
**INTEGRATING TARGET COSTING INDICATORS WITHIN THE
BALANCED SCORECARD MODEL IN MALAYSIAN AUTOMOTIVE
INDUSTRY: A RASCH ANALYSIS**

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ABSTRACT

Target Costing (TC) adoption is not only for a cost reduction as a financial objective. Further, quality, functionality and lead time, as non-financial objectives, should be simultaneously perceived. This particularly requires an effective integration of relative financial and non-financial Organizational Capabilities (OCs) measures to assess future customers' expectations towards company's products development, TC focus. Using Rasch Measurement Model (RMM), this study aims to measure the applicability level of OCs measures related to TC four principles "Price-led", "Customer-focused", "Design-centered", and "Cross-functional" to be respectively integrated within the four BSC's perspectives "Financial", "Customer", "Internal Process", and "Learning and Growth" in association with industry type and company strategy effectiveness. Among 380 Malaysian automotive companies, 48 companies have participated in filling out the questionnaire. The results showed higher applicability level of the developed TC indicators except those related to suppliers' participation. Specifically, parts and components makers when employing confrontation strategy had higher ability towards integration process than car makers as well as when employing non-confrontation strategies such as cost leadership and differentiation strategies. The study has added a new idea on integrating TC with the BSC as an integral system. From the methodological perspective, the study has provided insights on using the RMM in management accounting research.

Keywords: Target Costing, Balanced Scorecard, Organizational Capabilities, Rasch Measurement Model

1. INTRODUCTION

In the few last years with more diversity of products and customers' desires, organizations endeavor is to implement an effective management control system for product costs whilst not sacrificing the other features; quality, functionality, and lead time. TC is mainly initiated as a cost management technique to drastically manage product features; cost, quality, functionality, and lead time. It is a management-based philosophy proposed globally by companies as one of the ways that companies can adopt to ensure product competitiveness in terms of cost, design and development. Many studies have reported that the most important benefit of TC technique is to assist companies in making a trade-off between cost, quality and functionality (e.g. Ax *et al.*, 2008; Cooper & Slagmulder, 1997, 1999; Cooper, 1995; Kato, 1993). Although Cooper (1995), in his *Survival Triplet Framework*, stresses that the product cost, quality and functionality should be ensured, Souissi and Ito (2004) affirm that the lead time element is also important. In their theoretical study, they came up with a framework integrating some similar measures for these four elements within the Balanced Scorecard's (BSC) four perspectives. In addition, they explored new function for BSC model, not only as commonly known as strategic management tool to assess organizational performance but also can be used to assess TC performance. Yilmaz and Baral (2010) comment that the TC has some similarities in certain aspects with BSC system as both are used specifically to satisfy customers' needs and requirements for achieving financial objectives and overall strategic objectives. In some converse to Souissi and Ito's (2004) theoretical study, Yilmaz and Baral (2010) reported that the TC can be an effective tool in BSC's financial perspective for the objective of TC cost reduction. By looking at these two studies as a main ground of this study, TC and BSC in some context are working in the same direction, focusing on customers' satisfaction to achieve financial objectives through effective process and strategic plans assessed by financial and non-financial measures. In particular, the TC is not only seen to be related to product cost reduction as a financial objective. Instead, product quality, functionality and lead time as non-financial objectives should be seriously perceived. In a similar context, the balance between financial and non-financial objectives is practically aggressive when implementing TC technique. In some recent studies (e.g. Juhmani, 2010), respondents argued that the product quality will be affected as the product will become cheaper when implementing TC. Therefore, this study is motivated to add empirical evidence to the suggestions in the above debate through integrating TC and BSC into a comprehensive model. If the empirical findings show higher applicability level of integrating TC with BSC, then that will provide additional evidence concerning that the BSC model could be a supportive tool in assessing TC performance. The study has extracted the TC indicators to be integrated with the BSC model from the Organizational Capabilities (OCs) related to TC practices. According to Huh *et al.* (2008), the reason for focusing on the OCs is that the TC is a dynamic system which connects different tools and techniques, and these capabilities would show different aspects of

knowledge accumulated within the organization. They consider the concept of OCs as success factors of TC performance accumulated through the multi-level of knowledge within the organization. Thus, in the study's assumption, OCs could affect organizational functions when particularly supported by BSC model in relation to TC objectives.

This study empirically aims to measure the Souissi and Ito's (2004) theoretical framework through integrating the four TC principles; *price-led, customer-focus, process-design, and cross-functional*; within the four perspectives of BSC; *financial, customer, internal process, and learning and growth* respectively. In addition, the integration of TC's four principles within the BSC's four perspectives was measured in association with industry type and company strategy effectiveness. The remainder of the study is organized as follows: the second part provides an overview of previous studies pertaining to the implementation of TC and BSC, with supportive studies related to OCs factors and TC implementation. Third part presents the research method adopted in this study. The study findings are presented in the fourth part and discussed in the fifth part. Finally, the study is concluded with brief remarks, contribution, and future research direction in the sixth part.

2. LITERATURE REVIEW

2.1 Development of Target Costing

Target Costing (TC), as a financial concept, has been initially developed as a price-based approach for the products derived from estimated selling price and profit planned (Shank & Fisher, 1999). Kato (1993) writes that "...target costing is not a simple cost-reduction technique, but a complete strategic profit management system". Similarly, Cooper and Slagmulder (1997) assert that the term of TC should be "cost management" and not "cost reduction". This justifies the vital role of TC in providing products with a desired function and better quality at lower costs. Hence, the TC concept has been evolved from cost reduction and control to cost management and quality and functionality improvement over times (Hamood *et al.*, 2011; Sharaf-Addin *et al.*, 2014). The need for TC evolution framework is a part from the need of management accounting evolution framework described by the International Federation of Accountants (IFAC, 1998). The IFAC's framework explains the evolution of management accounting in four stages: cost determination (stage 1), generating information (stage 2), cost reduction (stage 3), and value creation (stage 4). According to Sharaf-Addin *et al.* (2014), within the management accounting evolution framework, the development of TC can be described and guided as an effective tool of management accounting practices. They developed an evolutionary diagram based on the literature review and consistent with the IFAC's (1998) framework of management accounting evolution. The diagram shows how the TC technique has served over

times. In addition, its function has been evolved to include existing products in terms of product quality and functionality improvement and not only cost reduction. This means that the TC role is shifted towards products marketable value as the management accounting has been evolved towards value creation.

