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Using the Rasch Model to Measure Malaysian Companies' Capabilities toward Target Costing Implementation

Hussein H. Sharaf-Addin[1,2], Normah Omar[2] & Suzana Sulaiman[2]

[1] Faculty of Administrative Sciences, Thamar University, Yemen

[2] Accounting Research Institute and Faculty of Accountancy, Universiti Teknologi MARA, Malaysia

Correspondence: Hussein H. Sharaf-Addin, an assistant lecturer at Faculty of Administrative Sciences, Thamar University, Yemen. The author is currently undertaking his PhD program at Faculty of Accountancy, Universiti Teknologi MARA (UiTM), Malaysia. E-mail: sharafidr@yahoo.com

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Abstract

Target Costing (TC) has been widely known as a cost management technique to manage product costs during the earlier stages of product life cycle. This study aims to measure Malaysian companies' capabilities towards TC implementation stages associated with industry type and company strategy effectiveness. Among 380 Malaysian automotive companies, 48 were involved in filling the questionnaire which includes six constructs representing the six common stages of TC implementation adapted from Ellram's (2006) theoretical model. Rasch Measurement Model (RMM) was used to analyze the data collected. The results revealed acceptable ability for the responding companies towards TC implementation stages especially Car makers and when employing the Confrontation strategy, except some capabilities required to follow-up TC activities in achieving cost reduction objective. All the six stages had different level of implementation difficulty, stage 5 (closing the gap between allowable target cost and estimated costs) was the most difficult stage while stages 3 (Computation of products' allowable target cost) and stage 1 (identify product characteristics) were the easiest ones. Suppliers' involvement in providing alternative design was most difficult, whereas identify customers' expectations before design stage was the easiest one to be implemented. The study has provided evidence on TC implementation in Malaysian context and added a new idea to the knowledge regarding the useful usage of RMM in management accounting research.

Keywords: target costing, automotive industry, Rasch measurement model

1. Introduction

Target Costing (TC) has been proposed as one of the ways that companies can adopt in ensuring product competitiveness in terms of product price, design and development. These three elements are the main concern of TC in ensuring the targets of higher quality products with lower costs and shorter time based on market-driven basic and customer-oriented attributes. In TC practice, once the selling price is determined based on the market price, the company should develop a product with the cost that can achieve an acceptable profit margin. However, the best practice of TC depends aggressively on Organizational Capabilities (OCs) where organizational functions combine with cross-functional teams. In TC literature (e.g. Joshi, 2001; Swenson et al., 2005; Kocsoy et al., 2008; Huh et al., 2008), OCs have been recognized as the most important factor for TC implementation success.

In Malaysian context during the last decades, automotive industry has responded to the global competitive pressure to ensure their competitive edge and sustainability among its global competitors. For example, several effective management accounting techniques such as Just-In-Time (JIT), Activity-Based Costing (ABC), Lean Production System, Total Quality Management (TQM), and Balanced Scorecard (BSC) have been established (Hamood et al., 2011). Despite TC, as one of these techniques, is crucially important in particular for automotive companies, empirical studies directly examining the TC implementation are almost nonexistent. By implementing TC, their products could be differentiated as being with higher quality, acceptable price, and shorter delivery time, so that can create their customers' value and maintain their overseas competitiveness.

The main objective of this study is to measure Malaysian automotive companies' capabilities associated with industry type and company strategy effectiveness towards TC implementation stages. These stages are the six common stages adapted from Ellram's (2006) theoretical model namely; (1) identification of products characteristics, (2) determination of products selling price, (3) computation of products allowable target cost, (4) target cost allocation to product's components, (5) closing the gap between allowable target cost and estimated costs, and (6) continuous improvement. The remainder of the study is organized as follows: section 2 provides an overview of previous studies pertaining to TC implementation in automotive industries. Section 3 presents the research method adopted in this study. Following this, the study findings are presented and discussed in section 4. Finally, the study is concluded in section 5.

2. Literature Review

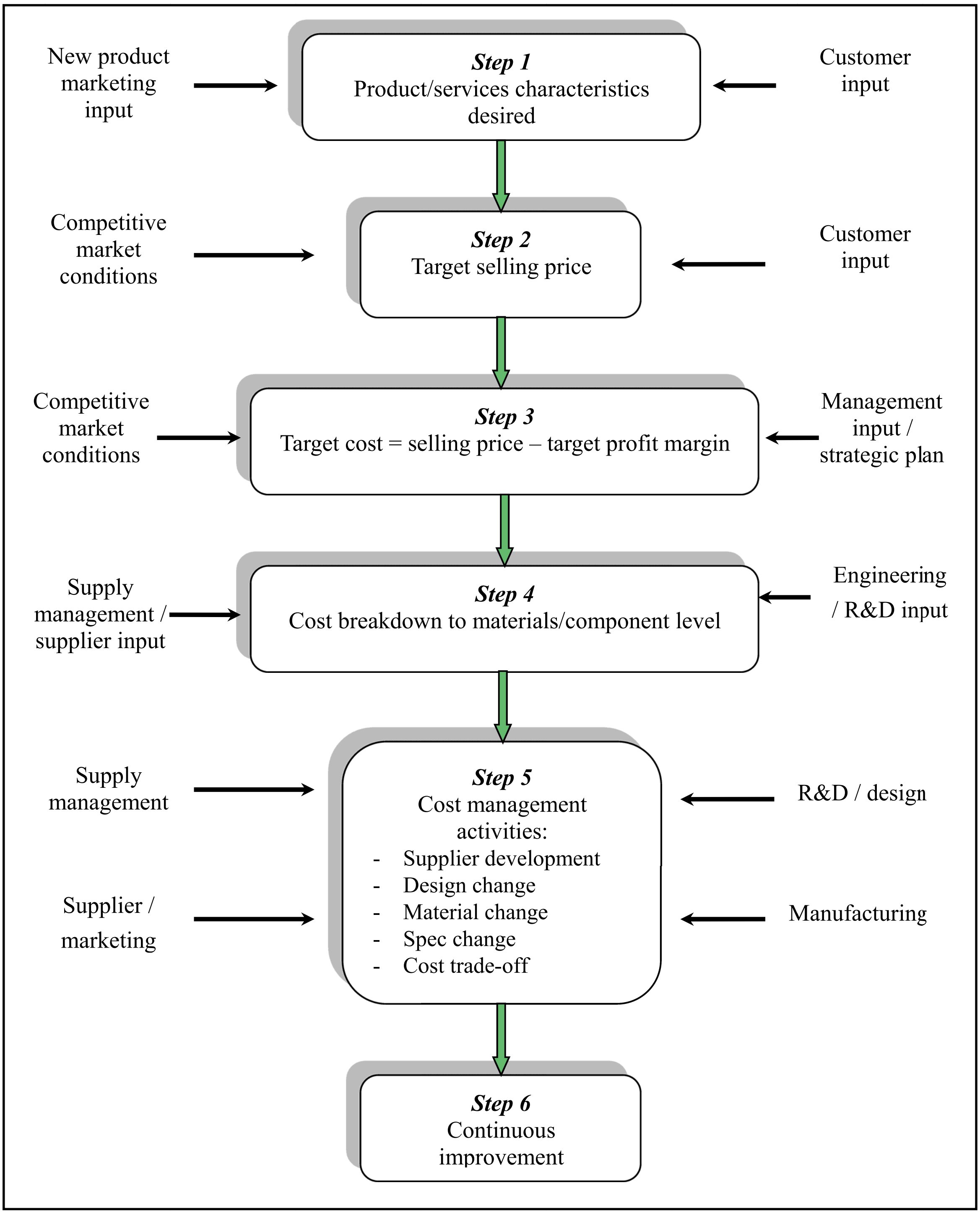


Figure 1. Target costing process
Source: Ellram (2006, p. 15)

