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EDITORIAL PREFACE

This is forth issue of volume three of the International Journal of Business Research and Management (IJBRM).The International Journal of Business Research and Management (IJBRM) invite papers with theoretical research/conceptual work or applied research/applications on topics related to research, practice, and teaching in all subject areas of Business, Management, Business research, Marketing, MIS-CIS, HRM, Business studies, Operations Management, Business Accounting, Economics, E-Business/E-Commerce, and related subjects. IJRBM is intended to be an outlet for theoretical and empirical research contributions for scholars and practitioners in the business field. Some important topics are business accounting, business model and strategy, e-commerce, collaborative commerce and net-enhancement, management systems and sustainable business and supply chain and demand chain management etc.

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TABLE OF CONTENTS

Volume 3, Issue 4, August 2012

Pages

Value Creation in Collaborative Supply Chain Network in Automobile Industry in Karnataka

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Abstract

This paper aims to determine the key factors that influence the value based supply chain in the collaborative network of Automotive sector in India and the extent of information sharing in a B2B set up and its implication on business decisions in the Automobile sector. The paper makes an attempt to examine the value creation in the supply chain network of e-commerce based automobile companies. The predominant factors that influence the Collaborative practices of Automobile Original Equipment Manufacturers (OEMs) in Karnataka and their dealership network in the background of e-commerce is thoroughly examined.

Design/methodology/approach: In the paper, the systemic and logical analysis of value creation expert research made over the past several years is used and statistical analysis(Exploratory Factor Analysis) has been conducted based on the survey results of perceptions of the dealers assimilated through online survey.

Findings: Major empirical findings based on automobile companies' data analysis vide Exploratory factor analysis allow stating that adoption of e-based collaborative arrangements and information sharing based on trust and long term alliance between partners enhances the value creation and results in the improvement in Supply chain management. It thus results in: Savings in cost, Timely decisions based on superior information, Better and positive relationships with Manufacturer-Suppliers and Dealers, Superior and strong collaboration, Integrated customer service and Enhancement of ultimate consumer value.

Originality value: This paper has thoroughly examined the Collaborative network of the e-commerce based automobile co's. and empirical findings suggest that the entire supply chain network has reaped the benefits of technology adoption and its
impact on business results is tangible which could be evidenced in positive outcomes like improvement in Manufacturer-Supplier-Dealer co-ordination and enhancement of long term customer relations.

Research limitations/implications: The presented research work confirms the positive implications of technology on value creation in the supply chain network of e-commerce based automobile companies. Research in this area highlights only the value addition in the collaborative supply chain network in select automobile co's (OEMs) in Karnataka and their dealership network in India. Broader generalisations could be drawn using this information, by selecting a larger sample size. The future research should be made on the entire industry in the country and by bringing more co's. and suppliers into the sampling frame.

Keywords : Value Creation, Collaborative Supply Chain, Information Sharing, Superior Collaboration.

1. INTRODUCTION

The most remarkable facet of the emerging "digital economy" is of course the Electronic Commerce. The Internet, which enables E-commerce, is radically changing not only the way businesses serve and communicate with their customers, but also the way they manage their relations with suppliers and partners. Both the new Internet-based companies and the traditional producers of goods and services are transforming their business processes into e-commerce processes in an effort to lower costs, improve customer service, and increase productivity (DOC, 1999).

The Automotive Supply chain is a complex network that consists of suppliers, manufacturers, distributors, retailers and ultimate users or customers working together to convert raw materials to work-in-process inventory (WIP) to final products. Owing to the high asset value involved and unique characteristics of the production process, firms must develop capabilities for collaborative manufacturing: like sharing of information, managing information technology, achieving operational excellence through strong and superior relationships with partners. In today's I.T. based manufacturing, managers rely heavily on Information technology to store, communicate and for retrieval of data for making informed decisions. Hence Information sharing and collaboration are the true corner stones in the spirit of the Value creation process in the Supply Chain.

According to Report published by Far Eastern Economic Review (1999), China's Internet users are expected to grow from 4 million by end of this year to 10 million by 2000, compared to a paltry 1.5 million in India the same year. China is aggressively developing its IT-based services sector. China's service sector activities used to be labour intensive, but are now increasingly capital and knowledge intensive as China is determined to emerge as Asia's services hub in the 21st century.

Now that the comparative advantage of nations lies in the application of knowledge, rather than on cost advantage, economists are worried that wealth creation in the next century won't be equally spread around the world. In his book, "Building Wealth," Thurow (1999) warns that global disparities are likely to become even wider as what he calls the "knowledge revolution" plays itself out. To gain stature in the global village of the next millennium, he warns, it is no longer enough to maintain free markets, invest in human and physical infrastructure, nurture the rule of law, and build democratic institutions. Unless they rapidly build a ***vibrant knowledge-based services sector***, the developing world might slide down the global *value chain* and slip lower on the slopes of a much steeper pyramid of world power (FEER, 1999). In order to achieve sustainable economic growth and be able to join the global knowledge economy, India needs therefore to accelerate the development of its services sector.

The Indian Automobile Industry perspective:

The Automobile Industry in India: Indian Automobile industry is the 9th largest in the world with an annual production of over 2.3 million units in 2008. India is expected to become one of the destinations for major global automotive industries in the coming years(Timmons 2007). A customized product or service demands that the customer's needs/wishes have to be specified and integrated into the seller's **value-creation process** so that customized adjustments can be made Kleinaltenkamp (1996). The activities necessary for achieving this cause increased customer related coordination costs for the seller. As will be discussed in what follows, this then has significant effects on the division of labor and thereby on value-creation structures in business-to-business markets. OEMs expect their component suppliers to: (1) provide integrated systems rather than individual components, (2) participate in the global automotive chain, (3) raise quality levels, (4) participate in research and development, and (5) monitor and absorb a greater share of the warranty costs. These requirements have considerable implications for the use of integrated IT systems, involving both the supplier network, as well as the customer base. Alliances between various global automobile manufacturers also depend on networks that facilitate communication and the integration of their structures.

Collaboration in the supply chain comes in a wide range of forms, but in general have a common goal: to create a transparent, visible demand pattern that paces the entire supply chain. Several seminal studies have identified the problems caused by a lack of co-ordination, and to what extent competitive advantage can be gained from a seamless supply chain (Forrester, 1961; Lee et al., 1997; Chen et al., 2003). Also, there is little doubt that the success of the Japanese manufacturing model is largely attributed to their collaborative supply chain approach and the tight integration of suppliers in Just-in-Time delivery schemes (Dyer, 1994; Hines, 1998; Liker and Wu, 2000).

In the light of the above implications of ICT on the major fast growing economies of the world, it is necessary to study in detail the factors affecting the growth of Indian economy in general. The specific problems and prospects of automobile industry would be highlighted since Indian auto industry has become a global hub for low cost manufacturing. The study tries to make a sincere effort to diagnose the problems of the Automobile Industry in India and the Supply chain linkages of Automobile companies in the process of Value creation and make suitable suggestions based on logical and systematic analysis of the data and Empirical testing of data of Automobile companies .

2. PROBLEM STATEMENT

Any given business-to-consumer transaction will involve a larger number of related business-to-business transactions. This transactions multiplier effect is not unique to e-business; however, its expected growth and continued change will add to the challenge of measuring e-business and e-commerce. Growth in transactions is expected because as e-commerce expands related business-to-business transactions will become more fragmented; participants will concentrate on performing their highest valued-activities and rely increasingly on third parties for lower-value added activities. The measurement challenges of this growth include accounting for the increased volumes, identifying the new areas for improvement for automotive dealers (e-business players), maintaining up-to-date information for the known players, and avoiding double counting the value of related transactions.

Change in the scope and nature of e-commerce transactions is expected because electronic business methods permit the players to change their roles relatively easily and they increasingly will do so. Examples of changes in roles are today seen in manufacturers and wholesalers who now sell directly to consumers, and in the "virtual" integration of firms through informal alliances that link firms electronically. These new arrangements impose additional measurement challenges including identifying the new players and their roles, maintaining up-to-date information on them and how their roles are changing, and updating data collection methods (such as including direct-sale "manufacturers" in an appropriate "retail" sales survey frame).

The research study begins with the aim of better understanding what predominant factors influence value creation and how collaborative e-business processes are changing the firm and its internal operations, re-engineering the supply chain and changing the collaborative relationship between manufacturers, wholesalers, retailers and customers, and effects on the automotive industry in India and economic structure. Specific deliverables include the development of a framework for evaluating e-business based collaborative processes' impact across the automotive value chains, and development of a forward-looking collaborative e-commerce taxonomy for supplementing existing automotive industry specific collaborative information systems.

3. RESEARCH OBJECTIVES

The objectives of the study are as follows:

- To determine the status quo of value creation in the collaborative network among companies and their dealership network in the automotive industry in India;

- To identify the predominant factors in the collaborative supply chain in the auto industry and extent of collaboration and information sharing in the configuration and coordination of value creation; and offer suggestions based on the empirical findings.

4. SIGNIFICANCE OF THE STUDY

The ability to collaborate with various players in the supply chain in creating value is critical success factor for all automobile manufacturers. What makes a supply chain successful is the collaboration, visibility, and trust of the various entities in the chain. Online collaboration and rationalisation of the entire value chain is popular in the American, Japanese, and European markets on account of their high sales volumes. These markets provide a reliable sales base for vendors and are well-integrated, making minimal taxation rates, as well as cost advantages for the supplier, possible. In contrast, sales in India are relatively low. Good information sharing and trust building between trading partners improves supply chain visibility that can lead to better coordination and build a solid foundation for collaboration in efficient operations, cost reduction and for perfecting customer service.

5. LITERATURE REVIEW

The effects of changed consumer-goods markets on business-to-business value Chains in developed economies, the demand in consumer-goods markets now exhibits an increasing individualization. This trend, which it is presumed will continue in the future,(Piller,2003) has the result that products offered on these sales markets are becoming increasingly differentiated. It is still a matter of debate to what degree this development has been caused by an actual increase in the diversification of consumers or, in contrast, artificially brought about through strategic marketing measures undertaken by consumer-goods manufacturers (Becker, 2002).

However, the result is definitely a growing segmentation of the various markets into ever smaller niches along with a corresponding diversification of products. This occurs first when existing products are offered in a greater number of models and variations. A vivid example of this development is the automobile industry. In the last thirty years, the number of automobile types offered per model has increased by five to eight times. Similar developments can also be observed in other industries.

Also, there is a second trend often referred to as “mass customization”. A number of Consumers are offered products which have been customized to meet their individual needs. In general, such customization is facilitated through the use of corresponding information-/communication technology. The manifestations of product individualization range from “match-to-order” or “locate-to-order” (assisting the customer in the selection of standard products) to “make-to-order”, in which an offer for goods/services is specifically tailor-made to the individual customer’s requirements. Such forms of mass customization can currently be found in offers for automobiles, clothing articles and shoes, cosmetics, media products, etc. Piller (2003). This more market orientation towards the individual customer in the consumer goods market is primarily sales-motivated. In tailoring their products to their customers’ requirements, sellers hope to be able to demand higher prices. At the same time, they aim at an overall increase of customer satisfaction, thereby improving overall customer relations. All of this will help the seller to maintain a competitive edge on the market. However, there are also costs involved in this which primarily take the form of an increase in “complexity” costs Schweikart (1997). These costs must be taken into consideration but are often ignored in business practice. A customized product or service demands that the customer’s needs/wishes have to be specified and integrated into the seller’s **value-creation process** so that customized adjustments can be made Kleinaltenkamp (1996). The activities necessary for achieving this, cause increased customer related coordination costs for the seller. As will be discussed in what follows, this then has significant effects on the division of labour and thereby on value-creation structures in business-to-business markets:

Adam Smith pointed out that production costs will fall when there is specialization in certain activities, accompanied by an increased output volume. At the same time, however, division of labour requires a greater degree of coordination and cooperation among the different participants – regardless of whether ‘participants’ denotes individual employees, corporate divisions or even entire companies. These additional coordination efforts increase the total costs. The more specialized the participants are, the higher the resulting coordination costs will be. Smith (1876).

Toyota, for instance, has invested in innovations to reduce gas emissions and improve fuel efficiency. The company has made efforts to reduce hydrocarbon, carbon monoxide, and nitrogen gas emissions through Diesel Clean Advanced Technologies—which incorporates technologies such as a computer controlled common rail fuel injection system—or the new Diesel Particulate Nox Reduction System (DPNR), which removes particulate matter (PM) and Nox from exhaust emissions.

Toyota has extended the scope of its value chain to construct an integrated customer lifestyle support system. The main elements of the value chain Toyota focuses on include e-commerce, financing, and Intelligent Transport Systems. The company’s e-commerce venture in Japan is steadily growing with Web site membership (gazoo.com) having reached three million. On average, 360,000 online requests for price quotes and catalogs are received by Toyota dealers annually, with 10% of these requests resulting in purchases of Toyota vehicles.

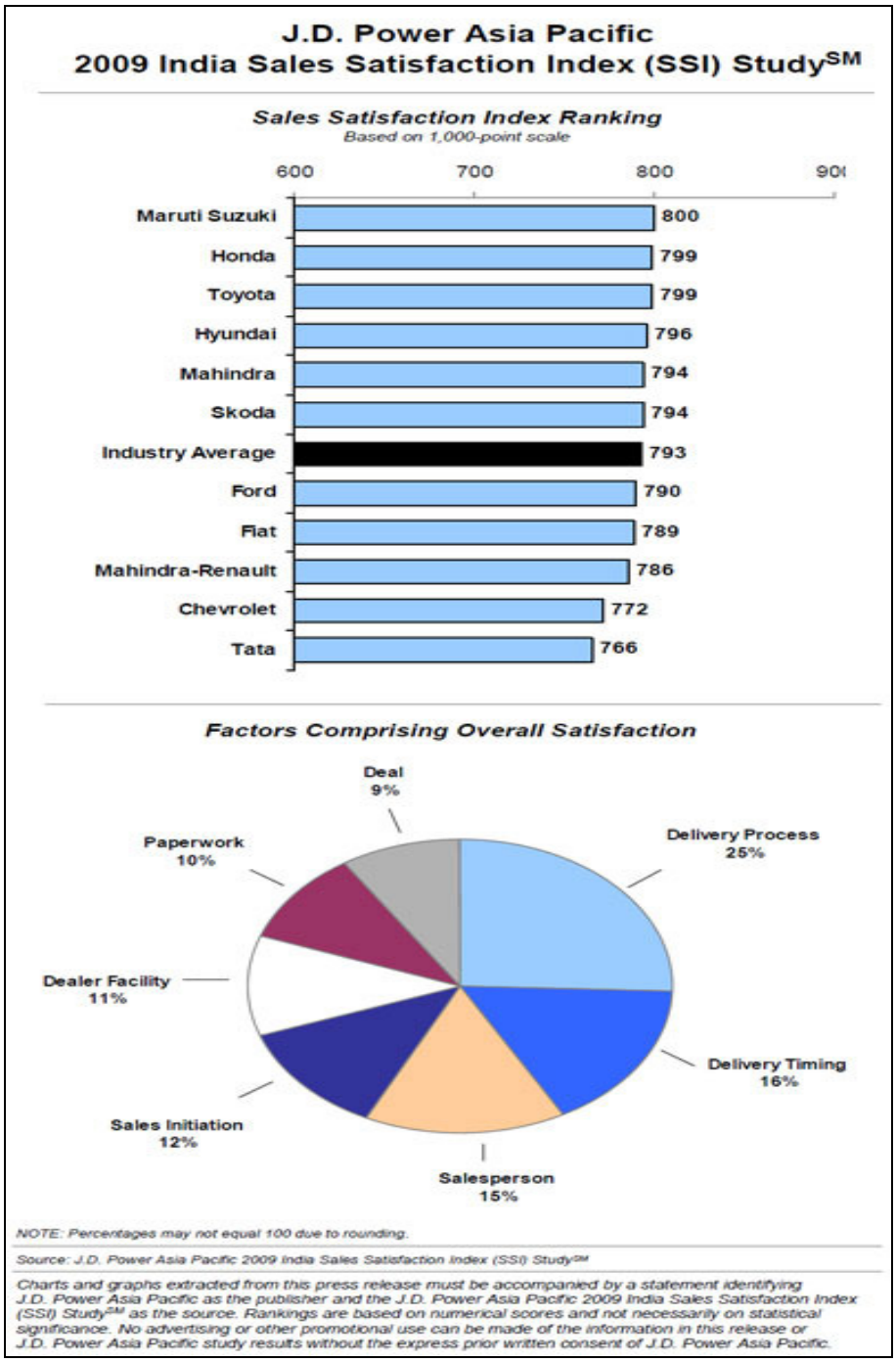
Duncan Austin et.al.,(2003) in their Report on “Changing Drivers: The impact of climate change on competitiveness and value creation in the automotive industry” bring to light the effect of carbon constraints on *value creation.* The purpose of the report is to help investors make better informed

decisions regarding automotive company stocks in light of emerging "carbon constraints" – policy measures designed to mitigate climate change by limiting emissions of carbon dioxide (CO2) and other greenhouse gases.

The report explores how carbon constraints in global automotive markets may affect value creation in 10 leading automotive companies between now and 2015, a timeframe in which major technological and policy changes are possible. The Original Equipment Manufacturers (OEMs) assessed are BMW, DaimlerChrysler (DC), Ford, GM, Honda, Nissan, PSA, Renault, Toyota and VW – the world's largest independent automotive companies.

The geographical scope of the assessment is the United States, European Union and Japanese markets, which together account for nearly 70 percent of current global sales. The report is the result of collaboration between SAM Sustainable Asset Management (SAM) – a Zurich-based independent asset management company specializing in sustainability-driven investments – and the World Resources Institute (WRI) – an environmental research and policy organization based in Washington D.C. Drawing on the respective strengths and expertise of the two organizations, the report analyzes both the risks and opportunities of carbon constraints, and then estimates the combined implications for OEMs' future earnings. The report is explicitly forward-looking, focusing on the main factors affecting OEMs' exposure to carbon constraints, and drawing on the latest publicly available information about the 10 assessed OEMs.