For the Japanese experience in developing TC, there are many factors which helped Japanese companies to develop and implement TC successfully (Feil *et al.*, 2004). Based on Huh *et al.* (2008), the OCs are the success factors for Japanese TC implementation. A part of these capabilities includes top management leadership, team-orientation, team-commitment, mutual trust built between managers and employees, management accounting structure, employees' education, and information network with customers and suppliers. Based on these factors, Hamood *et al.* (2011) developed the conceptual framework of TC consistent with the conceptual framework of management accounting evolution and based on the TC elements cited from Feil *et al.* (2004). The framework requires integrating the TC technique with other strategic cost management techniques. According to Kato (1993), TC is a combination of many techniques reinforced by the TC practice. Hence, the TC focus on cost reduction objective can be achieved through the effective use of organizational resources integrated with other managerial functions. In addition, the "TC Operationalization Model" developed by Filomena *et al.* (2009) enabled Brazilian companies to integrate TC with other cost control tools, and then functional teams to have accurate cost control. However, integrating TC with other cost control techniques is to ensure opportunities for value creation driven by continuous improvement initiatives in management accounting. Therefore, the integration of all cost and management accounting techniques is the predominant factor for achieving the desire of a success implementation of the TC. Nishimura (2002) suggests that the integration of accounting management and organization management is indispensable for the feed forward rather than feedback control system, and for the market orientation rather than production. This is supported by the evidence found in a case study of Romanian manufacturing company studied by (Briciu & Căpușeanu, 2013). They found that the management accountants are the main observer of the impact of competitive market and the increase or decrease of price and costs in the TC practice, and then pass all these signals to the organization management. Hence, TC technique has emerged as a market-oriented system which effectively manages the new product costs in the design and development stage (Monden & Lee, 1993). They report that the TC employed together with Kaizen Costing helps Japanese automobile industries to achieve their goal of cost reduction in the entire product design and development stage. Additionally, Monden and Talbot (1995) explains Toyota's cost reduction process starting from TC's role in the product design and development stage and carrying through Kaizen Costing in the production stage. Therefore, Japanese companies have learned to adopt TC not as a standalone technique, but in fact, they view TC as an integral part of the product design and development processes. On other hand, Cokins (2002) reveals, in his

study on US companies, the perceived benefits of integrating TC with ABC especially in the target costs allocation process. He affirms that ABC can provide key cost data to assure the “target” in target costing is attained. Jariri and Zegordi (2008) incorporated Quality Functional Deployment (QFD), Value Engineering (VE), and Target Costing (TC) into a mathematical programming model. The proposed model typically optimizes the customer satisfaction subject to the TC technique. In their sample automobile design example, for each technical attribute and each customer requirement, there is a customer rating in the House of Quality (HOQ), and then, VE is used to identify different solutions that show the level chosen to maximize customer satisfaction. In addition, Zaki (2013) found that the TC and Kaizen Costing represent a subjective alternative completing and developing the costing standardization system applied in Jordanian companies. He concluded that the TC is contributing in analyzing, evaluating and controlling the costs through product life cycle, and the Kaizen Costing is contributing in achieving the total quality requirements, elimination of value-not added activities and reducing the time of the product life cycle.

2.2 Target Costing and Balanced Scorecard

Although the Kaplan and Norton’s (1992) original development of the BSC was to measure organizational performance through combining both financial and non-financial measures, there is much less known about the specific purposes of the BSC system. Examples found of applying the BSC as designed by Kaplan and Norton (1992) are those related to BSC framework to assess the supportive functions towards strategic objectives (Alsyouf, 2006) and project performance system (Lo *et al.*, 2006). In product design and development, for example, Wong *et al.* (2009) developed the BSC for optimizing product design objectives and then assessing the performance of building designers in construction industry. Similar to the four perspectives of BSC designed by Kaplan and Norton (1992), they developed the generic BSC by using the four typical design objectives: Aesthetics, Functionality, Build-ability and Economics, and then numerous measures have been developed under each objective. They concluded that the proposed BSC system helped to translate the customer’s design aims expressing the integral set of the four objectives in specific key measures. In addition, Wiersma (2009) explored three different purposes of the BSC in manufacturing industry: decision-making and decision-rationalizing, coordination of activities within the organizational unit, and self-monitoring purposes. He identified different drivers for these three purposes of BSC including the evaluation style of managers, alternative controls used in the organizational units, and the receptiveness of managers to new type of information. However, these BSC purposes with the relative drivers are simply seen to be for managers to measure the multidimensional usage of management information system. Therefore, there is a prompt need to identify further specific purposes of BSC beyond assessing the management information system and the initial purpose of organizational performance evaluation. The BSC as

an integral system of financial and non-financial measures could be used through the Wiersma's (2009) three purposes mentioned above to assess any other management accounting practices. Each management accounting practices has two dimensions of measurement, “financial” and “non-financial” measures. This extends the purpose of the BSC through applying its four perspectives to assess not only organizational performance but also any management accounting technique performance.

Based on TC literature, the most important benefit of TC is to assist companies in making a trade-off between cost, quality and functionality (e.g. Ax *et al.*, 2008; Cooper & Slagmulder, 1997, 1999; Cooper, 1995; Hamood *et al.*, 2013; Juhmani, 2010; Kato, 1993; Zengin & Ada, 2010)), and this could definitely create a need to radically change their Organizational Capabilities (OCs) into the way in which the TC can be implemented successfully. Huh *et al.* (2008) considered the OCs as the capabilities of an organization to consider both internal and external competencies in addressing the environmental changes as sources of sustained competitive advantages. Therefore, companies should give much attention to the OCs factors related to the product development strategy and customers' expectations when implementing TC. Accordingly, the decision to implement TC is often linked to a firm's OCs which in turn influences the firm's decisions made to determine product price, cost and structure. This is to find out the product's features in terms of price, quality, functionality and timeliness which constitute the fundamental elements of TC technique. Hence, the best practice of TC depends aggressively on the OCs measures, indicated for the study purposes as TC indicators, to assess organizational functions combine with cross-functional teams.

On the other hand, the influence of OCs on the decision made to integrate TC indicators within the BSC model is likely supposed to be different according to the company strategy employed. According to Kato (1993), Tani (1995) and Tani *et al.* (1994), the effectiveness of TC implementation depends on the company strategy that determines the organizational functions. Following Hibbets' *et al.* (2003) definition, the company strategy includes information on the type of strategy that the company employed; produce products at lower cost than competitors (Cost Leadership Strategy), produce products with unique features different from those of competitors (Differentiation Strategy) and produce products at lower costs and higher quality and functionality (Confrontation Strategy). However, Kato (1993) stresses that the cost differentiation strategy alone is unlikely to be an effective strategy as cost competitiveness is a necessary requirement. He reported that the Japanese companies have sound methods of cost reduction with high quality and reliable products, as aiming for zero defects and higher quality means lowest costs (Confrontation Strategy). Schmeisser and Bertram (2010) found that the TC supports the Berlin BSC in relation to their company strategy (Cost Leadership) in a particular

technology area with the same level of quality. Therefore, the company strategy was defined including the three strategies mentioned above and was considered when measuring the companies' capabilities towards integrating TC with BSC.