TC was developed by Toyota in the beginning of the 1960s and it has been used since that period by Japanese automotive industry in general (Afonso et al., 2008). It has been reviewed by accounting literature as an excellent tool to manage cost of products and services, and most widely noted as a practice to support new product development (NPD) (Ellram, 2006). Cooper and Slagmulder (1997) describe TC as a feed-forward cost management technique rather than the traditional feedback techniques used to manage products cost during the production process. Kato (1993) stresses that the "…target costing is not a simple cost-reduction technique, but a complete strategic profit management system". This is supported by Cooper and Slagmulder's (1997) claim that the term of TC should be a "cost management" and not a "cost reduction". Hence, TC enables companies to manage their products cost and ultimately future profit target by determining the products' features at which the products must be manufactured.

Faced with growing increase of competition within the automotive industries worldwide, many of these industries are seeking to produce higher quality products at lower costs (e.g. Japanese companies such as Toyota, Nissan, Matsushia, and Daihatsu) (Cooper & Slagmulder, 1997; Tanaka, 1993). As such, adopting TC is mainly initiated as a cost management technique to drastically manage product features; cost, quality, and functionality; at the earlier stages of products life cycles. However, Japanese automotive industries have globally become more diverse in their products and market-oriented in their growth. This actually requires shorter product life cycles with more focus on the costs occurring at each stage of product life (planning, design and manufacturing).

Monden and Hamada (1991) examined the TC processes in Japanese automotive companies and divided them into five steps as follows: (1) corporate planning, (2) developing the specific new product project, (3) determining the basic plan for a specific new product, (4) product design, and (5) the production transfer plan. Through these steps, they emphasize the effective role of management accounting system in determining target profit, target cost and estimated cost. In addition, Ellram (2006) provides an in-depth description of the TC steps practiced within US companies. Figure 1 shows the TC process, step by step executed in US companies. He found a very tight linkage between supply management and the design function in the TC practice, especially at step 1, 4, and 5, which contrasts with Japanese focus as they pay much attention on the management accounting system in setting TC (Monden & Hamada, 1991; Cooper & Slagmulder, 1997).

Table 1 shows how the TC is being practiced among automotive industries and what are the variables used to determine the applicability of this practice in non-Japanese companies compared with its initial use in Japanese companies. However, the machining process is an important and widely used in automobile industries, and the high percentage of product's parts have machined components and assembled to result in the final product (Gopalakrishnan et al., 2007). As a consequence, the machining cost represents a significant portion of the total cost of the final product, and simultaneously depends on the machining process. Gopalakrishnan et al. (2007) also point out that the cost reduction can be achieved by proper design and selection of parameters such as machining process, cutting tools, labor, machine type, materials, and many other factors. However, several authors have assumed that the TC is applicable only in the early stages of the product life cycle. For example, Shank and Fisher (1999) believe that the TC must be applied early in the product life cycle based on the proposition that costs are fixed after a product is in manufacturing. Moreover, Monden and Hamada (1991) mentioned that the main reason of the importance of TC application in Japanese automobile companies is that the ratio of variable costs to total costs has increased remarkably (up to 90 per cent) and the ratio of direct material costs to total variables costs is about 85 percent. This indicates the important role of the management to adopt TC to control these costs compared with fixed costs. In contrary, Kocsoy et al. (2008) found that approximately 70 per cent of Turkish companies determine TC for all of the products in the production line, 22 per cent determine only for the new products, and 11 per cent determine only for the important parts of a product. This supports the findings of Rattray et al. (2007) which indicates that the TC is being used among New Zealand manufacturing companies to all existing products.

In addition, Ju et al. (2009) presented a methodology used for TC control during the design stage of Chinese automobile industry. In their study, the methodology developed consists of two steps; the target cost estimation and target cost realization. For each step, a particular model is further developed. A Back Propagation (BP) neural network is developed to estimate target costs of various design at the earlier stage, whereas a Genetic Algorithm is developed to balance target costs reduction and supplier satisfaction. They reported that if the total procurement cost decreased by 2%, the average supplier satisfaction would drop by 4.17%, and in this case, the automobile company should be alert to the potential risk caused by the suppliers. Similarly, the preliminary study conducted by Ibusuki and Kaminski (2007) suggests a methodology for the Product Development Process (PDP) in an automotive industry aiming to incorporate TC and VE. They found that VE and TC are complementary processes and identified some positive points that the keys to the success of this integration. This, however, justifies the idea that while VE helps to identify where the achievement of cost reduction could be, the TC shows the target to be achieved so as to ensure the long-term profitability strategic plan of a company.

Table 1. Target costing application in automotive industries

Country	Article	TC Application	Variables used in TC practice
Japan	Monden and Hamada (1991) Kato (1993) Tani et al. (1994) Tani (1995) Feil et al. (2004)	• TC steps • Higher ratio of VC than FC • The close linkage between TC and Kaizen costing • The active role of MAS	• Environmental uncertainty • Organizational structure - TCM • Information system • Customers' needs - market orientation - market competition - technological innovation - timely introduction • Influential powers: Sales managers - Product planning manager - Product managers - Market competition - Timely introduction - Purchasing managers - Production engineering managers - Technological innovation
Turkey	Kocsoy et al. (2008)	• Determination of TC for all product	• Customer expectation • Long-term product and profit planning • Profitability ratio • Cost-based profit margin • Cost estimation: pre-production, during designation phase, after production • Costs components: production costs, marketing and distribution cost, service/support costs, recycling costs. • Cross-functional teams - suppliers participation • Methods to reduce costs: VE, TQM, Kaizen, VA, on time production, action/operation costing, simultaneous engineering
China	Ju et al. (2009)	• Develop a methodology for TC control for the design stage: ➢ BP neural network ➢ Genetic Algorithm	• Cost ratio estimation • Cost calculation • Attribute identification/refinement • Cost items, cost structure, and cost changes • Supplier satisfaction
US	Ibusuki and Kaminski (2007)	• Incorporate VE and TC during PDP at three subsequent stages: VE concept, VE project, and VE validation	• Customer attributes • Supplier sharing in providing technical information • Product's functions • Product's components
Germany	Horvath and Tani (1997)	• Cost-reduction goal	• Market-oriented basis • Lead time reduction • High quality

In the study of Japanese-German comparison of TC, Horvath and Tani (1997) found that the cost reduction is the most important goal followed by market orientated product development and lead time reduction without sacrificing the higher quality of product. Besides to the important of cross-functional teams participation in TC practice in all countries reviewed, management accountants or controllers have an important role than others in German automotive companies. In conclusion, through review of the literature, it can be said that the variables used in establishing the TC implementation are mainly involving the deriving elements of TC principles; price-led, customer-focused, design-centered and cross-functional.

