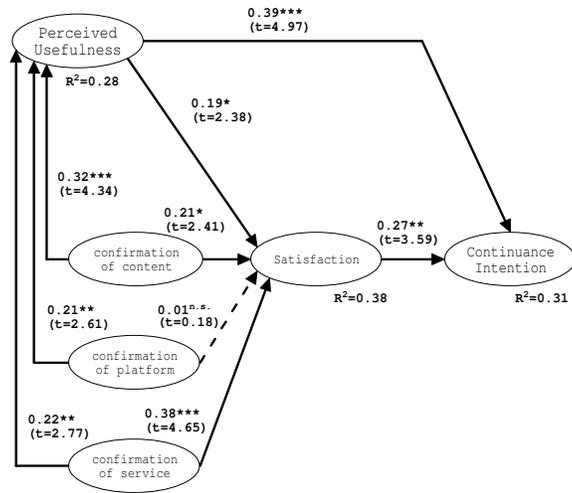
This research adopts composite reliability (CR) as the reliability measurement. The latent variables of CR is consisted by all measuring variable reliability, it indicates that the inner coherence of construct index and its suggesting scale is higher than 0.6 (Fornell and Larcker, 1981). High reliability means that there is high relation between the indices so that researchers will be confident to regard that the measuring item of this construct is coherent. The CR of this research construct (see Table 2) is in-between 0.87~0.90, all of which are higher than the suggested rate 0.6. Therefore, the CR of this research construct is within an acceptable range.

Table 2. Reliability Analysis of All Variables in Measured Model

Constructs	Item	Mean	STD.	Factor Loading	Composite Reliability
Continuance intention	CI1	5.25	0.96	0.873	0.89
	CI2	5.39	0.92	0.870	
	CI3	5.22	0.85	0.829	
Satisfaction	SAT1	5.15	1.01	0.808	0.90
	SAT2	5.01	0.98	0.853	
	SAT3	5.05	0.96	0.809	
	SAT4	5.05	0.98	0.830	
Information content confirmation	CON1	5.03	1.05	0.807	0.90
	CON2	4.97	1.06	0.856	
	CON3	5.13	0.90	0.820	
	CON4	4.89	0.82	0.842	
System platform confirmation	SYS1	4.82	1.04	0.822	0.90
	SYS2	4.78	1.10	0.904	
	SYS3	4.88	1.15	0.867	
Service quality confirmation	SEV1	5.09	1.04	0.820	0.87
	SEV2	5.17	1.07	0.806	
	SEV3	5.27	1.04	0.703	
	SEV4	4.98	0.98	0.833	
Perceived usefulness	PU1	4.92	1.03	0.814	0.90
	PU2	4.90	0.99	0.801	
	PU3	4.73	0.96	0.855	

Structural Equation Analysis

This research uses Structural Equation Model (SEM) to examine the proposed research model, and it adopts Smart PLS to make statistical analysis. Since PLS lacks the generation of overall goodness of fit index, it is represented only with the explained variance (R^2) of endogenous constructs, path coefficient between constructs and its statistical significance (see Figure 4).



*p<0.05, **p<0.01, ***p<0.001, n.s.=no significant

Figure 4. PLS Result of the Research Model

The variance explanation for continuance intention is 30%, the variance explanation for users' satisfaction rate is 38%, and the variance explanation for perceived usefulness rate is 28%. Of the nine proposed research hypotheses, only the satisfaction rate of systemic quality confirmation have not achieved an significant level, while the path coefficient of other eight hypotheses are in-between 0.19~0.39 and are statistically significant (p<0.01). Therefore, the model of this research can be accepted to make further analysis.

According to the adoption of Post-Acceptance Model, this research develops continuance purchasing books online model, and the testament shows that the influence of perceived usefulness and users' satisfaction with continuance intention are quite evident. The path coefficient ($\beta=0.39$) of continuance intention to perceived usefulness is larger than the path coefficient ($\beta=0.27$) of continuance intention to users' satisfaction.

Results

This result is different from the testament of Bhattacharjee (2001a; 2001b), which indicates that with the rapid development of e-stores, many customers already have mature online

shopping experiences. Therefore, the influences of continuance intention on the perceived usefulness of purchasing books online (the convenience, completeness and effectiveness) are higher than the influences on users' satisfaction. Moreover, the explanation of variance extent of continuance intention in this research (31%) is lower than the explanation of variance extent of Bhattacharjee (2001b) (41%). This indicates that the reasons of customers' repurchasing behavior may be more complicated through the influences of the development of e-stores and marketing strategies. Lin et al. (2005) regards that perceived playfulness is an important considering element for this cause. What's more, in the research, Yen and Tsai (2009) have deconstructed perceived usefulness as functional usefulness and social usefulness and added the concept of Web 2.0 into e-commerce. This is also the probable direction to promote the explanation of variance extent of continuance intention in the future.

Conclusions and Future Work

This research adopts Post-Acceptance Model as the base of the theory and uses IS success model of DeLone and Mclean (2003) to deconstruct the confirmation of Post-Acceptance Model. The result shows that systemic quality confirmation does not have evident influence on users' satisfaction; in other words, the website platform response rate, the easiness of using and the usability of website functions are more difficult in reaching a convergence concerning on the influence of user's satisfaction ($\beta=0.01, t=0.18$). This may be because those who have filled out the questionnaire have different opinions toward each e-bookstore platform, so it is worthy to make further study on the brand loyalty.

Carr (2003) indicated that IT changes swiftly concerning on the business operations' strategy. However, this advantage will be vanished if the IT had been imitated by competitors. Additionally, customers are gradually being dissatisfied with the platform functions that are

developed by e-stores using some other web techniques. The competition and imitation of website platform functions lower the uniqueness of web resources. With the concern of users' post-adoption behavior in purchasing books online, this study discovers that even though the confirmation of website platform shows influence on customers' rate of value, it, however, does not affect customers' rate of satisfaction. Therefore, under the premise of maintaining customers' satisfaction, it is suggested that companies should lay emphasis on elevating the service quality.

The deconstructing confirmation element of this research indicates that website service quality has more evident influence on users' satisfaction ($\beta=0.38$, $t=4.65$), and information content quality has more evident influence on perceived usefulness ($\beta=0.32$, $t=4.34$). Thus, this research suggests that the managers of e-bookstores need to specially recruit service staffs and operate valuable web contents after the website platforms are stabilized. Also, they should increase book commentary and book information and readers' interacting site in order to attract more customers to revisit.

With the more online purchasing experiences of Taiwanese, this research have not included the discussion of risk and trust problems of internet trading into the model. The main purpose of this research is to clarify the influence of continuance intention on perceived usefulness. This is also an issue that companies need to lay emphasis on. Even though low price is still the main promotion strategy for many e-stores, it will, nevertheless, not help the long-term continuance intention project, and the research also lacks the discussion of this issue. In this study, survey respondents are students of a polytechnic university. Although the result possesses reliability, it is still inadequate concerning the inference of external validity. As a consequence, the authors suggest that a larger scale of investigation can be made in the future under the circumstances of enough budgets and the cooperation of portal sites.

Appendix

Measurement Question Items

Continuance Intention:

- CI1. I tend to continually use e-bookstores rather than to discontinue the usage of it.
- CI2. My intentions are to continue using e-bookstores rather than using other alternative means.
- CI3. If I could, I would like to discontinue the usage of e- bookstores.

Satisfaction:

- ST1. I am satisfied with my decision on using e- bookstores.
- ST2. It is a wise choice for me to purchase books online.
- ST3. I am very delighted to purchase books online.
- ST4. I am satisfied with the usage of e-bookstores.

Confirmation of Information Context:

- CN1. The book information provided by e-bookstores fulfills my needs that are higher than I had expected.
- CN2. The book information provided by e-bookstores is more up-to-date than I expected.
- CN3. The book information provided by e-bookstores is more complete than my expectations.
- CN4. The book information provided by e-bookstores is more reliable than my expectations.

Confirmation of website platform:

- SY1. Every function provided by e-bookstores can always be properly used and is better than my expectations.
- SY2. The information shown on the screen of e-bookstores is faster than I expected.
- SY3. Every function provided by e-bookstores is easy to use and is better than my expectation.

Confirmation of Website Service Quality:

- SE1. Website services provided by e-bookstores being accomplished as scheduled and are better than I expected.
- SE2. Purchasing products on e-bookstores are trustable and are better than my expectation.
- SE3. E-bookstores actively assist customers in choosing and buying products and are better than my expectation.
- SE4. Particular requirements by different customers are being adequately taken care of and are better than my expectation.

Perceived Usefulness:

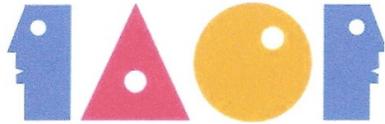
- PU1. It is more convenient for me to purchase books and other products online.
- PU2. E-bookstores' services allow me to find more products that conform to my interests.
- PU3. Using e-bookstores' services enhance my time arrangement effectively.

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THE RELATIONSHIP BETWEEN INTERIOR SPACE DESIGN AND
VISITORS' SATISFACTION: A CASE STUDY OF MALAYSIAN
MUSEUMS (INTERIOR CIRCULATION SCHEME)

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Abstract

The study examines how the interior environment of museums, interior circulation design quality, and visitors' satisfaction are related in the context of interior environment and space design of museums. This paper highlights a theoretical as well as practical key issue in the interior circulation and space design in museums in Malaysia. The research explores the interior circulation design that interacts with the interior environment and space planning in museums. This is to find the relationship between elderly visitors' satisfaction, interior space design and interior circulation design. This paper plans to answer the critical questions; what is interior circulation design? How do the interior space and circulation design of museums relate to the visitors' satisfaction? And what is the relationship between interior design quality and elderly satisfaction? This study is one of the few studies focus on elderly visitors and the interior circulation design of museums. The empirical analysis carried out on 509 of elderly visitors in the selected 21 museums in Malaysia allows us to confirm that the quality of interior circulation design and interior space design are the direct determinants of visitors' satisfaction. The results also find that there is a significant relationship between interior environment, elderly satisfaction and pre-expectation. Finally, the interior environment elements of museums such as lighting design, furniture arrangement and finishes materials are also considered.

Keywords: Interior Environment, Museums' Design, Interior Circulation, Elderly, Satisfaction.

Introduction

The purpose of this research is to investigate the visitors' satisfaction at museums in Malaysia. Therefore, this study is one of the few studies focus on the elderly visitors, the interior space design and the interior circulation design. So this research explores the relationship between elderly visitors' satisfaction, interior space and interior circulations design of the museums in Malaysia. It becomes a fact that the museums are the treasure-houses of the human race everywhere in the world. And the museums are the stores of the memories, cultures, dreams and hopes of peoples. Even though the definition of a museum is not finalized yet, Union of Great Britain Museums (1989), UGBM defines the Museum as "an institution which collects, documents, preserves, and exhibits and interprets material evidence and associated information for public benefit". At the same time the researchers agree that the success of a museum is in achieving the objectives of its formation. Therefore, a suitable museum is defined by the ability and success as shown by the activities carried out by independent objective functions and lines (UNESCO and Organisation 1973; Beirne 2003; UK Museum Association 2008; U.S. Department of Education and Institute of Education Sciences 2009; UK Standard 2010). Recently, a museum is not only the place to display or store collections, but a museum has become cultural centres and place for education (Black 2005). Moreover, the interior space design of the museum is the central issue for how the spaces and halls are connected, and how its interior circulation is solved. So, the interior circulation is the critical element of the museum design which gives the form and the shape to the building, and at the same time it differentiates between spaces and halls according to the functions. This is why, the interior designers must be careful to consider a proper hierarchy of halls and spaces that balance between aesthetic images and functional needs of visitors. This mission is crucial to the interior circulation design for a successful museum (Black

2005; Ambrose and Paine 2006). Therefore, it becomes a fact that the visitors' satisfaction in the museum is a very difficult mission to achieve. Moreover, Yalowitz (2002b) highlights that the visitors today have different expectations than those before decades. And with all these changes in museums and visitors, it is strongly advised to examine the visitors' experience, the expectations and the satisfaction. Recently the satisfaction of the visitors has become the key issue and one of the most important variables for museums (i.e., whether or not visitors are satisfied with their experiences). Consequently, if the visitors' attention and time are directed in ways that meet or exceed their expectations, they should leave feeling more satisfied. Visitors' satisfaction has been discussed widely in many articles (Boulding, Kalra et al. 1993; Bordass 1996; Oliver 1996; Brock 2007; Black 2008; Bolton 2010; Brock University Team 2010), but until now there is no agreement about the determinant variables that affected the visitors' satisfaction (Rojas and Camarero 2007). Moreover, several researches and studies (Babin and Griffin 1998; Baker and Crompton 2000; Balk, Zohreh et al. 2003; Babin, Lee et al. 2005; Babin, Lee et al. 2005; Banning and Schoen 2007; Baker 2008; Ballantyne, Packer et al. 2008) concentrated on describing the satisfaction by the evaluation of perceived quality (confirmation/disconfirmation theories) from their expectations (Rojas and Camarero 2007). In addition, there are no clear statistics or measurements about the elderly satisfaction inside the museums. In this context, we find out the possible positive or negative effects, to ensure the satisfaction of the elderly visitors. It is believed that the desired outcomes should be of assistance to designers and the others who are considering better ways for museums' design and industry in Malaysia.

Museums' Industry in Malaysia

According to Hasan (2006) the actual museum industry in Malaysia began in 19th century. Therefore, the first museum opened in 1883 by the British in Taiping, Perak, and that was before

the Malaysia Day. Then the national museum was established in 1907, which was known as *Selangor Muzium*. Hasan (2006) states that the national museum is considered as one of the prides of the nation and the most important museum in Malaysia. The current national museum is also called as *Muzium Negara*, and is still a part of the government institution, under the Ministry of Culture, Arts and Heritage Malaysia (Rahah Haji Hasan 2006). Taha (2008) figures out that the main function of all museums in Malaysia is to defend the national uniqueness and the heritage of the country. In addition, it is to instruct the public about it. Currently, in Malaysia there are thirteen states and each state has its own museum that displays the local materials, culture and heritage. At the same time there are over 50 museums in Malaysia that are managed by the federal and state government. It becomes a fact that the museums in Malaysia have contributed extremely to the success of the tourism industry in the country, locally and internationally (Taha 2008). Currently, the national museum, the rice museum and the Islamic art museum are good examples of that support and contribution. And this is why, the focus of these museums has exceeded beyond the museum walls (Rahah Haji Hasan 2006; Taha 2008). Moreover, the museums industry in Malaysia still faces the main and the hard challenge in how to strengthen the national unity with all the multi-cultural and the multi-racial society of Malaysia. Thus to build one state uniqueness in Malaysia, is critical, to ensure that the stability of the country and the harmony are not in danger. This is the reason why ,the Malaysian government exposes a big effort to inject millions of dollars into the museums industry (Taha 2008). In additions to all above, Malaysia government still considers the museums as semi academic and educational institutions (Rahah Haji Hasan 2006; Taha 2008). This issue was on the table during the first visit of Minister of Culture, Arts and Heritage, *Datuk Seri Utama* Dr Rais Yatim to the national museum in 2003, where he asked museums' managers to think freely and to move away

from the classic way of the museums' management and its exhibitions. He stated that Malaysia still needs a comprehensive development to be conducted in the museums in the areas of exhibition concept and design, displays, lighting and the use of interactive technologies to attract its visitors (Taha 2008). Recently, one of the challenges of the museums' industry in Malaysia is to further develop the relevant skills and the human resource. In this regard, the Ministry of Culture, Arts and Heritage has enacted a law which was recently passed by the Parliament to establish a learning institution pertaining to arts and heritage, and museum studies to be part of the curriculum of the institution (Rahah Haji Hasan 2006; Taha 2008).