FIGURE 1: Sales Satisfaction Index



Source: J.D.Power Asia Pacific 2009

The above diagram (figure1) reveals statistics based on survey of Indian consumers by J.D.Power Asia Pacific, India Sales Satisfaction Index (SSI). It reveals that Toyota is tagged with Honda in Sales satisfaction with 799 points which is above the industry average of 793 on a 1000 satisfaction measuring scale. This indicates the Toyota's endeavour and constant struggle towards enhancing customer satisfaction and putting the 'customer first' as a strategic business mission and

strengthening long term bondage with the customers. This suggests for a complete transformation in the supply chain. If customers needs are to be met, it is a must that all the partners in the supply chain i.e, Component Suppliers-Original Equipment Manufacturer-Dealer should align their objectives in line with that of customers' needs. The Original equipment manufacturers must take in to account the underpinnings of customers' real needs since there is an urgent need for the automobile industry to graduate from "build to stock" to "build to order". For this, to be achieved, superior information sharing and strong collaborative practices amongst all the players in the automotive industry is the need of the hour.

The "Global best, local best" principle "Global best, local best – these commitments rule the development of Toyota's mainstay global models. By "global best" we mean building cars with common value worldwide while pursuing the world's highest levels of quality and performance. The global best concept is fundamental to the Toyota mind-set. We want to give superior quality and outstanding cost performance to customers buying Toyota vehicles throughout the world. On the other hand, "local best" expresses a commitment to accurately reflecting the needs and values of customers in different regions. Toyota enhances the value of its core global models by marrying its commitments to being global best and local best." Toyota (2006: 18)

While examining the literature on collaboration in supply chain, there seems to be increased attention on collaborative efforts in forward supply chains in the last decade based on the assumed premise that closer inter-firm relationships and enhanced information exchanges do improve the quality of decision making, reduce uncertainty, and consequently improve supply chain performance (Whipple and Russel, 2007).

FIGURE 2 : Information-Based Supply Chain Innovations
Supply Chain Innovations

	Opportunity	*Examples*
Substitution Effect	New and improved planning process	Intelligent & scientific planning
Scale Effect	Extensive connectivity & visibility	Coordination; sense & respond
Structural Effect	Re-engineered information, materials & financial flows	Design collaboration, postponement, new financial flow

Source: Information-Based Supply Chain Innovations Hau L. Lee Stanford University

In recent years, numerous studies – many of them conducted by trade associations or management consulting firms – have focused on structural change in the automotive industry and the subsequent reconfiguration of value chains. The focus has often been on cooperation between manufacturers and suppliers and, particularly, on the scope of the value activities carried out by each side Sonnenborn (2009). The configuration and coordination of such activities have been largely ignored. Most notably, there has been little examination of the role of the configuration and coordination of value activities in generating competitive advantages. For the most part, the academic literature on this topic Roth(1992), Holtbrügge (2005) has failed to consider the decision-making approach of strategic management. There is virtually no literature for practitioners that addresses the issue of the configuration and coordination of value activities. This study is intended to fill this gap.

6. DEFINITION AND CONCEPTUAL FRAMEWORK

6.1 Definition and Review of Value Creation, Collaboration and Information Exchange in Supply Chain :

Value creation in Automobile industry which has a strong logistics base, and thus could be defined as "meeting customer service requirements while minimising supply chain costs and maximising partner' profits" Langley and Rutner (2000). They further define logistics value added as "either providing additional services or exceeding customer service requirements that further reduces the supply chain costs or increasing the partners profits and gains in competitive advantage in the marketplace".

Collaboration in a supply chain occurs when "two or more independent companies work jointly to plan and execute supply chain operations with greater success than when acting in isolation" (Simatupang and Sridharan, 2003). Ganesan (1994) posits "trust alludes to the extent to which supply chain partners perceive each other to be credible (i.e., partners have expertise to perform effectively) and benevolent (i.e., partners have intentions and motives that will benefit the relationship). (Yu et al., 2001; Sandberg, 2007) opine that: " Information exchange on the other hand is the extent to which data is accessible to partner firms through mutually agreed exchange infrastructure. *Information exchange (or information sharing) means that retailer and supplier still order independently, yet exchange demand information and action plans in order to align their forecasts for capacity and long-term planning.* Information sharing among supply chain partners is an important prerequisite for effective collaboration". Collaboration can also be defined as a relationship between independent firms "characterized by openness and trust where risks, rewards, and costs are shared between parties"(Sandberg, 2007).

6.2 Proposed Theoretical/ Conceptual Framework

The theoretical framework proposed for this study considers 12 predominant variables that affect the Collaborative supply chain network of the Automobile Industry. The variables are subjected to Exploratory Factor analysis and their inter-relationships are thoroughly examined and interpreted by using correlation matrix, extraction of factors through principal component analysis.

SECTION – A

EXTENT OF INFORMATION SHARING IN THE VALUE CHAIN BETWEEN PARTNERS : FACTOR STATEMENTS AND CORRESPONDING VARIABLES

STATEMENT NO.	STATEMENT	VARIABLE NO.	NAME OF VARIABLE
Statement 1	Accuracy of Information shared with partners	Variable 1	ACCURINFMNSHRD
Statement 2	Mutual access to the partners' databases	Variable 2	MUTACCSDTBS
Statement 3	The extent of cost data shared with the partners	Variable 3	COSTDATASHRD
Statement 4	The use of web-enabled inventory data shared	Variable 4	WEBENBLDDATA
Statement 5	Warehouse information shared	Variable 5	WAREHSINFMN

SECTION – B

COLLABORATIVE PRACTICES BETWEEN PARTNERS IN THE VALUE CHAIN : FACTOR STATEMENTS AND CORRESPONDING VARIABLES

STATE MENT NO.	STATEMENT	VARIABLE NO.	NAME OF VARIABLE
Statement 6	Trust between the partners	Variable 1	TRUSTBTWNPRTNR
Statement 7	Long-term alliance with the partners	Variable 2	LONGTERMALL
Statement 8	Well defined collaborative objectives, scope and responsibilities	Variable 3	COLLBRTVOBJ
Statement 9	Joint forecast and planning arrangements	Variable 4	JOINTFORCST
Statement 10	Jointly established performance measures	Variable 5	JOINTPERFMMEAS
Statement 11	Sharing of risk and reward with the partners.	Variable 6	SHARINGRISKREW
Statement 12	Opportunity for Improvement	Variable 7	OPPRTNTYFRIMPROV

7. RESEARCH METHODOLOGY

A survey and interview methods were employed to gather information regarding Value creation in the automobile industry in Karnataka with special emphasis on Car Manufacturers**.** Because of the specific time-focus of this initial reference position, the fact that data referring to the Internet and Internet usage are quick to age does not present a significant problem in this study. Following the standard approach **,** we measure the distributors' perceptions and related variables in terms of a Likert-type scale ranging from 1 to 5 with the following equivalences, ``1": ``not important" or ``strongly disagree"; ``2": ``slightly important" or ``slightly agree"; ``3" : ``neutral"; ``4" : ``important" or ``agree"; and ``5": ``very important" or ``strongly agree". Given the exploratory nature of the study and consistently with our interpretation of ``Value Creation", we decided to leave out considerations of a latent nature. The sample was therefore, restricted to Distributors of three OEM's namely, Toyota, Volvo and Reva in Karnataka State**.** A questionnaire on employees attitudes was designed and pre-tested according to the standard approach and it was dispatched online to 200 such individuals, securing 120 overall meaningful responses from the distributors of all the three OEMs. (60%). Its contents were framed with regard to the fact that Internet based transactions, collaborative practices and communications, and costs tended to remain small and constant over the relevant duration. Assistance was supplied to the respondents in case of difficulty, and SPSS 13 package was employed in data analysis. To complement the survey, interviews were conducted with executives of the Dealership network of Car Manufacturers. All these companies have been actively involved in developing and promoting B2C e-commerce in India.

7.1 Research Design

Research design is an overall framework of a research that explains the direction and method to be used in the study to gather the information needed, either from primary or secondary sources (Malhotra, 2007). According to Neuman (2006), quantitative approach has the characteristic of measuring objective facts using variables where data is separated from theory, statistically analysed and emphasized with its reliability. Quantitative approach has been used to develop hypotheses that consist of all the variables to empirically investigate the above statement vide statistical technique.

Due to adoption of quantitative approach, it is inevitably that the study will be carrying out causal research where the hypotheses formulated earlier consisting of all the variables will be empirically investigated using statistical technique such as charts, tables and other statistical measurements to prove the interdependencies of the factors through exploratory factor analysis.

7.2 Data Collection Methods

In this section, there would be illustration on what methods will be used in collecting the primary and secondary data in order to empirically test the formulated hypotheses, and hence solving the research questions.

7.2.1 Primary Data

For this study, a questionnaire consisting two parts namely, PART-A which highlights questions on dealership related information and PART-B which is very pertinent to this study highlights the online collaborative practices of the dealers with trading partners which is very crucial for the value creation process in the automobile industry. This section consists of two important areas namely,

A. Extent of Sharing Information between partners and
B. Collaborative arrangements with Partners

The first part, tries to investigate empirically, the perceptions of the dealers and assess the extent of online information shared between the partners. It has four main variables, namely, Mutual access to the partners' databases, The extent of cost data shared with the partners, The use of web-enabled inventory data shared and Warehouse information shared between partners.

The second part, emphasises and tries to investigate the collaborative arrangements with partners. It has six main variables, namely, Trust between the partners, Long-term alliance with the partners, Well defined collaborative objectives, scope and responsibilities, Joint forecast and planning arrangements, Jointly established performance measures and Sharing of risk and reward with the partners.

7.2.2 Secondary Data

In this study, most secondary data are extracted from online resource such as online databases, internet findings or other sources. The journal articles of relevant study field are adopted from various library Database like, Proquest Database and Science Direct database. Automobile Manufacturers' websites, SIAM, ARAI, and JD POWER ASIA survey results and other research publications.

7.3 Sampling Design

7.3.1 Target Population

Target population is said to be a specified group of people or object for which questions can be asked or observed made to develop required data structures and information Hair and Bush (2006) . Therefore, the target population in this research study is the focus group of the Car dealers in the automobile industry who sell the cars manufactured by the OEMS, namely, Toyota, Volvo and Reva.

7.3.2 Sampling Frame & Sampling Location

The sampling frame can be defined as set of source materials from which the sample is selected. The definition also encompasses the purpose of sampling frames, which is to provide a means for choosing the particular members of the target population that are to be interviewed in the survey (Anthony G. Turner, 2003). However, sampling location is a place where a research is conducted or/and a place where information is acquired. In this research study, the respondents are the Dealers of various Car Manufacturers' Dealership network spread throughout Karnataka and other parts of India.

7.3.3 Sampling Technique

According to Malhotra (2007), non-probability sampling is less expensive, less time consuming, and require only little sampling skills. Therefore, this sampling technique is adopted to conduct survey in this research. Moreover, units of sample in this research are selected on the basis of personal judgment or convenient because information and targeted respondent is readily available throughout the dealership network.

7.3.4 Sampling Size

In this research, sampling size is determined accordingly by using sample size formula adopted from Krejcie, R.V., and Morgan, D.E. (1970). Malhotra and Peterson (2006) and Zikmund (2003) stated that, larger the sampling size of a research, the more accurate the data generated but the sample size will be different due to different situation. The total targeted population in this research is counting according to the total available dealers of the three OEMs. There are approximately 1200 employees across the Dealership network of the three companies, namely, Toyota, Volvo and Reva and the information is adopted in the last updated date of 30th April 2012 in their respective websites. Therefore, according to the formula used, the sample size in this research will be 200 which accounts to nearly 16.66% of total population. 200 copies of questionnaire were elicited online as an e-mail attachment to all dealers and 120 meaningful responses were received which accounts to 60% response rate.

7.4 Research Instrument

The research instrument that used for the study is the online questionnaire. The purpose of using a Well designed structured Questionnaire in a survey is due to it's accuracy in obtaining desired results and obtaining the direct response and feedback from the respondent groups. The questionnaires can be collected in short period of time and in an easier manner and could be reached to a large number of population.

7.4.1 Questionnaire Design

In this study, the questions in the questionnaire are closed-ended or structured in order to ease the process of analyzing the data from respondents. This questionnaire consists of two parts, section A which relates to information sharing between partners which consists of five variables which were based on ordinal scale. (five point Likert scale) In section B, it consists of questions relating to seven variables which would be formed based on a five point Likert scale which allows respondents to indicate how strongly they agree or disagree with the statement provided.

7.4.2 Pilot Test

Prior to the data processing, a pilot study was conducted and pre-tested by contacting dealers online and nearly 25 respondents affirmed the correctness and technicalities of the questionnaire design. The details would be specified in later section and the pilot test enables the reliability of this instrument to be empirically tested. The survey results would later be tested using SPSS software.

8. RESULTS OF FACTOR ANALYSIS

The Exploratory factor analysis reveals that respondents consider all variables as important in adopting a collaborative e-commerce model in the supply chain for value creation. The technological confluence in designing the business models and collaborative practices is the need of the hour. Here, certain variables are grouped together into specific segments to identify the key factors in collaborative supply chain by applying factor analysis using Principal Component Analysis.

Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity are used to examine the appropriateness of factor analysis. As shown in (Table 1), the approximate Chi–Square statistic is 202.928 with 66 degrees of freedom which is significant at 0.05 level. The KMO static (.639) is also large (>.5). Hence, factor analysis is considered as an appropriate technique for further analysis of data.

TABLE 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.639
Bartlett's Test of Sphericity	Approx. Chi-Square	202.928
	Df	66
	Sig.	.000

Source : Primary Data

Results of Principle Component Analysis for variables related to collaborative practices in supply chain are calculated into communalities (Table 2), total variance explained (Table 3) and rotated component matrix (Table 4) are shown here under:

TABLE 2 : Communalities

	Initial	Extraction
ACCURINFMNSHRD	1.000	.791
MUTACCSDTBS	1.000	.550
COSTDATASHRD	1.000	.643
WEBENBLDDATA	1.000	.492
WAREHSINFMN	1.000	.720
TRUSTBTWNPRTNR	1.000	.645
LONGTERMALL	1.000	.541
COLLBRTVOBJ	1.000	.377
JOINTFORCST	1.000	.449
JOINTPERFMMEAS	1.000	.440
SHARINGRISKREW	1.000	.385
OPPRTNTYFRIMPROV	1.000	.574

Extraction Method: Principal Component Analysis.

Source : SPSS Output of Primary Data

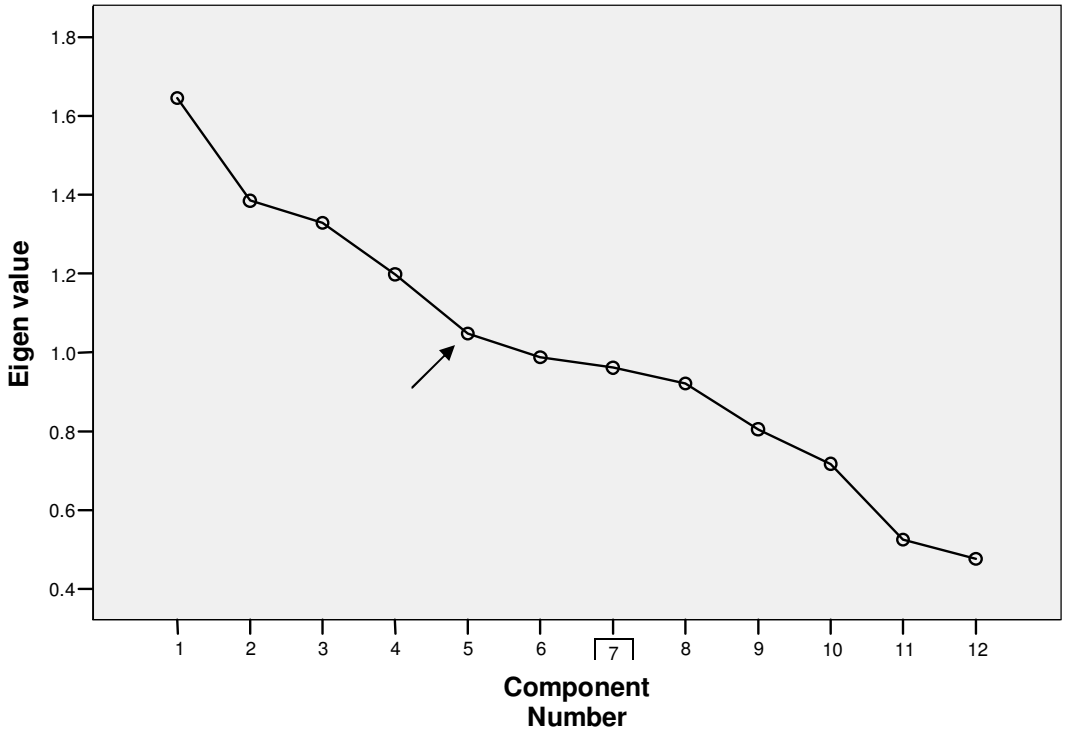
TABLE 3 : Total Variance Explained

Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.645	13.712	13.712	1.645	13.712	13.712	1.381	11.509	11.509
2	1.385	11.539	25.252	1.385	11.539	25.252	1.368	11.400	22.909
3	1.329	11.073	36.325	1.329	11.073	36.325	1.339	11.161	34.069
4	1.198	9.983	46.308	1.198	9.983	46.308	1.263	10.523	44.592
5	1.048	8.734	55.043	1.048	8.734	55.043	1.254	10.450	55.043
6	.988	8.233	63.275						
7	.962	8.013	71.288						
8	.921	7.675	78.963						
9	.805	6.709	85.672						
10	.717	5.978	91.650						
11	.525	4.377	96.027						
12	.477	3.973	100.000						

Extraction Method: Principal Component Analysis.
Source : SPSS Output of Primary Data

Retaining only the variables with Eigen values greater than one (Kaiser's Criterion), one can infer that 13.712 % of variance is explained by factor 1; 11.539 % of variance is explained by factor 2; 11.073 % of variance is explained by factor 3, 9.983 % of variance is explained by factor 4, 8.734 % of variance is explained by factor 5 and over all, the five extracted factors contributed to 55.043 % of variance as per Table – 3.