3. Research Methodology

3.1 Sample

Malaysian automotive industry was selected to execute the current study. Among 380 Malaysian automotive companies, 48 automotive companies were involved in the questionnaire survey based on Malaysian Automotive

Institute (MAI). Selecting 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 was designed to collect numerical data related to the identified six constructs representing the six common stages of TC implementation. Using a hand distribution, several visits to the sampled companies, and much more discussion of the study objectives and questionnaire sections during many meetings with focus groups of relevant managers were carried out. Along with the questionnaire distributed, the key informant that the CEO/GM/COO/MD, senior managers and relevant executives are the unit of analysis was informed. Through which, 515 questionnaires was distributed to 26 focus groups. After seven months interval, a total of 201 questionnaires were collected, 11 of them were from Motorcycle makers, 72 from Car makers, and the remaining 118 from Parts and Components makers. Since Motorcycle companies have not been addressed in the literature reviewed in this study, 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 of this, the number of responses was decreased to 176 reaching the net response rate of 34%.

3.3 Data Analysis

Rasch Measurement Model (RMM) was used in this study to measure thorough TC implementation stages the uni-dimensionality of Malaysian automotive companies' capabilities when deciding to implement TC approach. In TC previous studies, no finding has offered insights about the construct reliability and quality control of TC implementation by using the RMM. Hence, this study contributes to TC research by providing basic information about the construct validity assessment of the items developed in relation to TC implementation stages. According to RMM assumption, the Likert questions developed to measure respondents' ability are commonly known as a "uni-dimensionality" which is a fundamental assumption of the RMM. Hence, the 36 items developed in relation to TC implementation stages have made-up the questionnaire in order to measure the Malaysian automotive companies' capabilities. Since, in the context of this study, all the 36 questions used the Likert scales from 0 "not sure" to 5 "very high" with the same context, the most popular variants RMM known as Rasch Rating Scale Model (RRSM; Andrich, 1978) was used to analyze the data.

The Rasch analysis was conducted using WINSTEPS software (Linacre, 2005) which starts with major estimates for item and person. In such method, fit statistics are reported as mean-square (MNSQ) residuals, which have approximate Chi-square distributions and *t* standardized (Linacre, 2005, p. 12). To establish the reliability and quality control in addressing the study objective, the basic psychometric properties of the constructed measures of TC implementation stages were discussed below. The focus will be limited on the implications of two crucial issues: (1) Item Fit Statistics and (2) Differential Item Functioning (DIF) for TC implementation stages.

4. Results and Discussion

4.1 Fit Statistics

In measuring the Malaysian automotive companies' capabilities towards the adapted six TC implementation stages, fit statistics of 36 items were examined using RMM. The RMM suggests using Chi-square fit statistics to determine a good fit of empirical data with the model (Bond & Fox, 2007). The RMM analysis programs usually report fit statistics as two Chi-square ratios which are: *Infit* and *Outfit* mean square statistics (Wright, 1994; Wright & Masters, 1982; Bond & Fox, 2007). Table 2 shows the item fit statistics measure order. The *outfit* MNSQ of items was between 1.48 and 0.70 logit, while the *Infit* MNSQ was between 1.39 and 0.72 logit. This supports the uni-dimensionality where the results of Rasch Principle Component Analysis in Figure 2 revealed that the variance explained by measures (30.4%) was closely match the expected (30.8%), and the unexpected variance explained in the first contrast was only 7.6% less than 10.9%. Therefore, the data fit the model whereby the estimation of the Rasch measures was successful. As shown in Figure 2 also, the higher *outfit* MNSQ of 1.48 and 1.40 logits were identified for item 20 "*S4c_TC allocation based on department basis*" and item 17 "*S3e_using TC popular formula*". These results supported that the TC allocation based on departments in stage (4) and using TC formula in stage (3) were problematic items, highly unpredictable. As only one item was seen to be outfit item, this shows little discrepancies or variation from RMM according to Linacre (2010). Since the *Infit* MNSQ of both items is below 1.4 logit and each gets a positive point-measure correlation (PTMEA CORR.) above 0.3 logit, these two items were retained.

To determine the structural definition of what TC implementation stages items are measuring, item polarity, item fit and uni-dimensionality are specific indicators of concern. The results revealed that the item and person reliability were high, 0.93 and 0.90 logits respectively. Since the internal consistency index for the 36 items was

0.99 logit, the Cronbach-α for 176 respondents was 0.93 logit with standard error 0.07 logit for each. These results provide evidence that a similar ordering of person placement is reasonable if a similar analysis is conducted on this sample using another set of items that measures similar phenomenon. After diagnosing the data, the 176 respondents and 36 items were transformed to order respondents into the continuum of capabilities measures of TC implementation stages and item endorsements respectively. The step calibration of the 36 items demonstrated a good fit to the model; the difficulty of items is distributed from 0.88 to -0.89 logits with average error of 0.11 logit.

As expected, it can be noticed that the item 30 “S5h_suppliers participation in providing alternative design of product” (Mean = 0.88 logit) and item 9 “S2d_determin price based on suppliers participation in providing early estimation of selling price” (Mean = 0.68 logit) were the most difficult to be endorsed. On the other hand, the item 2 “S1b_identify customers’ expectations before design stage” (Mean = -0.89 logit) and item 33 “S6b_Kaizen Costing for continuous improvement in the production process” (Mean = -0.69 logit) were the least difficult items.

