

Value Analysis Dashboard in Supply Chain Management: Real Case Study from Iran

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Abstract—The goal of this paper is proposing a supply chain value dashboard in home appliance manufacturing firms to create more value for all stakeholders via balanced scorecard approach. Balanced scorecard is an effective approach that managers have used to evaluate supply chain performance in many fields but there is a lack of enough attention to all supply chain stakeholders, improving value creation and, defining correlation between value indicators and performance measuring quantitatively. In this research the key stakeholders in home appliance supply chain, value indicators with respect to create more value for stakeholders and the most important metrics to evaluate supply chain value performance based on balanced scorecard approach have been selected via literature review. The most important indicators based on expert's judgment acquired by in survey focused on creating more value for. Structural equation modelling has been used to disclose relations between value indicators and balanced scorecard metrics. The important result of this research is identifying effective value dashboard to create more value for all stakeholders in supply chain via balanced scorecard approach and based on an empirical study covering ten home appliance manufacturing firms in Iran. Home appliance manufacturing firms can increase their stakeholder's satisfaction by using this value dashboard.

Keywords—Supply chain management, balanced scorecard, value, Structural modeling, Stakeholders

I. INTRODUCTION

TO survive in competitive market, it's critical to evaluate of how much value is actually being created by supply chain [1]. A few researchers have considered quantitative and financial aspect of value and there is no clear base to compare current value. In competitive market customers remain as royal customer with companies that can create more benefit against paid cost for product named value therefore quantitative aspect of value helps managers to evaluate how much value generate for their customers and develop their market share. It is the most important motivation for managers to consider quantitative aspect of value. The effective collaboration of partners and coordination of all activities within the supply chain are prerequisites in competitive and dynamic market conditions [2]. Presented models are qualitative [3]. This study is to disclose the most important value indicators with respect to key stakeholders via supply chain and balanced scorecard metrics (BSC) [4] focused on value creation and develop an integrated approach to analyze

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and present an effective dashboard to evaluate value in the home appliance chain.

II. RESEARCH METHODOLOGY

The major stakeholders of an organization are shareholders, customers, employees, suppliers, community residents, governments, and the economy [5], [6]. There are five main stakeholders included customers, shareholders, employees, suppliers and society in home appliance supply chain as value perspectives [7]. Stakeholders' value indicators in home appliance companies had been identified by in depth interviews in past research [8]. BSC is an effective approach and has been used in many fields such as healthcare, banking, Social security and etc. [9]-[11]. The BSC metrics effective on creating value for stakeholders had been identified in a survey research by [12]. To identify supply chain value dashboard, value indicators and BSC metrics have been used in this research.

A. Supply Chain Value measurement Dashboard

This research has conducted in ten Iranian home appliance manufacturing implemented BSC approach to evaluate their supply chain performance and also possesses the typical features of creating value for their stakeholders. At first a questionnaire included value indicators and the related BSC metrics to each value indicator has been developed by in depth interviews with 10 managers and experts. The final questionnaire was ready in this step. Each item in questionnaire was based on a five-point Likert-scale. The questionnaire was long because they have been selected for five groups of stakeholders and metrics should applied in whole of company. This initial survey draft was to ensure that the wording, format and sequencing of questions were appropriate too. Then a survey has been applied to confirm selected indicators and to examine the relationships among value indicators and BSC metrics. The sample sizes included 231 managers mainly experts or core members in the management team or chief managers who have good understanding of the company's performance. Afterwards, the questionnaire was distributed simultaneously through email surveys to the sample. The respondents were asked to complete the questionnaire in consultation with the rest of the management, since the questions asked cover a wide spectrum of disciplines regarding every area of the company. Given that the questionnaire was long to manage a timely and complete response, the respondents were promised a summary of research findings and the promise was indeed fulfilled at the end of the study. Each mail package contained a questionnaire

and a cover letter addressed. After two rounds of mailings, follow-ups and periodic notifications, from 231 questioners a total of 211 usable and complete questionnaires were returned by the firms with a response rate of 91.3 %. Then factor analysis method and structural equation modeling (SEM) have been applied to identify the correlation between value indicators and BSC metrics by Lisrel software. The BSC metrics and related to value indicators used in questionnaire as proposed dashboard and steps of approach have been presented below.