Museums' Elderly Visitors and Satisfaction

Only few researches focused on the elderly satisfaction and museums' design. We have to know that elderly people are very interested in visiting museums, so based on Rogers' study (1998), most of the museums' visitors are ranged from 50 -70 ages (elderly). Another example is taking in a study for a botanical garden museum, where Hood and Roberts (1994) find out that the group with the largest attendance is aged 55 and older. This group account for one-third to one-half of the visitors on any given day. Rogers (1998) finds out that the elderly visitors have their own expectations concerning museums' interior design. Rogers also states that in order to use museum's resources in the most effective manner, museums need more studies to identify what factors to consider for the interior circulation and space design (Rogers 1998). Throughout the museums' basics there is a strong emphasis on the relationship between the museum and the people whom it serves. Through researchers' investigations (2009), one of the main problems highlighted in the museums in Malaysia, is the absence of interior design solutions for the elderly visitors. In the museums in Malaysia, elderly visitors are easy to get exhausted and tired. Moreover, elderly visitors have impaired mobility, and some of them use wheelchairs, but more

are simply walk slowly and painfully. Elderly visitors also may use sticks or simply find stairs difficult. In addition, many of the elderly visitors simply have poor eyesight, and for them it is important to design a proper interior space which can meet their satisfaction. Therefore, the suitability and the comfort level of the circulation and the space design for the elderly visitors must be considered in designing museums (Balk, Zohreh et al. 2003). To achieve that Malaysian government endorsed the Biwako Millennium Framework for Action (BMF). It proclaimed the extension of the Asian and Pacific Decade of Disabled and Elderly Persons, 1993-2002 (Meng 2009). The policy reflects the consequence of implementing barrier-free in order to accommodate involvement of disabled people and elderly in the society. Meng (2009) states in that the design strategy of the circulation design and space design for elderly visitors in museums in Malaysia needs to be ascertained (Meng 2009). In their study, Mohamed and Mustafa (2005) find out that the designers in Malaysia are often unfamiliar with the needs of the elderly users. Moreover, until now there is no source or study that can give a great information related to the elderly needs, capabilities, and abilities (Mohamed and Mustafa 2005). So, holding these sessions is a real challenge for several reasons, as these challenges involve adjusting for diversity of the older population and their physical and cognitive differences (Black 2008). This is because that the number of elderly people in Malaysia is likely to be 7 millions in the next twenty years (Department of Statistics in Malaysia 2009). An overview of the age-structure of the population for the past four censuses between 1970-2000 reveals a significantly decreasing proportion of population in the younger ages and a corresponding increase in the older age groups, indicating a continuing ageing trend in the coming years (Department of Statistics in Malaysia 2009).

Interior Circulation Design

The interior circulation design is a very important factor to consider, so Hsu (2004) recommends that, in order to design the museums properly, the interior circulation must be considered, and it must involve the creation of solutions for how movement in space/time will be resolved in the ultimate plan. Also Hsu highlights a very important issue that visitors of the museums may not be conscious of how their bodies and movement are in a dialogue with the building (Hsu 2004). Many researchers tried to define the interior circulation design of the museums. Black (2005) in his study defines interior circulation in buildings as:

They are all walking areas on all floors of a building required for physical access to some subdivision of space, whether physically bounded by partitions or not. Including Horizontal and Vertical circulation, which should be but is not limited to, public corridors, exhibition spaces, entrance foyers, elevator lobbies, tunnels, bridges, and each floor's footprint of elevator shafts, escalators and stairways. Also included are corridors, whether walled or not, provided they are within the outside facelines of the buildings to the extent of the roof drop line (Black 2005).

Beirne (2003) highlights and defines also the horizontal circulation as: “all walking areas on all floors of a building required for physical access to some space including the features like corridors, lobbies, verandas, porches, doors, entrance foyers, and balconies”. He also defines the vertical circulation as: “all walking areas and mechanical tools installed in all floors of a building required for vertical physical access to some space including staircases, ramps, elevators and escalators” (Beirne 2003). Finally Stephen (2009) in his study defines clearly the interior circulation within the buildings as:

A term describes how visitors make their way through the facility. What pathways do they take? Do visitors circulate the way the designers intended? Do visitors miss key exhibits because of the architectural design of the facility? Which direction do visitors turn when they reach choice points? Do visitors have a circulation strategy (e.g., "Turn right and follow the perimeter") or do they simply wander more or less aimlessly? (Stephen, 2009).

Currently, It has become a fact that visitors tend to be more satisfied when the interior space and the interior circulation are designed with full consideration of the factors that determine the circulation actions (Bitgood and Cota 1995). Therefore, the interior circulation elements should be adjusted and developed according to visitors' input and not exclusively by designers who may not be able to predict the impact of these elements on visitors (Griggs, 1983). It is very important to know that the efficiency of the interior circulation system in museums determined by the basic shape and form of the building itself. Moreover, The time needed by a visitor to move from one area in the building to another area and the enjoyment of doing this by visitors are affected by the building form and circulation style that is designed (Söderlund and Vilgon 1999; Springer-Heinze, Hartwich et al. 2003; Stephanie Clark Ridgway, Livingston et al. 2005; Sharma and Dhariya 2006; Shettel 2010). So the design of interior circulation elements such as stairs, corridors and mechanical circulation elements are very important issues for the interior designers. In addition to that, the quality of the building depends at first on the basic analysis of the interior circulation and its elements. So, the elements of circulation in buildings such as lifts and escalators, stairs and corridors differ in visitors' carrying capacity and their spatial and design requirements (figure1). Therefore, the interior designers must consider and match the characteristics of each element with those of the traffic generated in buildings (Bitgood and Thompson 1993; Bitgood 1999; Bitgood 2005). According to S. Bitgood (2010) there are two main types of interior circulation: the horizontal circulation and the vertical circulation. The horizontal circulation describes how visitors make their way through the facility in the same floor by using circulation elements. It is simply all walking areas on all floors of a building required for physical access to the spaces including the features like corridors, lobbies, verandas, porches, doors, entrance foyers, and balconies. But the vertical circulation describes how visitors make

their way in the building between different floors and levels using the circulation elements. It is simply all walking areas and mechanical tools installed in all floors of a building required for vertical physical access to the spaces including staircases, ramps, elevators and escalators, (Figure 2) (Bitgood 2010). In addition, the vertical and the horizontal circulations are considered as part of the form of the interior space that affects generally the visitors' movement in the museums, (Figure 3). Also, the location of the corridors, the staircases and its design, width and slope have to be considered in the overall design steps, because they affect the visitor's perception of the space and the level of visitor's satisfaction (Bitgood 2010). Ching (2004) discusses in details the interior circulation design and the configurations of the interior path, as he states that:

All paths of movement, whether of people or services are linear in nature. And all paths have a starting point, from which we are taken through a sequence of spaces to our destination. The contour of path depends on our mode of transportation. While we, as pedestrians, can turn, pause, stop, and rest at will (Ching 2004).

According to Ching, there are many types of circulation paths in buildings, (Figure 5) (Ching 2004). Furthermore, Kaynar (2010) points out that, designers must meet the circulation function of the building, and the architectural design should embrace appropriate space to house and to improve visitors' circulation from area to area (Kaynar 2010). According to Hsu (2004), this includes at least five aspects: approach, entrance, configuration of the path, path/space relationship and form of the circulation space (Figure 6). Ching (2004) describes clearly the relationship between pathway design and people. And he states that, people move in time through a sequence of spaces, so the circulation pathway can be considered as links between spaces in the building itself. He highlights that the people experience the space in relation to where they have been and where they anticipate going (2004).

Research Hypotheses

The design quality in any building can be defined from two perspectives: technical quality (what is delivered to the visitors and users) and the functional service quality (how it is delivered) (Rojas and Camarero 2007; Pile 2010). But Brady and Cronin (2001) figure out that the design quality can be outlined by three perspectives: a) outcome quality, b) interaction quality, and c) physical environment quality in the building. Where the environment quality refers to the ambient conditions (Rojas and Camarero 2007). Oliver (1997) states that the visitors' interpretation is related to the level of their expectations, so according to (Rojas and Camarero 2007) the expectation is known as previous prediction or belief of the visitors before they enter the building. Furthermore, based on Rojas & Camarero (2007) the expectations are shaped by several sources of factors and information such as, communication, advertising, word of mouth referrals, or experiences. So even for the visitors without experience they still have their own expectations about the design itself (Rojas and Camarero 2007). Based on Oliver (1997), the quality of design is completely based on the perceptions of excellence. So, it becomes a fact that visitors use their expectations to evaluate the design quality and the performance. Therefore, researchers propose the first hypothesis as:

H1. The visitors' expectations positively influence the visitors' perception of interior design quality and interior environment of museums.

Recently, design quality is the right judgment exposed by visitors who estimating the quality level of design. So, the satisfaction and the design quality are highly interrelated (Rojas and Camarero 2007). Researchers accept the theory said that the quality leads to satisfaction. Olsen (2002) approves with evidence that visitors' satisfaction is preceded by perceived quality (Rojas and Camarero 2007). Also, in the field of museums and visitors' satisfaction, there are

some studies agree that the design quality happens prior to visitors' satisfaction (Rojas and Camarero 2007). On this basis, we propose the second hypothesis:

H2. The interior circulation design (overall) of museums positively influences the elderly visitors' satisfaction.

Furthermore, the disconfirmation happens when the interior circulation design is lower or higher than what visitors expected after they made the final decisions (Oliver 1996). The visitors create negative or positive implications for the experience of service or design and its evaluation (Rojas and Camarero 2007). So, if the interior design of the museum is higher or lower than the visitors' expectations, a positive or negative disconfirmation occurs and this will increase or decrease the level of satisfaction. According to Oliver (1996) the visitors' satisfaction is a function of expectations and disconfirmation, as the prior expectations are used as the comparable standard (Oliver 1996; Rojas and Camarero 2007).

Methodology

In order to test the proposed hypotheses, the empirical study performed is based on the information collected by means of a questionnaire presented to visitors of 21 museums. The 21 museums are located in Kuala Lumpur, Terengganu, Selangor and Kedah in Peninsular Malaysia. After preceding the quantitative study of the museums, interviews and observations (qualitative study) conducted for some of the selected museums. Interviews with the visitors were performed in order to know visitors' reactions and emotions during their visits. A questionnaire was developed to test the aforementioned hypotheses. The questionnaire was divided into two parts. The first part covered the experience, mood and the expectations before the visit. The second part referred to the design quality, the disconfirmation of expectations, the pleasure and the

satisfaction after or during the visit. The first survey was conducted during the months of July to October 2009 and the total number of questionnaires collected was 509. A second set of data was collected through observations and interviews during October, and November 2009, providing valid data for analysis. Of these 800 questionnaires, 613 were returned. One hundred and four questionnaires were excluded (40 incomplete and 64 the age of participants were under 65 years old). All elderly visitors above 65 were chosen to answer the questionnaire for every museum. The total numbers of questionnaires analysed were 509 questionnaires with observed response rate of 76.6%. Analysis was conducted using the statistical software package SPSS version 17.0 with a sample size of 509, α (the probability of making a correct retention is 0.95) = 0.05, df (degree of freedom) = 1.0.

Of the 509 respondents, 290 were men (57.4%) and 215 were women (42.6%). Three hundred and forty eight visitors (69.3%) were 65-70 years old, One hundred and forty eight visitors (29.7%) were equal or more 71 to 90 years old. Of the 509 respondents, 271 (53.9%) were locals, and 229 (45.5%) foreigners. Of the locals, 162 were Malay (32.2%), 61 were Chinese (12.1%), 76 were Indian (15.1%). Indicating that the Malay visitors are more interested in visiting museums than others. Of the 509 Participants, only 43 (8.5%) of the elderly visitors came alone to the museum, while 212 (42.1 %) came with friends and 185 (36.7%) came with their families. The rest of participants 60 (11.9%) visited museums with organizations. Regarding the second part of questionnaire, the scale of expectations is constructed of five items adapted from the scale proposed by (Rojas and Camarero 2007) and also applied to the case of museums and exhibition centres. In addition, the scale of the perceived quality (six items) was prepared from the proposal of Brady and Cronin (2001). All of the items of expectations were adapted to reflect the context of interior circulation in museums. The results of the responses (either agree or disagree) were

presented under the check-list of three factors: a) horizontal circulation design, b) vertical circulation design, and c) interior environment. In the horizontal circulation items, the results of the responses (either agree or disagree) were presented under the check-list of six factors based on the component analysis: horizontal accessibility, halls' arrangement and spaces, corridors and entrance lobbies, waiting areas, orientation system, furniture arrangement and interior layout. At the same time, in vertical circulation design, the results of the responses (either agree or disagree) were presented under the check-list of three factors based on the component analysis: vertical accessibility, position, visibility and capacity of lifts, ramps and staircases, and interior paths and circulation. While in the interior environment items, the results of the responses (either agree or disagree) were presented under the check-list of four factors based on the component FA analysis: creativity and interior environment, interior materials and textures, interior lights and interior colours. Table 1 shows the result of factors analysis for each category. To measure satisfaction (five items) the Oliver (1996) scale was used and included additional items that measured the intention to repeat the visit and word-of-mouth recommendations. All scales were validated the values of reliability were calculated by the Cronbach alpha in each case.