Table 2. Item statistics measure order of TC implementation stages

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Item
30	450	174	.88	.10	.97	-.3	1.00	.0	.43	.54	51.1	46.5	S5h_SpplRedsgn
9	475	176	.68	.10	.88	-1.2	.93	-.7	.46	.53	53.4	47.2	S2d_SuppPrt
27	476	175	.65	.10	.96	-.4	1.01	.2	.43	.53	46.3	47.4	S5e_ChngPrdtSpc
4	476	174	.62	.10	.80	-2.1	.80	-2.2	.57	.53	48.9	47.6	S1d_Supp_Part
19	506	176	.36	.10	1.11	1.1	1.06	.6	.55	.52	48.3	50.3	S4b_FuncBsis_Alloc
29	481	166	.36	.11	1.04	.4	1.07	.7	.48	.51	51.8	50.6	S5g_TrdOff_PrdctFtur
26	508	175	.32	.10	.80	-2.2	.84	-1.7	.61	.51	52.6	50.6	S5d_VE
35	515	175	.24	.10	.82	-1.8	.80	-2.0	.57	.51	57.1	51.2	S6d_SppPart_FncImpv
22	498	169	.24	.11	1.10	.9	1.14	1.3	.50	.52	52.1	51.2	S4e_QFDInfo_Allco
12	513	174	.23	.10	1.03	.3	1.02	.2	.48	.51	52.3	51.2	S2g_TechInnoChnge
11	516	175	.23	.10	1.20	1.9	1.22	2.1	.35	.51	50.9	51.3	S2f_MrktChnge
17	508	171	.20	.11	1.22	2.0	1.40	3.4	.33	.51	46.2	51.6	S3e_TCFrmul
28	521	175	.17	.10	1.22	2.1	1.27	2.5	.43	.50	54.3	51.7	S5f_ChngMtrls
36	510	171	.17	.11	.94	-.5	.91	-.8	.55	.51	46.2	51.7	S6e_SppPart_LngStrgy
6	526	176	.15	.10	.86	-1.4	.86	-1.3	.52	.50	58.0	51.7	S2a_PrdctFturTme
25	528	176	.12	.11	.74	-2.8	.72	-2.9	.63	.50	62.5	51.8	S5c_CstRestmt
34	523	174	.12	.11	.82	-1.8	.79	-2.2	.56	.50	55.2	51.9	S6c_SppPart_QuImpv
20	526	175	.11	.11	1.39	3.5	1.48	4.1	.26	.50	42.3	51.8	S4c_DprtBsis_Alloc
21	529	175	.08	.11	1.07	.7	1.13	1.2	.48	.50	57.7	51.9	S4d_CustPref_Alloc
5	534	175	.03	.11	.81	-1.9	.83	-1.7	.56	.50	54.3	52.3	S1e_RvewChng
16	537	174	-.04	.11	.88	-1.2	.82	-1.7	.61	.49	54.0	52.8	S3d_SprDter_PrftDter
7	547	176	-.09	.11	1.13	1.2	1.13	1.2	.53	.49	53.4	52.9	S2b_FturB4Dsgn
32	548	176	-.10	.11	.81	-1.9	.78	-2.1	.60	.49	60.2	53.0	S6a_TrkSystm
8	547	175	-.13	.11	1.27	2.5	1.29	2.5	.38	.49	44.6	53.1	S2c_CustNego
23	529	168	-.14	.11	1.09	.9	1.28	2.4	.41	.49	48.8	53.3	S5a_InfoSystm
31	552	176	-.15	.11	1.05	.5	.99	-.1	.52	.48	56.3	53.1	S5i_NwTech_Redsgn
18	557	175	-.25	.11	1.27	2.4	1.18	1.6	.42	.48	50.9	53.4	S4a_PrtsBsis_Alloc
3	561	175	-.30	.11	1.05	.5	.99	.0	.51	.47	58.3	53.5	S1c_RD_TeckCharct
24	557	173	-.31	.11	.72	-2.8	.70	-2.9	.58	.47	64.2	53.6	S5b_CstTble
13	582	176	-.53	.12	.98	-.1	.91	-.8	.53	.45	60.8	54.3	S3a_PrftPln
10	580	175	-.55	.12	1.18	1.6	1.19	1.6	.37	.45	51.4	54.3	S2e_TpMgmt_Apprv
14	578	174	-.55	.12	.83	-1.6	.79	-1.8	.53	.45	56.9	54.3	S3b_UntPrftPln
15	577	173	-.58	.12	1.04	.4	.98	-.1	.47	.45	52.0	54.7	S3c_TpMgmt_PrftApprv
1	592	176	-.67	.12	1.03	.3	1.06	.5	.53	.44	48.3	55.2	S1a_Mrkt_PrdctCharct
33	594	176	-.69	.12	1.00	.1	.91	-.7	.56	.44	62.5	55.6	S6b_KznCst
2	607	176	-.89	.12	1.12	1.1	1.04	.4	.49	.42	58.0	57.4	S1b_Cust_Expec
MEAN	532.3	174.2	.00	.11	1.01	.0	1.01	.0			53.4	52.1	
S.D.	36.8	2.4	.41	.01	.17	1.6	.19	1.8			5.2	2.3	

		-- Empirical --			Modeled
Total raw variance in observations	=	50.3	100.0%		100.0%
Raw variance explained by measures	**=**	**15.3**	**30.4%**		**30.8%**
Raw variance explained by persons	=	6.3	12.5%		12.7%
Raw Variance explained by items	=	9.0	17.9%		18.1%
Raw unexplained variance (total)	=	35.0	69.6%	100.0%	69.2%
Unexplained variance in 1st contrast	=	3.8	7.6%	10.9%	

Figure 2. Standardized residual variance (in eigenvalue units): TC implementation stages