FIGURE 3 : Scree Plot



Source : SPSS Output of Primary Data

From the above diagram (Figure 3), it is apparent from the Scree plot that five factors are having Eigen values above 1.0 (Kaiser's criterion), which clearly indicates that these five factors are extracted through the Principal Component Analysis. For further analysis, the Rotated component matrix indicates what variables are loaded to each factor.

TABLE 4 : Rotated Component Matrix(a)

VARIABLES	Component				
	1	2	3	4	5
ACCURINFMNSHRD	.073	.227	**.849**	-.113	-.029
MUTACCSDTBS	-.210	**.682**	-.032	.180	-.084
COSTDATASHRD	-.137	-.425	**.619**	.242	-.037
WEBENBLDDATA	.015	.139	.139	**.658**	-.143
WAREHSINFMN	-.101	-.290	.311	.204	**.698**
TRUSTBTWNPRTNR	-.187	.220	-.292	-.185	**.665**
LONGTERMALL	**.703**	.201	-.040	-.022	-.068
COLLBRTVOBJ	-.142	-.049	-.062	**.578**	.130
JOINTFORCST	.417	.042	-.074	.030	**.517**
JOINTPERFMMEAS	.141	**.637**	.069	-.071	.065
SHARINGRISKREW	-.254	**.542**	-.111	.195	.025
OPPRTNTYFRIMPROV	**.534**	-.096	-.075	.521	.045

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 7 iterations.

Source : SPSS Output of Primary Data

9. DISCUSSIONS OF MAJOR FINDINGS

On the basis of Varimax with Kaiser Normalisation, 5 factors have emerged as could be evidenced from the above Rotated component matrix (Table 4). Each factor is constituted of all those variables that have factor loadings greater than or equal to 0.5 (Table 4) . Thus 7^{th} and 12^{th} variables constitute the first Factor, conceptualized as " Long term growth of partners". Variables 2^{nd}, 10^{th} and 11^{th} constitute the second Factor conceptualized as "Mutual business conduct online". 1^{st} and 3^{rd} Variables constitute third Factor conceptualized as "Extent of Information Shared ". 4^{th} and 8^{th} variables constitute fourth Factor conceptualized as "Online collaborative practices'. 5^{th} and 6^{th} and 9^{th} variables constitute the fifth Factor which is conceptualized as "Trust building and planning" The identified factors with the associated variables and factor loadings according to Rotated Component matrix (Table 4) are elucidated as follows in the following Correlation Matrix which is significant at 0.05 level.(Table 5).

TABLE 5 : CORRELATION MATRIX

FACTORS		LONGTERM GROWTH OF PARTNERS		MUTUAL BUSINESS CONDUCT ONLINE			EXTENT OF INFORMATION SHARED		ONLINE COLLABORATIVE PRACTICES		TRUST BUILDING AND PLANNING		
	VARIABLES	O.I	L.A	J.P.M	SRR	M.A.D	AIS	CDS	C.O	WED	W.I	TBP	JF
LONGTERM GROWTH OF PARTNERS	OPPRTNTYFRIMPROV(O.I)	1	.196	.001	-.074	-.057	-.021	-.013	.083	.114	.142	-.132	.069
	LONGTERMALL(L.A)		1	.050	-.126	.019	.055	-.084	-.027	-.035	-.158	-.010	.138
MUTUAL BUSINESS CONDUCT ONLINE	JOINTPERFMMEAS(J.P.M)			1	-.042	.098	.055	-.233	-.023	.052	-.072	.073	-.048
	SHARINGRISKREW(S.R.R)				1	.137	.006	-.100	.045	.017	.021	.042	-.069
	MUTACCSDBS (M.A.D)					1	.040	-.126	.026	.086	-.167	.101	-.037
EXTENT OF INFORMATION SHARED	ACCURINFMNSHRD(A.I.S)						1	.232	-.026	-.001	.071	-.187	-.021
	COSTDATASHRD(C.D.S)							1	.107	.178	.225	-.159	-.107
ONLINE COLLABORATIVE PRACTICES	COLLBRTVOBJ (C.O)								1	.061	.095	.008	-.015
	WEBENBLDDATA(W.E.D)									1	.008	-.118	.041
TRUST BUILDING AND PLANNING	WAREHSINFMN(W.I)										1	.143	.107
	TRUSTBTWNPRTNR (T.B.P)											1	.103
	JOINTFORCST(J.F)												1

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

Source : SPSS Output of Primary Data

The correlation matrix clearly suggests the inter dependencies amongst the variables. The constituents of the LONG TERM GROWTH OF PARTNERS factor are : Opportunity for Improvement(O.I) and Long term alliance (L.A). As per (Table 5**)** , the correlation matrix reveals that Opportunity for Improvement has significant correlation with Long term alliance between partners since the 'r' value = (.196). The positive relationship between the variables indicates that the long term alliance between partners using online services will increase the opportunities for improvement in information sharing between partners which is mutually beneficial for growth and thus would enhance the value creation process in the long run for the entire supply chain.

The constituents of MUTUAL BUSINESS CONDUCT - ONLINE factor are : Jointly established performance measures (J.P.M), Sharing of risk and reward with the partners (S.R.R) and Mutual access to the partners' databases (M.A.D) . The matrix depicts that (J.P.M) has significant correlation with (M.A.D) , and negative correlation with (S.R.R) since the 'r' value = (-.042) This suggests that the Jointly established performance measures(J.P.M) between the trading partners requires constant sharing and accessing the databases mutually(M.A.D) for improving business performance and relations between partners and thus enhancing the value creation process. However, this process may not yield good results when in it comes to sharing of risk and reward with the partners since jointly established performance measures will have a negative impact on Sharing of Risk and Rewards (S.R.R), 'r' value = (-.042). Hence, the Original Equipment Manufacturers (OEMs) should take responsibility to enhance dealer relationships and there is a strong need to institutionalise a suitable Dealer Relationship Management and Supplier Relationship Management policy that covers the full product lifecycle from component development to risk-sharing.

EXTENT OF INFORMATION SHARED between partners factor is constituted by Accuracy of Information shared (AIS) with partners and The extent of cost data shared (CDS) with the partners. Correlation matrix shows a significant relationship between (AIS) and (CDS) with an 'r' value of (.232). It can be inferred that the Accurate information shared between partners and the extent of usage of cost data have a positive relationship. This indicates the OEMs and dealers have a good integrative Web-based interface. Thus it increases the sharing compatibility between partners, which in turn enhances the value creation process.

The factor ONLINE COLLABORATIVE PRACTICES with partners constitutes The web-enabled inventory data (W.E.D) shared between partners and Well defined collaborative objectives, scope and responsibilities (C.O). The correlation matrix depicts a positive relationship between these two variables 'r' = (.061) which indicates there is low degree of positive correlation between these two variables. Todays' Automobile Industry requires a Comprehensive collaborative logistics programme to steer both just-in-time (JIT) procurement and unobstructed delivery. Hence sharing of reliable Inventory data with the partners is vital, as Just-in-sequence (JIS) and JIT require efficient collaborative information networks. To ensure smooth flow of information in the entire process, OEMs need to integrate with their dealers and networks have to be built with a strong IT base..

The factor TRUST BUILDING AND PLANNING constitutes Warehouse information shared(W.I), Trust between the partners (T.B.P) and Joint forecast and planning arrangements (J.F). Correlation matrix shows a significant positive relationship between (W.I), (T.B.P) & (J.F). Inference could be drawn in such a way that the variables Trust Building and Planning between partners and Warehouse Information shared, correlate positively 'r' = (.143). Joint forecast and planning arrangements (J.F) and Warehouse information shared (W.I), have a positive correlation 'r' = (.107). In case of Trust between partners and Joint forecast and planning arrangements the correlation coefficient 'r' = (.103). These values indicate that there is a low degree of positive correlation among these variables. Hence there is a need for meaningful dialogue between the dealers and the OEMs in strengthening mutual bondage and openness in communication which builds trust and aids collaborative planning and forecasting activities.

The above correlation values indicate there is scope for further improvement in relationship between the Dealers and the OEMs. OEMs cannot make accurate and timely decisions in isolation. Therefore, opportunities must be identified on demand with improved data analysis and insights. And, once in the market, supplier and dealer networks have to be developed with reliable local partners. For their integration, Automobile manufacturers have to install virtualised e-learning solutions and increase communication solutions. Any endeavour to build trust among partners with proper planning arrangements, would lead to proper information sharing. Hence a strong bondage of mutual trust would strengthen the long term joint strategic process building between partners and help the value creation process in the automotive supply chain.

10. IMPLICATIONS OF THE STUDY

The inter correlation matrix clearly indicates the positive relationship between the variables which are considered for the study. Our findings demonstrate that the information sharing leads to greater collaboration and thus aids the value creation in the supply chain which in turn leads to better performance of the firms in the entire automotive industry. A lesson here, for the managers is that superior collaborative practices and better information sharing is the first critical step in the process of value creation. The Original Equipment Manufacturers should take responsibility in implementing certain measures which should increase effectiveness and efficiency in the joint core processes of collaborative engineering, procurement and sourcing, and material SCM. The automotive SCM involves intense data exchange and as time elapses, and as trust level is built up, firms may gradually embed their relationship toward joint strategic process building and align their objectives strategically for mutual benefit. Good information sharing improves supply chain visibility that can lead to better coordination and build a solid foundation for collaboration in gaining operational efficiency, cost reduction, customer service perfection and for better value creation. Thus, this study throws light on intelligent collaboration among supply chain members in the automotive supply chain and how superior information sharing leads to cost benefits. By implementing the quality issue into various information sharing links of the automotive value chain, OEMs can become more resilient as the cross-functional integration of quality procedures removes bottlenecks, increases transparency of the procedures and helps eliminate potential risks for the Automotive Industry.

11. LIMITATIONS OF THE STUDY

Even though collaborative process management requires building trust, setting jointly established business goals, and designing inter-firm processes, however, to meet these goals, a strong technological confluence between all the partners in the entire Supply chain is required. Although these goals are not easy to reach, companies could strive to develop well defined collaborative objectives, establish joint performance measures in letter and spirit. The limitation of this study could be attributed to the limited survey sample concentrating only on Automobile companies in Karnataka and their dealership network in India. One such observation is that this study could be extended to other industries which are linked to Automobile industry and study the influence of other industries on the Automotive SCM.

12. CONCLUSION

The present study examines how the Superior Collaborative practices and good information sharing with a strong IT base in the entire automotive supply chain enrich the value creation process. The interplay of many key variables and their inter-correlations are brought to light with five predominant factors emerging out of the Exploratory factor analysis. Optimised collaboration can be achieved by having comprehensive specifications; clear definitions of tasks, targets and competencies; complete requirements management; risk sharing; and open organisation, IT, processes and communication. There is an urgent need for the OEMs to increase their value by collaboratively balancing all resources and optimizing the flow of goods, services, and information from the source to the end consumer. IT should play a pivotal role in enhancing the value of the automaker's preferred suppliers. To conclude, future research in this area prompts for longitudinal studies, which could be aimed at investigating cause and effect relationships in collaboration and information sharing among partners in the Automotive supply chain and their development over a period of time. Respondents from various other countries could be included in the sample, since web-based survey can attract more number of respondents and information could be easily gathered at any given point in time.

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Impact of Firm Specific Factors on Capital Structure Decision: An Empirical Study of Bangladeshi Companies

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Abstract

This study attempts to explore the impact of firm specific factors on capital structure decision for a sample of 39-firm listed on Dhaka Stock Exchange (DSE) during 2003-2007. To achieve the objectives, this study tests a null hypothesis that none of the firm's specific factors namely profitability, tangibility, non-debt tax shield, growth opportunitiy, liquidity, earnings volatility, size, dividend payment, managerial ownership, and industry classification has significant impact on leverage using estimate of fixed effect model under Ordinary Least Square (OLS) regression. Checking multicollinearity and estimating regression analysis through Pearson correlation and autoregressive model respectively this study found that profitability, tangibility, liquidity, and managerial ownership have significant and negative impact on leverage. Positive and significant impact of growth opportunity and non-debt tax shield on leverage has been found in this study. On the other hand size, earnings volatility, and dividend payment were not found to be significant explanatory variables of leverage. Results also reveal that total debt to total assets ratios are significantly different across Bangladeshi industries.

Keywords: Capital Structure, Leverage, Firm's Specific Factors, Dhaka Stock Exchange, Bangladesh.

1. INTRODUCTION

The theories of capital structure are the most attractive and complicated issue in the field of finance. Relating to capital structure two sides are frequently focused in finance that are the impact of capital structure on firm's value that is pertinent to optimal capital structure and the determinants of capital structure of firms. Decision making in capital structure is very much susceptible issue to all firms due to its internal and external effects on firms. One of the many objectives of financial managers is to maximize the wealth of the firm, more specifically shareholder's wealth maximization. To maximize firm's value as well as minimize the cost of fund, a manager should set up an optimal capital structure. The fundamental components in capital structure are debt and equity. A firm should attempt to determine the optimal capital structure that causes the maximization of firm's value. Positive relationship between leverage and value of the firm has been identified in some studies (Champion, 1999; Ghosh et al, 2000; Chowdhury S. & Chowdhury A., 2010). Capital structure policy is also important in a sense that level of risk and return of a firm is mostly affected by it. Using more debt in capital structure to finance firm's assets results in increase the variability of firm's cash flows stream more specifically it leads to generate higher risk consequently, to compensate the higher risk stockholders expect a higher rate of return to firm. But no strict theory has been developed yet to determine the exact optimal capital structure. So it concerns managers in identifying some factors influencing capital structure decision by which they can benefit to make an optimal mix of debt and equity to maximize firm's value. Moreover these factors vary across countries and firm's characteristics i.e. size of firm,

agency costs, bankruptcy costs, profitability, growth opportunity, variability of earnings, liquidity, assets structure, ownership structure, etc. Since Modigliani and Miller (1958), who are the pioneer in this field, executed an instructional research in identifying the determinants of capital structure. Thereafter, many researches have been conducted in the developed country such as Rajan and Zingales (1995) (the G-7 countries), Akhtar (2005) (Australia), and Akhtar and Oliver (2009) (Japan).

As a developing country Bangladesh has become an emerging market with a lot of potential of investment that gets an attention for investors and managers to rethink about the influencing factors of using debt and their extent of influence over firms. Although there have been small numbers of research in Bangladesh focusing on the primary determinants of capital structure such as Chowdhury MU. (2004), Lima M.(2009) , and Sayeed M.A. (2011), there is still disagreement regarding which factors have significant impact in determining a firm's capital structure. Nevertheless, an important factors affecting capital structure determination of a firm in developed country may not be equally important to a firm in developing country like Bangladesh. Furthermore, all possible factors affecting capital structure decision have not been considered in a research at a time and that is why some factors are still important to further use in measuring their impact on capital structure determination and there is a need to bridge between current study and capital structure theory.

This study extends the existing literature by analyzing the factors affecting capital structure decision on 39 listed companies in the Dhaka Stock Exchange by using the panel data models over the periods 2003-2007. This study is different from others because it considers some firm's specific factors that have not been used yet in Bangladesh. This study attempts to analyze the impact of firm specific factors on capital structure decision in a systemic manner and provides practical and applicable guideline for any one who wants to have insight of the topic. Therefore, this study provides further evidence of the capital structure theories pertaining to a developing country.
The remaining part of this paper is organized as follows. Section 2 shows some predictions associated with major leverage theories. Section 3 provides insights to recognize capital structure and its empirical determinants. The objectives of the study are addressed in section 4. Hypotheses of the study, that are to be tested, are presented in section 5. Chapter 6 summarizes the methods and methodology of the research. Data analysis and interpretation of results are presented in section 7. Conclusions and recommendations for further analysis are discussed in section 8 followed by references.

2. THEORETICAL DISCUSSION ON CAPITAL STRUCTURE

To represent and examine the possible determinants of leverage requires some theoretical platform. The importance of making a decision relating to the capital structure decision was firstly introduced by the article published by Modigliani and Miller (MM) in 1958 where they proved that, in a world of no taxes, the firm's value is unaffected by the debt to equity ratio. Following the pioneering works of MM in this field, many critical studies have been made about the assumptions made by MM. In fact, the MM theory does not crystallize the definition on how a company should finance its assets to enjoy the benefits of optimal capital structure and also it does not explain the empirical findings on capital structure very well. Then, after such criticisms, they reviewed their capital structure theory including corporate tax factor in and excluding dividends from the model and published the new article in 1963. Then, in 1977, Miller published another article and included corporate tax and individual income tax in their models. According to MM theory, an optimum capital structure is subject to tax advantages of debt and that is why firms should have a capital structure almost totally composed of debt. But in the real world, firms generally assume to use moderate amounts of debt due to its high bankruptcy costs. After MM theorem, three fundamental theorems have been developed on capital structure. These are Static Tradeoff Theory, Pecking Order Theory and Agency Cost Theory.

Jensen and Meckling (1976) are the pioneers in introducing the agency theory. Agency theory suggests that the managers (agent) are given authority by the shareholders (the principal) to

manage the firm in a way by which firm's welfare and shareholder's wealth are maximized. In particular, the managers do not always act in the interest of the shareholders in which the managers can adopt an opportunistic behavior and benefit them from achieving their own selfishness that may put the firm at risk. Eventually, achieving the goal of maximizing the value of the firm often becomes unattainable. Such a conflict of interest will create agency problems and costs. According to Jensen and Meckling (1976), an individual will work harder for a firm if he/she owns a large percentage ownership of the company than if he/she owns a small percentage. However, when managers hold a significant portion of a firm's equity, an increase in managerial ownership may lead to an increase in managerial opportunism and therefore may cause lower debt. Moreover, Jensen and Meckling (1976) argue that managers avoid leverage to reduce the risk of corporate bankruptcy and transfer of control to bondholders. The loss to managers from bankruptcy is potentially greater when managers hold larger ownership. Grossman and Hart (1982) suggest that the use of debt increases the chances of bankruptcy and job loss that further motivate managers to use the organizational resources efficiently and reduce their consumption on perks.