Analysis and Results

The first hypothesis (H1) states that there will be no significant relationship between elderly visitors' expectation and design's perception. The correlation coefficient is $-.083^{**}$. Where the result in the table 2 suggests that the significant relationship does not exist (Sig= 0.061); therefore, this can be concluded from the result that the elderly visitors' expectations before they enter the museum don't determine or affect the elderly visitors' perception of the design quality of the interior circulation in the museums, thus H1 is disconfirmed. The second hypothesis (H2) states that there will be a significant relationship between the elderly visitors'

satisfaction in the museums and the quality of interior circulation design. As shown in table 2, the correlation coefficient is 0.685**. Sig (2-tailed) or P value is $0.000 \leq \alpha 0.05$. This can be concluded from the results that there is a positive significant relationship between the elderly visitors' satisfaction in the museums and the interior circulation design. Thus H2 is confirmed that the interior circulation design and space design of the museums affect the level of the elderly visitors' satisfaction. Results also state that there will be a positive significant relationship between elderly visitors' satisfaction, and time spent in the museums. The correlation coefficient is 0.404**. Where the results state that a significant relationship exists, therefore, this can be concluded that the time spent in the museum is influenced by the elderly visitors' satisfaction.

So, time spent in the museums is considered as a good indicator of visitors' satisfaction. Looking at all the scores in the data, it is overwhelmingly clear that in the factors, the respondents have until today a far greater negative perception towards the interior circulation and space design of the museums in Peninsular Malaysia. Such a negative weak perception of the interior circulation design in the museums in Malaysia is an expression of their dissatisfaction level in the interior space design and the interior circulation of the selected museums. For the overall findings, the results present the summary of the overall composite averages as in Table 2. Where, in the three categories, the respondents have scored 41.03 % < 50% for qualitative and 43.26 % < 50% for quantitative analysis, suggesting a clear feeling of dissatisfaction towards the interior circulation design and the interior environments of the selected museums.

Discussion and Conclusions

This study began with the aim of analyzing a specific aspect of interior design applied to the museums in Malaysia, and the formation of visitors' satisfaction. The first implication of this research is the disconfirmation and confirmation of hypotheses due to the high validity and

explanatory power. In particular it is found that the respondents selected from the museums in Malaysia have high level of expectations towards the interior circulation design and interior environment of the selected museums. This study found that the interior circulation design's quality appears to be multidimensional, and it is consisting of different three dimensions: the horizontal circulation design, the vertical circulation design, and the interior environment design of museums. Under each dimension there are many different components, for example, under the horizontal dimension there are seven factors: the horizontal accessibility, the halls' arrangement and spaces, the corridors and entrance lobbies, the waiting areas, the orientation system, the furniture arrangement and the interior layout. At the same time, under the vertical dimension there are six components: the vertical accessibility, the position, the visibility and capacity of lifts, the ramps and staircases, and the interior paths and circulation.

While under the interior environment and space dimension there are four components: the creativity of interior environment, the interior materials and textures, the interior lights and interior colours. The scores from the survey have demonstrated overwhelmingly same low perceptions and bad expression about the interior circulation design and space of museums in Malaysia. These negative perceptions of the circulation design's quality in museums together with the positive and high expectations of the elderly visitors compositely justify the low level of general satisfaction with the museums in Malaysia. The interesting finding was the idea that interior circulation design must be good, as a high percentage of the elderly visitors find it useful and can enhance their satisfaction level. Yet, little thought seems to have been given to what interior circulation is, what is necessary to achieve visitors' circulation efficiency, and what benefits can be expected. From site investigations and empirical studies done in this research, it is found that interior designers of the museums in Malaysia have not considered effectively the

interior circulation design of elderly visitors. In sum, the museum design is likely to be more successful if the principles of interior circulation design and interior environment are applied to the design process. So the elderly visitors learn more and are to be more satisfied when they are properly circulated and oriented to an exhibition and when the exhibition is designed with an understanding of their needs and abilities. This will require us to re-think again about the interior circulation design's quality of the museums in Malaysia. At the same time, the interior circulation design could be the trend in museums and visitors' studies in the future, so more studies of this nature should be carried out. However, the interior designers are invited to continue these initial investigations of interior circulation design quality and interior spaces of museums, especially in new areas of design where we knew our user elderly preferences, needs and abilities. Therefore, the interior circulation elements are a design strategy, a success value and quality indicator of museums' design.

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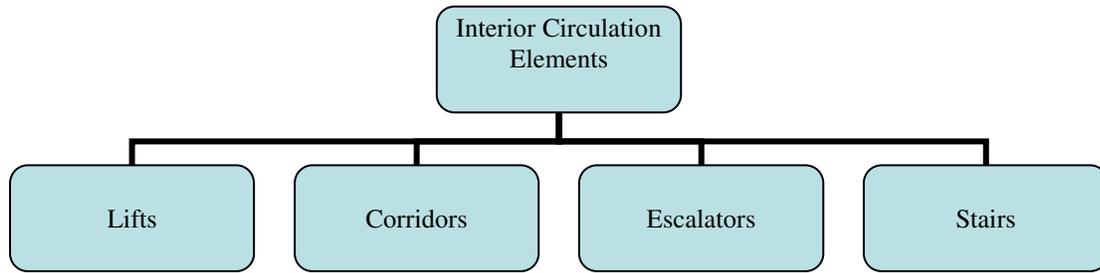


Figure 1: Elements of interior circulation design.

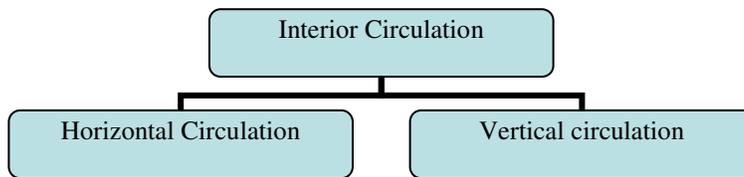


Figure 2: Types of Interior Circulation.

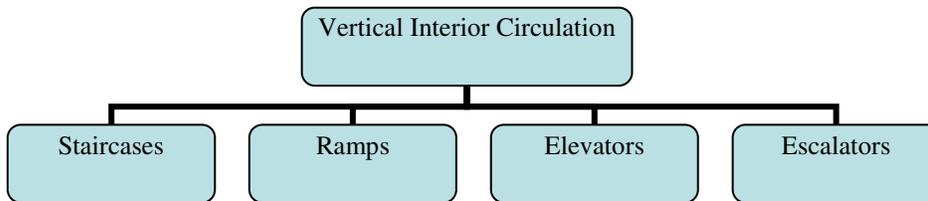


Figure 3: Design Elements of Interior Vertical Circulation System.

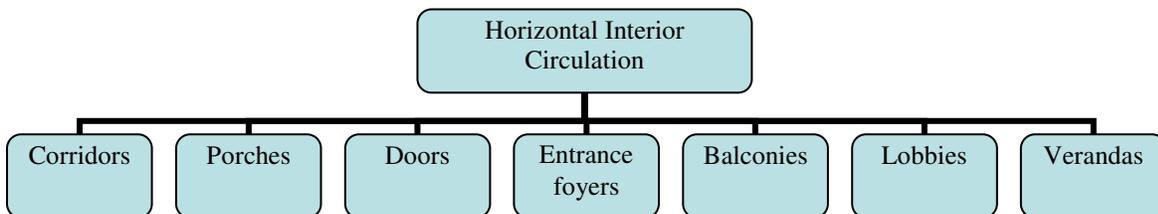


Figure 4: Design Elements under Horizontal Interior Circulation System.

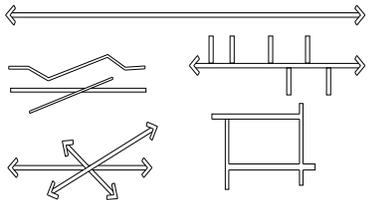
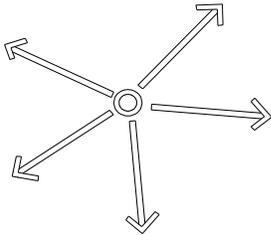
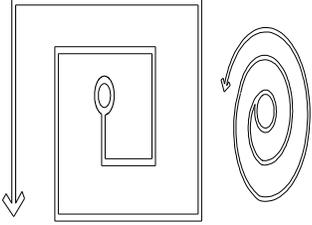
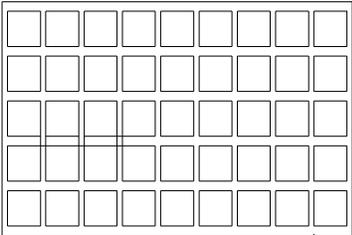
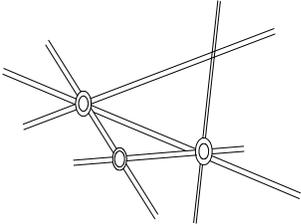
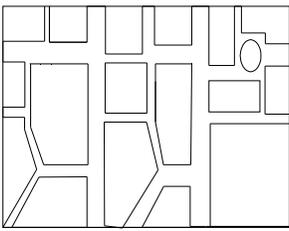
		
Linear Circulation Path.	Radial Circulation Path.	Spiral Circulation Path.
		
Grid Circulation Path.	Network Circulation Path	Composite Circulation Path.

Figure 5: Types of circulation paths within buildings (Ching 2004).

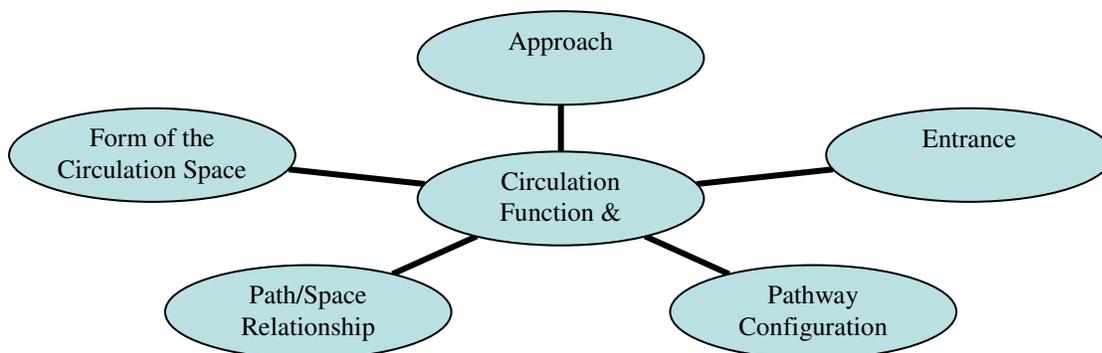


Figure 6: Components of circulation function & design within museums.

Table 1: Correlation between Expectation, Satisfaction and Circulation Design Quality.

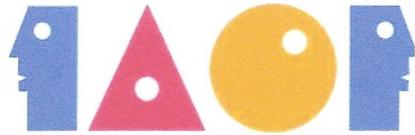
	Overall Expectation.	Overall Circulation Design Quality.
Overall Expectation.	1	
Sig. Value		
Overall Circulation design quality.	<u>-.083-</u>	1
Sig. Value	<u>.061</u>	
Overall elderly visitors' Satisfaction.	<u>-.495-^{**}</u>	<u>.685^{**}</u>
Sig. Value	<u>.000</u>	<u>.000</u>

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

* . Correlation is significant at the 0.05 level (2-tailed)

Table 2: Overall Composite Averages (Satisfaction scores) of all Categories.

Categories of factors	Selected Museums	
	"Satisfactory" scores from Qualitative survey (yes)	"Satisfactory" scores from Quantitative survey
Vertical circulation design	<u>42.33 %</u>	<u>44.33 %</u>
Horizontal circulation design	<u>41.12 %</u>	<u>44.12 %</u>
Interior environment	<u>39.66 %</u>	<u>41.33 %</u>
Overall composite average	<u>41.03 %</u>	<u>43.26 %</u>



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ORDER- PICKING ALGORITHMS FOR A MAN-ON-BOARD AUTOMATED STORAGE AND RETRIEVAL SYSTEM

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Abstract

The automated storage and retrieval system adopts a first-come-first-serve method for order-picking. Because this method takes more time to handle the material, several improvements can be made for order-picking operations. This paper deals with an order-picking problem in a man-on-board automated storage and retrieval system (MOB AS/RS). The results indicate that the proposed heuristic algorithm can efficiently improve order-picking operation. Through computer simulation, we illustrate that the heuristic proposed in this paper enhances order-picking efficiency.

Keywords: Order picking, Man-on-board AS/RS, Economic convex hull

Introduction

In a distribution warehouse, efficient order-picking is important. Coyle et al. (1996) manifested that order-picking operations account for approximately 65% of the total operating cost of a warehouse, and travel time accounts for roughly 50% of all order-picking operations (Vaughan and Petersen, 1999). The manager is therefore interested in finding the most economical picking operation and reducing the distance travelled and time spent (Bozer and White, 1984).

The Automated storage/retrieval System (AS/RS) reduces the requirements of land and human resource in the logistics center. In addition, AS/RS promotes efficiency of the logistics center. A typical AS/RS performs regular order-picking operations based on first-come-first-serve (FCFS). The FCFS is simple in applications. However, it may not be an efficient approach.

Order-picking sequence is the major influence on picking cost and time. The limitation of the order-picking sequence can be recognized as travelling salesman problems (TSPs) (Hwang, Baek and Lee, 1988). As a NP-hard problem, it is extremely difficult to obtain optimal solutions for large-scale obstacles within a tolerable computation time.

Several researchers have attempted to find the shortest distance by re-arranging the order-picking sequence (Hwang and Song 1993; Majakam et al. 1998; Daniels 1998; De Koster and Poort 1998; De Koster et al. 1999; Chew and Tang 1999; Vaughan et al. 1999; Malmborg 2001). Hwang and Lee (1988) developed clustering algorithms for order-picking in a man-on-board automated storage/retrieval system (MOB AS/RS). Their investigation operated under the premise that by not increasing a trip, the picker can move the biggest district, called the economic convex hull. According to the economic convex hull, the action measures a similar degree to conduct the batch merger. Pan and Liu (1995) considered a combination of four varied

seed algorithms and four order batch methods. This research pointed out that the order batches that merge with the economic method convex hull algorithm are the best in spite of the four seed algorithms. This paper evaluates the order-picking problem under the MOB AS/RS environment to prove that the economic convex hull as the best approach to solve a small order problem. We aim at this characteristic development to inspire heuristics.

Problem Formulation

A man-on-board (MOB) automated storage/retrieval system is a picker-to goods in-aisle order picking system where inventory items are stored in bulk. In this system, MOB retrieves in less than one unit load by a picker on a storage/retrieval (S/R) machine. Applications of the MOB system include distribution centers and spare part warehouses. This study makes the following assumptions.