Using OCs measures as main determinants of TC success as indicated by literature, the BSC system, in the study assumption, can be applied to evaluate TC performance related to the best combination of selling price with the desired quality and functionality to achieve product profitability. Since product selling price in the TC setting is a "market driven" and quality and functionality is a "customer driven", the most suitable operational strategy for manufacturers should be designed for balancing the cost-quality-functionality defined as a survival triplet framework by Cooper (1995). This implies that the manufacturers cannot make a trade-off between the three crucial elements; cost, quality, and functionality; with only cost reduction consideration. As BSC system uses a mix of "financial" and "non-financial" OCs measures, these measures are including both internally and externally focused OCs measures. According to Zengin and Ada (2010), the philosophy of TC is maximizing the customer satisfaction towards product quality and functionality, while minimizing costs has replaced the traditional cost-plus-pricing strategy. Since Pineno (2009) describes the BSC as a customer-based planning and process improvement system, it can be said that the focus of TC and BSC is the customer value. In the study of Schmeisser and Bertram (2010) conducted on Berlin car and mechanical engineering industry, they expanded the BSC approach to integrate TC and process costing. The developed measures were shown to be applicable for the development and design department and permit better control of an innovation project to substantiate the customer- and finance-oriented perspectives by linking of these two perspectives with the BSC model. Yilmaz and Baral (2010) comment that the TC has some similarities in certain aspects with BSC system as both are used specifically to satisfy customers' needs and requirements for achieving financial objectives. In addition, Souissi and Ito (2004) extended the survival triplet framework of Cooper (1995) to include another important element related to the lead time. In their theoretical study, the TC principles stated in CAM-I's (1999) definition of TC: "*price-led, customer-focused, design-centered and cross-functional*" are reflected respectively in the four perspectives of the BSC model: "*financial, customer, internal process, and learning and growth*". They also developed a framework which only concerned on the confrontation strategy as being suitable for TC implementation based on Cooper(1995). However, their measures developed are somehow simplistic in terms of the way that the BSC could be as a supportive tool to assess the TC performance. Simply, Souissi and Ito (2004) suggest that integrating TC and BSC through adopting the four perspectives of BSC as stated above supports the frequent processes occurred to decomposing the gap between TC and estimated cost. This could help to get the right balance among all the three crucial elements of TC; cost, quality and functionality. In some converse to their theoretical study, Yilmaz and Baral (2010) reported that the TC can be an effective tool in

BSC's financial perspective for the objective of TC cost reduction. Based on these two studies undermining the current study, it is the main aspect of TC and BSC as both in some context are working in the same direction, focusing on customers' satisfaction to achieve financial objectives through effective process and strategic plans. However, while Yilmaz and Baral (2010) recommended TC approach as an effective tool in BSC's financial perspective for the objective of TC cost reduction, Souissi and Ito (2004) explored a new function for the BSC model, not only as commonly known as a strategic management tool to assess organizational performance but also can be used to assess TC performance. The current study empirically examines the Souissi and Ito's (2004) theoretical framework that the four TC principles; price-led, customer-focus, process-design, and cross-functional; could be respectively reflected in the four perspectives of BSC; financial, customer, internal process, and learning and growth. Ultimately, there is a need for the BSC to assess TC performance including financial and non-financial through its indicators extracted from OCs measures.

2.3 Target Costing in Malaysian Automotive Industry

In an increasingly competitive market of automotive industry, Malaysian automotive industry has to learn from overseas success of such industry. In other words, it is important to emphasize on recent Management Accounting Practices (MAPs) and upgrade its capabilities into the way that these techniques can be implemented successfully. Since TC, as one of these techniques and among other factors, has enabled Japanese automotive companies to be globally competitive (Feil *et al.*, 2004), Malaysian automotive industry, in a similar context, has to pay much attention to this technique. Unfortunately, there is no direct study concerning such a technique, while most of the studies published pertain to MAPs in general (Hamood *et al.*, 2011). As Malaysian automotive companies has to move the development process upstream into product development stage, it is an opportunity for them to implement TC which manages and controls product costs during this stage and before it occurs. Focusing on TC objectives, including financial and non-financial, could also accelerate their OCs to innovate and produce products based on customers' desire for the quality-look with acceptable price and consequently achieve financial and non-financial strategic objectives.

3. METHODOLOGY

3.1 Research Sample

Malaysian automotive industry was selected to execute the current study. It has grown since the first national car rolled out in 1985 when it changed itself from importer prior to this period into a significant producer in the later period. In 2014, the total industry volume (TIV) of Malaysian vehicles reached 666,645 units and is expected to grow and reach about 670,000 units in 2015

(Sahari, 2014). Malaysia has two national carmakers (PROTON and PERODUA) which are urged to penetrate the local and overseas competitive market. Various car models have been produced by both PROTON and PERODUA, and both have made their parts and components supplied by numerous national vendors. However, selecting the automotive industry is confidently more suitable in the TC practice especially in the case that this practice had been initially developed in such industry.

3.2 Data Collection

A questionnaire survey was conducted to collect empirical data related to the four integration areas, the proposed four TC's principles to be integrated within the four BSC's perspectives. Using a hand distribution through several visits and meetings with focus groups of relevant managers during the period January 2014 to July 2014, 48 Malaysian automotive companies out of 380 companies population selected based on the Malaysian Automotive Institute (MAI) have responded. Along with the questionnaires distributed, the key informants were informed that the CEO/GM/COO/MD, senior managers and relevant executives are the unit of analysis. Out of 515 questionnaires distributed, 201 questionnaires were collected as follows: 11 of them from Motorcycle makers, 72 from car manufacturing companies, and the remaining 118 from parts and components companies. Since Motorcycle companies have not been addressed in the literature reviewed, the 11 questionnaires were cancelled. In addition, due to unusable answers for some questions and full/partial sections uncompleted, another 14 questionnaires were eliminated. As a result, the number of responses was decreased into 176 reaching the net response rate of 34%.

3.3 Variables Measurement

The aim of the study was to determine the applicability level of TC indicators to be integrated within the BSC's model. The TC indicators were represented by the OCs measures adapted from the Human Resource Alignment Scorecard (HRAS) (Becker *et al.*, 2001) and included "financial" and "non-financial" measures. Indirectly, the questions asked included the four areas of integrating TC indicators which represent the OCs measures in relation to the TC's four principle stated in CAM-I's definition: *price-led, customer-focused, design-centered and cross-functional*. These four areas were measured to be integrated in the BSC's four perspectives respectively; *financial, customer, internal process, and learning and growth*. Along with these four main variables, the study inquires the applicability level of integrating TC indicators within the BSC model in association with company strategy and industry type variables. While the company strategy was measured by the three types of strategy; Cost Leadership, Differentiation

and Confrontation; following Hibbets *et al.* (2003), the industry type was measured by the two types of Malaysian auto manufacturers; Carmakers and Parts and Components makers.