M. Jensen (1986) develops the **free cash-flows theory** to limit the managerial discretion. He defines the free cash-flows as the sum of the cash available to the managers after the financing of all the projects with a positive NPV. It concerns Jensen that the managers with ample free cash flow may be tempted to plow too much cash into mature business or ill-advised projects. If it is treated as problem, then it can be solved by either using more debt or paying more dividends. Even a firm can apply both policies concurrently. According to this theory debt reduces free cash flows, because the firm must make interest and principal payments. Furthermore, an increase in dividends should benefit the stockholders by reducing the ability of managers to pursue wasteful activities.

The **signaling theories** are initially developed by Ross (1977). According to Ross, managers often use capital structure as a signal of firm to investors. Ross assumes that managers (the insiders) know the true distribution of firm returns, but investors do not. If managers decide to add more debt into capital structure, investors interpret it as a signal of high future cash flows and a firm's commitment towards its contractual obligation. Thus, this shows higher level of confident to the public sentiment that lead them to think that the firm has delightful prospects in the near future. However, if managers decide to finance the firm by issuing new equity, it signals that firm has unfavorable prospects and attempt to raise new investors to share the losses. Accordingly, he concludes that investors take larger levels of debt as a signal of higher quality.

Trade-off theory (Scott, 1977) claims that a firm's optimal debt ratio is determined by a trade-off between advantages of using debt (tax deductibility of interest payments) and its disadvantages (cost of bankruptcy). Higher profitability of a firm decreases the expected costs of financial distress and let the firm increase their tax benefits by raising leverage. Furthermore, a firm with large investment in tangible assets will have smaller costs of financial distress than a firm relies on intangible assets. This theory suggests that firms would prefer debt financing over equity until the point at which the bankruptcy probability is equal to the tax advantage of using debt.

The **Pecking Order theory** (POT) was first initiated by Myers and Majluf (1984). According to this theory, a firm does not follow a target amount of leverage. Each firm chooses its leverage ratio based on financing needs. Firms first fund projects out of retained earnings. If retained earnings are not sufficient, the firms go for debt and if further financing is required, they issue equity. The retained earning is preferred over debt and equity because it almost has no cost, but if the external resources are used for financing like issuance of new shares it may take very high cost. Profitable firms generate cash internally and end up relying on less debt. Because the Pecking Order Theory is based on the difficulties of obtaining financing at a reasonable cost, a cynical investor thinks that a stock is overvalued if the managers try to issue more of it, thereby stock price is expected to fall.

3. CAPITAL STRUCTURE AND EMPIRICAL FACTORS AFFECTING CAPITAL STRUCTURE DECISION

3.1 Capital Structure

In this analysis, the capital structure is dependant variable and it is measured by total leverage that is the ratio of total debt to total assets. Total debt contains both long term debt and short term debt. It is argued by Harris and Raviv (1991), Rajan & Zingales (1995), Hung and Song (2006), Chen (2003), and Buferna, et al. (2005).

3.2 Firm Specific Factors Affecting Capital Structure Decision (Leverage)

3.2.1 Profitability

According to the pecking order theory, a profitable firm is more likely to finance from internal sources rather than external sources. More profitable firms are expected to hold less debt because they are able to generate adequate funds easily and cost effectively from internal sources for satisfying project's cost that shows an inverse relation between profitability and leverage. A negative relation between profitability and leverage is found in Rajan and Zingales (1995), Supanvanij (2006), Sayilgan et al. (2006) and Sheikh & Wang (2010). Sayeed M.A. (2011) found profitability is irrelevant in determining capital structure. On the other hand, the high ability of paying debt's obligations which is, in general, mostly considering factor to all lenders is often subject to firm's profitability that ultimately measures the firm's tolerable level of debt. It is argued that the more profitable companies can easily add more debt in their capital structure. Jensen (1986) shows that firms with more likelihood of agency problem use more debt to reduce availability of free cash flows at manager's hand so that managers can be restrained from bad investment decision. However, the trade-off theory, signaling theory, and agency cost theory support a positive relation between profitability and leverage. Following Rajan and Zingales (1995), and Supanvanij (2006), the ratio of operating income to total assets is used as a proxy for profitability.

3.2.2 Growth Opportunitiy

Myers (1977) argues that firms with growth potential will tend to have less debt in capital structure. Growth opportunities can produce moral hazard effects and push firms to take more risk. In order to mitigate this problem, assets in growth opportunities should be financed with equity instead of debt due to minimizing the loss/risk per stockholder. It supports inverse relation between firm growth and leverage which is also the findings of Gued et al. (2003), Sayilgan (2009), Buferna et al. (2005), and Akhtar and Oliver (2009). On the other hand, Titman & Wessels (1988), and Chen (2003) found a positive association between growth opportunities and leverage. According to pecking order theory firm prefers to finance new project with internal funds. Nonetheless, a growing firm may not have sufficient internal funds to finance its new projects frequently. As a result firms require external financing that prefers debt financing to equity financing. Following Chen (2003) and Buferna et al. (2005), the percentage change in book value of total assets is used as a proxy for firm growth.

3.2.3 Tangibility

The tangible assets of a firm can be considered as collateral to ensure guarantees against the default risk of borrowers to its creditors. The trade-off theory predicts a positive relationship between measures of leverage and the proportion of tangible assets. However, the direction of influence has not been clear yet. Empirical studies that confirm the above theoretical prediction include Friend and Lang (1988), Harris and Raviv (1991), Shah & Khan (2007), Rajan and Zingales (1995), Akhtar (2005), and Akhtar and Oliver (2009). Grossman and Hart (1982) suggest the idea that firms with less collateralizable assets should use more debt to monitor managerial activity, even at high cost of debt to limit the manager's tendency to consume excessive perks. This implies a negative relationship between tangibility of assets and leverage which is confirmed by the findings of Sheikh & Wang (2010), Sayilgan et al. (2006), and Abdullah (2005). This study measured tangibility as the ratio of net fixed assets to total assets following Friend and Lang (1988), Shah & Khan (2007), and Akhtar (2005).

3.2.4 Size

The relationship between firm size and leverage is also ambiguous. Some literatures offer the positive relationship between firm size and financial leverage with reasons that larger firms are more likely to be more diversified causes more stable or less volatile cash flows, less often failure, and more utilization of the economies of scale in issuing securities. Eventually, larger firms may issue debt at lower costs than smaller firms. In this case therefore, we can expect size to be positively related to leverage. Empirical studies, such as Rajan and Zingales (1995), and Booth et al. (2001), Gued et. al. (2003) generally found that leverage is positively correlated with company size. On the other hand, some of the studies conducted by Chung (1993), and Ozkan (2001) found no systematic relationship between firm size and total debt ratio. However, Fama and Jensen (1983) argue that there may be less asymmetric information about large firms, since these firms tend to provide more information to outside investors than smaller firms. Therefore, they increase their preference for equity relative to debt. Results of some studies such as Icke and Ivgen (2011), Elli and Farouk (2011), and Kila and Mahmood (2008) revealed negative association between size and leverage. In this study, our expectation on the effect of size on leverage is ambiguous. Following Rajan and Zingales (1995) the natural logarithm of net sales is used as a proxy for size.

3.2.5 Earnings Volatility

Earnings Volatility is a measure of business risk. According to Frank and Goyal (2003), the companies with more volatile cash flows face higher expected costs of financial distress and should use less debt in the objective of maintaining a moderate total risk profile. This suggests a negative relation between earnings volatility and leverage. A number of study such as Harris and Raviv (1991), and Akhtar and Oliver (2009) have indicated a negative relation between earnings volatility and leverage. However, risky firms are more likely to suffer from information asymmetries that make it difficult for firms to issue equity at higher price, and they are expected to have higher levels of leverage. This supports a positive relation between earnings volatility and leverage as shown in Booth et al. (2001), Deesomsak et al. (2004), and Ellili and Farouk (2011). In this study, our expectation on the effect of earnings volatility on leverage is ambiguous. Following Ellili and Farouk (2011) this study uses the ratio of standard deviation of EBIT over total assets to measure earnings volatility.

3.2.6 Non-debt Tax Shield

There is a another type of expenses that has a power of generating tax shield like interest expenses, which is depreciation expenses and that's why both can be considered as tax deductible expenses. Cloyd (1997) claims that the existence of non-debt tax shields provide an alternative (and perhaps less costly) means of reducing income taxes and may serve to mitigate the benefit of debt tax shields. Therefore, some of the literatures like Wiwattanakantang (1999) and Ozkan (2001) found an inverse relationship between non-debt tax shields and debt. But in the contrary to the results of above literatures, Graham (2006) and AL-Shubiri (2010) found a positive relation between non-debt tax shield and leverage. Hence, this study tries to find out whether non-debt tax shield affects leverage. Following Ozkan (2001) the ratio of depreciation over total assets has been used as a measure of non-debt tax shield.

3.2.7 Dividends

Professor Donaldson G. of Harvard (1961) suggested that firms set target dividend payout ratios based on expected future investment opportunities and expected future cash flows. Firms are reluctant to raise dividends unless they are confident that higher dividend can be maintained, and they are especially reluctant to cut the dividends. So dividend payment is likely to play a prominent role in the financing-mix decision mainly because of market imperfections. Bhaduris (2002) suggested that dividends are carefully considered as signal of financial health of a firm by the outsiders. If any increase in dividends signals an increase future earnings then the firm' s cost of equity will be lower, favoring equity to debt. This implies a negative relation between leverage and payout ratio that is also found by Kuczynski (2005), Frank and Goyal, (2003), and Rozeff (1982). On the other hand, the higher the amount of dividend payments the lower the amount of

internal funds to firms. And it needs more external financing. Moreover, if high dividend payout ratio conveys negative information to the investors in a sense that firm is lacking in profitable project resultant low growth opportunity, investors will be unwilling to pay more money for equity and firms prefer debt to equity. Chang and Rhee (1990) found a positive relationship between payout ratio and leverage. But Chen and Chen (2011) found that dividend policy is not significantly related with leverage.

In Bangladesh firms who paid at least 10 percent dividend in last year, that is one of the some obligations, can be categorized as A-category listed company in Dhaka Stock Exchange. In these sense paying a dividend above 10 percent may convey a significant message to investors and it is expected to have an influencing effect on firm's value as well as capital structure. Following Frank and Goyal (2003) dividend payment is used as dummy.

3.2.8 Liquidity

As predicted by the pecking order theory, firms with high liquidity will borrow less. The fact that a firm with more current assets is expected to generate more internal inflows, which can be used to finance its operating and investments activities. Thus a negative relationship between liquidity and leverage is expected. Friend and Lang (1988) Deesomsak, et al. (2004), Sbeiti (2010), and Icke and Ivgen (2011), found liquidity are negatively and significantly related to leverage. On the other hand, trade-off theory suggests a positive relationship between leverage and liquidity because higher liquidity ratio reflects the greater ability of a firm to meet short-term obligation on time. Ozkan (2001) suggests that liquidity has ambiguous effect on the capital structure decisions. In the line with study of Ozkan (2001) the proportion of current assets to current liabilities is chosen as a proxy for liquidity.

3.2.9 Managerial Ownership

According to agency theory, it is expected that there is a correlation between ownership (including managerial ownership) structure and leverage. Moreover, free cash flow theory suggests that managers with only a small ownership interest have an incentive for wasteful behavior or ill-investment. Ellili and Farouk (2011) found an inverse relationship between low level managerial ownership and leverage and a positive relationship between high level managerial ownership and leverage. Harris and Raviv (1991) affirm that the managers increase the debt ratio in order to reinforce their control mainly to control a large fraction of voting rights. Novaes and Zingales (1995) confirm that the threat of a takeover forces the managers to issue debts and to prove their alignment. Huang and Song (2006), confirm such positive correlation. On the other hand, Friend and Lang (1988) and Friend and Hasbrouck (1988) contended that an increase in managerial ownership pushes firms to reduce leverage in order to decrease default risk thereby advocating a negative relationship between managerial ownership and leverage. The results from Mohammed et al. (1998) for a sample of Malaysian firms indicate that both insider ownership and outsider ownership have a significant negative relationship with a firm's long-term debt ratio. According to Huang and Song (2006), in this empirical analysis, the managerial ownership is measured by the total shares held by top managers, directors and supervisors.

3.2.10 Industry Classification

Titman and Wessels (1988), among others, show that industry classification influences firms' capital structure. Harris and Raviv (1991) noted that it is generally accepted that companies in a given industry will have similar leverage ratios while leverage ratios vary across industries. Empirically, the regression results of Abor (2007) indicate clearly that the industry effect is important in explaining the capital structure and that there are variations in capital structure across the various industries. In the context of Bangladesh Sayeed M.A. (2011) found industry classification to be a significant determinants of leverage. Therefore, it is expected that capital structure should vary across different industry groups among listed firms in Bangladesh. Using dummy variables, we test if the leverage ratios are significantly different across the industries of cement, food, fuel & power, ceramic, information technology, pharmaceuticals, and jute in Bangladesh.

4. OBJECTIVES OF STUDY

This study will attempt to accomplish the following objectives:

i. To identify the firm specific factors affecting capital structure decisions of listed firms in Dhaka Stock Exchange.
ii. To analyze how the factors affecting capital structure decision are related to leverage.
iii. To analyze whether each of the factors has significant impact on leverage (total debt to total assets ratio).

5. HYPOTHESES OF THE STUDY

Taking into account the literature on capital structure debate, the null hypotheses we proposed about the possible determinants of the capital structure decisions of listed firms are as follows:

H_{O1}: There is no significant impact of profitability on leverage.
H_{O2}: There is no significant impact of tangibility on leverage.
H_{O3}: There is no significant impact of non-debt tax shield on leverage.
H_{O4}: There is no significant impact of growth opportunity on leverage.
H_{O5}: There is no significant impact of liquidity on leverage.
H_{O6}: There is no significant impact of size on leverage.
H_{O7}: There is no significant impact of earnings volatility on leverage.
H_{O8}: There is no significant impact of dividend payment on leverage.
H_{O9}: There is no significant impact of managerial ownership on leverage.
H_{O10}: There is no significant impact of industry classification on leverage.

6. METHODS AND METHODOLOGY OF THE STUDY

6.1 Sample Size

For the purpose of this study, population has been defined in term of the number of companies listed in Dhaka Stock Exchange Ltd. (DSE). There are 502 firms listed on Dhaka Stock Exchange including 137 non-financial firms in 2012. The banks and the other financial institutions were kept out of this study because of their specific financial activities and their supervision under the central bank. That is why initially this study started its journey taking into account 56 non-financial firms that were listed in DSE during 2003-2007 to discover whether firm's specific factors have significant impact on leverage. 12 firms out of 56 were excluded due to their inexistence in DSE in year 2012 for their continual poor performance that might cause an outlier's effects in that study, and in addition to, 5 firms were omitted because their financial period didn't satisfy the study periods ranging 2003-2007. Finally, our sample size stands at 39 non financial firms. Table 1 shows frequency distribution of industry classification.

Industry	Frequency
Ceramic	3
Cosmetic	3
Pharmaceuticals	10
Jute	3
Fuel &Power	7
Food	10
Information Technology	3
Total	39

TABLE 1: Frequency Distribution of Industry Classification.

6.2 Data Collection Procedures

This study is based on secondary data. The data used in this analysis can be divided into two groups: the firm specific factors influencing capital structure decision (independent variables) and the capital structure's variable (dependent variables). It takes ten potential firm specific factors that may have significant impact on capital structure decision namely profitability, size, tangibility, growth opportunity, earnings volatility, non-debt tax shield, dividend, managerial ownership, liquidity, and industry classification. In this analysis, the capital structure is the dependant variable and it is measured by the leverage. These data have been collected from the book value based yearly financial data given in the financial statements (Balance Sheet & Profit and Loss A/C) of selected companies over 2003 to 2007 which has been gathered from Dhaka Stock Exchange Library.

6.3 Data Analysis Procedures

This study combines cross-sectional with time series to make it a panel data. As noted by Schulman et al (1996), panel data allow economists and other social scientists to analyze, in depth, complex economic and related issues which could not be treated with equal rigidity using time-series or cross-sectional data alone. Like cross-sectional data, panel data describes each of a number of individuals. Like time-series data, it describes changes through time. According to Baltagi (1995), by combining time series of cross-section observations, panel data give "more informative data, more variability, less collinearity among variables, and more efficiency."

Descriptive and quantitative analysis is used for this research. Descriptive analysis presents mean, standard deviation, maximum and minimum value for each variable used in the study. In quantitative analysis, Pearson's correlation and pooled regression analysis is used. In regression analysis fixed effects model is used to investigate the relationship and also to prove the hypotheses. The cross section company data and time series data are pooled together in a single column letting the intercept may differ across each cross-sectional unit (here the eight industries) and each industry's intercept does not vary over time. In addition to, it is assumed that the slope coefficients of the regressors do not vary across industry or over time. Analyses are computed using Statistical Package for Social Science (SPSS) version 16.0 for windows.

Therefore the equation for our regression model is:

$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}$

Where ***i*** =1.....N is denoting the cross-sectional dimension and ***t*** =1...T is representing the time series dimension. The left-hand variable, ***Yit*** represents the dependent variable in the model, which is the firm's debt ratio. ***Xit*** contains the set of explanatory variables in the estimation model, ***α*** is the constant, ***β*** represents the slope coefficients, and ***ε*** is the random errors. In this context, the study includes 195 (=5×39) observations in total as 39 sections and 5 time periods.