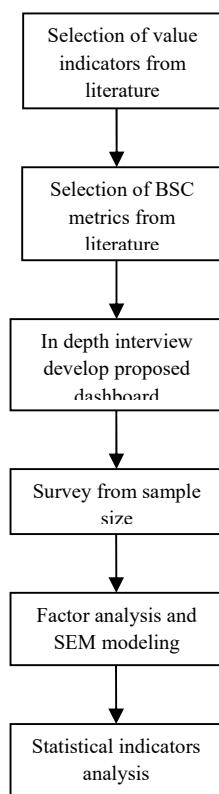


Fig. 1 Steps of research approach

1. Customers

- **Quality:** Performance of internal processes, Unfitted product percentage, Non defect deliveries of shareholder's level, Ability of shareholder's to responding the quality problem, Shareholder's and customer's partnership's level, Shareholder's partnership for responding technical issues, Information publication
- **Brand Fame and Credit:** Brand's Credibility, Customer received value from products, Stock prices, Investment in social programming, Production performance for environment, Quality levels of After sales service
- **Price:** Price, Logistics prices, Safety prices, Human resource price, Purchasing prices, Shareholder's thrift in Initiatives costs, Operation cost per hours, Total inventory cost including initial products level, Total inventory cost including work in process, Total inventory cost including salvage value, Total inventory cost including finished products in transit, Reducing cost projects, Information

transportation costs, Loss of energies, Cost of returned products

- **Previous Usage History:** Received level of customer from products, Quality of delivered products, Flexibility of service system for presenting specific needs of customers, Quality level of after sales services, Diversity of products & services, Prices, Level of product's Credibility
- **Others' Recommendations:** Received value of customer's from products, Diversity of products and services, Flexibility of service system for presenting specific needs, Customer's saving, Time responding to Complaints, Quality level of after sales services, Prices, Level of product's Credibility
- **Nationally-Manufactured Product:** Received value of customer's from products, Absorption rate & Resignation of customers, Stock prices, Final net income, Quality level of after sales services, Prices, Level of product's Credibility, Shareholder's and customer's partnership's level
- **Optimized Energy Consumption:** Received value of customer's from products, loss of energy
- **Product Design and Beauty:** Received value of customer's from products, Innovation ability, Usage of new technologies, Information publication
- **Advertisements:** Received value of customer's from products, Increasing in revenue, Liquidity's period for cash flow, The final net profit, Sales level, Investment in social programming
- **After-sales Services:** Received value of customer's from products, Quality level of after sales services, Flexibility of service system for presenting specific needs of customers
- **Product Availability:** Received value of customer's from products, Number of distribution channels, Effectiveness of distribution scheduling, Achieving to non-defects deliveries, Diversity of products, Sales level, Market sharing, Responding emergency deliveries, Development capacity, Time programmed for producing new products, Total supply chain cycle's time, Deliveries sequence, Non-defect shareholder deliveries level, Time cycle of new order, Time cycle of programmed processes, Effectiveness of the original production table, Capacity yield
- **Products Colour Sameness:** Received value of customer's from products, Diversity of products & services, Information publication, Accuracy of predicted techniques, Development capacity, Capacity yield's
- **Product Colour -Choice:** Received value of customer's from products, Diversity of products & services, Information publication, Accuracy of predicted techniques, Development capacity

2. Employees

- **Good Salary:** Liquidity's period for cash flow, Increasing in revenue, Received value of customer's from products, Customer saving's, Market sharing