3.4 Data Analysis

Rasch Measurement Model (RMM) was used to analyze the data collected. In particular, Fit Statistics and Differential Item Functioning (DIF) were used to provide stable estimates of companies' ability and the difficulty of TC indicators to be integrated within the BSC model. However, previous TC studies showed that there were no findings that offer insights on the construct reliability and quality control of TC implementation using RMM. This study contributes to TC research by providing valuable assessment of the applicability level of integrating TC indicators within the BSC's perspectives.

4. FINDINGS

To measure the ability/applicability level of TC indicators to be integrated within the BSC's perspectives, Rasch Measurement Model (RMM) using WINSTEPS software (Linacre, 2005) was chosen to provide stable estimates of companies' ability and the difficulty of TC indicators. The Rasch analysis is limited in Fit Statistics and Differential Item Functioning (DIF) for achieving this objective.

4.1 Fit Statistics

To determine item and person fit statistics of the 22 TC indicators that have made-up the questionnaire, item polarity, item fit and uni-dimensionality are specific indicators of concern. The RMM suggests using Chi-square fit statistics to determine a good fit of empirical data with the model (Bond & Fox, 2007). Table 1.1 shows the item fit statistics measure order.

Table 1.1: Item fit statistics measure order of TC indicators

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	EXACT MATCH EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Item		
22	480	175	.86	.12	1.06	.6	1.06	.6	.59	.62	57.4	56.1	I5-Rwrds_TCInfo
16	491	174	.67	.12	.94	-.5	.94	-.6	.60	.61	60.1	56.8	I5-SppPart_Coll
18	495	174	.59	.12	.99	.0	1.02	.2	.58	.60	58.9	57.1	L1-DsgnerBehv_CRProg
4	501	175	.55	.12	1.13	1.2	1.12	1.1	.49	.60	53.8	57.2	F4-Perc_CstExc_Prft
15	499	173	.51	.12	.79	-2.0	.77	-2.3	.64	.60	66.5	57.4	I4-TmeElap_TmlyIntro
17	498	172	.48	.12	.86	-1.3	.87	-1.2	.63	.59	60.2	57.5	I6-ValueIndex
13	504	174	.48	.12	1.20	1.8	1.29	2.5	.49	.60	62.5	57.5	I2-FrqCstEst_TmlyIntro
14	522	175	.25	.12	.68	-3.3	.66	-3.5	.66	.58	71.0	57.9	I3-Perc_CompoTCach
19	512	170	.19	.13	.71	-3.0	.70	-3.0	.65	.58	68.9	58.2	L2-CoorEffrft_CommSys
3	530	176	.17	.12	.97	-.2	1.00	.0	.57	.57	63.5	58.1	P3-Perc_WstElim
21	534	176	.11	.12	1.07	.7	1.03	.3	.61	.57	50.0	58.2	I4-HgherTech_Inno
5	538	176	.04	.12	1.11	1.1	1.10	.9	.53	.57	57.6	58.3	P5-PrdctFtur_CustPrc
20	540	176	.01	.12	.95	-.4	.91	-.8	.62	.56	56.5	58.3	L3-NewTech_Inno
12	539	175	-.01	.13	1.22	2.0	1.24	2.0	.52	.56	60.9	58.4	I1-FrqCstEst_Qul
1	541	174	-.08	.13	.68	-3.4	.69	-3.1	.63	.56	73.2	58.4	P1-Perc_TCach
2	548	175	-.15	.13	.85	-1.5	.81	-1.8	.59	.55	65.7	58.5	P2-Perc_PrdctVol
9	551	175	-.21	.13	.97	-.3	1.13	1.1	.53	.55	59.8	58.5	C4-CustFdbk_TmlyIntr
8	573	176	-.52	.13	.91	-.9	.93	-.6	.59	.53	63.5	59.1	C3-CustFdbk_Func
11	573	176	-.52	.13	1.49	4.1	1.40	3.1	.49	.53	51.8	59.1	C6-CustRct_FuncReduc
10	593	176	-.87	.13	1.54	4.4	1.42	3.0	.45	.50	61.2	60.3	C5-CustRct_QulReduc
6	609	176	-1.17	.14	.93	-.6	1.28	1.9	.48	.48	64.1	62.8	C1-CustFdbk_SP
7	620	176	-1.39	.15	1.10	1.0	.96	-.2	.49	.46	66.5	64.8	C2-CustFdbk_Qul
MEAN	536.0	174.8	.00	.13	1.01	.0	1.01	.0			61.5	58.6	
S.D.	37.8	1.5	.58	.01	.22	2.0	.22	1.9			5.7	1.9	

Using the guideline of Bond & Fox (2007), the findings revealed two indicators identified with higher *infit* MNSQ than 1.40 logit; item11 “C6_customer reaction to functionality reduction” and item10 “C5_customer reaction to quality reduction” (1.50 and 1.53 logits respectively). Since the *outfit* MNSQ of both indicators is equivalent to 1.4 logit and each gets a positive point-measure correlation (PTMEA CORR.) above 0.3 logit, these two indicators were retained (Bond & Fox, 2007). This is supported by the results of Rasch Principle Component Analysis showing that the variance explained by measures (38.7%) was exactly match as Rasch expects, and the unexpected variance explained in the first contrast was only 9.4% less than 15.4% (see Figure 1.1). Therefore, the data fit the model whereby the estimation of the Rasch measures was successful.

In addition, a good reliability of Fisher (2007) (reliability > 0.70) was found for item and person (0.95 logit and 0.87 logit respectively). This in general gives supportive evidence that the instruments can differentiate the person ability with the item difficulty. Moreover, the indicators

can be separated into four groups (ISI 4.26) which matches the reliability assumption that should be more than 1 and reflects the four TC principles supposed to be integrated within the four BSC’s perspectives.