- (1) It only considers the pick sequence of order, and not order batching.
- (2) The MOB system has a double-sided storage rack. For each storage or retrieval operation, the moving distance from starting point to either is the same. Therefore, the double-sided problem can reduce to a single sided problem.
- (3) The starting and ending point of the MOB system is located at the bottom left-hand corner, also recognized as the origin point (0, 0). The position of each storage slot is represented by x and y coordinates.
- (4) The MOB system travels in both vertical and horizontal directions simultaneously at constant velocities, recognized as Tchebychev travel. The AS/RS typically possesses two independent motors that allow movement in both horizontal and vertical directions simultaneously. Therefore, the critical distance is decided by the maximal distance in the vertical or horizontal direction. This movement is called Tchebychev travel (Bozer and White, 1984).

- (5) Each storage slot is the same size and can accommodate only a single item.
- (6) Location of each storage slot is represented by the center point of each storage slot.

The following notations are used in the model development:

n = Number of storage slots in column (x-axis), one slot requires one unit distance

m = Number of racks in row (y-axis), one slot requires one unit distance

K = Total items to be picked up in one order, $k = 1, 2, \dots, K$

$i, j = 0$ represents origin point

$X_{i,j} = 1$, if location of item j is visited immediately after location of item i . Otherwise, $X_{i,j} = 0$.

x_i : The coordinate of location i on X axis

y_i : The coordinate of location i on Y axis

$T_{i,j}$: Moving time from slot i to slot j

V_x : Speed of horizontal movement (in x-axis direction) of S/R machine

V_y : Speed of vertical movement (in y-axis direction) of S/R machine

Q : A set of to-be-picked items in one order, and $Q \neq \phi$.

Minimize

$$Z = \sum_{i=0}^K \sum_{j=0, j \neq i}^K X_{i,j} T_{i,j} \quad (1)$$

Subject to

$$\sum_{i=0}^K X_{i,j} = 1 \quad j = 0, 1, 2, 3, \dots, K \quad (2)$$

$$\sum_{j=0}^k X_{i,j} = 1 \quad i = 0, 1, 2, 3, \dots, K \quad (3)$$

$$\sum_{i \in Q} \sum_{j \notin Q} X_{ij} \geq 1 \quad i, j = 1, 2, 3, \dots, K \quad \text{and} \quad i \neq j \quad (4)$$

$$T_{i,j} = \max \left[\frac{|x_i - x_j|}{V_x}, \frac{|y_i - y_j|}{V_y} \right] \quad (5)$$

$$X_{i,j} = 0 \text{ or } 1 \quad i, j = 1, 2, 3, 4, \dots, nm \text{ and } i \neq j \quad (6)$$

The objective function, equation (1), minimizes total moving time of the order picking tour. Equations (2) and (3) ensure that each arc in the tour has exactly two endpoints *i.e.* one on either side of the arc. Equation (4) ensures no subtours. A feasible solution must only have one tour connecting all the points required in the order. Equation (5) indicates the calculation of the traveling time. In equation (6), $X_{i,j}$ takes on binary values, *i.e.* 0 or 1, depending on whether or not location of item j is visited immediately after location of item i in the order picking sequence.

Given the value of each $X_{i,j}$, the total distance travelled in tour from item i to j , can be determined using a travelling salesman algorithm. Although optimal algorithms exist for solving the TSP or TTSP, they are generally not preferred because they are both known to be NP-complete. In addition, the order-picking problem occurs in high frequency. A quick solution is required in real world situations; therefore, heuristic algorithms are more attractive in solving the order-picking sequence problem (Goetschalckx et al., 1988).

A Heuristic Approach

We study the order-picking problem in a MOB AS/RS and determine that the order-picking of the economic convex hull is the best solution in small orders. Section 3.1 simplifies the characteristic of the economic convex hull and section 3.2 is the heuristic algorithm that uses the economic convex hull characteristic.

Economic Convex Hull

The economic convex hull is divided into three districts. The moving distance will not increase while increasing the number of picking times in each district. We indicate all the

cardinal points of picking on the coordinates axis first. The economic convex hull running parallel moves, is surrounded by three dotted lines and the X-Y axis, shown in Figure 1. P1, P2, and P3 are the boundary points selected from all numbers picking items. The dotted lines with P1 and P2 slope in s ($s = \arctan(Vx / Vy)$). The other dotted line with the P3 slope is

$$-s \text{ (} -s = -\arctan(Vx / Vy) \text{)}.$$

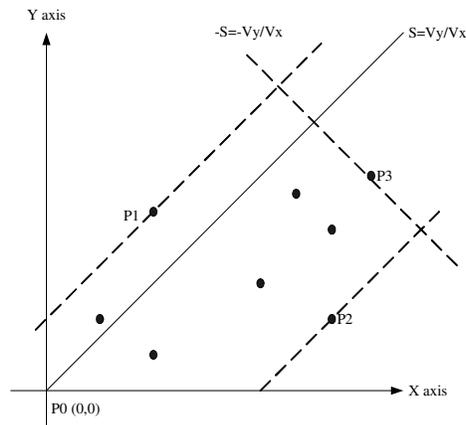


Figure 1. The economic convex hull

The economic convex hull is divided into three areas: A, B, and C. The A-area is surrounded with slope s through P1, slope $-s$ through P1, and slope s through the origin. The B-area is surrounded with slope s through P2, slope $-s$ through P2, and slope s through the origin. The remaining economic convex hull is the C-area. Figure 2. graphically represents the economic convex hull.

When increasing an item in the same area, the picking time cannot increase. The reasons are as follows. For deducing convenience, suppose that the S/ R machine moving at horizontal and vertical speed is equal ($s = 1$).

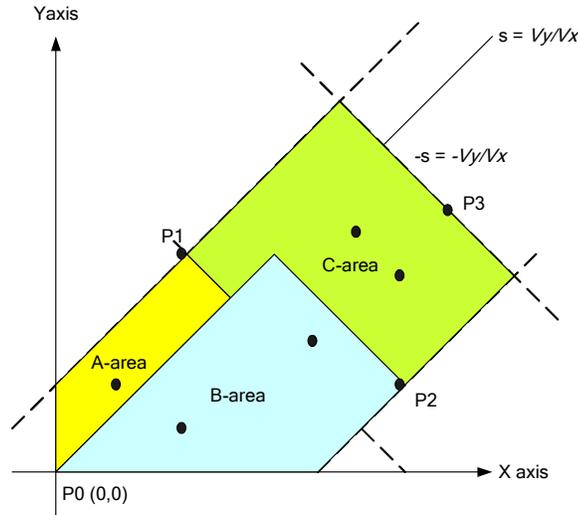


Figure 2. Divided economic convex hull into three areas

In the A-area, the P1 coordinates are (x_j, y_j) . Given any point P_i within area A, the coordinates are (x_i, y_i) in the A-area. The distance between the original point $P_0 (0,0)$ and point $P_1 (x_j, y_j)$ can be defined in equation (7).

$$d_{P_0, P_1} = \max\{x_j, y_j\}$$

∴ P_1 located above the S axis, indicates $y_j \geq x_j$.

$$\square d_{P_0, P_1} = y_j \tag{7}$$

$$d_{P_0, P_i} = \max\{x_i, y_i\}$$

∴ P_i located above the S axis, indicates $y_i \geq x_i$.

$$\square d_{P_0, P_i} = y_i \tag{8}$$

Equation (8) shows that the distance from the origin to any slot $P_i (x_i, y_i)$ in A-area is equal to y_i .

$$d_{P_i, P_1} = \max\{|x_i - x_j|, |y_i - y_j|\}$$

□ P_i located in the A-area, indicates $y_i \leq x_i + b$, and $y_i \leq -x_i + b'$.

$$\square y_i - b \leq x_i \leq -y_i + b' \quad (9)$$

□ P1 (x_j, y_j) is an edge point.

$$\square y_j = x_j + b \quad (10)$$

$$\square y_j = -x_j + b' \quad (11)$$

$\therefore |x_i - x_j| \geq 0$, Then $x_i - x_j$ is determined as follows:

1. if $x_i - x_j \geq 0$ then $|x_i - x_j| = x_i - x_j \geq 0$

By equation (9), (10), and (11), we know that:

$$y_i - b - y_j + b \leq x_i - x_j \leq -y_i + b' - b' + y_j$$

$$y_i - y_j \leq x_i - x_j \leq -y_i + y_j$$

$$\therefore x_i - x_j \geq 0 \quad \therefore 0 \leq x_i - x_j \leq -y_i + y_j \quad (12)$$

$$\therefore y_i \leq x_i + b \quad \therefore |y_i - y_j| = y_j - y_i \quad (13)$$

By equation (12) and (13), we know that: $0 \leq x_i - x_j \leq y_j - y_i$.

Therefore, $d_{P_i, P_1} = \max\{|x_i - x_j|, |y_i - y_j|\} = y_j - y_i$ and

$$d_{P_0, P_i} + d_{P_i, P_1} = y_i + y_j - y_i = y_j = d_{P_0, P_1}$$

2. if $x_i - x_j \leq 0$ then $|x_i - x_j| = x_j - x_i \geq 0$

By equation (9), (10), and (11), we know that:

$$-y_i + b + y_j - b \geq x_j - x_i \geq b' - y_j + y_i - b'$$

$$-y_i + y_j \geq x_j - x_i \geq -y_j + y_i$$

$$\therefore x_j - x_i \geq 0 \quad \therefore -y_i + y_j \geq x_j - x_i \geq 0 \quad (14)$$

By equation (13), and (14), we know that $-y_i + y_j \geq x_j - x_i \geq 0$.

Therefore, $d_{P_i, P_1} = \max\{|x_i - x_j|, |y_i - y_j|\} = y_j - y_i$ and

$$d_{P_0, P_i} + d_{P_i, P_1} = y_i + y_j - y_i = y_j = d_{P_0, P_1}.$$

No matter whether joining any slot $P_i(x_i, y_i)$ from the origin to slot $P_1(x_j, y_j)$, the moving distance cannot increase. The B-area and C-area prove to be similar to the A-area.

Heuristic Algorithm

Known by the section 3.1 deduction that it joins any need to pick up the item in the same area, the pick time (and distance) is the same. Thus, the economic convex hull is divided into the three A, B, and C districts to establish order within path planning. The heuristic procedure is summarized as follows. We use an example to explain the algorithm.

Example: There are seven items to pick in the order. The pick-up material coordinates are shown in Table 1 and assume $V_x = V_y$.

Table 1. Example

No.	Coordinate	$b (y = x + b)$	$b' (y = -x + b')$	Notes	Region
1	(3,5)	$5 = 3 + b; b = 2$	$5 = -3 + b'; b' = 8$	b Maximum P1=(3,5)	A-area
2	(9,6)	$6 = 9 + b; b = -3$	$6 = -9 + b'; b' = 15$	b' Maximum P3=(9,6)	C-area
3	(8,2)	$2 = 8 + b; b = -6$	$2 = -8 + b'; b' = 10$	b Minimum P2=(8,2)	B-area
4	(2,3)	$3 = 2 + b; b = 1$	$3 = -2 + b'; b' = 5$		A-area
5	(4,5)	$5 = 4 + b; b = 1$	$5 = -4 + b'; b' = 9$		C-area (C1-area)
6	(10,4)	$5 = 10 + b; b = -6$	$4 = -10 + b'; b' = 14$		C-area (C2-area)
7	(5,1)	$1 = 5 + b; b = -4$	$1 = -5 + b'; b' = 6$		B-area

Step 1: Find the Boundary points, access the economic convex hull.

Calculate the $b (y = x + b)$ and $b' (y = -x + b')$. The P1 is the biggest in the b . The P2 is the smallest in the b , and the P3 is the biggest in the b' .

The boundary points of this example are listed as follows: No.1 is P1. No.2 is P3. No.3 is P2.

Step 2: The economic convex hull is divided into the three A, B, and C areas.

The A-area is round by $y \leq x + b_{p1}$, $y \leq -x + b'_{p1}$ and $y \geq x$ of the area. The B-area is round by $y \geq x + b_{p2}$, $y \leq -x + b'_{p2}$, and $y < x$ of the area. The C- area reduces the district that the A- area and B- areas leave for the economic convex hull.

Regarding the example, the A-area is round by $y \leq x + 2$, $y \leq -x + 8$, and $y \geq x$ of the area. The B-area is round by $y \geq x - 6$, $y \leq -x + 10$, and $y < x$ of the area. The C-area = the economic convex hull - (A-area) - (B-area). The result of this step is presented in Figure 3.

Step 3: Arrange the items to pick in the A-area.

Be located the material of the A- area picks up to take sequence as according to the y-axis by small go to greatly.

About the example, the sequence of the order pick is from N0.4 to N0.1.

Step 4: Arrange the items to pick in the B-area.

Be located the material of the B- area picks up to take sequence as according to the x-axis by big go to small.

About the example, the sequence of the order pick is from N0.3 to N0.7.

Step 5: The C-area district is divided into C1 and C2 areas.

The algorithm divides the C-area into two districts according to the parallel $y=x$ and passing P3. The area on the left is C1 and the other is C2.

For this example, C1 and C2 areas are indicated in Figure 3. Picking item within C1 is No.5. Picking item within C2 is No.6.

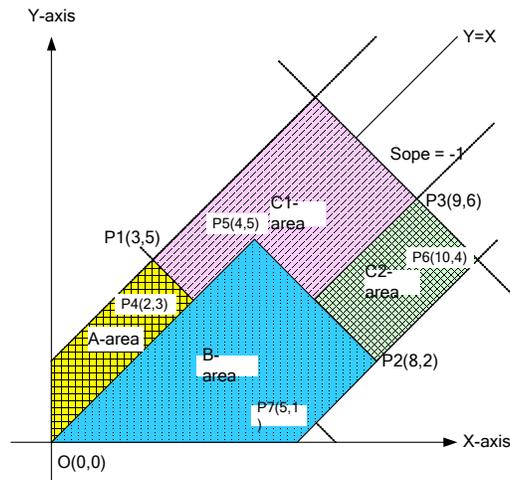


Fig. 3 The region of C1-area and C2-area

Step 6: Arrange the items to pick in the C-area.

We discuss how to direct items into the C1-area and C2-area. The items that are located in the C1-area pick up the sequence as according to the b' by small go to greatly. For the C2-area, these items pick up the sequence as according to the b' by big go to small.

About the example, the sequence of the order pick is from No. 5 to No. 2 (P3) and No. 6.

Step 7: The pick sequence of items in the order.

The order is picked as the following area: (A-area) \rightarrow (C1-area) \rightarrow (C2-area) \rightarrow (B-area)

For example, the picking sequence in the order is N0.4 \rightarrow N0.1 (P1) \rightarrow N0.5 \rightarrow N0.2 (P3) \rightarrow N0.6 \rightarrow N0.3 (P2) \rightarrow N0.7.

