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Supply Chain Performance Measurement using Balanced Scorecard in some of Libyan Companies

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Abstract:despite the fact that supply chain measurement is considered as a vital topic for organizations in order to achieve suitable and reasonable place in the competitive market, the primary objective of this paper was measuring and evaluating the supply chain performance in some of Libyan industrial organizations using balanced scorecard approach through studying literature review and researches in order to collect a number of supply chain (SC) key performance indicators (KPIs) in the theoretical part. On the other side relating the practical part, the researcher has conducted a scientific visits and face to face interviews with employees and managers in the Libyan industrial organizations in order to build a strong basic for developing a questionnaire to the organization's employee in order to rank the most important of them. A questionnaire was been developed and distributed to (197) individuals who belong to (18) companies practising different types of industries. (181) samples were retrieved, of which (19) were not valid for analysis. The final analysis was based on (162) responses, representing the final sample. Data was been collected and statistically analysed. Despite a huge number of key performance indicators were collected, a factor analysis was been done in order to find out most important indicators. Finally, important KPIs were selected and ranked according to their priority in order to use them in an effective performance measurement.

Key Words: Balanced Scorecard, Supply Chain, Key Performance Indicators, Performance Measurement

I. Introduction:

Organizations nowadays should achieve and realize that conformance and connection between external environment requirements and its possibility of available resources related to its internal environment is important factors to survive as other successful organizations, thus enable these organizations to obtain continuous improvement needed to customer satisfaction through recognition of measuring the supply chain performance (SCP) incurred at all levels and stages of manufacturing the products. Therefore, supply chain performance measuring and evaluation system should be able to generate indicators indicate performance attitudes and its future developments and comparing it with planned performance objectives such as market share, new customers, competitors and satisfying all shareholders. Supply chain management (SCM) has been considered as one of the major subjects to increase organizational efficiency and achieve the desired business objectives. SCM is focussing on the discipline that optimizes the different processes associated with the materials, goods, services, and information amongst suppliers, manufacturers, and customers. It is concerned with the effectiveness of dealing with the final customer's demand by the parties engaged in the provision of the product as a whole (Wong 2009). A supply chain consists of different levels, namely supplier, manufacturer, distributor, and consumer, forming a network of companies that influence each other and affect one another's performance (Lambert and Pohlen 2001), (Cai et al. 2009). The supply chain system involves those companies that motivate manufacturing and converting raw material to finished (semi/completely) product, by constructing channel of activities beginning from primary level activity proceeding to secondary and tertiary level (Sharma, Tyagi, and Bhardwaj 2020). Supply chain (SC) refers to those operations starting with production, processing, distribution and ending with consumption by customer, by assuring quality and safety of variety of products being the part of the chain in a very efficient and effective way (Sharma, Tyagi, and Bhardwaj 2020). Increasing products demands, environmental aspects, and overpopulation have an impact on the SC. There are many parameters in any SC that should be considered, for instance resources, packaging, waste management, etc. (Yontar and Süleyman 2020). In today's dynamic business environment supply chains aim to decrease costs, increase agility as well as increase effectiveness by providing better services and rapid responsiveness to customers. In order to achieve these objectives, firms should develop metrics for performance measurement to gauge their success and ensure sustainable growth. Measurement of supply chain performance with regards to the key performance metrics is an area under focus of researchers. The lack of clearness and comparability regarding this area creates confusion and makes it more difficult to express a clear strategy (Azfar, Khan, and Gabriel 2014). As it well known, "*You can't manage what you can't measure*", measuring the supply chain performance is a very important prerequisite for company survival, especially nowadays in reasons of globalization and the dynamic nature. The performance measurement system (PMS) is a framework to measure and evaluate the efficiency and perfection of the

supply chain activities (Reddy. K, Rao. A, and L 2019). Both practitioners and researchers are interested in having such integrated PMS (Mishra et al. 2018). The success of the PMS relies on different aspects e.g. the alignment of the performance measures with the organization's strategy, and the transformation of the organization's vision, mission, value, and strategic directions to employees and external stakeholders (Mathiyalagan, Mannan, and Parthiban 2014).