		-- Empirical --	Modeled
Total raw variance in observations	=	32.6 100.0%	100.0%
Raw variance explained by measures	=	12.6 38.7%	38.7%
Raw variance explained by persons	=	6.5 19.8%	19.8%
Raw Variance explained by items	=	6.2 18.9%	18.9%
Raw unexplained variance (total)	=	20.0 61.3%	61.3%
Unexplned variance in 1st contrast	=	3.1 9.4%	15.4%

Figure 1.1: Standardized Residual Variance (in Eigenvalue units): TC indicators

The overall data collected were diagnosed through assessing the indicators calibration of the four dimensions of TC and BSC respectively; *price-led (financial perspective)*, *customer-focused (customer perspective)*, *design-centered (internal process perspective)* and *cross-functional (learning and growth perspective)*. The structural definition of the difficulty measure of OCs measures related to TC indicators to be integrated within the BSC model was shown in Figure 1.2. The findings demonstrated reasonable fit to the model, item difficulty ranged from 0.86 to -1.39 logits (SD = 0.58 logit). The four TC principles reflected in the four perspectives of BSC were depicted also in the item map (see Figure 1.3). The respondents based on their ability/capability in logits level were located in the left side of the map while the OCs measures as TC indicators were located on the right side of the map. Overall, the map illustrates that the applicability of integration process was relatively easy for the respondents since the mean-square of respondents ability was 1.32 logit, higher than the mean-square of item difficulty (0.00 logit). However, the four integration areas had different levels of difficulty measures. The most difficult indicator found “*specific rewards for evaluating personnel concealment of cost reduction information*” was related to (cross-functional principle with learning and growth perspective) (Mean = 0.84 logit, SD = 0.12 logit). In contrast, the easiest one “*customer feedback compared with competitors on product quality*” was related to (customer-focus principle with customer perspective) (Mean = -1.54 logit, SD = .15 logit).

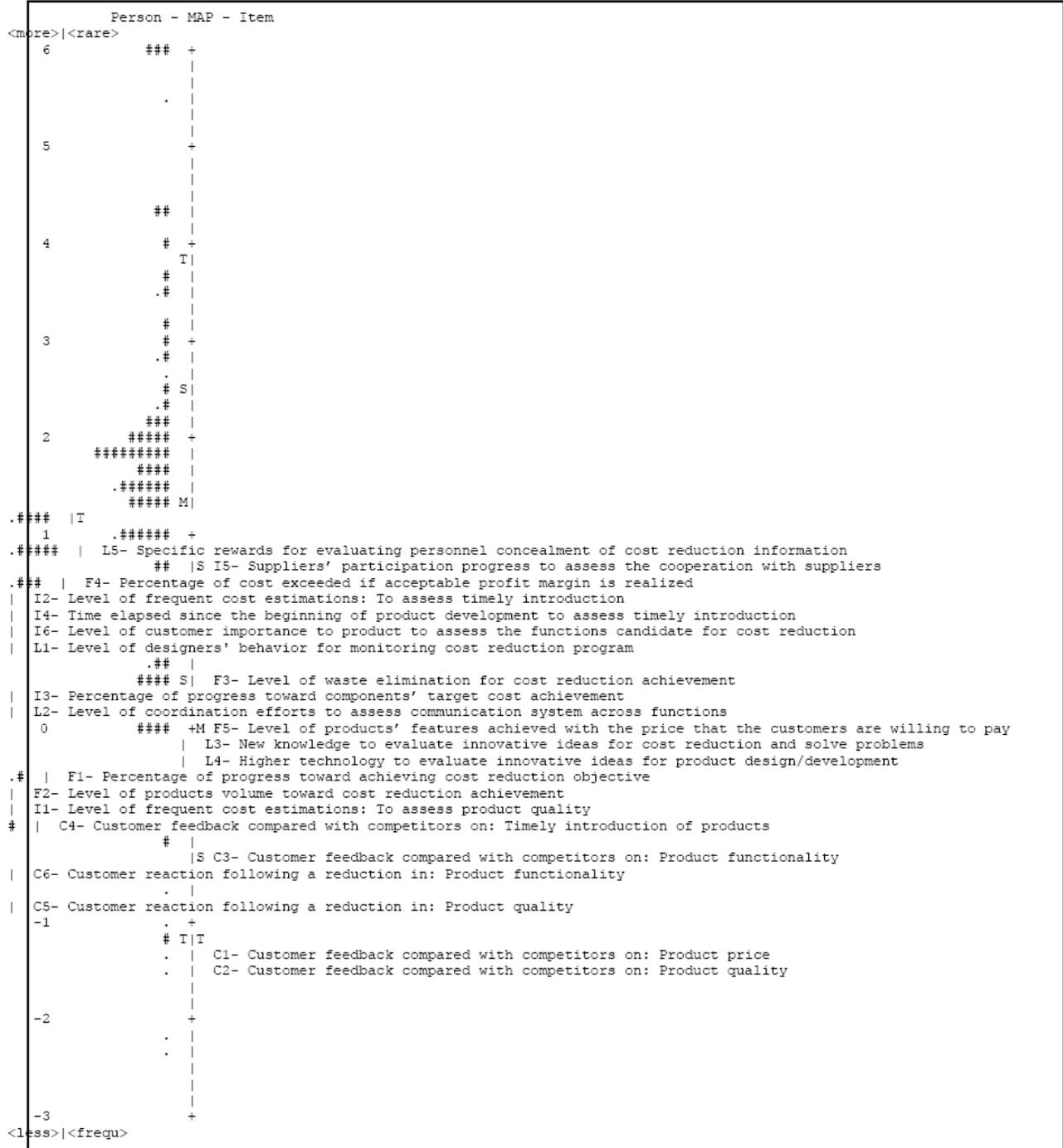


Figure 1.2: Wright Indicators-Ability Map: Integrating TC Indicators within the BSC perspectives