Experimental Results

To investigate the performance of the heuristic, the following experiment was conducted with the data set:

Experiment 1:

The order picking quantity is 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, and 60. Each size randomly generated 50 orders. There are 50 storage slots in x-axle ($m=50$) and 30 storage slots in y-axle ($n=50$). The total storage slots are 300 ($50*30*2$). This experiment includes into FCFS, Simulated annealing (SA) and heuristic three kinds and choose way of fetching. The design parameters of the SA algorithm are indicated as follows: starting temperature 200, cooling temperature $\alpha(T)=0.9897$, and ending temperature 0.0001.

Table 2. shows the simulation results. The results show that for any order fetch quantity to pick, the heuristic solution is superior to FCFS. The results of SA and the heuristic algorithm gain are close, with an average difference of 3.50%. However, the heuristic algorithm execution time is superior to SA.

Experiment 2:

The order pick quantity is 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, and 60. Each size randomly generated 50 orders.

There are 50 storage slots in x-axle ($m=50$) and 30 storage slots in y-axle ($n=50$). The total storage slots are 300 ($50*30*2$). The purpose of this experiment is to understand the relation between order size and the economic convex hull. Divided into three kinds of economic convex hulls, Table 3. shows the association content.

Table 4. shows the simulation results. Distance is influenced by order size changes. This violates the assumptions of Hwang and Lee (1994) that order size changes in the same economic

convex hull will not increase travel time. In addition, for the same size of order, the economic convex hull is larger and the order picking time is greater.

Table 2. The average traveling time of the same problem's size

Problem size	(1) FCFS	(2) SA	(3) Heuristic Algorithm(HA)	Comparison	
				Difference* (FCFS-HA)	Difference** (HA-SA)
5	137.88	101.18	101.18	36.27%	0.00%
10	228.28	128	130	75.60%	1.54%
15	316.72	150.2	152.6	107.55%	1.57%
20	424.12	165.32	167.26	153.57%	1.16%
25	505.42	190.57	193.68	160.96%	1.61%
30	615.86	200.41	210.52	192.54%	4.80%
35	702.52	228.21	232.92	201.61%	2.02%
40	796.72	248.15	251.6	216.66%	1.37%
45	902.58	262.3	274.04	229.36%	4.28%
50	993.8	275.2	302.32	228.72%	8.97%
55	1095.6	290.1	314.8	248.03%	7.85%
60	1202.28	329.1	353.3	240.30%	6.85%
Average	660.15	214.06	223.69	174.27%	3.50%

*: difference = $\frac{(1) - (3)}{(3)}$ **: difference = $\frac{(2) - (3)}{(3)}$

Table 3. Three kinds of economic convex hull

Combination	$y=x+b$	$y=-x+b'$
Combination 1	Max of $b = 25$ Min of $b = -45$	Max of $b' = 60$
Combination 2	Max of $b = 25$ Min of $b = -45$	Max of $b' = 70$
Combination 3	Max of $b = 25$ Min of $b = -45$	Max of $b' = 80$

Table 4. The simulation result of difference economic convex hull

k	$b'=60$	$b'=70$	$b'=80$	p -value
5	124.24	127.02	131.22	0.06
10	154.66	160.86	163.82	0.24
15	176.96	181.48	186.82	0.118
20	197.72	206.12	207.84	0.117
25	224.96	228.64	229.36	0.727
30	242.88	247.92	253.04	0.332
35	264.74	265.32	269.96	0.714
40	292.84	297.38	306.08	0.26
45	312.72	322.12	324.12	0.338
50	342.84	342.98	355.18	0.324
55	367.7	367.88	378.92	0.422
60	369.28	376.6	384.92	0.284

Conclusion

This paper deals with an order picking problem in a man-on-board automated storage and retrieval system (AS/RS). The algorithms intend to infer that adding a single order picking material under the same area dimension takes the same time. Simulation analyses suggest the following conclusions.

1. With a large quantity order, it is more efficient to be heuristic than use FCFS.
2. With a small order, a heuristic algorithm and SA obtain similar results.
3. The larger the economic convex hull area is, the farther AS/RS moves the distance.

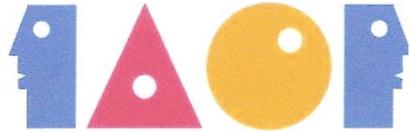
The following issues need further study.

1. How can a heuristic algorithm solution be an initial solution of SA that can reduce simulation time?
2. How can the order picking and planning stores location be considered at the same time? This will yield a better solution.

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AN APPROPRIATE BUDGET ESTIMATE FOR THE FIGHT AGAINST
CORRUPTION: A COMPARISON BETWEEN
THAILAND AND HONG KONG

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Abstract

Investment to prevent and solve corruption problems needs empirical investigation in order to show whether or not the cost gives value for money. The National Counter Corruption Commission (NCCC) has formulated a policy and strategy to prevent and solve corruption by allocating an appropriate budget. It is believed that to invest in an appropriate budget not only helps to drive anti-corruption strategy effectively but also decreases corruption and increases revenue for the Government. In addition, it was hoped that in 2011 the international transparency index for Thailand should be at least 5.00. In order to estimate the anti-corruption budget more appropriately, empirical investigation was undertaken simultaneously with the formulation of a national anti-corruption strategy. At present, Thailand has estimated its budget for the fight against corruption by adopting and adapting Hong Kong's experience in budget estimation.

Keywords: Cost Of Corruption; National Counter Corruption Commission (NCCC), Thailand's Anti-Corruption Budget, Hong Kong's Anti-Corruption Budget

Introduction

Thailand's National Strategy for Prevention and Suppression of Corruption (NSPSC) was formulated on a participatory approach with representatives from the public sector, state enterprises, private sector, and non-government organizations (NGOs). The objectives were (1) to specify a National Strategy for Prevention and Suppression of Corruption that can support a mutual work process, including responsible participation, (2) to have a leading role in developing a sustainable networked alliance for the prevention and suppression of corruption both within the country and abroad, in bringing about the development of a genuinely democratic political system under His Majesty the King as Head of State, holding to the principles of legal government and good governance, and (3) to take a lead in the mechanism of development and create the requirements for prevention and suppression of corruption nationally and internationally.

The rationale and justification of the NSPSC are the challenges of severe and chronic problems of corruption which have not yet been successfully solved. The NSPSC itself is used as a development guideline for all public sectors and state enterprises to set up their own strategic plans and action plans for prevention and suppression of corruption, which is a challenging agenda. In order to implement the NSPSC systematically and successfully, the NCCC has appointed one steering committee and three sub-committees to assist all public sectors and state enterprises to implement the NSPSC. In addition, the most challenging target for the NCCC as well as for Thailand's National Economic and Social Development Board is to improve the Transparency International Corruption Index from 3.4 in 2009 to attain 5.0 in 2011. This target was listed officially both in the 10th National Economic and Social Development Plan and in the National Strategy for Prevention and Suppression of Corruption.

It was thought by relevant persons during the NSPSC formulation process that to implement the NSPSC there needs to be an appropriate budget estimate for the fight against corruption. The author as the leader of the NSPSC formulating team was assigned to investigate an appropriate budget estimate for the fight against corruption. The findings from the empirical study were used to set up policy for allocating budget. At present, parliament allocates the anti-corruption budget as 0.3 per cent of the Government's annual budget, adopting and adapting the experience of Hong Kong in allocating its anti-corruption budget.

Literature Review

Results of government studies in several countries have found that investment in prevention of corruption can give rise to an increase in available capital of up to 50% of tax revenue. When compensation for revenue collection, calculated as a percentage, for customs officials in countries of the Latin American region is considered it is found that the income from tax collection has increased by 60% within 1 year (The Destructive Costs of Greasing Palms, 1993). A study of the effect of corruption on policy for public procurement in many Asian countries has found that their governments must incur additional expenditure on procurement on account of corruption, from 20% to more than 100% (Nakata, 1978; Gray, 1979; Wade, 1982).

When we look from the point of view of return on investment, the results of an analysis by Mauro (1997) for data from 94 countries suggest that to be able to reduce corruption by 23.8%, the Government must increase investment by an amount of 4% of GDP, which will thereby increase growth of per capita GDP by 0.5%. However, Bugarin and Vieria (2007) have conducted a study that finds that setting up a mechanism to enable the people to participate in activities for prevention and suppression of corruption, according to how they are interested in participation, most especially to participate in controlling government expenditure, can greatly

reduce the capital invested in combating corruption. Bugarin and Vieria call this method “social control of government expenditure.” Apart from this, a report by the World Bank (1997) has greatly helped to clarify the relationship between corruption and investment by pointing out the difference between the levels of corruption and the ability to forecast expenditure and outcome. That is to say, investment will be much less in countries with a high level of corruption. On the contrary, investment will increase in countries with a low level of corruption.

The Center for Democracy and Governance, USAID (1999) has summarized the results of its study as that, in the course of the 1980s, the Government of Ghana undertook a reform of taxation and customs units, whereby the Government divested or retired most corrupt civil servants. Since then, there has been an improvement in salaries and working conditions as well as inducements for personnel to perform well and for all units whose function is to find public revenue. Apart from this, revenue goals have been defined for these units to receive a bonus of 3.5% of revenue from taxes and 2.5% of customs revenue. The result is that revenue from taxes and customs has risen from 6.6% to 12.3% of GDP. (If Thailand’s GDP in fiscal year 2008, equal to 9,070,920 million baht, increases from the figure previously collected, by only 6.6% of GDP or 598,680.72 million baht, that is 12.3% of GDP or 1,115,723.16 million baht, then it can be seen that the increased revenue is $1,115,723.16 - 598,680.72 = 517,042.44$ million baht, which amounts to an investment value of incentives and bonus expended on personnel and work units.)

From the above example it can be maintained that an investment in the fight against corruption is necessary and is of value, but the problem is: What is the appropriate amount to invest? An appropriate estimate of budget to be allotted to the civil service sector and to independent organizations concerned, to be applied to implementing the National Strategy for

Prevention and Suppression of Corruption, is needed because Thailand does not yet have figures for budget expended on combating corruption as a percentage of GDP, as do some countries such as Hong Kong in the year 2002. The Independent Committee Against Corruption (ICAC) of Hong Kong has received an annual budget of US\$ 90 million or about US\$ 15 per GDP per person. This budget for combating corruption amounts to 0.3% of the Government's overall budget, or 0.05% of GDP (www.kwok-manwai.com./Speeches and www.unafei.or.jp/english/pdf/PDF).

In the case of ICAC in Hong Kong, in financial year 2007, a budget was received of 701.247 million US dollars, from a total budget expended of 216,670.735 million US dollars, or equal to $(701.247 \times 100) / 216,670.735 = 0.32\%$. In the financial year 2006, a budget was received of 656.171 US dollars, from a total budget expended of 197,259.623 million US dollars, or equal to $(656.171 \times 100) / 197,259.623 = 0.33\%$. In financial year 2005, a budget was received of 640.440 million US dollars from a total budget expended of 193,817.669 million US dollars, or equal to $(640.440 \times 100) / 193,817.669 = 0.33\%$ (The 2008-9 Budget: The Government of the Hong Kong Special Administrative Region of the People's Republic of China, 2008. <http://www.budget.gov.hk/2008/eng/estimates.html>).

In comparison with Hong Kong, the Thai organization against corruption, that is the NCCC office, if it were to be allotted a budget amounting to 0.3% of the total budget expended in the financial year 2008, would receive a budget amounting to $(1,660,000 \text{ million baht} \times 0.3) / 100 = 4,980 \text{ million baht}$.

The budget calculated from 0.3% of the total budget means the budget applied to salaries of personnel and other expenses not connected with implementing the strategy. In practice the budget for development or accounting for investment is likely to be about 25% of the total

budget. For this reason, the budget for implementing the National Strategy for Prevention and Suppression of Corruption for the financial year 2008 stands at $4,980 \times 25 / 100 = 1,245$ million baht. However, estimating the appropriate budget for prevention and suppression of corruption in Thailand is likely to require consideration of many related components. For this reason it is felt to be in order to make a study to ascertain an appropriate budget estimate for fighting corruption, which will enable budget expenditure to achieve the maximum value.

The basic objective of this article is to achieve an appropriate budget estimate, in order that it can be apportioned by the Cabinet, together with a consideration of the allotment of budget to the civil service sector which will apply it to driving the National Strategy for Prevention and Suppression of Corruption, as appropriate to each specific aspect as follows: To estimate the budget to be applied to implementing the National Strategy for Prevention and Suppression of Corruption, *as it should be*; and the budget *that can actually be allotted*, from financial year 2009 to financial year 2013, for units having the specific duty of prevention and suppression of corruption, for example the NCCC office, and to be used as a database for improving the budget estimate so as to be in accordance with its appropriate purpose or as it should be in the future.

Research Methodology

Scope of the Study

The scope of the study is limited in its subject matter to the following specific issues:

(1) The scope of the subject matter: The budget estimate for organizations having roles and duties concerned with the prevention and suppression of corruption, specifically the budget concerned with application to implementing the National Strategy for Prevention and Suppression of Corruption.

(2) Time scope: (2.1) The figures for budget received for financial years 2005-2008 are applied to forecasting the budget estimate over the five financial years 2008-2013. (2.2) Since there had already been an announcement for financial year 2008, the allotment of budget in this case means diversion of budget from other sections to this use.

The authority for assigning the budget lies with the Bureau of the Budget where, according to the Budget Act of 1959 Section 1, it is the authority and duty of the Director.

The Conceptual Framework

The basic conceptual framework is based on the attempt to answer the questions: What should be the budget estimate for application to the National Strategy for Prevention and Suppression of Corruption that is most appropriate or that yields the greatest value in return for the money spent, and what means are there to calculate the budget expense? What units should be allotted a large budget and what units should be allotted a small budget or should not be allotted any budget? The answers are as follows:

Issue 1: How much should be the overall budget for all units in the given financial year?

At this first stage, we should take an example from the experience of Hong Kong. That is to say, Hong Kong has used the method of allotting budget to units having the duty of fighting corruption, using a value of 0.3% of the Government's expense budget in the given financial year, or 0.05% of the country's GDP. In the case of Thailand, if we take 0.3% of the total expense budget in financial year 2008 for our calculation, we will obtain a figure for the budget to be spent on the fight against corruption as follows:

Financial year 2008: 1,660,000 million baht x 0.3 / 100 = 4,980.00 million baht.

Then if we take the value of 0.05% of GDP for the financial year 2008 for our calculation we will obtain a figure for the budget to be spent on the fight against corruption as follows:

Financial year 2008: $9,070,920 \text{ million baht} \times 0.05 / 100 = 4,535.46 \text{ million baht}$.

We can see that the methods of using 0.3% of the total expense budget, and 0.05% of GDP give similar quantities. The former approach gives the somewhat greater figure, and will be adopted for this study.