As an example of a type of industry which is food industry and according to (Knoema, 2018) , the Libya food production index is growing at annual rate of 3.53% that indicate a special interest for the food industry. Moreover, the net value of food production based on PPP (purchasing power parity, in constant prices 2004-2006) is annually growing with an average of about 3.49% over the period from 1967 to 2016. Due to this growing interest of the food industry and the research gab for the management of FSC performance.

Measuring supply chain performance in Libyan Industrial Organization still suffering problems and obstacles due to the huge number of overlapped KPIs. Individuals cannot choose the suitable of them during measuring the supply chain performance .Therefore this paper proposes a balanced scorecard for supply chain performance measurement for Libyan Industries Organizations. Relying on the qualitative analysis, the performance metrics in Libya companies can be scrutinized. This work also contributes to the SCPM literature by introducing a generic performance metrics that can be used for the different stages of the Supply chain. First, the different performance metrics of the four perspectives of the BSC were collected based on the literature. The appropriate indicators were discussed and validated by experts. Consequently, a questionnaire was developed and distributed to different organizations. After that the statistical analysis are performed and the BSC model was developed and validated by the industrial experts in Libyan factories.

II. Background and literature review

The successful organizations need to manage and execute a continual performance evaluation of all of their activities to ensure that they are on the right way of development. For performing this activity, organizations need to adopt a performance management framework. Besides, they need to identify the suitable key performance indicators or performance metrics that should be aligned with their strategic objectives. The choice of the performance metrics affects the success and competitive nature of the enterprise (Rajat Bhagwat and Sharma 2007). In 1992 (Kaplan and Norton 1992) published an article about the Balanced Scorecard (BSC). At that time, it was a new approach to strategic management. They recognized some of the weaknesses and vagueness of previous management approaches. According to (Robert S. Kaplan and David P. Norton 1996); the balanced scorecard approach provides a clear description as to what companies should measure in order to 'balance' their financial perspectives. Nowadays many large companies use a performance measurement system like the BSC but many smaller companies have no performance measurement system. The Balanced Scorecard is a performance management tool that enables a company to translate its vision and strategy into a tangible set of performance measures. However, it is more than a measuring device. The scorecard provides an enterprise view of an organization's overall performance by integrating financial measures with other key performance indicators around customer perspectives, internal business processes, and learning &growth. Metrics used in the BSC are typically called Key Performance Indicators (KPIs) because they measure how well the organization performs against predefined goals and targets. There are two major types of KPIs: leading and lagging indicators. Leading indicators measure activities that have a significant effect on future performance, whereas lagging indicators, such as most financial metrics, measure the output of past activity. Leading indicators are powerful measures because it gives managers more time to influence the outcome). There are many approaches to measure and evaluate supply chain performance. Following section illustrate that.

2.1 Perspective based approaches

Perspective based measurement model was developed by (Otto and Kotzab 2003). They take all the possible perspectives of a supply chain into account and provide measures to evaluate each perspective. The authors defined a perspective as a unique view of what SCM is about. The authors proposed a goal-oriented approach suggesting six perspectives on SCM each of which follows a particular set of goals, which consequently leads to a particular set of performance metrics. These perspectives are: (Systems Dynamics, Operations Research/Information Technology, Logistics, Marketing, Organization and Strategy). Each perspective has its very own notion of a supply chain, its standard problems and solutions, and its performance metrics. Note that there can be a trade-off between measures of one perspective with the measures of other perspectives. Two main perspective based models are BSC based models and Supply chain operations references based model (SCOR) based model.

2.1.1 Balanced scorecard (BSC)

The balanced scorecard (BSC) offers an integrated system to measure the company performance relying on the four perspectives of Financial, Customer, Internal process and learning and growth. The BSC was first obtainable by (Kaplan and Norton 1992). They proposed it to evaluate the company performance relying on the four perspectives simultaneously. The name of this approach comes from a set of items to balance between financial and non-financial measures, between lagging and leading indicators, between internal and external performance perspectives and finally between short term and long term objectives. BSCs have two main attitudes: customer perspective and financial