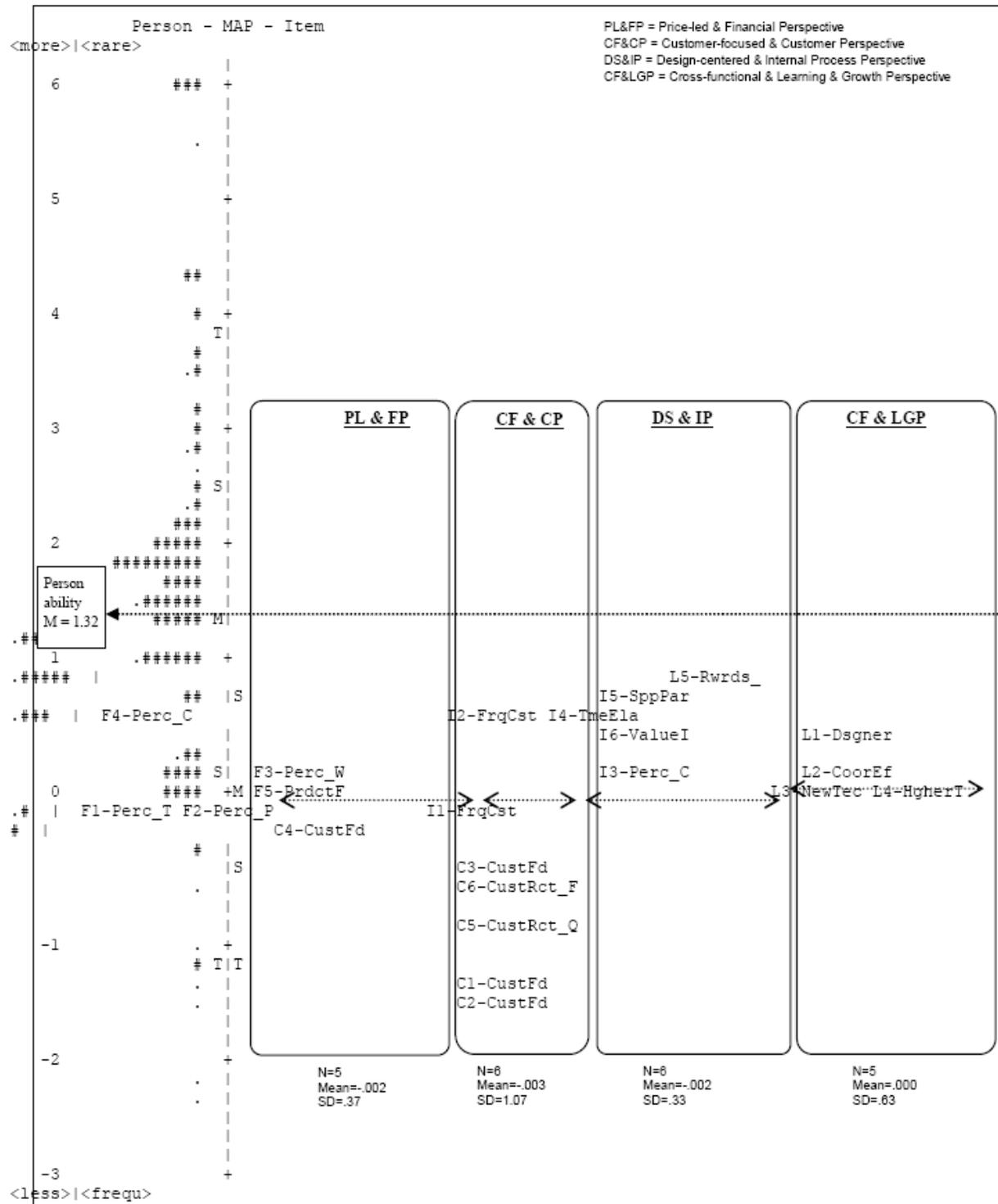


Figure 1.3: Means of person ability and item difficulty level of the four integration areas

Table 1.2 shows means, median, standard deviation and mean errors in logits for all four areas of integration process. Overall, the respondents as a group have higher ability in all integration areas. Specifically, they have higher ability in (*customer-focused principle with customer perspective*) followed by (*price-led principle with financial perspective*), (*design-centered principle with internal process perspective*), and (*cross-functional principle with learning and growth perspective*).

Table 1.2: Means and medians (in Logits) for integration areas of TC with BSC

Integration Areas	Mean	Median	Std. Deviation	Std. error of Mean	n
Price-led (financial)	-.002	-.10	.37	.17	5
Customer-focused (customer)	-.003	-.06	1.07	.54	6
Design-centered (internal process)	-.002	.12	.33	.13	6
Cross-functional (learning & growth)	.000	-.32	.63	.28	5

One of the main concerns of the study when determining the applicability level of integrating TC indicators within the BSC’s perspective is to determine in which industry type and company strategy employed was showing higher applicability level. There are two groups of respondents which include Car makers (N=67, Group 1) and Parts and Components makers (N=109, Group 2). The findings revealed that both groups had different levels of difficulty measures. Table 1.3 shows that the Parts and Components makers as a group had higher ability than Car respondents. The mean-square for respondents of Parts and Components was 1.61 logit (SD = 1.62 logit), while the mean-square for Car makers was 1.58logit (SD = 1.08 logit).

Table 1.3: Means and medians (in Logits) for industry type in integrating TC with BSC

Industry Type	Mean	Median	Std. Deviation	Std. error of Mean	n
Car Manufacturers	1.58	1.08	2.01	.25	67
Parts and Components	1.61	1.62	1.27	.18	109

The most difficult indicator related to (*cross-functional principle with learning and growth perspective*) (Mean = 0.84 logit, SD = 0.12 logit) was found to be matched by more respondents from group 1 than group 2. Additionally, the easiest indicator related to (*customer-focus principle with customer perspective*) did not match any respondent from group 2. Further analysis on the differences between two groups ability is presented later in DIF analysis.

In terms of company strategy followed, three strategies were examined; (1) Cost Leadership, (2) Differentiation, and (3) Confrontation strategies following Hibbets *et al.* (2003).The findings of

the distribution of all respondents' ability measures associated with these three types of strategy are presented in Table 1.4.

Table 1.4: Means and medians (in Logits) of company strategy in integrating TC indicators within the BSC perspectives

Strategy	Mean	Median	Std. Deviation	Std. error of Mean	n
Cost leadership	1.36	1.21	1.34	.34	15
Differentiation	1.48	1.48	1.02	.16	41
Confrontation	1.53	1.35	1.74	.16	120

From the Table above, it can be noticed that the respondents employed Confrontation strategy, as a group, had higher ability than those employed the other two strategies. The mean-square for respondents with Confrontation strategy was 1.53 logit (SD = 1.74 logit), while the mean-square for respondents with Cost Leadership and Differentiation strategies were 1.36 and 1.48 logits (SD = 1.34 and 1.02 logits) respectively.

4.2 Differential Item Functioning (DIF)

The sampled companies classified into two groups: Car makers and Parts and Components makers were again tested using DIF analysis to essentially establish the validity across the two groups. The DIF analysis was run through the equation of indicators estimates for the two groups. Figure 1.4 shows the DIF analysis results with the line indicating the 95% confidence intervals. It can be noticed that some of indicators outside the control lines favor group 1 while others favor group 2. Bond and Fox (2007) recommended that the DIF contrast should be more than 1.00logit to have a substantive meaning.