- **Proper Environment for Creativity and Innovation:** Innovation abilities, Learning abilities, Personnel educational programming, Final net income, Human resource costs, Group Collaboration, Motivational programming
- **Timely Salary Payments:** Increasing in revenues, Final net income, Sales level, Received value of customer's from products, Customer's saving, Market sharing
- **Rewards:** Liquidity's period for cash flow, Increasing in revenues, Final net income, Sales level, Decreasing cost
- **Training/Instructions:** Ability of learning, Personnel educational programming, Final net income, Absorption rate & resignation of human resources, Motivational programming
- **Access to Correct and Proper Information:** Information publication, Information transaction cost, Running ERP system, Joint programming system with shareholders
- **Timely Information Accessibility:** Information publication, Information transportation cost, Running ERP system, Joint programming system with shareholders
- **Team Work Opportunity:** Information publication, Information transportation cost, Running ERP system, Joint programming system with shareholders
- **Respect:** Team working

3. Shareholders

- **Higher Stock Benefit:** Personnel educational programming, Received value of customer's from products
- **Capital Growth:** Final net income, Increasing of revenues, Liquidity's period for cash flow, Stock price, Rate of return, Received value of customer's from products
- **Increase in Advantages:** Final net income, Liquidity's period for cash flow, Stock price, Rate of return, Received value of customer's from products
- **Being Shared in Incomes:** Final net income, Liquidity's period for cash flow, Stock price, Rate of return, Received value of customer's from products
- **Risk Minimization:** Increasing in revenues, Stock price, Rate of return, Received value of customer's from products, Customer's saving, Market sharing
- **Being informed properly and Accurately:** Final net income, Liquidity's period for cash flow, Stock price, Rate of return, Received value of customer's from products
- **Brand Fame:** Brand's Credibility, Customer received value from products, Stock prices, Investment in social programming, Production performance for environment, Quality of After sales service
- **Respect:** Personnel educational programming, Received value of customer's from products
- **Timely Benefit Payments:** Increasing in revenues, Final net income, Sales level, Received value of customer's from products, Customer's saving, Market sharing

4. Suppliers

- **Fair Pricing:** Final net income, Joint programming system with shareholders
- **Risk Sharing:** Increasing in revenues, Stock prices, Received value of customer's from products, Rate of return, Customer's saving, Market sharing
- **Being Paid in Cash:** Increasing in revenues, Rate of return, Final net income, Level of sales, Received value of customer's from products
- **Timely Payments:** Liquidity's period for cash flow, Increasing in revenues, Rate of return, Final net income, Level of sales, Received value of customer's from products
- **Proper Technology and Information Sharing:** Information publication, Information transportation costs, Shareholder's and customer's partnership's level, Joint programming system with shareholders, Running ERP
- **Benefits Sharing:** Final Net income, Increasing in Revenues, Liquidity's period for cash flow, Shareholder's and customer's partnership's level, Joint programming system with shareholders
- **Being Assisted in Troubleshooting and Improving:** Shareholder's partnership for responding technical issues, Shareholder's and customer's partnership's level, Joint programming system with shareholders, Ability of shareholder's to responding the quality problem
- **Timely Demands/Requests:** Shareholder's and customer's partnership's level, Accuracy of predicted techniques, Running ERP system, Joint programming system with shareholders, Time cycle of new order, Performance of new order's cycle, Submission of supplier's guidelines, Time of total supply chain cycle, Time of Customer's request, Time cycle of planned process, Method's Order, Information publication
- **Long-term Relations:** Supplier saving cost in initiatives, Shareholder's partnership for responding technical issues, Non-defect shareholder deliveries level, Ability of shareholder's to responding the quality problem, Supplier's rate ROR, Time to drop industry standards, Quality of delivered products, Shareholder's and customer's partnership's level, Final net income
- **Organization Permanence:** Brand's Credibility, Final net income, Sales level, Customer saving's, Market sharing, Stock prices, Received value of customer's from products, Flexibility of service system for presenting specific needs of customers, Investment in social programming
- **Experts/Specialists Availability:** Shareholder's partnership for responding technical issues, Ability of shareholder's to responding the quality problem, Personnel educational programming, Motivational programming
- **Brand History and Credit:** Brand's Credibility, Stock prices, Investment in social programming