The functional form of econometric model is as follows;

$$Lev_{it}=\alpha+\beta_1 Prof_{it}+\beta_2 Tang_{it}+\beta_3 Ndts_{it}+\beta_4 Gro_{it}+\beta_5 Liq_{it}+\beta_6 Size_{it}+\beta_7 Eavo_{it}+\beta_8+Divdum_{it}+\beta_9 Mang_{it}+\beta_{10} Indum_{1it}+\beta_{11} Indum_{2it}+\beta_{12} Indum_{3it}+\beta_{13} Indum_{4it}+\beta_{14} Indum_{5it}+\beta_{15} Indum_{6it}+\beta_{16} Indum_{7it}+\beta_{17} Indum_{8it}+\varepsilon_{it}$$

Where:

	Variables	Measures (proxy)
Lev =	Leverage	Total Debt/Total Assets
Prof =	Profitability	EBIT / Total Assets
Tang =	Tangibility	Net Fixed Assets / Total Assets
Ndts =	Non-debt Tax Shield	Depreciation / Total Assets
Gro =	Growth Opportunity	% Change in Total Assets
Liq =	Liquidity	Current Assets / Current Liabilities
Size =	Size	Natural Logarithm of Sales
Eavo =	Earnings Volatility	Standard Deviation of EBIT/ Total Assets
Divdum =	Dividend Paying Dummy	"1" if a firm pays more than or equal to 10% dividend and "0" otherwise.
Mang =	Managerial Ownership	The part of the capital held by the manager, directors and supervisors.
$Indum_1$ =	Industry Dummy	"1" if the observation belongs to Food, "0" otherwise.
$Indum_2$=	Industry Dummy	"1" if the observation belongs to Fuel & Power, "0" otherwise.
$Indum_3$=	Industry Dummy	"1" if the observation belongs to Jute, "0" otherwise.
$Indum_4$=	Industry Dummy	"1" if the observation belongs to Cosmetic, "0" otherwise.
$Indum_5$=	Industry Dummy	"1" if the observation belongs to Pharmaceuticals, "0" otherwise.
$Indum_6$=	Industry Dummy	"1" if the observation belongs to Information Technology (IT), "0" otherwise.

7: ANALYSIS AND DISCUSSION OF RESULTS

This section contains the descriptive statistics, correlation coefficient and the results of regression analysis of 39 sample firms in seven types of industries listed on DSE during the five year period from 2003 to 2007. The interpretation of the empirical findings is also presented in this section. Finally, important conclusions about the results of the study have been drawn.

7.1 Descriptive Statistics

The analysis of this study starts with a descriptive statistics of dependent and independent variables revealing mean, maximum, minimum, and standard deviation presented in table 2. From the table 2, the results of dependant variables, which is the ratio of total debt to total assets, shows that on average selected Bangladeshi companies are financing 60% of total assets with total debts. The maximum debt financing used by any one company in any year is 360.41% which seems to be unusual but it may happen when the equity of one company is negative. The minimum level of debt ratio is 15%.

	Mean	Maximum	Minimum	Std. Deviation
Lev	59.9638	360.41	.15	46.61529
Prof	5.4416	35.87	-16.25	7.87189
Tang	47.0537	97.97	.02	25.35355
Ndts	3.3367	18.10	.00	3.09299
Gro	10.2551	153.41	-33.81	22.67409
Liq	2.5541	253.00	.02	15.11372
Size	18.9223	23.12	.00	2.79308
Eavo	3.6978	75.00	.11	5.40012
Divdum	.6591	1.00	.00	.47510
Mang	44.9589	92.72	.01	17.91285

Table 2: Summary of Descriptive Statistics.

Source: Calculations based on annual financial reports of 39 listed firms during 2003-2007

The average value of profitability is 5.4416% with the variation of individual data set from the mean value by 7.87189%. The maximum profitability for a firm in any year is 35.87% while the minimum value is -16.25%. The mean value of tangibility shows that, on average, firms use 47.0537% of net fixed assets in their assets structure. The maximum tangibility for a firm in any year is 97.97% and minimum value of tangibility is .02%. The mean value of non-debt tax shield is 3.3367% with a standard deviation of 3.09299 %. The minimum value of no-debt tax shield for a firm in any year is 0.00 which means that no depreciation has been computed and it may possible if firms do not go to production and trading. The average growth rate of selected firms is 10.2551% with a standard deviation of 22.67409%. The liquidity ratios indicate that on average firms use current assets by 2.5541 times of current liabilities. The mean value of size measured in log of sales is 18.9223% while the standard deviation is 2.79308. The maximum and minimum value of size is 23.12 and 0.00 respectively. The mean value of earnings volatility measured in the ratio of standard deviation of EBIT over total asset is 3.6978-time with a standard deviation of 5.40012. On average, 44.958% of firm's ownership is held by the directors, sponsors, and managers, which are the measure of managerial ownership, while the standard deviation is 17.91285%. The maximum value of managerial ownership is 92.72% and minimum value is 0.01%.

7.2 Collinearity

To examine the existence of multicolinearity among regressors pearson correlation coefficients is used. In general, independent variables having collinearity at 0.7 or greater would not include in regression analysis due to multicollinearity. As shown in table 3 the highest correlation coefficient is 0.4275 between profitability and dividend payment. Thus all of the independent variables are free from serious problems of multicollinearity and more competent for regression analysis.

	Lev	Prof	Tang	Ndts	Gro	Liq	Size	Eavo	Divdum	Mang
Lev	1.0000									
Prof	-0.4205	1.0000								
Tang	0.0609	0.1378	1.0000							
Ndts	0.1666	0.1895	0.2966	1.0000						
Gro	-0.1411	0.1924	0.0648	0.0337	1.0000					
Liq	-0.3271	0.1012	-0.2585	0.2804	0.1627	1.0000				
Size	-0.0877	0.4146	-0.2011	0.0174	0.0616	0.0321	1.0000			
Eavo	0.0604	0.1187	0.1455	0.0814	0.0247	-0.0586	-0.0315	1.0000		
Divdum	-0.2017	0.4275	-0.2203	0.1241	-0.0344	0.0963	0.2729	-0.1365	1.0000	
Mang	-0.1519	0.0315	-0.2966	-0.1256	0.0380	0.0408	0.1162	0.0738	-0.0979	1.0000

Table 3: Summary of Pearson Correlation Coefficients between Variables.

7.3 Regression Model

7.3.1 Results of Regression Analysis

Table 4 shows the results of pooled regression analysis, in which fixed effect model is applied. In our regression model for leverage has an R-squared (coefficient of determination) of 0.501.It tells us that the fraction of variation in the dependent variable that is explained by variation in the independent variables more precisely it shows how well the sample regression line fits the data (goodness of fit). Thus, 50.1% of the variation in leverage (Total Debt/Total Assets) is accounted for by variation in the independent variables. The value of adjusted R-squared is 0.459. F-statistic, 11.982, shows that overall model is satisfied at the 1% level. But the low value of Durbin-Watson, 0.770, signals that perhaps the model is affected by positive autocorrelation. The existence of autocorrelation does not bias the estimated coefficient, but it makes the estimates of the standard errors smaller than the true standard errors. This means that the t-ratios calculated for each coefficient will be overstated, which in turn may lead to the rejection of null hypothesis that should not have been rejected. So it is no longer successful to interpret the estimated regression coefficient presented in table 4.

Coefficients [a]

	Beta Coefficients	Standard Error	t-value	Sig.
(Constant)	89.123	31.653	2.816	.005
Prof	-3.030	.532	-5.695	.000
Tang	-.388	.155	-2.508	.013
Ndts	10.471	1.385	7.561	.000
Gro	.168	.138	1.214	.226
Liq	-9.866	2.043	-4.830	.000
Size	.632	1.312	.482	.630
Eavo	.791	.471	1.679	.095
Divdum	-12.163	7.164	-1.698	.091
Mang	-.704	.187	-3.767	.000
$Indum_1$	19.572	11.447	1.710	.089
$Indum_2$	36.915	12.054	3.063	.003
$Indum_3$	13.699	14.136	.969	.334
$Indum_4$	43.592	14.047	3.103	.002
$Indum_5$	23.016	11.464	2.008	.046
$Indum_6$	-52.718	21.757	-2.423	.016

Table 4: Regression Model results

Model Summary [b]

R- Squared	.501
Adjusted R -Squared	.459
Durbin-Watson	.770
F-statistic	11.982
Sig. (F-statistic)	.000

a. Predictors: (Constant), Prof, Tang, Ndts, Gro, Liq, Size, Eavo, Divdum, Mang, $Indum_1$, $Indum_2$, $Indum_3$, $Indum_4$, $Indum_5$, $Indum_6$
b. Dependent Variable: Lev

R-squared and Adjusted R-Squared measure “Goodness of Fit”.

Since this study has an attempt to investigate the impact of firm specific factors on capital structure decision, it ran an autoregressive model, among the several suggested models, for estimating factual regression coefficient through eliminating the possible effects of autocorrelation. In autoregressive model one lagged value of dependent variable is employed as an independent variable. Table 5 shows the results of autoregressive model.

Coefficients [a]

	Beta Coefficients	Standard Error	t-value	Sig.
(Constant)	51.657	21.815	2.368**	.019
Prof	-1.796	.374	-4.800*	.000
Tang	-.284	.106	-2.674*	.008
Ndts	7.799	.966	8.075*	.000
Gro	.161	.095	1.704***	.090
Liq	-5.918	1.425	-4.154*	.000
Size	-.318	.900	-.353	.724
Eavo	.348	.324	1.076	.283
Divdum	-7.848	4.911	-1.598	.112
Mang	-.269	.131	-2.042**	.043
$Indum_1$	.715	7.942	.090	.928
$Indum_2$	15.412	8.383	1.838***	.068
$Indum_3$	2.846	9.702	.293	.770
$Indum_4$	19.375	9.759	1.985**	.049
$Indum_5$	10.004	7.896	1.267	.207
$Indum_6$	-41.331	14.907	-2.773*	.006
TD/TA(1-lagged)	.598	.042	14.296*	.000

Table 5: Results of Autoregressive Model

TD/TA= Total Debt/ Total Assets
*significant at 1% level
** significant at 5% level
*** significant at 10% level

Model Summary [b]

R- Squared	.768
Adjusted R -Squared	.747
Durbin-Watson	1.837
F-statistic	36.769
Sig. (F-statistic)	.000

a. Predictors: (Constant), Prof, Tang, Ndts, Gro, Liq, Size, Eavo, Divdum, Mang, $Indum_1$, $Indum_2$, $Indum_3$, $Indum_4$, $Indum_5$, $Indum_6$, TD/TA(1-lagged)
b. Dependent Variable: Lev
R-squared and Adjusted R-Squared measure “Goodness of Fit”.

The results of this regression reveal the Durbin-Watson of 1.837 which is almost close to 2, but it is not appropriate to find out if there is any autocorrelation in the data because the model contains lagged regressand as a regressor. For this type of model Durbin has developed the so-called *h-statistic* to test for serial correlation. According to Durbin, *h-statistic* follows the standard normal distribution where the null hypothesis is ρ (rho) =0, that is, there is no first order autocorrelation.

From the properties of normal distribution it is given that the probability of $|h|>1.96$ is about 5 percent. Therefore, we can reject the null hypothesis that ρ (rho) =0, that is, there is evidence of first order autocorrelation in the autoregressive model, if a calculated $|h|$ is greater than 1.96. Since the sample used in this study is reasonable large and the computed *h,* (1.4051), is less than 1.96, null hypothesis can’t be rejected at 5% significance level. So our results confirm that there is no strong evidence of serial correlation in this model. According to autoregressive model,

the value of R-squared (0.768) suggests that 76.8% of the variation in leverage is captured by the variation in the regressors. The result of F-statistic is 36.769 which shows that the model is statistically significant at 1 % level and hence prove the validity of estimated model.

7.4 Discussion of Results

7.4.1 Profitability

As it is observed from the table 4, the coefficient value of profitability is -1.796 which is significant at 1% level. Thus, first null hypothesis, profitability has no significant impact on leverage, is rejected. Negative coefficient of profitability implies that 1% increase in the ratio of EBIT/Total Assets causes the ratio of TD/TA to decrease by 1.796%. The negative relation between profitability and leverage is consistent with pecking order theory, whereas trade off theory is not substantiated. That means that profitable firms listed in DSE use internal funds at first to finance its assets before seeking debts. Thus the more profitable firms would tend to use lower debts in their capital structure. This result is also in line with other studies as Rajan & Zingales (1995), Sayilgan et al. (2006) and Sheikh & Wang (2010). This finding is contrast to the previous findings by Sayeed M.A. (2011) in Bangladesh. He found that profitability has insignificant and positive association with leverage. However the reason may be that he used the ratio of net income to total assets as a proxy of profitability and this study used the ratio of EBIT to total assets.

7.4.2 Tangibility

The negative coefficient value of tangibility rejects the second hypothesis, tangibility is not impacting leverage ratio significantly, at 1% significance level. The coefficient value of tangibility is -0.284 which reveals that 1% increase in the ratio of net fixed assets to total assets of listed firms in DSE leads to 0.284% decrease in the ratio of total debt to total assets. This negative association between tangibility and leverage is consistent with implication of pecking order theory and contradict with trade off theory. According to Gaud et al. (2005), in favoring of this association, the companies with lower level of tangible assets are more subject to information asymmetry problems that lowers price of equity, and consequently, more willing to use debt to finance their assets. The results also support the findings of Sheikh & Wang (2010), Sayilgan et al. (2006), and Abdullah (2005). Sayeed M.A.(2011) and Lima (2009) found a positive coefficient of this control variable in Bangladesh using total fixed assets to total assets as a proxy of tangibility, but this study used net fixed assets to total assets as a measure of this control variable, where net fixed assets are gross fixed assets less accumulated depreciation and found negative coefficient value that may be the reason of inconsistent results with those of previous studies.

7.4.3 Non-debt Tax Shield

Results of regression model show that exogenous non-debt tax shield has significant positive association with leverage and third hypothesis is rejected at1% level. A positive coefficient value of non-debt tax shield, (7.799), explains 1% increase in the ratio of depreciation to total assets results in 7.799% increase in the leverage ratio. Bangladeshi firms heavily depend on depreciation as well as debt to enjoy a big advantage of tax shield. This result is in line with AL-Shubiri (2010) who also found a significant positive relation between leverage and non-debt tax shield but it contrasts with the findings of Sayeed M.A (2011) most probably due to different cross-sectional and time series observations.

7.4.4 Growth Opportunity

Beta coefficient value of control variable growth is 0.161 and rejects the fourth hypothesis at 10% significance level. This positive coefficient implies that 1% change in growth rate which is measured by the percentage change in total assets leads to 0.161% change in leverage ratio. Although this relationship is in contradiction with what the trade-off theory predicts. However, it supports pecking order theory and signaling theory with an explanation that growing firm require more financing but may not have sufficient retained earnings and then firms go to finance their new projects with debt financing before equity financing. The results of this study are in compliance with the results of Titman & Wessels (1988), Chen (2003), Abdullah (2005), Sheikh & Wang (2010), Lima (2009), and AL-Shubiri (2010).

7.4.5 Liquidity

One of the most important explanatory variables in this study is liquidity that has not been used as control variable in Bangladesh yet and it is significant at 1% level in this study. Beta coefficient associated with liquidity rejected the fifth null hypothesis. The coefficient of liquidity is -5.918. It suggests that liquidity has strong negative impact on leverage for listed firms in DSE. This association of liquidity with leverage confirms to the prediction of pecking order theory. Firms that maintain high liquidity ratio tend to employ less debt in their capital structure because it is expected that they are able to generate high cash inflows and resultant the excess cash flows can be used to finance the operations and investment activities. The findings also confirm some earlier studies such as Friend and Lang (1988), Sheikh and Wang (2010), Icke & Ivgan (2011), and Abdullah (2005).

7.4.6 Size

The regression model finds insignificant negative relation between size measured in log of sales and leverage and thus sixth null hypothesis is accepted. One possible explanation regarding the negative sign of size may be that bigger size firms have more easy access in equity market form where they can raise substantial long term funds at true price due to less asymmetric information compared to firms of smaller size that confirms the view of Fama and Jenson (1983). The negative association between size and leverage is also in the line with Icke and Ivgan (2011), Elli and Farouk (2011), and Kila and Mahmood (2008). This result does not parallel the findings of previous study done by Sayeed M.A. (2011) for selected Bangladeshi listed companies as likely as not due to use of ln(total assets) in his study as a proxy of size of firm instead of ln(net sales).

7.4.7 Dividend Payment

Dividend, Control variable, has not been used yet in Bangladesh in measuring its effects on leverage that is why it gives us new insights into this field. The negative relationship between dividend payment and leverage is observed in this study but the eighth hypothesis has not been rejected at 10% level. The beta coefficient of dividend payment is -7.848. It implies that dividend payment has negative impacts on leverage. Though negative sign is consistence with signaling theory sustaining one possible explanation that a firm with a dividend payment above 10% can send a message to public about favorable future earnings capacity, causing investors to discount the firm's earnings at a lower rate and, all else being equal, to place higher value on the firm's stock. Therefore, high payout firms can enter equity market with low costs that lowers the firm's necessity to seek more debt. This result also indicates that investors of DSE prefer high payout ratio to low payout ratio and this investors' behavior may impede the growth of firm as it makes firms reluctant to create retained earnings. This result is compliance with the findings of Chen & Chen (2011).

7.4.8 Earnings Volatility

The insignificant positive relationship between earnings volatility and leverage is found in this study with a coefficient value of 0.348. Thus results of regression do not reject the seventh null hypothesis. One possible explanation is that the higher the earnings volatility the higher the risk of firms, resulting in firms are no longer beneficiary to issue equity due to high cost of equity and intend to use debt in their capital structure. This result is in line with Booth et al. (2001), Deesomsak et al. (2004), Ellili and Farouk (2011) and Sayeed M.A. (2011).

7.4.9 Managerial Ownership

There are very few empirical evidence in examining the impact of managerial ownership on capital structure decision especially in Bangladesh. In this study it is found that managerial ownership is negatively related to leverage at 5% significance level. The coefficient of this control variable is -.269 that rejects the ninth hypothesis. This sign implies that any increase in managerial ownership results in a decrease in leverage ratio. One possible explanation regarding this result is that when managers are given more shares of the company they become high risk averse and more reluctant to invest in risky project thus firm's profit may be more stable . According to Smith (1990), there exists a positive relationship between management ownership and the performance of the firm. In addition to, an increase in managerial ownership significant

portion of agency costs can be eliminated because they work in the interest of the share holders and finally it leads to increase profit, retained earnings and firm performance. For high profit the availability of retained earnings of a firm lowers the use of debt in capital structure. These findings are partly in compliance with Ellili and Farouk (2011).