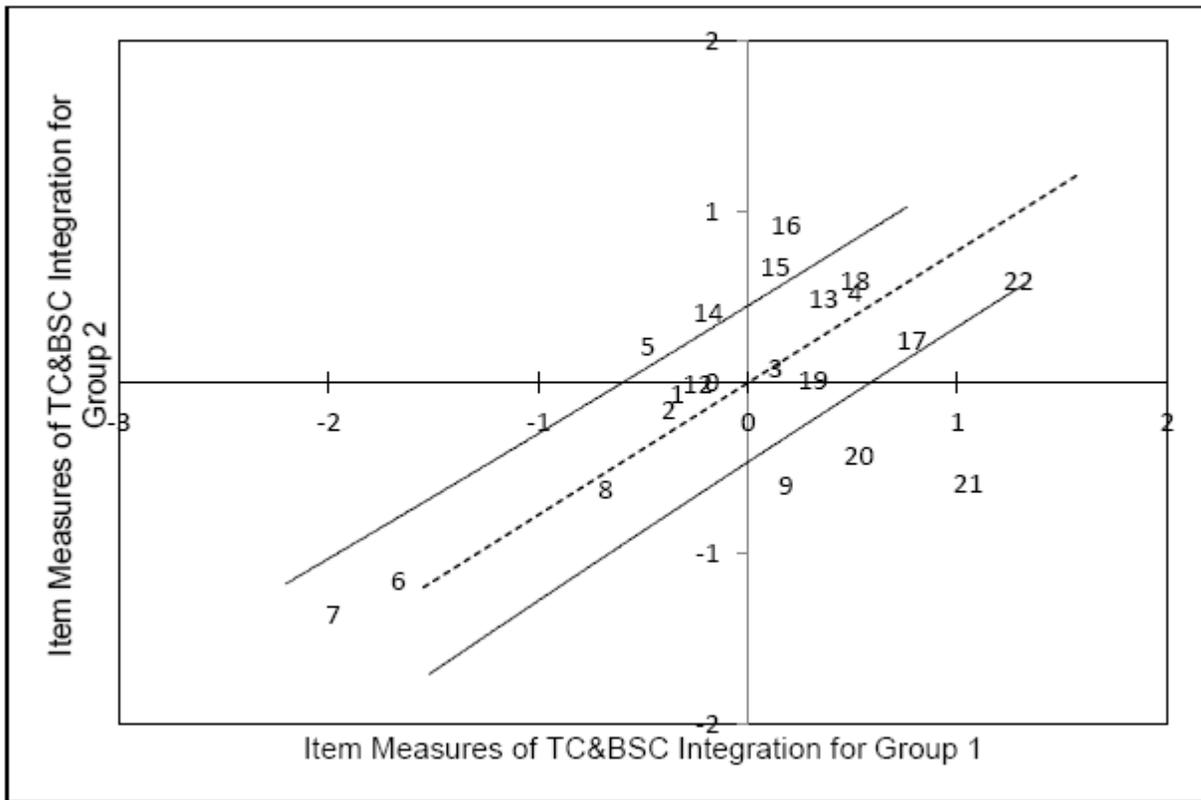


Figure 1.4: Item estimates of TC & BSC integration for Group1 and Group

Table 1.5 shows the indicators estimates differences in logits for the two groups. These indicators are considered more problematic as DIF logit of each indicator is more than 0.5 logit (Bond & Fox, 2007). The difficult indicator for group 1 was 21 (*higher technology to evaluate innovative ideas for product design/development*) (DIF = 1.57logit, $P < .05$). In contrast, indicator 16 (*suppliers' participation progress to assess the cooperation with suppliers*) was difficult for group 2 (DIF = 0.75logit, $P < .05$).

Table 1.5: Item estimates differences in Logits of integrating TC with BSC for the two groups

Groups	Items	DIF Contrast	Joint S. E.	t-value	P-value	Item Description
Group 1	Item 9	.73	.27	2.71	.0075	Customer feedback compared with competitors on: timely introduction of products
	Item 20	.90	.26	3.42	.0008	New knowledge to evaluate innovative ideas for cost reduction and solve problems
	Item 21	1.57	.26	5.97	.0000	Higher technology to evaluate innovative ideas for product design/development
Group 2	Item 5	.70	.27	2.61	.0102	Level of products' features achieved with the price that the customers are willing to pay
	Item 14	.61	.27	2.31	.0226	Percentage of progress toward components' target cost achievement
	Item 15	.56	.26	2.89	.0346	Time elapsed since the beginning of product development to assess timely introduction
	Item 16	.75	.26	2.89	.0045	Suppliers' participation progress to assess the cooperation with suppliers

5. DISCUSSION

5.1 Ability towards Integration Areas

The results in wright item-ability map revealed that the average person location in general is greater than the average indicators location indicating some misalignment of persons and indicators distribution. Since the mean-square of all indicators are below person mean-square, this indicates that these indicators are overall easily to be endorsed. Therefore, the results indicate that overall the respondents achieved higher performance in all the four integration areas; *price-led principle with financial perspective, customer-focused with customer perspective, design-centered principle with internal process perspective* and finally *cross-functional principle with learning and growth perspective*. The following sub-sections discuss in details the applicable indicators of each TC principle to be integrated with each BSC's perspective separately:

1. Price-led Principle with Financial Perspective

It was apparent that the price-led principle of TC can be reflected in the financial perspective of BSC model (Souissi & Ito, 2004). As such, several indicators have been asked to find their applicability level of integration under this area. It was found that the overall indicators can be integrated as they were easier for respondents to be endorsed. Specifically, the indicator

“percentage of cost exceeded if acceptable profit margin is realized” (Mean = 0.50 logit) was found the most suitable to be integrated. This indicator assesses the frequent cost estimation when calculating the allowable TC and then evaluates the timely introduction of products. However, the unexpected result was found in the indicators “percentage of progress towards achieving cost reduction objective” and “level of products volume towards cost reduction achievement” (Mean = -0.16 logit and -0.23 logit respectively). Although these two indicators constitute the financial focus of TC(cost reduction objective), they were not considered by respondents in assessing TC performance. This indicates less awareness of companies towards the assessment of frequent cost estimation process when calculating the allowable TC and then it’s effect on the timely introduction of products. The rest of indicators “level of waste elimination for cost reduction achievement” and “level of products’ features achieved with the price that the customers are willing to pay” were found to be in line with 0.00 mean-square of indicators indicating acceptable level of application.

2. Customer-focused Principle with Customer Perspective

Customer satisfaction in the automotive industry is one of the indicators to assess product performance and set future targets for farther improvement (Prakash & Goel, 2008). It is the main similar aspect of TC and BSC as both are used specifically to satisfy customers’ needs and requirements for achieving financial objectives and overall strategic objectives (Yilmaz & Baral, 2010). Consistently with this argument, the results showed that this area of integration was found to be the easiest one among all the four areas. Within these indicators, it is apparent that the indicators “customer feedback compared with competitors on: product price” and “customer feedback compared with competitors on: product quality” were found to be easy (Mean = -1.54 logit and -1.30 logit respectively). This is in a comparison with the other two indicators “customer feedback compared with competitors on: timely introduction of products” and “customer feedback compared with competitors on: product functionality” (Mean = -0.29 logit and -0.62 logit respectively). Nevertheless, the easy measure found for these four indicators gives further evidence supporting the role of customer feedback in assessing products competition through TC implementation.