5. Community

- **Pollution and Losses Minimization:** Environmental performance, Reduce wastes, Loss of energy resources, Usage of resources & materials, Recycling products, Investment social programming
- **Timely Tax Payment:** Final net income, Liquidity's period for cash flow
- **Energy Usage Optimization:** Loss of energy resources, Productivity in time
- **Waste Minimization:** Reduce wastes, Productivity in time, Usage of resources, Recycling product
- **Recycling:** Recycling products
- **Employment Growth:** Final net income, Stock prices, Human resource cost's, Absorption rate & Resignation of customers
- **Commitment to Laws, Acts, and Standards:** Time to drop for industry standards
- **People's Attitude Augmentation:** Investment in social programming, Final net income, Increasing in revenues, Liquidity's period for cash flow, Level of sales, Stock prices
- **Social Activities:** Investment in social programming, Final net income, Increasing in revenues, Liquidity's period for cash flow, Level of sales, Stock prices, Rate of returns
- **Help to Charities, Societies, Associations, etc:** Final net income, Increasing in revenues, Liquidity's period for cash flow, Sales level, Stock prices, Rate of returns
- This study has been applied factor analysis and structural equation modeling to explore relationships between value perspectives and BSC metrics [13].

B. Descriptive Test and Respondents Attributes

This section mentions the statistical discussion and standard indicators. For Cronbach values were greater than 0.70, so the scale was accepted as reliable [14]. The suitability of each inter-correlation matrix for factor analysis was determined by Kaiser-Meyer-Olkin statistics (KMO). The value of this statistic is higher than 0.7 so the existing correlation is appropriate for factor analysis [15]. The conformity factor analyzing was done for each value and BSC metrics. The metrics that had greater than 1.96 t-value remained and the others eliminated. This statistic showed the construct validity of value and BSC metrics. In order to reveal the best fit structure of complex relations among variables for each value perspective and proposed BSC metrics, carry out SEM approach, since SEM procedure obtains path estimates while performing an iterative scheme of multiple regressions until a solution converges on a set of weights used for estimating the latent variables scores. The value of χ^2 / df ratio of 1.86 for each value metrics was acceptable. This ratio shows the appropriateness of the model within the range of 0–5 [16]. The goodness-of-fit indices include the comparative fit index (CFI)[17], the incremental fit index (IFI)and the normed fit index (NFI)[18] indicate a very good fit close to1. The value of root mean square error of approximation (RMSEA) were reasonable error of approximation about 0.08 or less[19].At

the end a single- step SEM analysis was performed for all value perspectives and acceptable BSC metrics together by Lisrel and analyzed according to goodness-of-fit indices. The measurement model of SEM was performed using maximum likelihood estimation and it is based on the comparison of variance–covariance matrix obtained from the sample to the one obtained from the model. The goodness-of-fit indices for value dashboard conform to the acceptable standard with the value of χ^2 / df ratio of 1.86 demonstrate in Table I.

TABLE I
 FITNESS INDEX OF STRUCTURAL MODEL

Index	Acceptance level	Reported Value
RMR	Near zero	0.14
SRMR	Near zero	0.21
GFI	0.85 and greater	0.88
NFI	0.9 and greater	0.92
NNFI	0.9 and greater	0.91
IFI	0.9 and greater	0.92
CFI	0.9 and greater	0.92
RMSEA	0.08	0.074