Issue 2: What data are there for specifying the budget per year for the fight against corruption and the budget figures over the period of 5 years to come?

Specifying the budget per year for the fight against corruption covers in particular the budget for work performance (operating budget) or project budget, in accordance with the National Strategy for Prevention and Suppression of Corruption. It does not cover the budget for salaries and compensation, which is the budget for routine work that is not concerned with driving the National Strategy or, if it is concerned, it is concerned indirectly, for instance the budget for building an office or for salaries of personnel. (Note: 0.3% of the overall budget, as used by Hong Kong, means the budget specifically for units fighting corruption (ICAC) only, but for Thailand the coverage is expanded to cover independent organizations and all units at department level that have a part in implementing the National Strategy.)

Method of Estimation

The method of budget estimation for implementing the National Strategy for Prevention and Suppression of Corruption follows a conceptual framework for setting up figures for estimation in accordance with the following stages.

Stage 1: Considering the choice of units directly concerned with or closely related to prevention and suppression of corruption.

These are independent organizations and departments, altogether 11 units, comprising:

- (1) Office of the Election Commission of Thailand (ECT),
- (2) Office of the Ombudsman (OO),
- (3) Office of the National Human Rights Commission of Thailand (HRC),
- (4) The Constitutional

Court of the Kingdom of Thailand (CC), (5) Courts of Justice (CJ), (6) The Administrative Court (AC), (7) Office of the National Counter Corruption Commission (NCCC), (8) Office of the Auditor General of Thailand (OAG), (9) Department of Special Investigation (DSI), (10) Anti-Money Laundering Office (AMLO) and (11) Office of the Attorney General (AG). Under Stage 1, there are activities that must be conducted in order from first to last, as follows:

Activity 1: To collect annual budget figures going back from financial year 2002 to financial year 2008, as are found in the following table:

Table 1. Budget of civil service units concerned with the problem of corruption.
(Unit : Million baht)

Unit	Budget year						
	2002	2003	2004	2005	2006	2007	2008
1. Office of the Election Commission of Thailand (ECT)	357.00	415.00	981.50	3,326.60	3,203.60	1,735.20	5,563.10
2. Office of the Ombudsman (OO)	32.70	45.40	58.30	76.00	78.10	98.40	120.00
3. Office of the National Human Rights Commission (HRC)	35.80	65.70	74.50	93.60	128.80	146.10	147.70
4. The Constitutional Court (CC)	61.10	69.00	72.70	138.60	155.90	100.10	198.70
5. Courts of Justice (CJ)	5,938.60	6,103.60	6,652.00	7,097.10	8,283.30	8,631.10	9,572.70
6. The Administrative Court (AC)	642.00	615.20	757.30	933.20	1,034.40	1,499.80	1,333.90
7. Office of the National Counter Corruption Commission (NCCC)	273.60	319.70	333.70	935.30	784.70	650.50	731.20
8. Office of the Auditor General of Thailand (OAG)	632.00	815.20	838.50	1,017.20	1,123.90	1,240.90	1,464.30
9. Department of Special Investigation (DSI)	-	12.30	610.10	614.40	718.00	687.90	702.90
10. Anti-Money Laundering Office (AMLO)	197.60	71.30	96.30	152.80	230.90	170.10	151.10
11. Office of the Attorney General (AG)	2,729.30	2,988.80	3,325.70	3,513.60	4,041.00	4,775.60	4,993.50
Total Budget	10,899.70	11,521.20	13,800.60	17,898.40	19,782.60	19,735.70	24,979.10

Source : Bureau of the Budget

Budget for implementing the National Strategy: If specified on the basis of 25% of budget received by the 11 units for financial year 2008, the amount of budget that should be received is $24,979.10 \times 25 / 100 = 6,244.77$ million baht.

Activity 2 : To apply the budget for civil service units from the Bureau of the Budget for the years 2002 to 2008 as a basis for estimating the budget for the year 2009; and from then on to increase the budget by 5% annually.

Principles of Calculation

1. To use the data from the Bureau of the Budget as a basis for estimating the figures for year 2008, using the principle of time series.

$$Y_{CPL_{08}} = a + bX \quad \text{where } b = \frac{\sum XY - n\bar{X}\bar{Y}}{\sum X^2 - n\bar{X}^2}$$

$$a = \bar{Y} - b\bar{X}$$

Specifying the values: Y represents the budget for civil service units for the years 2002 to 2008, X represents the year as follows:

Year	2002	2003	2004	2005	2006	2007	2008	2009
X	1	2	3	4	5	6	7	8

The equations for estimating the data for the year 2009 for each unit are shown as follows:

1. $Y_{\text{Election Commission}} = -699.829 + 732.457X$
2. $Y_{\text{Ombudsman}} = 17.429 + 13.846 X$
3. $Y_{\text{Human Rights Commission}} = 20.200 + 19.671 X$
4. $Y_{\text{Constitutional Court}} = 33.986 + 19.936 X$
5. $Y_{\text{Courts of Justice}} = 4955.686 + 628.164 X$
6. $Y_{\text{Administrative Court}} = 384.829 + 147.214 X$

7. Y National Counter Corruption Commission = 220.471 + 88.764 X
8. Y Auditor General of Thailand = 499.757 + 129.775 X
9. Y Department of Special Investigation = 70.314 + 108.286 X
10. Y Anti-Money Laundering Office = 125.343 + 6.882 X
11. Y The Attorney General = 2183.714 + 395.768 X

2. To estimate the budget for the years 2010 to 2013, use the principle of an increase of 5% of the estimated value for the previous year as in Table 2 as follows:

Table 2. Estimation of the budget for the years 2009 to 2013, on the principle of a 5% increase over the estimated value for the previous year.

(Unit : Million baht)

Unit	2009*	2010	2011	2012	2013
	Result of estimation	5% on year 2009	5% on year 2010	5% on year 2011	5% on year 2012
1. Office of the Election Commission of Thailand (ECT)	5,151.83	5,409.42	5,679.89	5,963.89	6,262.08
2. Office of the Ombudsman (OO)	128.20	134.61	141.34	148.41	155.83
3. Office of the National Human Rights Commission (HRC),	177.57	186.45	195.77	205.56	215.84
4. The Constitutional Court (CC)	193.47	203.14	213.30	223.97	235.16
5. Courts of Justice (CJ)	9,981	10,480.05	11,004.05	11,554.26	12,131.97
6. The Administrative Court (AC)	1,562.54	1,640.67	1,722.70	1,808.84	1,899.28
7. Office of the National Counter Corruption Commission (NACC)	930.58	977.11	1,025.96	1,077.26	1,131.13
8. Office of the Auditor General of Thailand (OAG)	1,537.96	1,614.86	1,695.60	1,780.38	1,869.40
9. Department of Special Investigation (DSI)	(670.8) 936.60	(704.34) 983.43	(739.56) 1,032.60	(776.53) 1,084.23	(815.36) 1,138.45
10. Anti-Money Laundering Office (AMLO)	180.4	189.42	198.89	(208.84) 208.83	219.28
11. Office of the Attorney General (AG)	5,349.86	5,617.35	5,898.22	6,193.13	6,502.79
Total	(25,864.21) 26,130.00	(27,157.42) 27,436.50	(28,515.28) 28,808.33	(29,941.07) 30,248.75	(31,438.12) 31,761.18

* The estimated budget for the year 2009 is obtained from the representative value X or 8 in the equations above. Budget for implementing the National Strategy: On the basis of 25% of budget received by the 11 units. The amount of budget that should be received is as follows:

Financial year 2009 = 25,864.21 x 25 / 100 = 6,466.05 million baht.

Financial year 2010 = 27,157.42 x 25 / 100 = 6,789.35 million baht.

Financial year 2011 = 28,515.28 x 25 / 100 = 7,128.82 million baht.

Financial year 2012 = 29,941.07 x 25 / 100 = 7,485.26 million baht.

Financial year 2013 = 31,438.12 x 25 / 100 = 7,859.53 million baht.

Activity 3: Adjust the money value of budget for each year to the same base year, which will enable comparison of the money value of budget as between years, by employing the Consumer Price Index to adjust values, comparing with the base year 2002 value as denominator and multiplying by 100 and after that increasing the budget by 5% per year.

Principles of Calculation

1. Estimate the CPI for the year 2008: Since the CPI as stated by the Ministry of Commerce is for the year 2007, the estimation of the CPI value uses the CPI for the years 2002 to 2007 as the basis for calculation.

$$Y_{\text{CPI}_{08}} = a + bX \quad \text{where } b = \frac{\sum XY - n\bar{X}\bar{Y}}{\sum X^2 - n\bar{X}^2}$$

$$a = \bar{Y} - b\bar{X}$$

Specifying the values: Y represents CPI for years 2002 - 2007, X represents the year as follows :

Year	2002	2003	2004	2005	2006	2007	2008*
X	1	2	3	4	5	6	7
CPI	100	101.8	104.6	109.3	114.4	117	120.6

Source : Ministry of Commerce

* Estimation of the CPI by means of time series

The series of equations for estimating the CPI for the year 2008 shows that

$$Y_{CPI_{08}} = 95.100 + 3.643.$$

The formula for deflating the data for the years 2002 – 2008, to convert them to the true budget values is

$$\text{Deflated figure} = \frac{\text{Budget} \cdot 100}{\text{CPI}}$$

Where:

“Budget” is the budget data for the civil service unit concerned with the problem of corruption.

CPI is the Consumer Price Index from the Ministry of Commerce.

When the values of the budget figures for each year have been adjusted by comparison with the base year 2002 as having the value 100, to obtain the deflated money values, these are as illustrated in the following Table 3. (See the end of the article for this Table.)

2. Take the deflated data for the years 2002 – 2008, according to Table 3, as a basis for estimating the data for the year 2009, using the principle of time series in the same way.

$$Y_{09} = a + bX \quad \text{where} \quad b = \frac{\sum XY - n\bar{X}\bar{Y}}{\sum X^2 - n\bar{X}^2}$$

$$a = \bar{Y} - b\bar{X}$$

Specifying the values:

Y represents the budget for the civil service unit for the years 2002 – 2008 deflated by the CPI.

X represents the year as follows.

Year	2002	2003	2004	2005	2006	2007	2008	2009*
X	1	2	3	4	5	6	7	8

The series of equations for estimating the deflated budget data for the year 2009 for each unit is shown as follows:

1. $Y_{\text{Electoral Committee}} = -448.224 + 599.300X$
2. $Y_{\text{Ombudsman}} = 23.321 + 10.426 X$
3. $Y_{\text{Human Rights Commission}} = 27.870 + 15.073 X$
4. $Y_{\text{Constitutional Court}} = 42.639 + 14.761 X$
5. $Y_{\text{Courts of Justice}} = 5385.923 + 344.312 X$
6. $Y_{\text{Administrative Court}} = 455.540 + 104.553 X$
7. $Y_{\text{National Counter Corruption Commission}} = 251.676 + 66.031 X$
8. $Y_{\text{Auditor General of Thailand}} = 567.903 + 87.391 X$
9. $Y_{\text{Department of Special Investigation}} = 115.503 + 83.810 X$
10. $Y_{\text{Anti-Money Laundering Office}} = 132.643 + 1.554 X$
11. $Y_{\text{The Attorney General}} = 2419.397 + 245.649 X$

Table 4: Estimated budget figures for the financial years 2009 – 2013, values adjusted to the same base year of 2002.
(Unit : Million baht)

Unit	Estimate	5% on year 2009	5% on year 2010	5% on year 2011	5% on year 2012
	2009*	2010	2011	2012	2013
1. Office of the Election Commission of Thailand (ECT)	4,346.18	4,563.49	4,791.66	5,031.25	5,282.81
2. Office of the Ombudsman (OO)	106.62	112.07	117.67	123.55	129.73
3. Office of the National Human Rights Commission (HRC),	148.45	155.87	163.67	171.85	180.44
4. The Constitutional Court (CC)	160.73	168.77	177.20	186.07	195.37
5. Courts of Justice (CJ)	8,140.42	8,547.44	8,974.81	9,423.55	9,894.73
6. The Administrative Court (AC)	1,291.96	1,356.56	1,424.39	1,495.61	1,570.39
7. Office of the National Counter Corruption Commission (NCCC)	779.92	818.92	859.86	902.85	948.00
8. Office of the Auditor General of Thailand (OAG)	1,267.03	1,330.38	1,396.90	1,466.75	1,540.08
9. Department of Special Investigation (DSI)	872.93	825.28	866.54	909.87	955.36
10. Anti-Money Laundering Office (AMLO)	145.08	152.32	159.94	167.94	176.33
11. Office of the Attorney General	4,384.59	4,603.82	4,834.01	5,075.71	5,329.50

(AG)					
Total	21,557.06	25,187.92	26,320.65	27,510	28,758.74

* The estimated budget for the year 2009 is obtained from the representative value X or 8 in the equations above.

3. Estimation of the budget for the years 2010 to 2013 uses the principle of a 5% increase on the estimated value for the previous year.

Method of Budget Estimation using the Principle of Budget to Implement Strategy as a Percentage of Total Budget Expenditure in the Given Year

1. Thailand has not yet ever specified what percentage of the Government's annual expense budget should be applied for implementing the National Strategy for Prevention and Suppression of Corruption.

Hong Kong is a country that has experience of the concept of calculating components of the budget for fighting corruption using the principle of 0.3% of total expense budget.

When we speak of the total annual expense budget, we have data for the financial years between 2002 and 2008, according to the following table:

Table 5: Thailand's total expense budget and GDP for the years 2002 to 2008

(Unit : Million baht)	
Year	Total Expense Budget
2002	1,023,000
2003	999,900
2004	1,163,500
2005	1,250,000
2006	1,360,000
2007	1,566,200
2008	1,660,000*

Source : Bureau of the Budget

Notes : * Figure for total estimated budget

If we apply to Thailand Hong Kong's experience in using 0.3% of the Government's expense budget to specify the budget for units having the duty of fighting corruption, we obtain figures as follows:

Table 6: Calculation of the value of 0.3% of the total estimated expenditure for the financial years 2002 to 2008 (figures before deflating value).
(Unit : Million baht)

Financial Year	Total Budget for the Financial Year	Formula for Calculating Rate of 0.3% of Total Budget	Result of Calculation (set at 0.3% of Total)
2002	1,023,000	$(1,023,000 \times 0.3) / 100$	3,069.00
2003	999,900	$(999,900 \times 0.3) / 100$	2,999.70
2004	1,163,500	$(1,163,500 \times 0.3) / 100$	3,495.50
2005	1,250,000	$(1,250,000 \times 0.3) / 100$	3,750.00
2006	1,360,000	$(1,360,000 \times 0.3) / 100$	4,080.00
2007	1,566,200	$(1,566,200 \times 0.3) / 100$	4,698.60
2008	1,660,000	$(1,660,000 \times 0.3) / 100$	4,980.00

Allotment of Budget on the Basis of 0.3% of the Total Expense Budget for the Financial Year

Allotment of the budget based on the principle of 0.3% of the annual expense budget requires use of the principles as follows:

(1) The Consumer Price Index (CPI) is used to deflate the figure for the annual expense budget for each year to obtain the adjusted money value (real value) for the same base year of 2002, according to the procedure employed to adjust the money values in Table 3 above, which gives the figures for the budget according to the following Table 7.