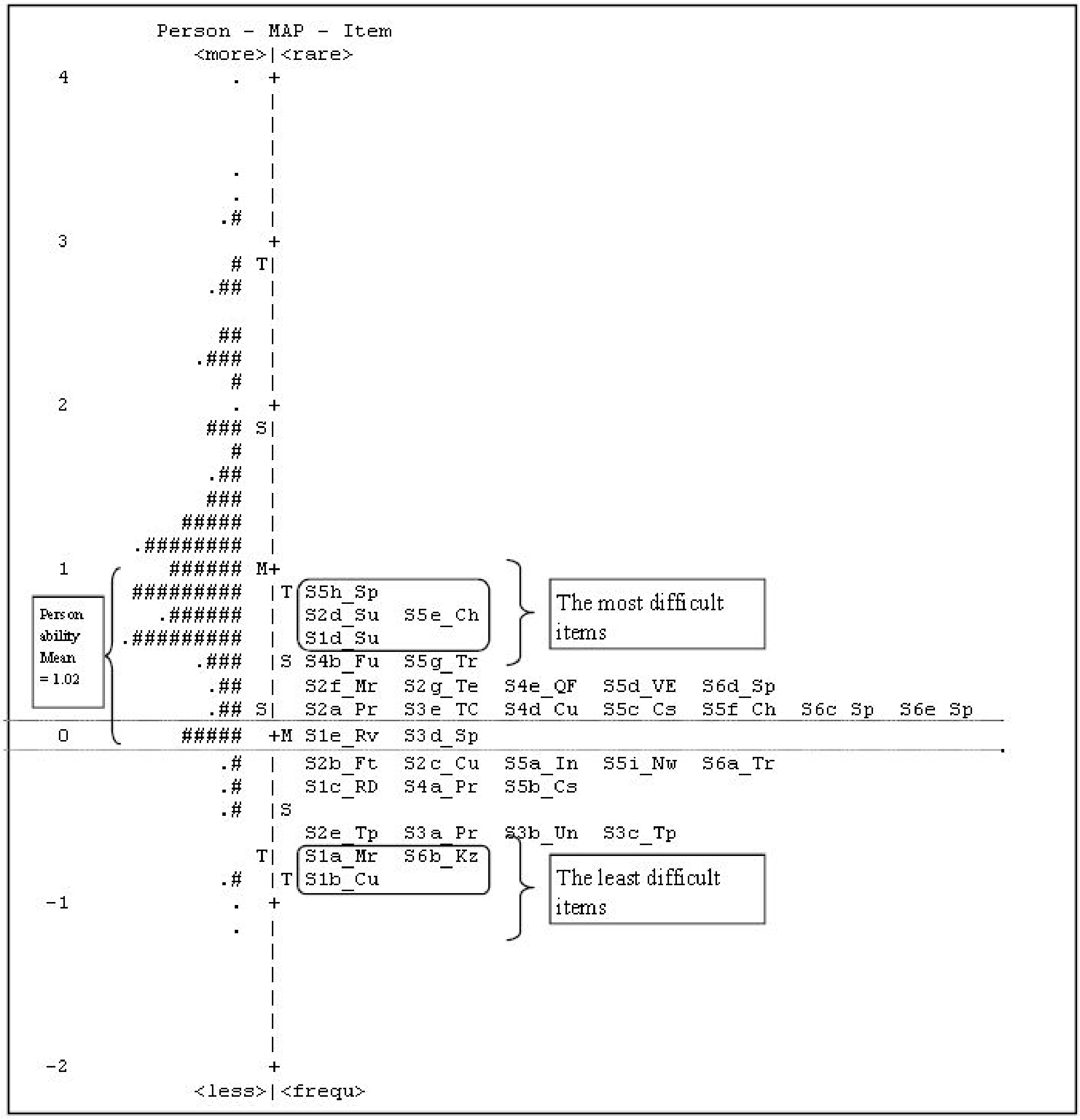
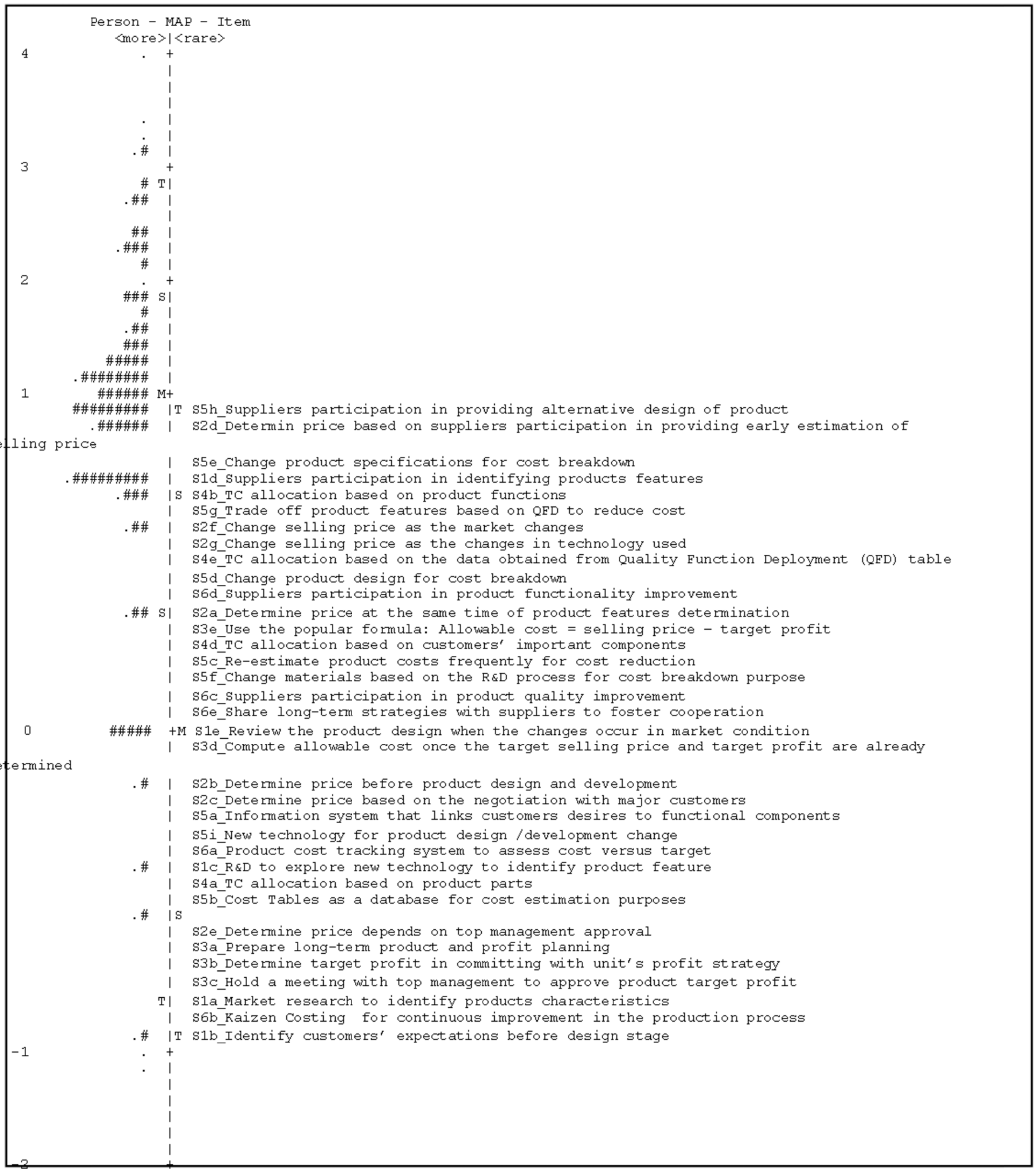


Figure 3. Wright item-ability map: TC implementation

The item-ability map depicted in Figure 3 shows the distribution of respondents (N=176) according to their capability and items (N=36) according to their difficulty. In the map, the TC implementation stages items are on the right side whereas the respondents are on the left side. On top of the map, the most difficult items to endorse and the respondents with the highest capabilities towards TC implementation stages, whereas on the bottom of the map, the easiest items to endorse and the respondents with the lowest capabilities towards TC implementation stages. Through the item map, it can be noticed how the items spread out over the TC implementation stages continuum and how the respondents distribute on the TC implementation stages. It is useful to see what the items that represent the difficulty to implement TC stages. The results indicate an inadequacy in the calibrated items. About half of the respondents were located above all items in the logits continuum. This inadequate of overlap between the distribution of items difficulty and person capability means that the items are too easy to be endorsed. To examine the nature of items under each stage of TC implementation, Figure 4 shows the items map in words of TC implementation stages.