C. Proposed Value Dashboard Validation

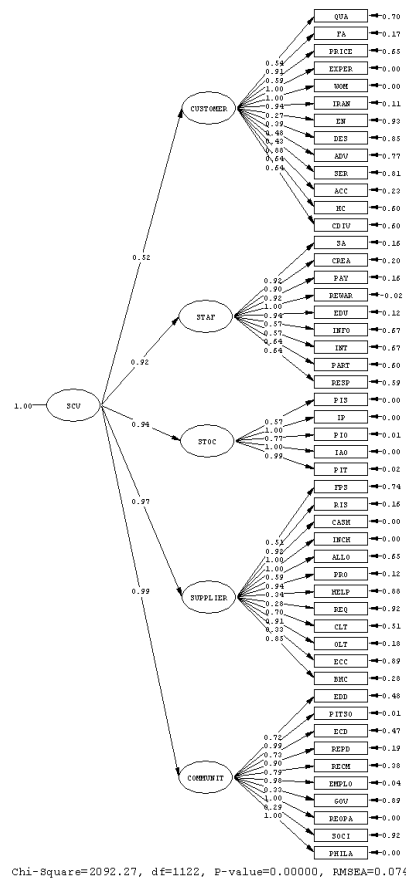


Fig. 2 Value dashboard Lisrel output

Table II shows the effectiveness of value perspectives in supply chain and effectiveness of BSC metrics on creating value for stakeholders as a real case study in home appliance industries. Managers can create more value by improving more effective metrics in balanced scorecard. They can

monitor creating value quantitatively and identify the most effectiveness metrics.

TABLE II
FINAL VALUE ANALYSIS DASHBOARD

Value perspective	Value indicators	BSC metrics
Customers (0.52)	Quality	0.54
	Brand Fame and Credit	0.91
	Price	0.59
	Previous Usage History	1
	Others' Recommendations	1
	Nationally-Manufactured Product	0.94
	Optimized Energy Consumption	0.27
	Product Design and Beauty	0.39
	Advertisements	0.48
	After-sales Services	0.43
	Product Availability	0.88
	Products Color Sameness	0.64
	Product Color –Choice	0.64
	Good Salary	0.92
Employee (0.92)	Proper Environment for Creativity and Innovation	0.9
	Timely Salary Payments	0.92
	Rewards	1
	Training/Instructions	0.94
	Access to Correct and Proper Information	0.57
	Timely Information Accessibility	0.71
	Team Work Opportunity	0.64
	Respect	0.64
	Higher Stock Benefit	0.57
	Capital Growth	1
Shareholder (0.97)	Increase in Advantages	0.77
	Being Shared in Incomes	1
	Risk Minimization	0.92
	Being Informed Properly and Accurately	0.59
	Brand Fame	0.85
	Respect	1
	Timely Benefit Payments	0.99
	Fair Pricing	0.51
	Risk Sharing	0.92
	Being Paid in Cash	1
Timely Payments	1	
Supplier (0.97)	Proper Technology and Information Sharing	0.59
	Benefits Sharing	0.94
	Being Assisted in Troubleshooting and Improving	0.34
	Timely Demands/Requests	0.28
	Long-term Relations	0.7
	Organization Permanence	0.91
	Experts/Specialists Availability	0.33
	Brand History and Credit	0.85
	Pollution and Losses Minimization	0.72
	Timely Tax Payment	0.99
Community (0.99)	Energy Usage Optimization	0.73
	Waste Minimization	0.9
	Recycling	0.79
	Employment Growth	0.98
	Commitment to Laws, Acts, and Standards	0.33
	People's Attitude Augmentation	1
	Social Activities	0.29
	Help to Charities, Societies, etc.	0.85

III. CONCLUSIONS

There are many metrics, suggested in past literatures, to evaluate supply chain performance. The most of them mentioned about some stakeholders not all of them and there are not comprehensive assessments focused on creating value for all stakeholders. The contribution of this study is a holistic view of evaluating supply chain to creating value and comprehensive assessment for all stakeholders quantitatively. This study shows the effect of each metric on creating value for each stakeholder. In this research, proposed metrics based on BSC approach and relationship between these metrics with stakeholders' value indicators in supply chain addressed. Regard to previous studies, stakeholders is value scope in supply chain and effect on total value creation. In this paper, firstly, supply chain evaluation in value field considered. According the literature review there are five groups of stakeholders in supply chain. Value indicators of each group and balanced scorecard metrics with respect to value creation were identified from literature too. A survey was conducted by home appliance experts and structural equation modeling had been used to identify the relationship between BSC metrics and value indicators. The results showed the effectiveness of proposed indicators based on BSC approach selected by experts group and relationship between these indicators with value indicators addressed. So the value creating dashboard in supply chain proposed to home appliances firm to increase stakeholders' satisfaction. Developing a dynamic model based on knowledge management and performance metrics can be generated as further research. Knowledge management exerts a mediator role between supply chain performance and stakeholder's satisfaction via value creation by ongoing assessment.