Year	2002	2003	2004	2005	2006	2007	2008*
X	1	2	3	4	5	6	7
CPI	100	101.8	104.6	109.3	114.4	117	120.6

Formula for deflating data for years 2002 – 2008, to give the real budget values.

$$\text{Deflated figure} = \frac{\text{Budget} \cdot 0.3}{\text{CPI}}$$

Where "Budget" means the data for 0.3% of the total expense budget before deflation for each year.

CPI means the Consumer Price Index according to the Ministry of Commerce.

(2) When the deflated money value of the budget has been obtained, the budget value resulting from calculation (specified as 0.3% of the total for the previous financial years, comprising financial years 2002 to 2008) is applied to forecasting 0.3% of the total expense budget on the

Table 7: Figures for 0.3% of the deflated annual expense budget for the financial year.
(Unit : Million baht)

Financial Year	Annual Expense Budget Before Deflation to the Same Base, from 0.3% of Total	Formula for Calculating Rate of 0.3 of Total Budget Deflated by the CPI for Each year as Denominator Deflated figure = $\frac{\text{Budget} \cdot 0.3}{\text{CPI}}$	Result of Calculation (Set as 0.3% of Total)
2002	3,069.00	$3,069.00 \times 100 / 100$	3,069.00
2003	2,999.70	$2,999.70 \times 100 / 101.8$	2,946.66
2004	3,495.50	$3,495.50 \times 100 / 104.6$	3,337.00
2005	3,750.00	$3,750.00 \times 100 / 109.3$	3,430.92
2006	4,080.00	$4,080.00 \times 100 / 114.4$	3,566.43
2007	4,698.60	$4,698.60 \times 100 / 117$	4,015.90
2008	4,980.00	$4,980.00 \times 100 / 120.6$	4,129.35

Year	2002	2003	2004	2005	2006	2007	2008*
X	1	2	3	4	5	6	7
CPI	100	101.8	104.6	109.3	114.4	117	120.6

principle of estimating the budget for the financial years 2009 to 2013 as a 5% increase on the maximum value estimated for the previous year. Thus we obtain the budget

figures with values estimated according to Table 8 as follows:

Table 8: Budget estimate for the fight against corruption using the criterion of 0.3% of the deflated annual expense budget, from financial year 2009 to financial year 2013.

Year	Rate of 0.3% of Total Budget	Value of 0.3% of Total Budget Deflated by CPI to Base Year 2002	CPI
2002	3,069.00	3,069.00	100.00
2003	2,999.70	2,946.66	101.80
2004	3,495.50	3,337.00	104.60
2005	3,750.00	3,430.92	109.30
2006	4,080.00	3,566.43	114.40
2007	4,698.60	4,015.90	117.00
2008	4,980.00	4,129.35	120.60*
2009*	-	5,435.01	5%
2010**	-	5,706.76	5%
2011**	-	5,992.10	5%
2012**	-	6,291.71	5%
2013**	-	6,606.29	5%

The budget amount as estimated above is the budget that should in practice be required by a country that achieves an adequate level of success in the prevention and suppression of corruption. Hong Kong achieved a score equal to 8.3 on the International Transparency Index for the year 2007, coming 14'th. in order, while Thailand achieved a score of 3.3, coming 84'th. in order. Hong Kong achieved a score of 5.46 on the Global Competitiveness Report (GCR) for the year 2006, coming 11'th in order, while Thailand achieved a score for competitiveness of 4.58, coming 35'th in order.

The Budget that can Actually be Allotted According to the Approach to Estimation of the Bureau of the Budget

A budget estimate in accordance with the National Strategy for Prevention and Suppression of Corruption is made on the basis of a budget system that emphasizes strategic results. It accords with a principle of estimating the budget over the mid-term future, in accordance with previously existing policy or strategy, and measures and approaches to practice that have been previously set out in the National Strategy for Prevention and Suppression of Corruption. Here there are four components for consideration, in order to present a picture of the budget that is clear and can be put into practice, as follows:

Component 1 is an analysis and estimate of expenses at the bottom level of the civil service sector concerned. This includes the budget for expenses on personnel and other remuneration according to personnel positions and costs of public utilities in an office carrying on its work in accordance with its mission and its usual authority and duties.

Component 2 is an analysis of the budget for expenses over the year required by the law concerned with budgeting procedures. For this the civil service sector has already received a budget for the first year, and must continuously provide a budget in accordance with the

conditions of the purchase and hiring contract that the civil service sector has made with its employees.

Component 3 is an analysis of the budget in support of performance in accordance with the obligations normally required by law for the exercise of its authority and duties by the civil service sector. Usually this is that, if we have already considered the aspects of efficiency and experience, this section of the budget should not need to increase. However, at this time we may use for analysis the average figures over 5 financial years as a basis for calculation (financial years 2004 – 2008).

Component 4 is an analysis of the budget in accordance with the measures, approaches and driving mechanisms.

Findings and their Application

Budget associated with the prevention and suppression of corruption.

The above 4-fold analytical approach to budget estimation is one that the civil service sector concerned has adopted for continuous application over a period of five years, to the measures and approaches to performance of the National Strategy.

When we consider the budget of the 11 civil service sectors directly concerned with the prevention and suppression of corruption, financial year 2002 to 2008, this is seen to be as in Table 1 above.

Conclusions and Recommendations

By taking the experience of Hong Kong's campaign against corruption as an example of best practice and applying to Thailand Hong Kong's approach of allotting a figure of 0.3% of the Government's overall budget to combating corruption, it is possible to estimate a reasonable amount to invest yearly in the prevention and suppression of corruption. Moreover, assuming

that relevant conditions remain essentially the same, an appropriate budget for the future 5 years can be estimated.

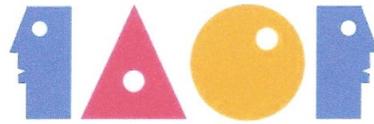
However, the problems are complex, and the effort to combat them is still at an early stage. An appropriate budget estimate is still experimental. We must await the outcome; and future policy, including financial policy on the prevention and suppression of corruption, must be flexible, in order to accommodate changing and possibly unpredictable social circumstances.

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Table 3: Budget figures for civil service units that are independent organizations and units at department level, for which values are adjusted to the same base year.
(Unit : Million baht)

Unit	CPI ₂₀₀₂ = 100.0		CPI ₂₀₀₃ = 101.8		CPI ₂₀₀₄ = 104.6		CPI ₂₀₀₅ = 109.3		CPI ₂₀₀₆ = 114.4		CPI ₂₀₀₇ = 117.0		CPI ₂₀₀₈ = 120.6	
	Budget	Deflated	Budget	Deflated	Budget	Deflated	Budget	Deflated	Budget	Deflated	Budget	Deflated	Budget	Deflated
1. Office of the Election Commission of Thailand (ECT)	357.00	357.00	415.00	407.66	981.50	938.34	3,326.60	3,043.55	3,203.60	2,800.35	1,735.20	1,483.08	5,563.10	4,612.85
2. Office of the Ombudsman (OO)	32.70	32.70	45.40	44.60	58.30	55.74	76.00	70.27	78.10	68.27	98.40	84.10	120.00	99.50
3. Office of the National Human Rights Commission (HRC),	35.80	35.80	65.70	64.54	74.50	71.22	93.60	85.64	128.80	112.59	146.10	124.87	147.70	122.47
4. The Constitutional Court (CC)	61.10	61.10	69.00	67.78	72.70	69.50	138.60	126.81	155.90	136.28	100.10	85.56	198.70	164.76
5. Courts of Justice (CJ)	5,938.60	5,938.60	6,103.60	5,995.68	6,652.00	6,359.46	7,097.10	6,493.23	8,283.30	7,240.65	8,631.10	7,377.01	9,572.70	7,937.56
6. The Administrative Court (AC)	642.00	642.00	615.20	604.32	757.30	724.00	933.20	853.80	1,034.40	904.20	1,499.80	1,281.88	1,333.90	1,106.05
7. Office of the National Counter Corruption Commission (NCCC)	273.60	273.60	319.70	314.05	333.70	319.02	935.30	855.72	784.70	685.93	650.50	555.98	731.20	606.30
8. Office of the Auditor General of Thailand (OAG)	632.00	632.00	815.20	800.79	838.50	801.63	1,017.20	930.65	1,123.90	982.43	1,240.90	1,060.60	1,464.30	1,214.18
9. Department of Special Investigation (DSI)	-	-	12.30	12.08	610.10	583.27	614.40	562.12	718.00	627.62	687.90	587.95	702.90	582.84
10. Anti-Money Laundering Office (AMLO)	197.60	197.60	71.30	70.04	96.30	92.07	152.80	139.80	230.90	201.84	170.10	145.38	151.10	125.29
11. Office of the Attorney General (AG)	2,729.30	2,729.30	2,988.80	2,935.95	3,325.70	3,179.45	3,513.60	3,214.64	4,041.00	3,532.34	4,775.60	4,081.71	4,993.50	4,140.55
Total	10,899.70	2,926.9	11,521.20	13,863.49	13,800.60	15,740.7	17,898.40	18,924.23	19,782.60	19,841.5	19,735.70	19,418.12	24,979.10	23,263.35



TOWARDS IMPROVING THE DEVICE FOR MEASUREMENT
OF WORKABILITY AND COMPACTIBILITY OF ASPHALT MIXTURE
USING ELECTRONIC TRANSDUCER AND TEMPERATURE REGULATOR

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Abstract

Traffic volumes and loading over the last two decades has placed more demands for innovative research relating to the properties of material such as the workability, compactibility and stability of Hot Mixed asphalt. While the literature presents the trend in development and improvement of workability device for asphalt mixture, several authors have suggested further research which focuses on improving the device. This paper presents a preliminary stage of improved device that uses electric transducer and heat regulator for evaluating mixing temperature for workability and compactibility. This device can also facilitates the process correlating workability and compactibility; develops an index for measuring compactibility and workability at different temperatures; determines the stripping at different mixing and compaction temperatures as they relates to workability and controlling the gradation of aggregate during mixing in the laboratory.

Keywords: Workability, Transducer, Mix Asphalt Design, Compactibility, Mix Performance, Gradation.

Introduction

Traffic volumes over the last two decades have placed more demands on engineering roads. This development has resulted in the need for improvement in the research relating to properties of material such as the workability, compactibility and stability of Hot Mixed asphalt.

While a well designed and constructed road will not only support regional and national development of a country, high quality roads will also assist in sustaining the infrastructure for the lifespan it was designed for. To achieve this, an adequate design mix of Asphalt and other tests such as workability and stability is required.

Researchers have evaluated the workability of asphalt mixture either by torque or indicators from gyration compactor and porosity. Marvillet and Bougault (1979); Gudimettla and Cooley (2003; 2004) measured workability by torque, Cabrera (1991; 1992; 1994); Mohamed et al. (2008); Celik and Atis (2008) measured workability by number of indicator from gyration compactor and porosity.

Literature in this field of research has shown that little efforts have been directed towards the examination of the influence of temperature on the compactibility of hot mix asphalt (Kweir, 1991). In a related study, Celik and Atis (2008) also called for a study on the effect of mixing temperature on compactibility of asphalt mixture to produce the desirable pavement. We argue that such study can be achieved only by an improved device such as workability device.

Previous researches have shown that research in relation to improvement of device for measurement of workability is needed (Marvillet and Bougault, 1979; Cabrera 1991; Gudimettla et al., 2004; Oliver, 2006)

Empirical researches that support the necessity of this present research are (Marvillet and Bougault, 1979), the authors work focuses on development of device for measuring and comparing the workability of various asphalt mixes of HMA, workability and compactibility. Gudimettla and Cooley Gudimettla et al. (2003) worked on development of new device to measure workability of HMA. Similarly, Gudimettla et al. (2004) focused on evaluation of a prototype device to measure the workability of HMA due to changes in mix characteristics. Relating to quality of materials for road and pavement construction, Turochy and Parker (2007) highlights the importance attached to the quality control and quality assurance of Hot mixed asphalt in countries such as Florida, North Carolina and California transport agencies.

While the hot-mix asphalt industry is constantly exploring technological improvements that will enhance the material's performance, increase construction efficiency, conserve resources, and advance environmental stewardship. It is logical that one approach to achieve these goals would involve the production of improved prototype devices and through research and development of improved methods and materials.

Marvillet and Bougault (1979) was the first to device a workability meter in which the five interchangeable springs were used to determine the torque. The electrical signal was converted to numeric value and subsequently expressed in unit of torque. Using a similar device, Gudimettla *et al* (2004) evaluate a prototype device to measure the workability of hot mix asphalt (HMA) that could identify the influence of mix characteristics on workability. The authors converted the amperage to torque.

Recently, Mogawer *et al* (2010) presented a workability measurement device which does not have a temperature control system for maintaining temperature during mixing. The author however installed a device that could only be used to measure the temperature but not to maintain it. Contrary to Mogawa *et al* (2010)'s workability device in which the bowl rotates and the paddle fixed. The present device is designed such that the paddle is fixed and the bowl rotates.

We also note that Mogawa *et al* (2010) failed to discuss the specific type of torque meter used in their device in their work. However, their works are stepping stone in this field of research particularly on Compaction, workability and temperature of Hot mix Asphalts.

Future research suggested by the authors is a clear testimony of the need for further research in the field of workability device that can be used to measure workability on road

construction site, relationship between workability and compaction, and effect of temperature on workability.

Gudimettla *et al* (2003) suggested the need for a refinement of the prototype as it relates to design of paddle and container. Another improvement needed in the device is to include an additional temperature sensor to provide a better measure of temperature. The authors call for development of device that would yield better results and will be more users friendly. Their work suggested that workability is an important element in obtaining the desired HMA smoothness and density within a compacted pavement, temperature as well as the constituents in the mix influence workability of Hot Mix Asphalt and that compactibility of HMA is related to workability.