7.4.10 Industry Classification

To identify the impact of industry classification on firm's leverage, total numbers of firms used in this study were categorized into seven industries namely Food, Fuel and Power, Jute, Cosmetic, Pharmaceuticals, Information Technology (IT), and Ceramic in accordance with the category read by DSE. In our study it is revealed that Fuel & Power, Cosmetic, and IT industry are statistically significantly different from Ceramic industry at least at 10% significance level and thus tenth hypothesis is rejected. On the other hand Pharmaceuticals, Jute, and Food are not significantly different from Ceramic industry.

Lagged dependant variable Total Debt/Total Assets (one lagged) has significant positive impact on leverage.

8. CONCLUSION

This study attempted to investigate how firm specific factors are impacting the capital structure decision of a sample of 39 Bangladeshi firms listed in DSE utilizing OLS regression method. Data were collected from the financial statements of each firm during the five-year period from 2003 to 2007. Under OLS regression, fixed effect model was run but the results were affected by autocorrelation. As a remedial measure of autocorrelation, autoregressive model was used to examine the impact of ten explanatory variables such as profitability, tangibility, non-debt tax shield, size, earnings volatility, liquidity, managerial ownership, dividend payment, growth, and industry classification on total debt to total assets ratio. The findings of the study show that profitability, tangibility, liquidity, and managerial ownership have significant negative relations with leverage. This study also found that growth and non-debt tax shield are positively and significantly related with leverage. Where as size, earnings volatility, and dividend payment were not found to be significant explanatory variables of leverage. Results also reveal that leverage ratios are significantly different across Bangladeshi industries. Overall all the results are almost consistent with previous study and capital structure.

Nonetheless, the limitations of this study can open the door of opportunity for further research work in this area. This study only uses total debt to total assets as a dependent variable, the other definition of leverage can be used in future study to identify which definition of leverage is powerfully explained by given control variables. In conclusion, overall results can be improved by including new explanatory variables and observations.

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Industrial Designers' Attitudes Toward Product Design

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Abstract

The aim of this research is to find out the attitudes of designers regarding product design. Subjects practicing product design are the main targets of this study. Factors designers of different attitudes towards product design emphasize in project design are explored, from which types of industrial designers are speicfied in terms of their value point of view in product design. From related literautre, six design-oriented attributes were identified for the measurement of designer's attitudes towards product design, including affective aesthetics, form manipulations, behaviorial attitudes, production and functional requirements, objective conditions, and personal skills. In this study, Q-methodology was adopted to collect the information about how the industrial designers feel in processing their product design. Then, experts were invited to compile appropriate questions for the questionnaire. This questionnaire was divided into six types of design dimensions and contained 50 declarative sentences. The results of investigation were analyzed with Q factor analysis to study the interviewers' design attitudes. Six types of industrial designers in terms of their attitudes toward product design were identified. It is suggested that manager of the design department allocate suitable designers for the design team according to the features of design attitudes and the property and complexity of design projects.

Keywords: Designer's Attitude, Product Design, Q-methodology

1. INTRODUCTION

Industrial design refers to a kind of creative activity in which multiple disciplines such as engineering, human factors, commerce, aesthetics, social environment and culture are involved [1,2,3]. Due to the fact that industrial designers have an indepth understanding of the customer's preferences and needs, they play an important role in the procedure of new product development [4]. In the new product development (NPD), particularly from idea development to product innovation, industrial designers are primarily responsible for carrying out the specification of a new product and endowing a representative product form [5]. In the design process, designers are different in their ways of thinking and points of view [6], causing the outcome to be different.

The human resource is a key factor to enterprise competition ability [7]. The subtle allocation of the most appropriate personnel on the most suitable position at the most appropriate time in NPD will make possible the biggest beneficial result of the plan, equipment, and budget [8]. In the twenty first century, design has played a dominant role in NPD [9]. Therefore, managers at design department should be able to maintain the competition ability of the design divisions and

enterprises through the allocation of excellent man power so as to make biggest benefit for the company [10;11,12]. Employee selection is important in industries, jobs, organizations, and psychological research [13]. Psychologist Belbin generalized nine types of team members to help design managers select proper designers for an efficient design team [14]. In addition, personal characters are also used for the measurement of team member selection [15, 16, 17].

Industrial design is a job that integrates multiple lines of profession. In such creative activities, different designers may place more emphasis on some things and ignore other things due to their ways of thinking towards different parts of design. Their behaviors and attitudes may further influence their concept and value of products. Consequently, the authors attempted to explore the factors designers emphasize in product design from which types of value and attitudes designers have towards product design were specified. It is hoped to help design managers select designers most suitable for the team or duties for specific design projects. In a study similar to occupation classification, Wen and Mei explored the performance of NPD from the viewpoints of product managers in Taiwan IT industry and categorized product managers into six types, including project planner, technical director, marketing director, assembly director, manager in general, and project manager [18]. They also suggested the managing director to select appropriate product manager from the viewpoint of product innovation.

In this study, the survey is limited to the stages from idea development to prototype making in NPD and the designer's attitudes towards product design are brought forth for the explanation of the data obtained. It is similar to the individual design strategy of industrial designers proposed by Teng [6]. He claimed that designers would develop their own individual design strategies from the ways they work out ideas and solutions to varying problems. In his study, the approach and method designers used to solve problems are more emphasized. Particularly, it is focused upon the concepts and attitudes designers have in settling down design problems. For the classification designers' behavioral attitudes, Q methodology was used in the questionnaire survey and interview.

2. THE DESIGN ATTITUDES OF INDUSTRIAL DESIGNERS

The purpose of professional discipline of industrial designers is to cultivate personnel that are creative and capable of developing special styles of commodities for industries. Therefore, industrial designers should be able to apply their aesthetic disposition in product form, professional knowledge about specific industries and presentation skills in their duties. Moreover, they need to integrate knowledge from multi-discipline to work out products that fulfill the enterprise's expectation. In light of this, the authors attempted to explore industrial designer's attitudes, professional skills and duties in this study.

2.1 Attitudes

The term "attitude" is a specific evaluative response to things, objects and people. It is often stored in our long term memory. Some previous studies claimed that attitude is a mixture of permanent appraisal (positive or negative) people have toward persons, things, objects, and concepts, a sort of combination of positive and negative points of view [19; 20]. Kolter defined attitude as a lasting appraisal of liking or disliking emotional reactions, and activity tendency toward some concepts [21]. McGuire pointed out that attitude is a kind of assessment composed of three ingredients: affective, cognitive, and behavioral parts [22]. Ajzen & Fishbein proposed a theory of reasoned action suggesting that people's behavior could be only predicted from their special attitudes toward the things they concerned [23]. In other words, we cannot predict the target's real behavior only from the intention of their ideologies. Based on the abilities and skills industrial designers have learned and cultivated from the practical experience, the factors and key points industrial designers consider in the design and development procedure are originated from their subjective conscientiousness. And such kinds of inner awareness will by all means influence their tendency of attitudes toward product design and dominate the way they handle design projects in the manner of their outer behaviors.

2.2 Selecting Designers

In enterprises, the employee selection is often done under the person-job fit consideration, and the allocation of man power and organization is considered the most influential factor in the selection procedure [24, 25]. In addition to the evaluation of job characteristics, the multilayer allocation selection in enterprises also depends upon person-team fit and person-organisation fit [13]. In other words, in selecting designers, the design manager needs to take into consideration whether the person fits the job, whether the person fits the project, and whether the person fits the company's policy and value. According to Colbert, the practice of human resource strategy management in enterprises is based upon the employee's skill, behaviors, and interactions [26]. Therefore, design managers can evaluate designer's performance from his or her ability and potential [27]. Besides, Behling (1998) claimed that the best performance of an employee can be recognized by their personal characteristics in jobs [28]. Furthermore, Sonnenwald maintained that the selection of designers should be decided after the observation of the interaction between the designer and other team members [29]. In addition to the consideration of experience and ability for a certain role in the design team, a successful team also depends on whether the team members can develop the complementary relationships in the design activity [14].

2.3 Design-Oriented Attributes of Industrial Designers

During stages of product development, industrial designers need to take into account a variety of tasks, including the strategy making from conceptual design, marketing, product plan, and market positioning [30]. Hence, Cooper & Press suggest design schools pass on students what contains in design jobs through design knowledge, design techniques, and cases in design practice [31]. Among them, design knowledge consists of the appropriateness of materials, product form and manufacturing methods, workshop practice, human factors, design trends and methods, computer aided design, and practical design. In addition, design techniques cover developing solutions to the design problem, using creative methods in problem solving, problem analysis, data collection, problem evaluation and judgement, pursuing aesthetic acuteness and visual judgement, using sketches, drawings and computer aided design to develop and present ideas, making models and prototypes to solve problems, and communication in visual and verbal ways. At last, design cases include design history, design philosophy and contemporary issues, commercial consciousness, and marketing. In addition, Roozenburg & Elkels assert that in designing new products, designers should take into account product function, usage, appearance, quality, production, cost, market, and environment [32]. They also pinpoint that, for industrial designers, products are objects in psychological layer that possess cultural vales. To help designers set up design conditions, motivations, and grasp inspirations. Morrison & Twyford proposed key elements of design development, including issues of the organization of idea groups, techniques and materials, functions and costs, social culture and history, incubation of design ideas, design trends and fashion culture, social welfare, public opinions and development, and aesthetic ideals [33]. Moreover, Borja de Mozota claims that designers' jobs include problem resolution (plan and manufacturing), creation (produces beautiful things through industries), systemization (needs transformation), coordination (team work), and cultural contribution (semantic culture) [34]. In looking for jobs, industrial designers are primarily required to have the 3D model making ability, communication in English, 2D computer graphics, creativity, and imagination [2]. Hsu, Chang & Yang indicate the evaluation items for the junior designers, including product form, free-hand sketches, design creativity, personal characters, aesthetics disposition, product plan, manufacture engineering, computer application, ergonomic knowledge, and project schedule control. At last, as far as designer selection is concerned, the ranking order for designers are creativity, product form, design work quality, observation ability, and aesthetics disposition, from the viewpoints of design managers [12].

Design-oriented attributes	Detailed contents	Descriptions
Affective aesthetics	Design creativity	Creative thinking and problem solving ability.
	Aesthetics disposition	Sense and acuteness of arts, humanity, and fashion trends.
	Subjective affection	Emotional appeals that products pass on to the users.
Form manipulations	Product form	Ways designers use to make the product form, color, and texture.
	Ergonomic design	User interface and anthropologic requirements in product design.
Behavioral attitudes	Product plan	Key points and specifications according to the demands in the market.
	Activeness and responsibility	Keep optimistic, active, and curious and have sense of responsibility.
	Communication and coordination ability	Project presentation and interaction with colleagues in the jobs.
Production and functional requirements	Mechanical and structural design	Mechanic motions and structural design of the product.
	Operational function	User-centered product operations and functions.
	Material characteristics	Purposes and characteristics of varying materials.
	Machining knowledge	Knowledge for the application of machining tools in product manufacturing.
	Manufacture engineering	Knowledge in product manufacturing procedure.
	Engineering knowledge	Basic knowledge of mechanics, electronics, and so on.
Objective conditions	Marketing survey analysis	Distribution in the market, competitor's products, marketing channels, and the like information.
	Practical consideration	The ideas do not came out of nowhere but consider the practical production and cost.
	Marketing strategy	Methods in product sales.
	Project schedule control	The management and control of the procedure and timing in design projects.
	Interpersonal relationship	Getting along with colleagues in the design project.
Personal skills	Technical presentation	Presentation ability to show the familiarity designers have toward science and technology.
	Computer application	Ability in application of different compute r software.
	Free-hand sketches	Using free hand sketches for the idea development.
	Model making	Manual model making ability to verify the feasibility of ideas.

TABLE 1: Design-oriented attributes of industrial designers

From the above literature, design-oriented attributes of industrial designers were listed in Table 1. Among six design-oriented attributes, affective aesthetics include design creativity, aesthetics disposition of designers and subjective affections designers endow in products. Form manipulations refer to the unique methods designers provide in product form and the user interface. The behavioral attitudes are referred to the duty and attitude designers have in their jobs including product plan ability and communication and coordination ability. Production and functional requirements indicate that designers are able to handle mechanical and structural design in the implementation of design; they are familiar with the operational function, material characteristics, machining knowledge and manufacture engineering so that products will meet the requirements of good to use, durable, and easy to produce. The objective conditions refer to the

duties of different divisions or specific panels where designers are not in charge of or other businesses that do not directly influence the design activity. Some examples are the marketing survey analysis, marketing strategy and project schedule control that are not dominated by designers. As a final point, though practical consideration and interpersonal relationship are related to designer's job, they are not the major factors closely related. Personal skills are referred to as the representation of designer's professional competence in which computer application, free-hand sketches, and model making are basic skills and technical presentation indicates the familiarity designers have in the application of technical knowledge. For example, animation or the latest machining technique can reinforce product manufacturing conditions. The design-oriented attributes and their detailed contents are listed in Table 1.

2.4 Main Duties of Industrial Designers

Generally speaking, NPD may be divided into three categories, including functional division, project plan, and array organization [35]. Therefore, Teng proposed six types of design projects in enterprises based upon the types of missions in enterprises, including multiple sub-project teams, formal project team, informal project team, sub-contract double project teams, industrial design project team, and independent work [36]. There are advantages and disadvantages for team work and independent work. In terms of the productivity in five abilities in product form manipulation, independent designers are only better than a team work in the ability of major features. In other words, they are not as good as a design team in overview revision, feature alternation/assessment, mounting point, and particular details [37]. In addition, for the implemention of product ideas, independent working model and chain communication model are better than free-open team communication model [38]. According to the above-mentioned studies, project plan and array organization will be applied only in a large-scale NPD case. The duties of functional divisions contain the NPD tasks conducted only by the industrial design department and the frequent small-scale redesign and detail modifications.

From the viewpoint of product dimensions in NPD, there are three hierarchies: reasons for NPD, innovation properties in NPD, and types of NPD. Among them, reasons for NPD may contain market demands, new technique development, competition in couterpart products, product line expansion, and regular NPD. Innovation properties in NPD may consist of the addition of new functions, functional improvment, and differentiation in product appearance. Types of NPD cover totally new products, product expansion, current product redesign, product extension, and reposition of products [35]. From the viewpoints of design experts, design strategies cover product series, product diversification, product line expansion, deepened product lines, new target market, new technical innovation, cost down, sharing the same mould, adding additive value, creative product form, product image, product color, green design, and so on [6]. The idea development of industrial designers is mainly focused on product appearance, most of which are redesign, a few of which are totally new product form, and few of which belong to the functional structural design [39, 5]. From the above literature, the work of industrial designers are majorly design projects of independent work or a design team. In terms of the extent in product form redesign, industrial designers are often put in charge of product form redesign in serial products, new product form with old functions, totally new design, and new conceptual design.

3. Methods

In this study, 50 subjects engaged in industrial design were interviewed to explore the factors designers of different personal characters emphasize in design activities and projects. From this, types of value senses and attitudes regarding product design were induced. Q methodology was adopted to gather the viewpoints and cognition the subjects had toward product design.

From a pool of 56 industrial designers interviewed, 50 effective questionnaire surveys were collected. In these 50 subjects, 30 were male; 20 were female. In terms of the year range, 3 were in the range of 20-25; 23 in the range of 26-30; 16 in the range of 31-35; 3 in the range of 36-40; 5 in the range of 41-45. Overall, most subjects (46%) were aged between 26 and 30. In terms of the experience of design, 14 had 1 year of design experience; 25 had 1-3 years of design

experience; 7 had 4-8 years of design experience; 4 had more than 9 years of design experience. As far as educational degrees are concerned, 4 were with senior college degree; 12 with college degree; and 34 with graduate school or higher degree.

Sorting in Q Methodology

Q methodology is a method to explore or define the subject's attitude from their statements or opinions. In exploring personal attitudes, Q methodology makes it easy for a subject, even one that has difficulty in speaking out his or her mind subjectively, to express his or her attitudes from the statements [40].

In a special way similar to the psychological test, Q methodology combines the technique of factor analysis to offer a systematic and precise quantitative method for the assessment of people's subjectivity. Moreover, it helps to analyze and interpret the ambiguous and hard-to-explain personal views and opinions. The biggest advantage of Q methodology lies in the face-to-face interview in that the researcher can judge the effectiveness of data from the observation of the person interviewed. This helps release the doubt of the effectiveness of data in collecting the survey questionnaire, particularly by mail. Moreover, through the interview, the direct contact of the subject uplifts the authenticity of the research and, in the meanwhile, helps understand the opinions and attitudes of the group and individual subjects, from which some of them can be quantified for an objective analysis and definition of the target group's attributes [41].

In this study, a structured Q Sort was used to compile the content of statements. In the selection of the number of statements, 50 was the number for the formal experiment. In compiling the statements, the results and contents of related quantitative and qualitative studies were first referred to. Initially, 94 items of statements were made. To increase the reliability of the statements, twenty subjects were invited for the selection and improvement of the questionnaire of these statements before the expert validity test and the pilot test. From the degrees of importance of these questions, statements of which the correlations were low were deleted from cluster analysis. Then, the statements whose meanings were not clear were improved for a better readability. In this process, 94 statements were shrunk to 75. Feedbacks from the subjects were then used for the improvement of the contents of these 75 statements. Furthermore, to make it easy for the subject to understand the statements, five experts of 10-15 years in industrial design and design education were invited to delete or improve statements whose texts were not clear or doubtful to compile the formal questionnaire. In this process, the expert validity test was based upon two criteria: CVI (Content Validity Index) and ICC (Intraclass Correlation Coefficient). After the screening and revisions from these experts, 50 statements evenly distributed in six industrial design perspectives were determined.