3. Design-centered Principle with Internal Process Perspective

Although the overall applicability level of this area of integration was found to be easy (Mean = -0.002 logit), the results showed different levels of difficulty among the indicators developed under this area. As Souissi and Ito (2004) stated that “the time elapsed since the time of product development is an important indicator” is most important to assess TC performance, this indicator is found difficult to be applied (Mean = 0.47 logit). In conjunction with this indicator in

assessing timely introduction, two indicators have been tested. While the “*level of frequent cost estimations: to assess product quality*” is found easy (Mean = -0.09 logit), the “*level of frequent cost estimations: to assess timely introduction*” is reversely found difficult (Mean = 0.43 logit). This simultaneously supports that the frequent cost estimation when calculating allowable TC significantly affects the TC implementation. However, the most difficult indicator was found here is the “*suppliers’ participation progress to assess the cooperation with suppliers*” (Mean = 0.63 logit) which consistently supports the difficult found of TC indicators related to suppliers participation in other integration areas.

4. Cross-functional Principle with Learning and Growth Perspective

While the overall results showed that all indicators as a group are easy to be applied (Mean = 0.000 logit), some indicators individually had different levels of application difficulty. The indicator of “*specific rewards for evaluating personnel concealment of cost reduction information*” (Mean = 0.84 logit) is not only found difficult in this area but also over all indicators in the integration process. The carelessness of this indicator may affect the availability of required information for achieving TC. According to Everaert *et al.* (2000), rewards is one of the factors influencing employee motivation for achieving TC objective. On the other hand, “*new technology to evaluate innovative ideas for cost reduction*” and “*higher technology to evaluate innovative ideas for product development*” (Mean = -0.06 logit and 0.04 logit respectively) are found to be the easiest indicators for assessing TC implementation in this area. Souissi and Ito (2004) suggest that the controlling designers behavior, enhance accumulated knowledge and communication skills are measures to assess cross-functional principle of TC which are encountered under learning and growth perspective. The results confirm this suggestion where the indicators “*level of designers’ behavior for monitoring cost reduction program*” and “*level of coordination efforts to assess communication system across functions*” (Mean = 0.65 logit and 0.12 logit respectively) are found at the acceptable level of application.

5.2 Integration Process Associated with Industry Type

The two types of industry, Car makers and Parts and Components makers were also measured. Both types of industry are basically different in terms of resources and knowledge necessity for implementing any strategic technique such as TC. Therefore, it is interesting to determine the applicability level of integrating TC indicators within the BSC perspectives among these two industries. The results showed that, on average, Parts and Components makers as a group have higher ability than Car makers (Mean = 1.61 logit and 1.58 logits respectively). This contrasts with the research assumption consisting with the literature that the large companies have adequate resources to implement TC technique.

Although the difference found between both mean-square of the two groups is small, it has a substantive meaning especially for some indicators with higher DIF logit more than 1.00 logit(Bond & Fox, 2007). By looking at the indicators outside the control lines shown in Fig. 6 and in details described in Table 5, the indicators that are difficult for Car makers (Group 1) are those related to “Customer” and “Learning and Growth” perspectives. In contrast, the difficult indicators for Parts and Components makers (Group 2) are related to “Financial” and “Internal Process” perspectives. Interestingly, it was obviously noted that the indicator “*higher technology to evaluate innovative ideas for product design/development*” is difficult for Car makers but easy for Parts and Components makers (DIF=1.57, $P<.05$). This contrasts with Souissi and Ito's (2004) suggestion that the new knowledge that generates high technology is an important measure that can be reflected in learning and growth perspective of BSC model. On the other hand, the indicator “*suppliers’ participation progress to assess the cooperation with suppliers*” is difficult for Parts and Components makers while it is easy for Car makers (DIF=.75, $P<.05$). It is possible to say that the Parts and Components’ suppliers are commonly those for raw materials but not for finished products like those for Car makers who supply them with finished products. Therefore, the difference in suppliers’ nature of both groups leads to a different realization of this indicator between both groups.

5.3 Integration Process Associated with Company Strategy

As reviewed in TC literature, one of the main directions of TC performance is business competitive strategy. Since the strategic goals aim to determine the unique place of any automotive company in the marketplace in terms its product cost and design and development, TC should be assessed as a supportive tool in achieving those goals. According to Cooper (2005), Confrontation strategy is most suitable for TC implementation. Kato (1993) initially described TC as a technique aims to reach Cost Leadership strategy by reducing products life-cycle costs. Yilmaz and Baral (2010) recently recommend TC approach in the success of BSC system when organizations use the two fundamental strategies: Cost Leadership and Differentiation strategies. Among these arguments with much focus on the latest one, the three types of strategies were measured when integrating TC indicators within the BSC’s perspectives. The results revealed that on average the companies employed Confrontation strategy, as a group, have higher ability than those employed the other two strategies (Mean = 1.53 logit). This confirms that the Confrontation strategy is suitable for integrating TC indicators within the BSC’s perspectives. Therefore, the results obtained support the role of Confrontation strategy for TC implementation success consistently with what Cooper (1995) recommended. However, by looking back at the industry type, the Car makers were seen again to be adopting Confrontation

strategy. This gives further evidence that the Car makers compared with Parts and Components makers achieved higher performance in integrating TC indicators when they adopt Confrontation strategy. It means that they tend to have assessment measures for TC performance by using the four perspectives of BSC model as an attempt to confront a highly competitive market.

6. CONCLUSION

The main objective of this study is to measure the applicability level of TC indicators to be integrated within the BSC's perspectives using RMM. The aim is to get the right balance among the TC four elements (cost reduction, quality, functionality and lead time) once the OCs measures related to TC principles are integrated within the BSC's perspectives. Through which, the BSC model could be a supportive tool for the TC success. The gap found in the literature that the lack of a comprehensive list of OCs measures in relation to TC implementation was fulfilled through developing such measures from broader dimensions including "financial" and "non-financial" dimensions. The applicability level of developed OCs measures related to TC principles; *price-led, customer-focused, design-centered and cross-functional*; to be respectively integrated within the BSC perspectives; *financial, customer, internal process, and learning and growth* was measured by using the RMM. The results showed acceptable level of applicability towards the four integration areas. This supports the TC focus that is not only a cost reduction, but further focus on quality and functionality features is extremely important. In essence, OCs "financial" and "non-financial" measures have to be seriously perceived when implementing TC technique. This particularly requires serious interaction and an effective integration of relative OCs measures to maintain TC performance success. This study contributed to the overall TC implementation that the success of TC not only needs radical changes in OCs, but needs further balance across all OCs measures in order to get the right balance across all TC performance elements; cost, quality, functionality and lead time. The study also added a new idea to TC research in relation to the integration of TC with BSC model and using the RMM in data analysis as unique insights provided that never been found in the literature. Despite that, one main limitation of the study is that the study used a single-industrial case study as well as the TC strategy map based on the BSC model was not provided. Hence, future research is highly encouraged to counter this limitation by extending the study sample to include multiple industries. In which, a fundamental list of KPIs to assess TC performance could be developed and then the TC strategy map based on the BSC generation model could be drawn.

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