Literature search has shown that the workability test is currently conducted in the laboratory; hence the need to develop a suitable device for conducting workability test on site and to investigate the relationship between workability and compactibility of Hot mixed Asphalts on site. The purpose of numerous researches conducted on HMA mixture is to achieve the production of improved layers of road pavement, and stronger and more durable asphalt pavement with better surface structure that can withstand the increasing axle loading of heavy vehicles and traffic (Ziari and Khabiri, 2007), along side with changing climatic conditions experienced in many parts of the world. Research on HMA is crucial because every now and

then new roads are being built and the old ones are being reconstructed. The demand for bituminous mixes and the requirements for their quality are also increasing. This paper presents a preliminary stage in development of the device for the measurement of torque using series M420 Rotary torque transducer.

The present improved device is based on Gudimettla *et al* (2004) method. The device is designed for the following uses:

1. Measuring workability using transducer
1. Investigating the effect of mixing temperature on compactibility and workability
3. Developing a new procedure to achieve workability parameter in mix design.
4. Investigating the relationship between compactibility and workability; and
5. Developing the relationship between compactibility and workability at varying temperature.

While a major objective of this paper is to present an improved workability measurement device, the process of improvement also includes selecting the best rate of revolution of paddles and types of configurations. It is interesting to note that the transducer in the present device transmits digital data providing the end user with a clean and definite data transmission. Previous researches have shown that research in relation to improvement of device for measurement of

workability is needed (Mavillet and Bougault 1979; Gudimetla et al., 2004; Cabrera,1991; Oliver, and Anderson, 2006).

The temperature control system on the present device does not only allow temperature of asphalt mixture to be measured, it also enables mixing temperature to be maintained. The issue of changing gradation during mixing and problems encounter during field compaction (Birgisson and Ruth 2001; McDaniel, 2007); issue of small change in aggregate gradation that produces poor pavement performance during mixing which Chowdhury *et al* (2001) discussed in their work; and the influence of aggregate properties on compactibility discussed in (2007) can all be addressed using the device presented in this paper. This is achieved because the value of torque is influenced by the nominal maximum aggregate size of the gradation.

This paper has both theoretical and practical contribution. This research contributes significantly to the asphalt and workability device literature thereby adds to the body of knowledge. Practically, workability device provides a better, faster, and more reliable data that can enhance research and construction of pavement.

Materials And Method

After an extensive literature review of previous research on workability measuring device, each of the device components is based on table 1 below. The table presents the reference

for selection and design of the components of the workability device. However the following materials will be used in conducting the workability and compactibility related test.

1. Aggregate nominal maximum aggregate size 14 mm of two gradations;
2. Binders with penetration grade 60/70 and 80/100 bitumen; and
3. Mineral Filler –Ordinary Portland cement.

Verification of Device

The process of verification of the workability device involves the following procedure.

Verification test aims at selecting the best of rate of revolution of the paddle and type of configuration. The purpose is to identify the torque values for each mix (different binder 60-70,80-100) at temperatures 120 °C, 130 °C, 140 °C, 150 °C, 160 °C, and 170°C for every three paddles and three revolutions respectively, then, plotted to determine the rate of revolution of paddle and type of configuration designed form attached in index. The processes of verification of the device consist of testing three paddles with different configurations labeled A, B and C. each of these Paddles will be tested on four asphalt mixtures. The summary of the mix is presented in table 2 below.

The mix samples are labeled 1, 2, 3, and 4 mixes. Paddle A will be fixed to the device and the motor set at 5 RPM, the paddle will be immersed into mix 1 at 120 °C. The torque will be recorded during the paddle revolution. At the same temperature, the RPM will be adjusted to

Table 1. Reference for design and selection of device components

S/N	Components	Reference	Remark
1.	Paddle	Gudimettla et al (2003); Mogawa et al (2010) Federal Highway administration (2009)	Three different types
2.	Motor	Marvillet and Bougault (1979); Gudimettla et al (2004)	Rotational speed of 22, 15 RPM
3.	Transducer	Datum Electronic UK	Company Recommendation
4.	Bowl	AASHTO; ASTM; Kett (1998)	Based on quantity of sample (5 liter)
5.	Heater	AASHTO; ASTM; Kett (1998) Freddy (2007) Cominsky (1994)	Suitable for HMA
6	Thermometer	AASHTO; ASTM; Kett (1998)	10 °C to 232 °C

10 RPM and the torque recorded, this will be repeated for 15 RPM. Using the same paddle A, the temperature will be increased to 130 °C using the heater attached to the device, at RPM 5. The same procedure will be repeated for RPM 10 and 15 RPM while the torque is recorded in each case. The same procedure will be repeated for temperatures 140 °C, 150 °C, 160 °C and 170 °C respectively for mix 1. The entire procedure will be repeated using paddle B and C on mix 1 to complete one set of the test. A graph of torque against temperature will be plotted to obtain the paddle and revolution that produce the widest range of torque. Paddle A, B and C will be repeated on Mix 2, 3 and 4 using the same range of 120 °C-170 °C and revolution of 5, 10 and

15 RPM respectively to produce another three graphs to determine another three sets of wide range of torque.

Table 2. Matrix for verification of device

NO		Mix 1	Mix 2	Mix 3	Mix 4
1	Paddle A	3	3	3	3
2	Paddle B	3	3	3	3
3	Paddle C	3	3	3	3
Subtotal		9	9	9	9
Total		36			

Note: Each sample will be tested at six different temperature three rates of revolutions

Calibration of Device

Owing to the fact that the device is locally produced, there is need for its calibration to ensure the required efficiency and performance. A quantity of aggregate will be sieved to pass 5.0 mm sieve. From the aggregate that 3.35 sieve retained, ten (10) samples of 3 kg will be obtained for the calibration process. Each sample of the 3 kg will be mixed in the device bowl using optimum paddle and rate of revolution obtained from verification process described above. The torque and the power will be recorded for each sample of 3 kg aggregate to establish upper and lower limits of torque and power for the device. This calibration process will be repeated after every ten tests. Table 3 below presents the summary of the tests to be conducted during the calibration of the device.

Table 3. Matrix for calibration of device

10 samples for establishing upper and lower limits of torque and power will be used as standard	Mix 1	Mix 2	Mix 3	Mix 4
	13	13	13	13
Subtotal	13	13	13	13
Total sample = 52				

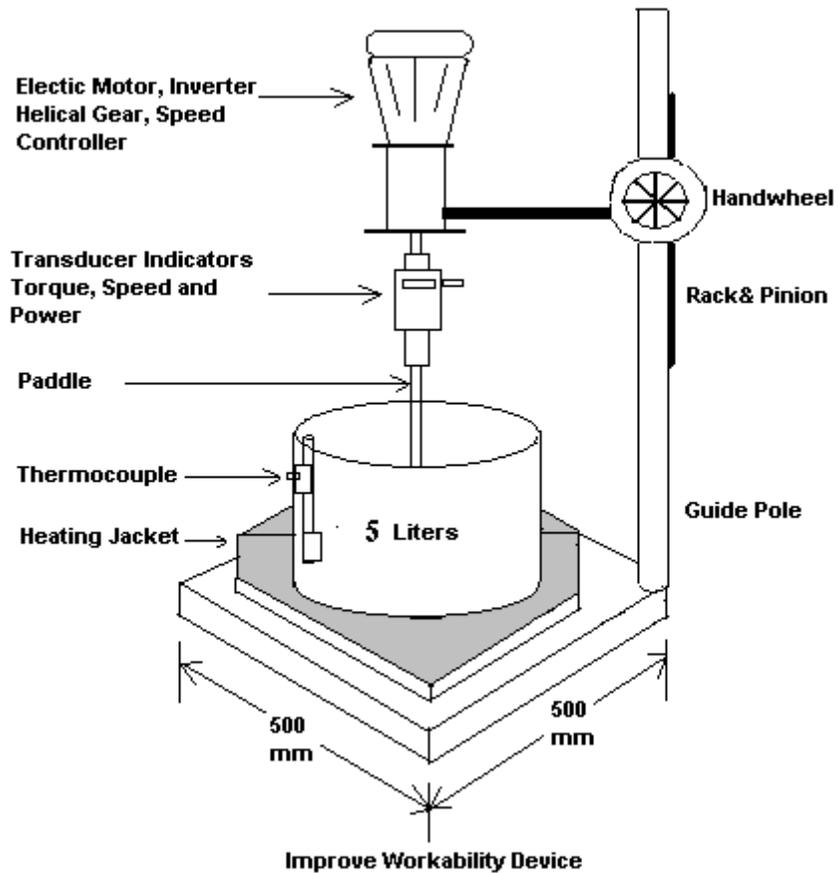


Figure 1: Workability device

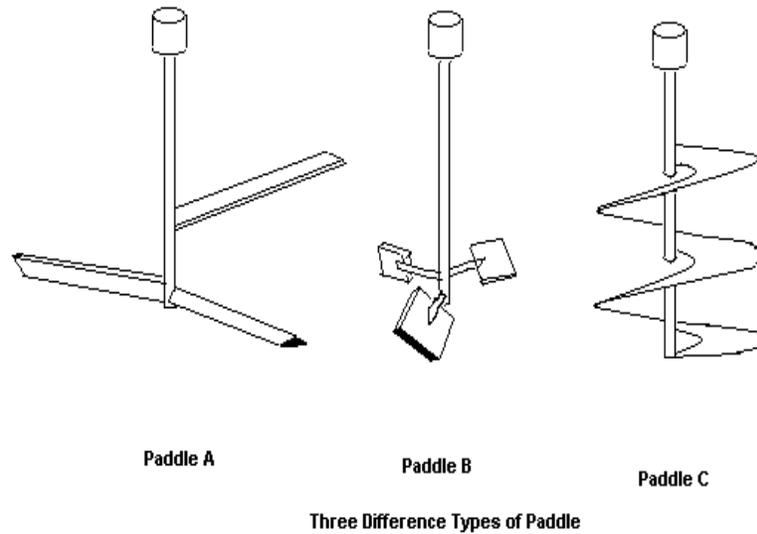


Figure 2. Three types of paddles

The outputs of workability device provided by transducer in terms of torque, speed, power and energy with performance tests will be correlated. This will be achieved using the device presented in figure 1. The test involves the preparation of four samples labeled mix 1, 2, 3 and 4 as shown in figure 2 above. In the first step, mixture 1 will be mixed at 140 °C and the value of torque recorded. The temperature will be regulated to 135 °C and mixed again; the torque at this temperature will be recorded. The mix will be compacted at the same 135 °C, volumetric properties and performance test (Resilient Modulus ASTM 4123, indirect tensile strength ASTM D 4867, Marshall Stability ASTM D 1559) [21, 23, 23] will finally be conducted.

The temperature of the same mix1 will be regulated to 130 °C. The torque will be recorded during mixing and later compacted at the same 130 °C and volumetric properties and

performance test will also be conducted. The temperature of the same mix 1 will be regulated to 125 °C, 120 °C, 100 °C and 80 °C and volumetric properties and performance test conducted.

The second step involves mixing mix 1 at 155 °C and the value of torque recorded, the temperature will be regulated to mixing temperature and the torque recorded during mix and then compacted at this temperature before the volumetric properties and performance test carried out. This process will be repeated at the temperatures of 145 °C, 135 °C, 130 °C, 125 °C, 120 °C, 100 °C and 80 °C, then volumetric properties and performance test will be carried out. Step one and two will be repeated for mix 2, mix 3 and mix 4 respectively.

The test procedure discussed above will use the improved workability device presented in this paper which will lead to achieving the following:

1. Evaluate mixing temperature for workability and compactibility.
2. Determine the correlation between workability and compactibility.
3. Develop an index for measuring compactibility and workability at different temperature variation as depicted in figure 3 below.
4. Determining the stripping at different mixing and compaction temperature as it relates to workability.
5. Check the gradation of aggregate during mixing in laboratory.
6. Developing a new procedure to achieve workability parameter in mix design.

Workability Index

Figure 3. depicts the four categories of workability and compactibility values that will be obtained from the proposed 504 samples of Hot Mixed Asphalt at two mixing temperature (140 °C and 155 °C) and compaction temperature of 150 °C to 80 °C. The reason for selecting this temperature is to obtain a wide range of compactibility. The parameters to be presented in this index are temperature, air void in mix, density, stiffness, stability, stripping. The two extreme categories (Under stress and overstress) is base on the Kari's (1967) work. The normal and higher performances are to allow for values that fall within and higher than the minimum

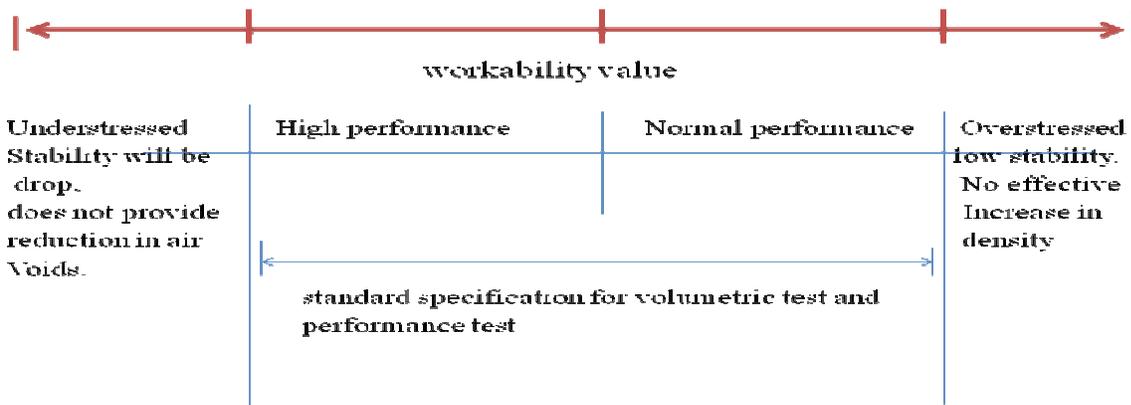


Figure 3. Grouping of workability value to develop an index

standards expected. All the values obtained from the test that fall within the normal and higher performance will form the workability values.

Theoretical Background

Theoretically, this research is underpinned by Electrostatic theory, Chemical Bonding theory, Weak Boundary layer theory, Mechanical theory and theory of mixing, for the purpose of this paper, the theory of mixing is considered as the underpinning theory for the proposed device. The reason is that the aim of this research is to design and develop a prototype device for measuring asphaltic concrete workability; evaluate and investigate the relationship between compactibility and workability; and formulate the categories of compactibility against the torque mixing HMA.

Conclusion

This paper has attempted to present the preliminary stage of production of an improved workability device. The improvement is based on the trends identified in the literature. Although the research work is at the preliminary stage, publishing this preliminary stage enables the authors to proceed with to the next stage. Additionally, this research is a response to the development of workability index. The proposed device will reduce time spent in measuring torque, power and speed using transducer. The workability testing of HMA can be used as a tool to select desired HMA and improve the quality control and assurance.

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