In the design of questionnaire, Q sorting method was used in this study, in which each of 50 statements was printed on a separated card (5X8 cm^2). In the Q sorting test, the subject first divided these 50 questions into three groups with specific numbers. That is, 11 most important questions (grades 1-3), 28 moderately important questions (grades 4-6), and 11 least important questions (grades 7-9). Then specific scores were assigned to each card as shown in Table 2. In the test, the interview was conducted in an individual way so that the researcher could answer any questions of the subject immediately. After the test, the subject was asked to give his or her comments for the most important and least important statements for further references. Therefore, the subject worked much harder in filling the survey than the way they dealed with mail questionnaire survey. After deleting 6 subjects of lower reliability, a total reliability of 0.941 was found for the rest 50 subjects.

Degree of importance		Most important	←			Moderately important	→			Least important
Grades		1	2	3	4	5	6	7	8	9
Scores		9	8	7	6	5	4	3	2	1
Number of cards assigned	N=50	2	3	6	8	12	8	6	3	2

TABLE 2: The assignment and evaluation scores of Q sorting of cards

4. RESULTS AND DISCUSSIONS

This part discusses the result of Q Factor analysis, from which six types of designers in terms of their viewpoints of design direction are explained.

4.1 Importance Subjects Place on Design Attitudes

The result of Q Factor analysis indicated that there were 15 factors whose eigenvalues were bigger than 1, with 79.5% accumulated percentage of variance explained. If the rule that factors of which the eigenvalues are bigger than 1 is followed, then there would be too many factors and after the third factor, there would be only one or two subjects in a factor. According to Brown, there should be at least four to five subjects in Q factor analysis if a factor is to be defined [42]. Other scholars, for example, Lo claimed that there should be at least two or more variables that have remarkable factor loading in a factor [43]. Consequently, six factors were extracted in this study after the factors with only one subject were deleted. Totally, these six factors could explain 54.1% of variance (Table 3).

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Eigenvalues	13.72	3.61	2.75	2.51	2.27	2.21
% of variance explained	27.44	7.22	5.51	5.02	4.53	4.42
Accumulated % of variance	27.4	34.7	40.2	45.2	49.7	54.1
Number of subjects (Male/ Female)	11 (8/3)	8 (4/4)	10 (6/4)	7 (5/2)	9 (5/4)	5 (2/3)
Percentage (%)	22%	16%	20%	14%	18%	10%

◎Extraction method: Principal Component Analysis, Oblique Rotation Method

TABLE 3 : Result of factor analysis of the design attitude statements

In Q factors, if the factor loading of subjects is higher, it is closer to the presumed attitude type. And if the factor loadings of some subjects in one factor are bigger than 0.80, they can be used as representative samples of the specific factor for further analysis (Lo, 1986). In this study, all the factor loadings of subjects in six factors were smaller than 0.8, a ranking order of the factor loading in six factors was therefore used to assign subjects to the factors they belong so as to explain the meaning or features of each factor. Because the factor scores of each subject varied in the statements, a standardization procedure of the factor score was conducted. Based upon the ranking order of factor scores of subjects (Table 2), a number from 1 to 9 was assigned as the standardized scores according to their positions in the ranking order. Table 4 lists the average factor score of each type of attitudes in six dimensions of personal characters of industrial designers. The standardized scores were then used for the analyses of design attitudes and tendency in personal characters.

	Affective aesthetics	Product form treatments	Attitudes in behaviors	Production and functional requirements	Basic requirements	Personal skills
Type A	5.60	5.56	4.63	4.56	4.38	5.17
Type B	5.40	4.33	5.13	6.00	5.88	3.83
Type C	4.60	4.67	5.50	5.33	5.75	4.00
Type D	5.70	5.78	5.25	4.11	4.25	4.67
Type E	4.70	5.11	4.00	6.33	5.88	3.50
Type F	6.00	5.11	4.25	4.89	5.88	3.17

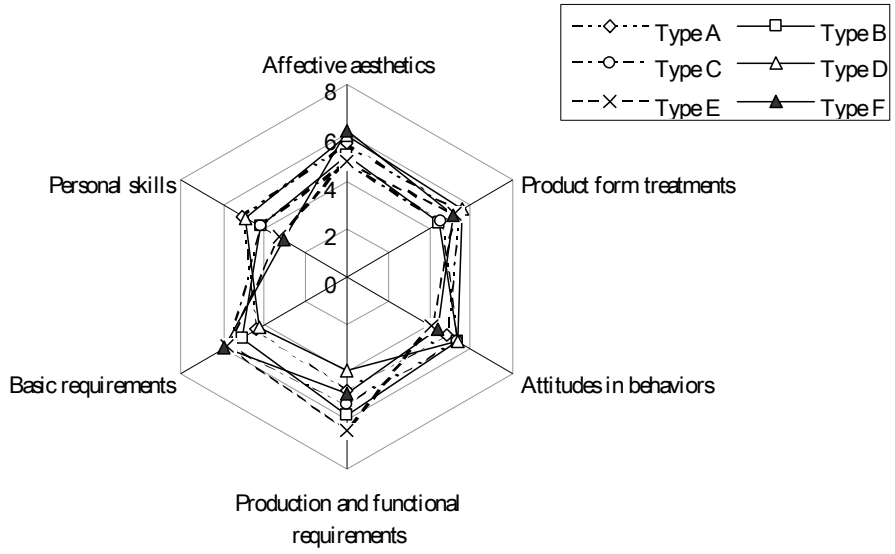

TABLE 4 : The average factor score of types of industrial designers and their distribution patterns in six personal character dimensions

4.1.1 Type A: Plan and Care All Aspects in Product Design

Eleven subjects belonged to Type A, the biggest group in six types, 22% in the total number of subjects. There were 8 males and 3 females, aged in the range of 26-35. In design experience, 7 were of 1-3 years and 3 of 4-8 years and 8 of them had the experience of multimedia design. The basic subject profile of this type indicated that Type A industrial designers can be referred to as young middle-aged generation with a certain period of design experience. Generally, they are not yet expert designers.

For Type A industrial designers, the most important statement was S05, Design is aimed to bring forth people nice experience in their life" whose factor score was high up to 7.409 (Appendix A)

In this group, five subjects chose this statement as the most important statement and two subjects considered S04, "A beautiful appearance is an important factor to consider in product design" the most important. These two statements belong to dimension of affective aesthetics. On the other hand, six subjects in this group considered S39, "Design should work out a compromising proposal that meet requirements of different parties" the least important, with a factor score of 1.809.Sven subjects in Type A regarded S27, "The amount of man power invested in a project depends on the amount of one's income" the least important, with a factor score of 2.146.This demonstrated that industrial designers in Type A were enthusiastic about product design. They believed that design should bring people fun and offer them better life experience.

Therefore, they would not cater to the market place with a compromising design due to the short amount of pay.

From the interview, most of industrial designers in Type A had the consensus that design should give people better life experience and satisfy or even please the user. It is also essential that products meet the ergonomic requirements and have quality. In addition, industrial designers in Type A placed emphasis on personal presentation skills. No statements in dimension of production and functional requirements were considered most important criteria. Besides two statements in affective aesthetics dimension, the statements considered most important by Type A subjects were evenly distributed in all dimensions. In Table 4,the standardized average factor scores of Type A industrial designers in six personal character dimensions fall between 4.380 to 5.600,with affective aesthetics dimension the top one (5.600) and basic requirements dimension the bottom one (4.380). There was no big difference among other dimensions and the radar diagram resembled to a regular hexagon. This indicated that industrial designers in Type A lay special emphasis upon the viewpoints of affective aesthetics but were in equal favor of other objective realistic conditions and personal skills. In other words, industrial designers in Type A tend to plan and care all aspects in product design.

4.1.2 Type B: Young and Equally Emphasize Fashion and Function

Eight subjects (16%, 4 males and 4 females) belonged to Type B, most of whom fell in the year range of 26-30. Basic profile of this type shows that they were young and junior in experience of product design.

The statements industrial designers in Type B considered most important and least important. Among them (Appendix A) , statements S05 “Design is aimed to bring forth people nice experiences in their life” and S29 “Product design should meet the security regulation” were considered most important by 4 subjects, with an average factor score of 7.798 and 7.841 respectively. Other statements statement S16 “Product design should meet the user’s ergonomic requirements,” S24 “Design calls for the quality of a product,” and statement S25 “Design is somewhat of a representation for the environmental protection concept.” On the contrary, statement S27 “The amount of man power invested in a project depends on the amount of one’s income,” was considered least important by Type B designers, with a low factor score of 1.613. Besides, other statements of least importance, included statements S08 “The masterpieces of famous designers will affect the aesthetics of my product design,” and S19 “The biomorphic approach to product form design brings fun to a product.” Overall, industrial designers in Type B cared a lot about the concept of environmental protection and whether the product meets safety regulation in addition to the requirements of design quality and ergonomics. Quite the opposite, they were not much interested in the biomorphic approach and masterpieces of famous designers in product form design.

From the statements Type B designers considered most important, subjects in this group cared quite a lot about safety regulation and design quality as well as the durability of products in addition to the consideration of environmental protection. It demonstrated that they paid much more attention to the production and functional requirements. In terms of the distribution pattern of most important dimensions of personal character, they were prominent in the dimensions of affective aesthetics and attitudes in behaviors.

From Table 4 and the radar diagram of Type B, subjects in this type were more prominent in dimensions of production and functional requirements (factor score 6.000), affective aesthetics (factor score 5.400) and attitudes in behaviors (factor score 5.125). In contrast, they were not evident in dimensions of personal skills (factor score 3.833) and product form manipulations (factor score 4.332) where the factor scores were lower and considered least important by more subjects. It is, therefore, evident that industrial designers in Type B emphasized the function of products. And because they were young in age and junior in design experience, they were referred to as a group that was practical and function-oriented.

4.1.3 Type C: Emphasize The Group's Benefit

Nine subjects (18%) were of Type C, 5 males and 4 females within the year range of 36-40. In terms of design experience, three were junior designers with experience less than one year and five with 1-3 years of design experience. Therefore, they were typical of junior product designers. From the statements designers in Type C emphasized (Appendix A), statements S29 “Product design should meet the security regulation” (factor score 7.225), S10 “Designers need to consider the balance between products and the environment” (factor score 7.402), and S25 “Design is somewhat of a representation for the environmental protection concept” (factor score 6.990) were the top 3 important factors. Other important statements such as S40 “The emphasis on marketing data analysis is an essential design procedure” (factor score 6.814) and S23 “Brain storming brings a wider variety to product design” (factor score 6.806) were also considered important. Quite the reverse, statements S46 “Doing a project alone demonstrates one’s self-value” (factor score 1.729) and S21 “It is better for a design to have the compliment of some design award” (factor score 2.073) were considered least important by five and four subjects respectively with standardized scores of 1 point. The ranking order of the importance of statements in Type C indicated that industrial designers in this type stressed a lot about the marketing and product planning at the early design state. They think highly of the needs of the enterprise but don’t care too much about their individual benefits and self values.

Subjects in Type C believed that it is essential to understand the market needs and to take marketing into consideration in product design and that it is necessary to draft a product planning. Meanwhile, they would never neglect the brain storming in a team and the regulations of quality and safety. Generally speaking, the issue of marketing in the dimension of basic requirements was the most important factor for Type C designers to consider in product design.

Among the six statements Type C designers considered most important, two belonged to attitudes in behaviors and other two belonged to affective aesthetics. Next to these two dimensions, one statement in basic requirements and one in production and functional requirements were also considered most important. On the contrary, there were two statements in affective aesthetics considered least important. Therefore, industrial designers in Type C tended to place top priority on the group’s benefit. From the distribution pattern of the standardized scores of six dimensions, there was no big difference among different dimensions. The average score of personal skills dimension in Type C was lower (factor score 4.000) while that of basic requirements dimension was higher (factor score 5.750).

4.1.4 Type D: Emotional Product Form and Personal Style Oriented

Six subjects (12%) joined Type D, with 5 males and 1 female at a year range of 20-35. On average, they had 8 years in product design experience and three of them had won design awards.

For the statements industrial designers in Type D emphasized (Appendix A), statements S05 “Design is aimed to bring forth people nice experiences in their life” (factor score 8.201) and S22 “The preliminary plan is a key factor to a successful design” (factor score 7.580) were the most important ones. In the next place were statements S47 “Product sketches can efficiently express a designer’s ideas” (factor score 7.026) and S14 “Design is aimed at showing outstanding attraction” (factor score 6.802), which belong to attitudes in behaviors dimension. In the least important statements, two belonged to basic requirements, including S21 “It is better for a design to have the compliment of some design award” (factor score 1.811), and S42 “The amount of man power invested in a project depends on the amount of one’s income” (factor score 3.239). Besides, two statements of personal skills, S45 “Design calls for the application of high technology” (factor score 1.950), and S48 “3D model construction and rendering are important in design proposals” (factor score 3.389), were also of least importance. This demonstrated that industrial designers in Type D didn’t consider the dimensions of basic requirements and personal skills significant in product design.

In their consideration of statements regarding product design, it is important that design can provide wonderful experience of life for users and that designers can apply unique designs to catch the consumer's eyes. In addition, they also paid much attention to product planning and idea sketches. Different from other types, no statements in dimensions of production and functional requirements and basic requirements were considered most important. On the contrary, one or two statements in these two dimensions were thought least important. In other dimensions of affective aesthetics, attitudes in behaviors and personal skills, each of them had two statements that were considered most important.

Moreover, the standardized scores and their radar diagram (Table 4) reflected a tendency to skew to the upper right, meaning that designers in Type D didn't think highly of the dimensions of production and functional requirements (factor score 4.111) and basic requirements (factor score 4.250). Therefore, this type of industrial designers were thought emotional and personal style oriented in product design.

4.1.5 Type E: Focus On The Realistic Aspects

Four males and four females (16%) belong to Type E industrial designers. Four of them were aged 26-30; three were 31-35; two were 36-40. In design experience, six of them had 1-3 years of product design experience; two had less than a year in product design experience. Particularly, five subjects in this type had been in charge of mechanical design and five had experience in graphic and multimedia design. On average, designers in Type E were older than those in other types but with design experience less than 3 years.

For the attitudes of industrial designers in Type E (Appendix A), the following statements were considered most important, including S16 "Product design should meet the user's ergonomic requirements" (factor score 7.638), S30 "Design makes it easy for users to operate a product" (factor score 7.308), S32 "Product form design should take mechanisms into consideration" (factor score 6.824), and S13 "The success of a design project lies in the communication between people" (factor score 6.541). This demonstrated that designers in Type E lay greater emphasis on product form manipulations and production, functional requirements and basic requirements. On the other hand, statements considered least important covered S21 "It is better for a design to have the compliment of some design award" (factor score 2.226), S27 "The amount of man power invested in a project depends on the amount of one's income" (factor score 2.561), and S45 "Design calls for the application of high technology" (factor score 2.697). Among these least important statements, the former two belonged to the attitudes in behaviors, which indicated that designers in Type E didn't think that the winning of design awards and the amount of income would influence their attitudes toward product design.

Among the statements concerning product design, industrial designers in Type E cared much about the operational function of a product and the combination of the mechanism and product form. Furthermore, subjects in this type concerned about interaction between product and users, brain storming, design budget, and the schedule of design projects. This indicated that designers in Type E placed much more emphasis on production and functional requirements than on other dimensions.

The distribution of standardized scores and their radar diagram (Table 3) show that the dimensions Type E designers considered most important covered affective aesthetics, product form manipulations, production and functional requirements, and basic requirements, which was consistent with the slanting lines in radar diagram. Among these dimensions, production and functional requirements had an average standardized score of 6.333, while personal skills dimension had an average standardized score of 3.500. To sum up, industrial designers in Type E cared more about product function and the production requirement. Therefore, they were considered as a group focusing on realistic aspects.

4.1.6 Type F: Well-Experienced and Aesthetics-Oriented In Product Form

There were only five subjects in Type F, the smallest group (10%). This group was composed of two males and three females. Three of them were aged 26-35 and two aged 41-45. Exceptionally, there were three senior designers in Type F, with more than 9 years of design experience. Moreover, four out of five in Type F had won some design awards. Four of them had the experience of graphic and multimedia design experience. Above all, four of them had been managers. The basic profile of this group indicated that Type F designers were senior designers with rich experience of design expertise.

The statements Type F designers considered most important were different from those of other types (Appendix A). Statements considered most important in Type F designers included S18 "A product design should have its own unique features" (factor score 8.450), S09 "Designers should carefully consider the aesthetic views of the target user group of a product" (factor score 7.204), and S43 "Design should take the budget and cost of a company into consideration" (factor score 6.874). The differences in the consideration of statements were due to the fact that the designers in Type F were older and senior in product design experience. On the other hand, the least important statements covered S45 "Design calls for the application of high technology" (factor score 2.393), S21 "It is better for a design to have the compliment of some design award" (factor score 2.615), S19 "The biomorphic approach to product form design brings fun to a product" (factor score 2.650) and S46 "Doing a project alone demonstrates one's self-value" (factor score 2.925). Two of these least important statements belonged to personal skills dimension.

From the opinions of Type F subjects, designers in this group thought that products should be different from the competitors, and that designers should take target user group's aesthetic points of view into account. In addition, they believed that affective design would become more and more important and that product design should include innovative functions. In contrast, designers in Type F didn't place much emphasis on personal skills dimension, with a remarkably low degree of importance. For the most important factors, there was at least one statement from each dimension except personal skills. With two statements considered most important, affective aesthetics dimension was the most emphasized aspect from the eyes of senior designers in Type F. At last, the least important statements evaluated by this group were centered on the attitudes in behaviors (2 statements) and personal skills (2 statements).

From the viewpoints of standardized scores (Table 4), affective aesthetics dimension had a highest score of 6.000 in Type F and basic requirements (5.875) the second. The standardized score of attitudes in behaviors (4.250) was not as low as expected. As mentioned above, the dimension personal skills was thought least important by Type F designers, with a standardized score of only 3.167, reflecting the missing corner in the radar diagram. Therefore, designers in Type F were referred to as well-experienced and aesthetics-oriented in product form.