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        #########  |T S5h_Suppliers participation in providing alternative design of product
          .######  |  S2d_Determin price based on suppliers participation in providing early estimation of
elling price
                   |  S5e_Change product specifications for cost breakdown
       .#########  |  S1d_Suppliers participation in identifying products features
             .###  |S S4b_TC allocation based on product functions
                   |  S5g_Trade off product features based on QFD to reduce cost
              .##  |  S2f_Change selling price as the market changes
                   |  S2g_Change selling price as the changes in technology used
                   |  S4e_TC allocation based on the data obtained from Quality Function Deployment (QFD) table
                   |  S5d_Change product design for cost breakdown
                   |  S6d_Suppliers participation in product functionality improvement
              .## S|  S2a_Determine price at the same time of product features determination
                   |  S3e_Use the popular formula: Allowable cost = selling price - target profit
                   |  S4d_TC allocation based on customers' important components
                   |  S5c_Re-estimate product costs frequently for cost reduction
                   |  S5f_Change materials based on the R&D process for cost breakdown purpose
                   |  S6c_Suppliers participation in product quality improvement
                   |  S6e_Share long-term strategies with suppliers to foster cooperation
  0         #####  +M S1e_Review the product design when the changes occur in market condition
                   |  S3d_Compute allowable cost once the target selling price and target profit are already
etermined
               .#  |  S2b_Determine price before product design and development
                   |  S2c_Determine price based on the negotiation with major customers
                   |  S5a_Information system that links customers desires to functional components
                   |  S5i_New technology for product design /development change
                   |  S6a_Product cost tracking system to assess cost versus target
               .#  |  S1c_R&D to explore new technology to identify product feature
                   |  S4a_TC allocation based on product parts
                   |  S5b_Cost Tables as a database for cost estimation purposes
               .#  |S
                   |  S2e_Determine price depends on top management approval
                   |  S3a_Prepare long-term product and profit planning
                   |  S3b_Determine target profit in committing with unit's profit strategy
                   |  S3c_Hold a meeting with top management to approve product target profit
                  T|  S1a_Market research to identify products characteristics
                   |  S6b_Kaizen Costing  for continuous improvement in the production process
               .#  |T S1b_Identify customers' expectations before design stage
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Figure 4. Wright item-ability map with items labels: TC implementation

Figure 5 shows the distribution of the items related to the six stages of TC implementation. All the six stages had different level of difficulty measures. The most difficult item "*suppliers participation in providing alternative design of product*" (mean = 0.88 logit, SD = 0.10 logit) was related to Stage 5 (closing the gap between allowable target cost and estimated costs), while the easiest one "*identify customers' expectations before design stage*" (mean = -0.89 logit, SD = 0.12 logit) was related to Stage 1 (identification of products characteristics). Since this contrasts with Japanese and U.S. highly involvement of suppliers in TC implementation (Cooper & Slagmulder, 1997; Ellram, 2006; Tani, 1994; Toni & Nassimbeni, 2001), it is consistent with recent Romanian experience where they found problems related to the focus on the close cooperation with supply chain partners (Briciu & Căpuşneanu, 2013).

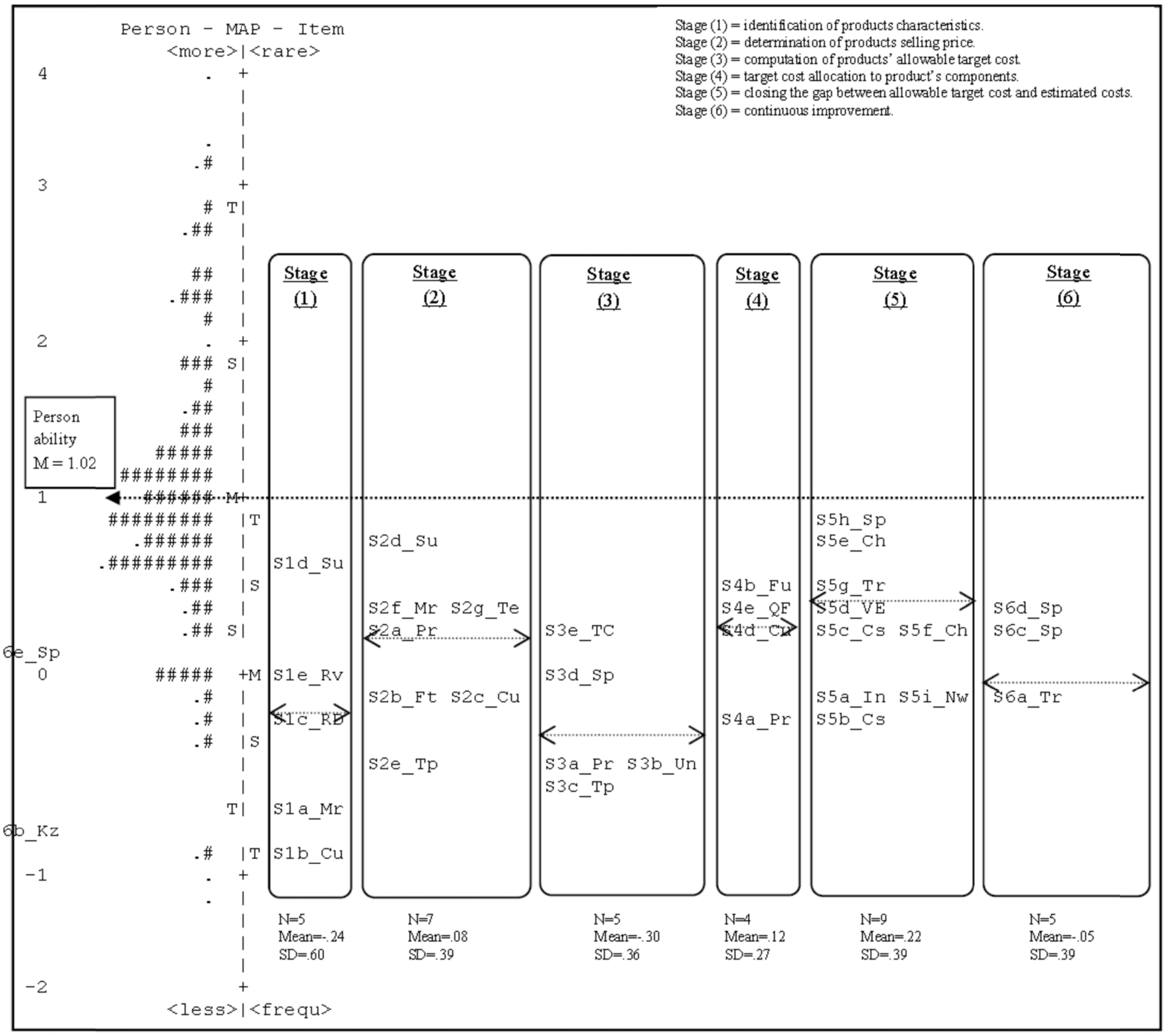

Figure 5. Means of person ability and difficulty level of TC implementation stages

Table 3 shows means, standard deviation, median and mean errors for all the six stages of TC implementation. On average, the respondents as a group have higher ability towards all the six stages except for items related to "closing the gap between allowable target cost and estimated costs" (stage 5). According to Ellram (2006), this stage is a sensitive stage in the TC practice as it represents the crux role of cost management in achieving cost reduction objective. Hence, stage 5 was the most difficult stage (Mean 0.22 logit) while stage 3 was the least difficult stage (Mean = -0.30 logit). However, the items under each stage showed different distributions. Some items were located at the top while others were positioned in the middle or at the bottom of the scale shown in Figure 5. This indicates that respondents were highly able in certain items and slightly unable in other items.