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REFERENCES

- [1] J.H. Heinrichs, J. Lim, "Integrating web-based data mining tools with business models for knowledge management," *Decision Support Systems*, vol. 35, no.1, pp. 103-12, 2003.
- [2] M. Bahri, M.J. Tarokh, "A seller-buyer supply chain model with exponential distribution lead time," *Journal of Industrial Engineering International*, vol.8, no, 13, pp. 1-7, 2012.
- [3] A. Gunasekaran, C. Patel, and E. Tirtiroglu, "Performance measures and Metrics in a supply chain environment," *International Journal of Production and Operations Management*, vol. 21, no.1/2, pp. 71–87, 2001.
- [4] R. Kaplan, D. Norton, "The balanced scorecard: measures that drive performance," *Harv Bus Rev*, vol. 70, no.1, pp. 71–99, 1992.
- [5] C. Salter, "A prescription for innovation," *Fast Company*, vol.104, no.1, pp. 83–86, 2006.
- [6] A. Kothari, J. Lackner, "A value based approach to management," *Journal of Business & Industrial Marketing*, vol. 21, no. 4, pp. 243–249, 2008.
- [7] S.M. Seyedhosseini, S.F. Golrizgashti, "Vital value drives in supply chain, (Published Conference Proceedings style)" in *Proc. 25th Annu.*

- IABD Conf. International Academy of Business Disciplines, Atlanta, 2013, pp.11-13.
- [8] S.F. Golrizgashti, "Effect of knowledge management on supply chain value, Empirical evidence from Iran," International journal of business performance and supply chain modeling (Accepted for publication), 2015.
- [9] K. Yiannis, "Balanced scorecard: application in the General Panarcadian Hospital of Tripolis, Greece," International Journal of Health Care Quality Assurance, vol. 26, no.4, pp. 286-307, 2013.
- [10] M. Ibrahim, "Investigating the use of four perspective of balanced scorecard as technique for assessing Nigerian banks, performance by," Journal of accounting and taxation, vol.7, no.4, pp. 62-70, 2015.
- [11] M. Hakkak, M. Ghodsi, "Development of a sustainable competitive advantage model based on balanced scorecard," International Journal of Asian Social Science, vol. 5, no.5, pp. 298-308, 2015.
- [12] S.F. Golrizgashti, "Supply chain value creation methodology under BSC approach," Journal of Industrial Engineering International, DOI 10.1007/s40092-014-0067-5, vol. 10, no.67, pp. 1-15, 2014.
- [13] P.M. Bentler, D.G. Bonett, "Significance tests and goodness of fit in the analysis of covariance structures," Psychological Bulletin, vol.88, no.3, pp. 588-606, 1980.
- [14] DL. Streiner, "Starting at the beginning: an introduction to coefficient alpha and internal consistency," Journal of Personality Assessment, vol. 80, no.1, pp. 99-103, 2003.
- [15] D. De Vaus, Surveys in Social Research. (5th edition). London: Routledge. (The earlier editions, published by George Allen & Unwin and by UCL Press are still relevant), 2001.
- [16] B. Wheaton, B. Muthe'n, D.F. Alwin, and G.F. Summers, "Assessing reliability and stability in panel models, Sociological Methodology, vol.8, no.1, pp. 84-136, 1977.
- [17] P.M. Bentler, "Comparative fit indexes structural models," Psychometrika, vol.107, no.1, pp. 238-246, 1990.
- [18] P.M. Bentler, D.G. Bonett, "Significance tests and goodness of fit in the analysis of covariance structures," Psychological Bulletin, vol. 88, no.1, pp. 588-606, 1980.
- [19] M.W. Browne, R. Cudeck, "Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.)," Testing Structural Equation Models. Newbury Park, CA: Sage, 1993.