4.2 Differences in The Job Allocation Among Different Types of Industrial Designers

The standard deviation in the viewpoints of six design attributes in designers that plan and care all aspects in product design (Type A) is smaller (sted=0.45). This indicates that designers in Type A are not partial to specific aspects of design activities and it will be easier for this type of designers to get along with other departments in an enterprise. Moreover, they are highly enthusiastic about design. Therefore, they are suitable for the coordination and management of design projects. And because they care about all aspects of design activity, they are not particularly aggressive in the product form manipulation. In handling a design project, they may not be suitable to be in charge of design projects that call for a high degree of innovation.

Designers in Type B are young and equally emphasize practical aspects and function. They often pay more attention to the issues of product quality, human factors and environmental protection. For this reason, they are not going to design products that are difficult to produce. On the contrary, they may work out product design that meets the requirement of production cost. Therefore, they are more suitable to be in charge of design projects where cost is the key issue.

However, because they are young in age and junior in design experience, they may need some other senior designers or managers to guide and offer help.
Designers in Type C place more emphasis on the group's benefit than their individual value and interest. For product design, they often care a lot about marketing survey and analysis in the early design stage. As a result, they are suitable to be responsible for data collection and analysis and the related design activities in a project.

Designers in Type D emphasize an emotional product form and personal style. They are the most creative and unique in design thinking among six types of designers. Because they care about different design skills, they are suitable for a totally new project and concept design that require distinctive points of view. Relatively, this type of designers do not emphasize production and functional aspects of products, so it is better that they are not put in charge of design projects that consider a lot about costs.

Type E designers focus on the realistic aspects of product design. They have a bigger deviation in the viewpoints of design attributes (sted= 1.14). Because they care about whether product function fits the requirements of production, they are suitable to be responsible for design projects where costs are of important consideration and risks are higher. This type of designers can complete design projects in a severe and dutiful manner.

Designers in Type F are experienced and aesthetics-oriented in product form. They also have a bigger variation in looking at design attributes (sted = 1.12). With rich experience in product design, Type F designers think highly of emotional aesthetics of product form but lay least emphasis on personal skills. Because they have rich design experience and care about affective aesthetics in product design, they are appropriate for product form design projects. The difference between Type F and Type D is that designers of Type D place less emphasis on production and functional aspects than Type F designers. For the redesign projects constrained by production conditions, it is better to put Type F designers that are well-experienced and product form oriented in charge.

4.3 General Discussions

In allocating designers for the cross-division design projects or small-scale redesign in regular projects in design departments, the job allocation model for industrial designers (Figure 1) can be used by design managers as a reference. Suitable designers can be selected for different design projects. The model of design job allocation is based upon six design attributes and characteristics of types of industrial designers in the radar diagram as well as the consideration of complexity in design projects, risks in the investment of product design, scale of production, and production cost of products.

In terms of the degrees of product form modification, the allocation of industrial designers should consider the following routine jobs: (1) product form redesign in serial products, (2) new product form with old functions, (3) totally new design, and (4) new concept design. The new concept design has the biggest degree in product form modification; totally new design the second; followed by the new product form with old functions; the serial product design has the lowest degree in product form modification. Because the scale and complexity in redesign of product form are smaller, it is suitable for independent work whereas a team work is more appropriate for other duties of higher degrees of innovation.

In allocating jobs to industrial designers, the following aspects should be also considered:
(1) Complexity in design projects, including aspects design projects are involved, involvement design and other departments have in design projects, difficulties of product development, and the like factors.
(2) Risks in investment: high risk indicates a bigger amount of investment, a higher product selling price, and a higher turnover in mass production.

(3) Quantity in production: a bigger scale in production for new products means a higher investment on the mold, manufacturing facility, production man power, causing a relatively larger risk to the business.
(4) Production costs: in launching a new product in the competitive market, the product cost should be put under strict control; otherwise the product will not be competitive in the market. Therefore, the strict control and saving in parts, mold, material and machining procedure can reduce the production costs and reinforce the product competition ability in the market.

In job allocation of industrial designers, the design managers are suggested to judge the innovation degree of jobs and the content of design projects. Then the design-oriented attributes of designers and characteristics in specific types can be used for the collocation of designers and design projects. The upper part of the radar diagram in the model of design job allocation is made up of affective aesthetics, product form manipulations, and personal skills (Figure 1). The higher tendency in these three design aspects indicates that designers emphasize a lot the emotional product form and that they are better in the jobs of new concept design and totally new design projects. Designers who place more emphasis on these three aspects are often more emotional and care less about cost and manufacturing. Therefore, it is suggested that they are assigned design projects of lower risk, lower investment, less complexity and looser schedule. The lower part of the radar diagram of the job allocation model is composed of attitudes in behavior, production and functional requirements, and basic requirements. Designers who emphasize these three aspects are more rational. Consequently, it is suggested that this type of designers take charge of projects for product form redesign in serial products and new product form with old functions. In addition, because of their realistic attitude toward product design, it is suggested that they are put in charge of projects with higher risks and investments or of projects where cost issue is essential, complexity is high, and schedule is tight. It is suggested that managers first figure out the property of designers in term of six design attributes and understand whether they belong to emotionally creative or rationally practical in their design attitudes. Then a specific type of designer in terms of design attitude can be identified. Furthermore, a proper design project can be assigned for designers in different types based upon the content of design jobs (Table 5) (refer to Section 4.2). In this way, each designer can make most of his or her talent to carry out the design project.

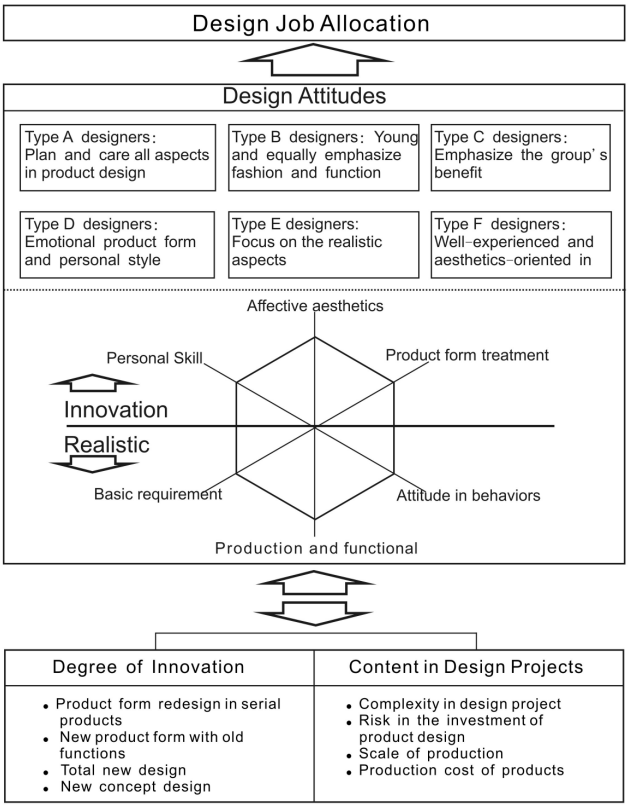

FIGURE 1: A job allocation model for industrial designers

	Tendency in attitudes toward design	Factors most emphasized	Features in personal character	Suitable jobs or projects	Notes
Type A designers: Plan and care all aspects in product design	Not partial to specific design attributes, not particularly ambitious in product form, but believed that design should bring people fun and offer them better life experience.	Place most emphasis on affective aesthetics but there is no big difference in all factors.	Enthusiastic about product design and will not cater to the market place with a compromising design due to the short amount of pay.	Project coordination job.	Not suitable for highly innovative projects.
Type B designers: Young and equally emphasize fashion and function	Design should meet the cost and production requirements.	Design quality and ergonomics are most emphasized; then they care about environmental protection and product safety regulation.	They will avoid designing products difficult to produce.	Projects where cost is important.	Junior in design experience.
Type C designers: Emphasize	Emphasize a lot the marketing	Marketing and product planning are highly	Don't care too much about their individual	Suitable for product planning or	Not very curious and weak in

the group's benefit	survey to help design projects.	emphasized.	benefits and self values.	research-oriented projects.	creativity.
Type D designers: Emotional product form and personal style oriented	Emphasize most the product aesthetics and creativity.	Consider product form manipulations and affective aesthetics most important.	Creative and unique in thinking but not careful in design routines.	Totally new and concept design projects.	Because they don't emphasize production requirements, they are not suitable to be in charge of projects where cost is dominant.
Type Edesigners: Focus on the realistic aspects	Take practical consideration into account in their design.	Emphasize most product function and production requirements.	Careful and businesslike in attitude.	Suitable for mass production and cost-oriented as well as highly risky projects.	They are pioneering and creative in design thinking.
Type F designers: Well-experienced and aesthetics-oriented in product form	Keep a balance in product form aesthetes, production and costs.	Affective aesthetics is most important.	Responsible and prudent; not good in social activity; not enthusiastic enough about design.	Most suitable for serial product design and redesign projects where cost factor is dominant.	Rich in design experience but don't emphasize personal skills.

TABLE 5.: Suggestions for the allocation of different types of product designers

Based upon the tendency and attitudes designers have toward product design as well as characteristics of projects in terms of innovation degree and content of design activity, jobs or projects suitable for different types of product designers are listed in Table 5. This can serve as a reference for design managers to select and assign designers for new projects or design duties.

5. CONCLUSIONS

In the present study, six types of industrial designers in their attitudes toward product design were specified from Q methodology. Based upon the attitudes designers have toward product design and their tendency in personal character, managers can select the appropriate members for a design team. From related studies, six dimensions of the skills and duties of industrial designers were induced, including affective aesthetics, product form manipulations, attitudes in behaviors, production and functional requirements, basic requirements, and personal skills. They were used to evaluate the category of design attitudes for the designers.

Type A industrial designers are young middle-aged generation with a certain period of design experience. The order of degree of importance they had toward product design is affective aesthetics > product form manipulations > personal skills > attitudes in behaviors > production and functional requirements > basic requirements. Generally, designers in this type care all aspects in product design, with approximately the same degrees of importance for all dimensions. Typically, industrial designers in Type A placed special emphasis upon the viewpoints of affective aesthetics and are highly enthusiastic about design.

Designers in Type B are young and equally emphasize fashion and function. Compared with other types of designers, they care a lot about production and functional requirements but place least importance on product form manipulations and personal skills. As a result, designers in Type

B are suitable to be in charge of design projects where costs are of greater importance because they will not work out difficult design proposals to meet the requirement of production cost. This type of industrial designers often pays more attention to practical issues such as product quality, human factors and environmental protection.

Designers in Type C emphasize the benefit of an organization. They considered aspects of product design in the order of basic requirements > attitudes in behaviors > production and functional requirements > product form manipulations > affective aesthetics > personal skills. Designers in Type C fell in a wide year range with design experience less than three years. They thought highly of basic requirements but least important for personal skills. With the group benefit in top priority, designers in Type C emphasized a lot about team work and were easy to get along with. But they might be a group of designers that were neither curious nor creative. Therefore, they are appropriate for being members in big-scaled design projects.

Industrial designers in Type D were emotional and personal style oriented in product form. They thought highly about product form manipulations and affective aesthetics but considered production and functional requirements and basic requirements least important. Because of the characteristic of being emotional and personal style oriented in product form, they were remarkably creative and unique in their product design. But they were least careful and tended to stick to their own ways of processing design routines. Accordingly, designers in Type D are suitable for totally new or conceptual design projects.

Focusing on the realistic aspects, designers in Type E emphasized production and functional requirements but didn't think highly of personal skills and attitudes in behaviors. Therefore, they can work out unique and creative products with solemn and well-disciplined state of mind. For this reason, designers in Type E are suitable to be allocated for design projects of which the risk is high.

Industrial designers in Type F were well-experienced and aesthetics-oriented in product form. The distribution of their age and design experience had two extremes. To them, affective aesthetics and basic requirements were the most important elements for product designers while personal skills were least imperative. Consequently, they could assume the full responsibility and consider all detailed aspects of product design due to the fact that they were the oldest group of designers. However, they did well in the performance of creativity. The only thing to desire is that they are not passionate enough so that they are not good in social intercourse. Such well-experienced and aesthetics-oriented product designers are suitable to be in charge of one-man projects, instead of controlling or coordinating the team work because they are often more cautious and introverted.

The identification of the designer's attitudes of product design and features in their personal character will help managers make most of the human resource. Managers at design department can categorize designers according to the feature of their attitudes toward product design. And based upon the quality of designers' attitudes and the innovation degree and complexity of design projects, appropriate industrial designers can be recruited or assigned for a team so as to complete the mission efficiently.

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Appendix A : Six dimensions and 50 statements of industrial designers' design attitudes

Dimension	No.	Statements	Factor score					
			Type A	Type B	Type C	Type D	Type E	Type F
A. affective aesthetics	S01	The fashionable messages should be endowed in the product design concept	3.72	3.59	3.79	5.34	4.10	5.54
	S02	A product design endowed with feelings will make it more attractive	5.63	6.23	5.13	6.31	6.31	6.79
	S03	Design is a concrete representation of our aesthetic experience	5.69	5.45	4.62	4.99	5.41	5.67
	S04	A beautiful appearance is an important factor to consider in product design	7.28	5.16	5.18	5.11	5.18	6.71
	S05	Design is aimed to bring forth people nice experiences in their life	7.41	7.80	6.73	8.02	6.50	5.58
	S06	Design is a transformation of personal tastes in products	5.52	4.79	3.35	4.41	4.38	4.36
	S07	Design needs to present the international point of view	4.57	5.56	3.81	5.40	3.57	5.83
	S08	The masterpieces of famous designers will affect the aesthetics of my product design	4.07	2.80	3.47	4.87	3.01	3.86
	S09	Designers should carefully consider the aesthetic views of the target user group of a product	4.79	4.06	5.72	5.71	5.23	7.20
	S10	Designers need to consider the balance between products and the environment	5.38	6.66	7.04	5.93	4.39	5.35
B. product form manipulations	S11	The form manipulations popular in the market will affect the design proposal	4.46	3.58	4.23	6.03	4.99	5.69
	S12	Design applies form elements to express the product semantics	5.16	3.88	5.37	6.32	4.72	4.63
	S13	Product form design should make users feel fun and enjoyable	6.80	4.48	5.03	5.87	6.43	6.28
	S14	Design is aimed at showing outstanding attraction	6.15	4.81	3.78	6.80	4.20	5.01
	S15	Design is a shape combination that features harmony	4.94	5.43	4.87	5.98	5.27	4.63
	S16	Product design should meet the user's ergonomic requirements	6.35	7.59	6.54	5.98	7.64	4.76
	S17	Design is a subtle combination of geometric elements	3.33	4.05	3.58	4.54	3.50	3.76
	S18	A product design should have its own unique features	6.19	5.13	5.39	4.08	5.52	8.45
	S19	The biomorphic approach to product form design brings fun to a product	3.85	2.74	4.10	3.54	3.37	2.65
C. attitudes in behaviors	S20	The description of design concept is a key factor in the design process	6.42	5.59	5.19	5.48	5.36	5.42
	S21	It is better for a design to have the compliment of some design award	4.74	3.71	2.07	1.81	2.27	2.62
	S22	The preliminary plan is a key factor to a successful design	5.10	6.53	6.72	7.58	5.56	6.75
	S23	Brain storming brings a wider variety to product design	4.39	4.16	6.81	6.55	5.84	3.63
	S24	Design calls for the quality of a product	6.32	7.57	5.94	6.25	4.44	5.42
	S25	Design is somewhat of a representation for the environmental protection concept	4.52	7.19	6.90	4.11	3.64	6.63
	S26	Design is a sharing of proposals and a search of suggestions	4.63	4.31	4.85	5.68	5.70	3.75

	S27	The amount of man power invested in a project depends on the amount of one's income	2.15	1.61	4.28	3.24	2.56	2.94
D. production and functional requirements	S28	A design proposal should have an innovative function	5.48	4.82	4.65	5.54	5.26	6.74
	S29	Product design should meet the security regulation	5.98	7.84	7.23	4.30	6.10	5.07
	S30	Design makes it easy for users to operate a product	5.83	6.38	5.94	5.02	7.04	5.70
	S31	Design should consider the durability of products	4.12	5.75	4.93	3.62	5.11	3.98
	S32	Product form design should take mechanisms into consideration	5.42	4.80	5.83	4.71	6.82	4.90
	S33	Design should consider the ease of manufacturing	5.09	4.91	4.86	4.22	5.57	4.07
	S34	Design should consider the maintenance of a product	4.88	5.31	5.05	4.31	5.55	4.02
	S35	A product design with simplification of materials will meet user's expectation	4.06	4.71	5.02	3.57	4.98	3.18
	S36	Design makes possible the integration of complex functions	2.95	5.94	3.84	4.11	6.14	5.78
E. basic requirements	S37	The success of a design project lies in the communication between people	4.94	5.90	4.86	5.68	6.54	4.88
	S38	Design project should follow the timing schedule	4.17	5.21	5.51	3.76	6.48	6.10
	S39	Design should work out a compromising proposal that meet requirements of different parties	1.89	4.46	3.61	3.81	3.60	4.96
	S40	The emphasis on marketing data analysis is an essential design procedure	6.32	6.11	6.81	5.89	6.15	5.80
	S41	Design should take marketing into consideration	5.50	5.51	6.02	3.58	6.06	5.27
	S42	Design is a thinking process oriented toward the boss's preferences	3.11	3.09	3.96	3.16	4.38	4.36
	S43	Design should take the budget and cost of a company into consideration	4.84	4.66	5.69	4.14	6.10	6.87
	S44	Design should consider the corporate identity of an enterprise	5.42	4.63	6.12	6.02	4.63	6.26
F. personal skills	S45	Design calls for the application of high technology	3.54	3.40	2.98	1.95	2.70	2.39
	S46	Doing a project alone demonstrates one's self-value	2.98	3.84	1.73	5.38	4.07	2.92
	S47	Product sketches can efficiently express a designer's ideas	6.18	5.47	5.75	7.03	4.97	4.79
	S48	3D model construction and rendering are important in design proposals	6.15	4.69	5.05	3.39	4.54	3.13
	S49	Models should be able to precisely express the product form	6.01	3.68	5.87	4.54	4.20	4.42
	S50	Design is a representation of personal style and taste	5.56	4.45	4.22	6.33	3.94	4.49

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