perspective. Customer perspective, involve value-adding view and aims to promote efficiency and effectiveness in the business processes. Financial perspective, involve the shareholders' view and aims to success financially, by change capabilities and sustaining innovation, through continuous improvement and preparation for future challenges. (Bigliardi and Bottani 2010) proposed a BSC model for measuring the performance of the food supply chain (FSC). For the different BSC's perspectives, the KPIs were collected from the literature. After that, the Delphi method was adopted to enhance the collected KPIs on two rounds. The revised BSC was verified on two companies who are working in food industry. (Yang 2009) suggested an enhanced version of the BSC to measure the supply chain performance index. The developed BSC integrates five perspectives that include intra-flow process, future development and society development besides the financial and the customer perspective. The learning and growth was replaced by the future development. For each perspective, a set of KPIs were proposed for its assessment e.g. the society perspective was proposed to be assessed relying on the efficiency of environment protection, recycling level, usage of the raw material and employee number with per capital invested. (Xia et al. 2017) developed a adjusted strategic balanced scorecard to measure the technology candidates in terms of their features of sustainability. (Thanki and Thakkar 2018) proposed a BSC and strategy map based on quantitative framework for assessing the lean and green performance of the SC in Indian textile industry. (Farajpour Khanaposhtani et al. 2017) used a mixed approach consisting of BSC, Game theory and System Dynamics (SD) to measure the automobile industry performance. Recently, (Dwivedi et al. 2021) approved the BSC besides the best-worst method to manage the performance of an assurance company. More recently, (Rasolofo-Distler and Distler 2018) investigated the role of the BSC in the management of SC uncertainty in service activities. They concluded that the BSC can be used to facilitate communication between supply chain stakeholders

2.1.2 Supply chain operations reference (SCOR)

The Supply chain operations reference (SCOR) model provide a modelling of the supply chain processes, people, practices and performance. The Supply chain council (SCC) established the SCOR model in 1996, containing performance features and metrics depend on five different management processes (plan, source, make, deliver and return). Furthermore, SCOR contains ten metrics corresponding to level 1 which fall into five categories; SC reliability metrics, flexibility metrics, responsiveness metrics, cost metrics, and assets metrics. The first three categories have directly linked to the customers and hence called customer facing. The rest of the metrics, measurements within the internal operation of the SC are named as internal facing. Many authors have used SCOR in the context of Supply chain performance management (SCPM). For SC benchmarking by using data envelopment analysis (DEA), (Rajabzadeh Ghatari et al. 2013) evaluated the swiftness of the pharmaceutical supply chains based on the SCOR model, using quantitative and qualitative measures. Besides, (Essajide and Ali 2017) approved the SCOR model to represent the pharmaceuticals wholesale distributors considering information sharing amongst SC partners and uncertainty. More recently, (Zuniga et al. 2018) adopted the SCOR model to symbolize the supply chain of critical products to decrease the difficulties of the SC system during strong earthquakes or tsunamis. (Yadav, Garg, and Luthra 2020) used the second level performance metrics of the SCOR model to manage the agriculture supply chain.

2.2. Process based approach

The problem of identifying the performance metrics of the whole sectors of the SC was started by (Gunasekaran, Patel, and Tirtiroglu 2001). They divided the SC into four major supply chain processes (plan, source, make/assemble, and deliver). Relying on the literature, they gathered the metrics and grouped them according to the management level (strategic, tactical and operational). (Yontar and Süleyman 2020) determined considerations that affect sustainable SC and attempted to measure the performance of the parameters along the supply chain. In their study different performance indicators are defined and several parameters are adopted (e.g. customer satisfaction, resource utilization, product safety, innovation, reliability, company information, packaging and waste management). (Kirwan, Maye, and Brunori 2017) recognized five dimensions of SC performance (economic, social, environmental, health, and ethical) that were being argued across a range of national contexts in four different scopes of discourse (public, market, scientific, and policy). (Yadav, Garg, and Luthra 2020) proposed to use the Internet of things (IOT) to collect the performance associated data from remote fields. (Maestrini et al. 2017) reviewed the literature related to the supply chain performance management (SCPM) systems with focusing more on the definition of performance measurement. (Reddy. K, Rao. A, and L 2019) considered and classified the SCPM as approaches and techniques and followed a systematic literature review procedures. They disclose that simulation techniques are more suitable than other performance techniques and approaches for the SCPM in an unstable environment. Their study provides a basis for academicians and future researches in applying the PMS for dynamic supply chain. (Qazi et al. 2018) used a utility based process approach to capture the interdependencies among risks, risk mitigation strategies and performance measures in an SC network. (Venkatesh et al. 2019) developed a framework to explore the social issues relevant to the suppliers and to recognize the performance measures in the emerging economies