Table 3. Means (in Logits) for the six stages of TC implementation

TC Implementation Stages	Mean	Std. Deviation	Std. error of Mean	*n*
1. Identification of products characteristics	-.24	.60	.27	5
2. Determination of products selling price	.08	.39	.15	7
3. Computation of products' allowable target cost	-.30	.36	.16	5
4. Target cost allocation to product's components	.12	.27	.14	4
5. Closing the gap between allowable target cost and estimated costs	.22	.39	.13	9
6. Continuous improvement	-.05	.39	.17	5

In addition, along with the difficulty to share suppliers to provide earlier estimation of product selling price, TC follow-up activities to reduce product cost by change product specifications in stage 5 is another most difficulty found to be implemented. Interestingly, the easiest item at the down end of the scale "*S1b_identify customers' expectations before design stage*" (Mean = -0.89 logit, see Table 4.15) supports the TC literature indicating that the first stage of TC implementation is identification of products and services characteristics based on the marketplace requirements and customers' expectations before production process to be launched (Ansari & Bell, 1997; Cooper & Slagmulder, 1997; Cooper, 1995; Dekker & Smidt, 2003; Feil et al., 2004; Hamood et al., 2011; Kato, 1993). In addition, review of product characteristics when the market changes occur (stage 1) and Kaizen Costing application (stage 6) are measured in line with the item mean of 0.00 logits. This indicates that all respondents agreed, easily to endorse these items that below item mean.

Based on the industry type of the sampled companies, two groups have been identified: Car makers (Group 1, N=67) and Parts and Components makers (Group 2, N=109). Table 3 shows, on average, Car makers as a group have higher ability than Parts and Components makers. The mean for respondents with Car makers was 1.11 (SD = .92 logit), while the means for Parts and Components makers was .97 logit (SD = .92 logit). This supports the study of Nordin *et al*. (2010) concluded that the highest implementation of recent MAPs was found in large automotive companies as these practices need large investments in equipment and facilities.

Table 4. Means (in Logits) for industry type in TC implementation

Industry	Mean	Std. Deviation	Std. error of Mean	*n*
Car makers	1.11	1.05	.13	67
Parts and Components makers	.97	.81	.07	109

Investigating the items under each group, both groups had different levels of difficulty measures. The most difficult item related to stage (5) "*suppliers participation in providing alternative design of product*" (mean = .90 logit, SD = .10 logit) matched more respondents from group 1 than group 2. In contrast, the easiest item related to Stage (1) "*identify customers' expectations before design stage*" matched more respondent from group 2 than group 1. On average, Group 1 (Mean = 1.11 logit, SD = 1.05 logit) had higher ability than Group 2 (Mean = .97 logit, SD = .81 logit). The majority of Group 1, with exception six respondents only, measured in line item mean of 0.00 logit. This indicates that the majority of Car makers easily for them to endorse the items that below this item mean.

Table 5. Means (in Logits) for company strategy in TC implementation

Strategy	Mean	Std. Deviation	Std. error of Mean	*n*
Cost leadership	1.08	1.26	.33	15
Differentiation	1.02	.90	.14	41
Confrontation	1.01	.86	.08	120

In terms of company strategy followed, three types of strategies were identified: (1) Cost Leadership (N=15), (2) Differentiation (N=41), and (3) Confrontation (N=120). This is to see the most employed strategy among companies when they deciding to implement TC stages. Based on Cooper (1995), confrontation strategy is most suitable for TC implementation. Table 4 shows, on average, respondents as a group achieved higher ability with Confrontation strategy than those with other two strategies. The mean for respondents with Confrontation strategy was 1.01 logit (SD = .86 logit) was lower than both means for respondents with Cost Leadership and Differentiation strategies, 1.08 and 1.02 logits (SD = 1.26 and .90 logits) respectively.

4.2 Differential Item Functioning (DIF)

As mentioned earlier that the industry type of the sampled companies were classified into two groups: Car makers (Group 1, N=67) and Parts and Components makers (Group2, N=109), Differential Item Functioning (DIF) analysis is essential to establish the validity across the two groups. DIF analysis was run through the equation of items estimates for the two groups. Figure 6 shows the DIF analysis results with the line indicating the 95% confidence intervals.

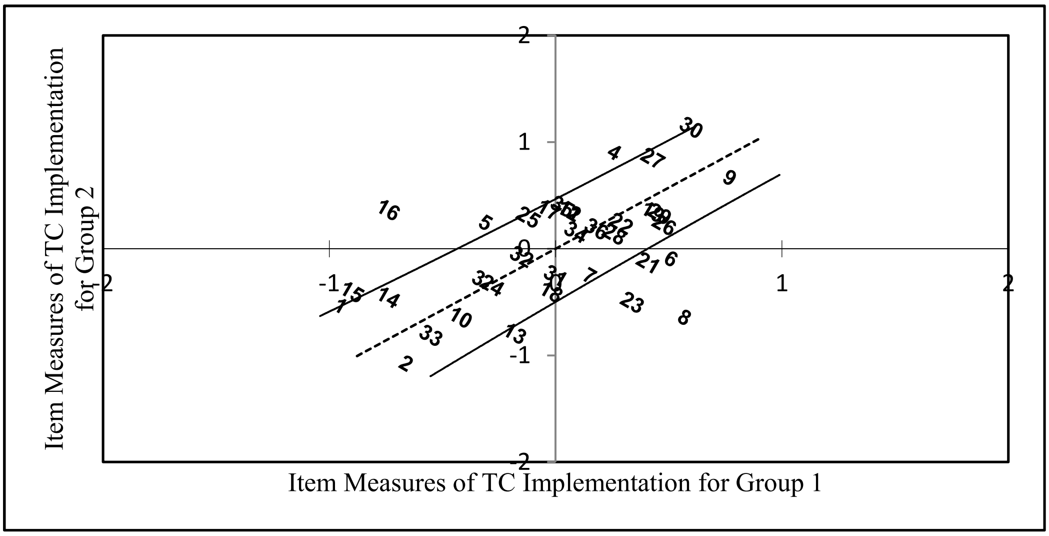

Figure 6. Item estimates of TC implementation for group 1 and group 2

The results in Figure 6 revealed a significant difference between two groups where some of items outside the control line favor group 1 and other group 2. According to Bond & Fox (2007), the differences should be more than 0.5 logit to have a substantive meaning. By looking to the items outside the control line, the items 8, 16 and 23 are worth investigating. When items 8 and 23 were harder to be endorsed for group 1 but easier for group 2, item 16 was harder to be endorses for group 2 but easier for group 1. Table 5 shows the items estimates differences in logits for the two groups.

Table 6. Item estimates differences (in Logits) of TC implementation for the two groups

Groups	Items	DIF Contrast	Joint S. E.	*t*-value	*P*-value	Item Description
Group 1	Item 6	.62	.22	2.84	.0051	Price determination at the feature determination time
	Item 8	1.21	.23	5.36	.0000	Price determination based on the negotiation with major customers
	Item 13	.55	.24	2.32	.0216	Determine target profit in committing with unit's profit strategy
	Item 21	.55	.22	2.50	.0133	TC allocation based on customer preference
	Item 23	.82	.23	3.57	.0005	Information system that links customers desires to functional components
Group 2	Item 4	.57	.21	2.68	.0083	Suppliers participation in identifying products features
	Item 5	.56	.23	2.44	.0157	Review the product design when the changes occur in market condition
	Item 15	.56	.25	2.21	.0287	Hold a meeting with top management to approve product target profit
	Item 16	1.12	.24	4.65	.0000	Compute allowable cost once the target selling price and target profit are already determined

Investigation of the items outside the control lines, Table 6 gives the description of these items based on their logits differences, joint standard error, *t*-statistic and probability. These items are those considered more problematic as DIF logits of each item is more than 0.5 logit based on the guideline of Bond & Fox (2007). In this case, item easier for group 1 was item 16 "*compute allowable costs once the target selling price and target profit are already determined – stage 3*" (DIF=1.12, P<.005). In contrast, items 8 "*price determination based on the negotiation with major customers – stage 2*" (DIF=1.21, P<.005) was easier for group 2. This indicates that the price determination based on the negotiation with major customers is difficult for Car makers to be implemented. In other words, the price in Car makers is considered fixed and only determined based on the market condition without reference to their major customers. However, this totally contrasts with the main conception of TC as the product price is the price that the customers are willing to pay and consists with the competition-oriented pricing method examined by Kocsoy *et al*. (2008). This method as Crow (1999) comments as cited by Ibusuki and Kaminski (2007) is the component of the market-driven price step which suits the TC implementation. On the other hand, compute allowable TC after determination the selling price and target profit is seen to be difficult for Parts and Components makers. That means the product allowable TC is not related with the determination of target price and profit among Parts and Components makers. Therefore, there is a misunderstanding among Parts and Components makers towards the TC formula as they depend totally on the estimated costs but not allowable TC. This is supported with higher *Outfit* MNSQ of such item (refer to Table 6) indicating their misunderstanding on how the TC formula practically is working.

Given these findings summarizing the view of TC implementation items differences with DIF contrast more than 1.00 logit, Figure 7 confirms that the item 8 and item 16 meet this criteria recommended by Bond & Fox (2007). Item 8 as a performance item of "*price determination based on the negotiation with major customers*" appears to be difficult for group 1 and easy for group 2. Meanwhile, item 16 is a performance item of "*compute allowable cost once the target selling price and target profit are already determined*" appears to be easy for group 1 and the only most difficult for group 2.

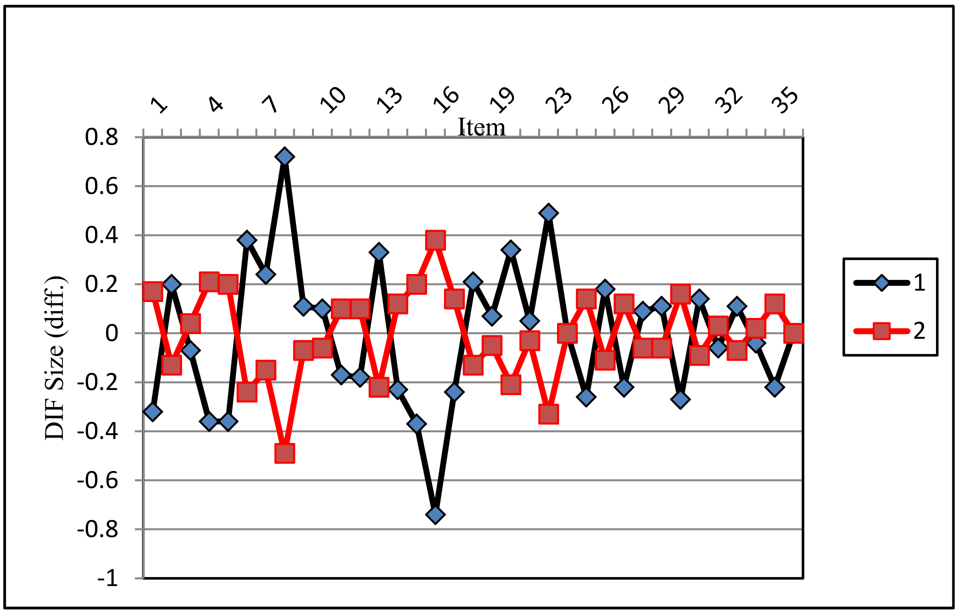

Figure 7. Plot of TC implementation items comparing group 1 and group 2

5. Conclusion

The main objective of this study was to measure Malaysian companies' capabilities towards TC implementation associated with industry type and company strategy effectiveness. For perusing this objective, the Malaysian automotive industry was selected to represent the wide range of Malaysian companies acting in such industry especially those in parts and components manufacturing. The aim was mainly to measure how the TC implementation stages adapted from Elram's (2006) theoretical model is being practiced. These stages include: (1) identification of products characteristics, (2) determination of products selling price, (3) computation of products allowable target cost, (4) target cost allocation to product's components, (5) closing the gap between allowable target cost and estimated costs, and (6) continuous improvement. The questionnaire survey was used to collect validated information about the TC practices. The RMM was used to analyze the Malaysian automotive companies' capabilities towards TC implementation stages.

The results in general revealed acceptable ability towards the six stages of TC implementation except some capabilities required to follow-up TC activities. For example, supplier participation in terms of product re-design (stage 5), price determination (stage 2) and characteristics identification (stage 1) were found most difficult to be implemented. In addition, TC popular formula and TC allocation based on the departments as a cost center were found more problematic items in TC implementation stages. In comparison with US companies adopting TC approach, some clear differences were found. This can be noted particularly in the suppliers' involvement in the design stage where achieving TC objetive depends on the team work in conjunction with suppliers' involvement. By looking at the industry type, Car makers have higher ability than Parts and Components makers towards all TC stages items. The statistical significant difference between both groups was found in determining product selling price. Moreover, the results gave some supports to Confrontational strategy recommended by Cooper (1995) for TC implementation where most of companies were placed above the item mean in the person-item map. This indicates their continuous efforts to maintain product quality and functionality when they reduce product costs.

This study has added a new idea to the knowledge regarding the useful usage of RMM in management accounting research like its popular usage in education research. In addition, the study provides an empirical evidence of TC implementation among Malaysian companies and determines their capabilities towards this technique. Like any other study, there are some limitations that should be addressed in the future research. Firstly, the sample size was limited to the automotive industry. Moreover, the study only is concerned on the TC implementation stages without focusing on the factors that could influence the successful implementation of TC. For these limitations, it is highly encouraged for future research to involve the multiple case studies in order to harvest richness of sufficient experience from different participants. Finally, using Structural Equation Modeling (SEM) is very important to be used to examine the effect of relative factors on the TC implementation.

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