2.3 Hierarchical based approach

The hierarchical based approach was used to explore the importance of the performance criteria. (Rajat Bhagwat and Sharma 2007) proposed to use the pairwise Analytical

hierarchy process (AHP) method for computing the overall SC performance. The AHP hierarchy was constructed relying on four levels: the lower level (the fourth) represents the four perspectives of the BSC as the AHP alternatives. The third level represents the different KPIs relying on the work of (Gunasekaran, Patel, and Tirtiroglu 2001) as a sub-criteria of the second level. The second level represents the three managerial levels of strategic, tactical and operational. The first level is the overall performance of the supply chain. (Sufiyan et al. 2019) proposed a fuzzy-DEMATEL method to analysis the different criteria and the associated metrics for assessing the FSC. Results indicate three criteria are the most important, which are service to customer, quality, and supply chain performance.

2.4 Qualitative and quantitative measures approach

(Chan F.T.S 2003) presents SCM performance measurement approach which consists of qualitative and quantitative measures. Quantitative measures are cost and resource utilization and qualitative measures are quality, flexibility, visibility, trust and innovativeness. (Gunasekaran, Patel, and McGaughey 2004) classified the different metrics of supply chain into three levels of importance (High, Average, and Low). The assessment was performed for metrics of the four processes (plan, source, make/assemble, deliver) and the management levels (strategic, tactical and operational).

III. Methodology (case study):

Despite the fact that, continuous improvement leads to customer satisfaction especially nowadays where the competition plays a big role between organizations to obtain suitable market share , a supply chain performance measurement should be realized through using a suitable technique like balanced score card technique that include four perspectives namely financial, customer, internal processes and learning &growth perspectives. Each perspective includes a lot of key performance indicators.

A Case study, that include measuring and evaluating the supply chain performance in the Libyan industrial organizations using BSC technique in which ranking of KPIs was been applied through questionnaire for the managers of different administrations and departments.. The necessary data and information were collected through scientific visits, interviewing and questionnaire. After examining the survey questionnaire and its responses by the sample of the study, the statistical analysis of the data that emerged from the questionnaire questions was carried out using the Statistical Package for Social Science (SPSS). The study relay on statistical descriptive analysis.

Financial	Customer	Internal processes	Learning &Growth
FF1: variation against budget	**CCS1**: Nr. Of satisfied customers	**IPCT1:** Customer order	**LGE1:** Increase employee
		cycle time	competence
FF2: net price of product	**CCS2:** Nr. Of customers complaints	**IPCT2:** Manufacturing cycle time.	**LGE2:** Improve motivation
FF3: productivity ratio	**CCS3:** Nr. Of new customers	**IPCT3:** Inventory replenishment cycle time	**LGE3:** Training to enhance employees skills
FF4: increase sales	**CCS4:** Time required to answer customer complaints	**IPCT4:** Purchase order cycle time	**LGE4:** Sustainability in employees training
FF5: return on investment	**CCS5:** Increase customer satisfaction	**IPCT5:** Total supply chain cycle time	**LGE5:** Employees involvement
FF6: Control of margins	**CCS6:** Increase loyalty of customers	**IPCT6:** Planned process cycle time	**LGE6:** Employee satisfaction
FF7: Market share	**CCS7:** Percentage of sales to new customers	**IPCT7:** Product development cycle time	**LGE7:** Employee suggestion per year
FF8: Use of assets and return on it	**CCS8:** Reduce cost for customers	**IPCT8:** Supplier cycle time	**LGE8:** Employee motivation
FF9: Level of indebtedness	**CCS9:** Responsiveness to customers	**IPP1**: Productivity per business unit	**LGE9:** Employee capability
FF10: Earnings before taxes	**CCS10:** Customer query time	**IPP2**: Accuracy of production planning	**LGE10:** Number of complaints
FF11: Cash flow	**CCS11:** Customer perceived value of product	**IPP3**: Improve production process	**LGE11:** absenteeism

FF12: Economic value added	**CCS12:** Flexibility of system to meet customer	**IPP4**: Improve supply chain	**LGE12:** Percentage of employees training
FF13: Improve financial stability	**CCS13:** Satisfaction of all business partners	**IPP5**: Increase capacity	**LGE13:** Employees productivity
FF14: Profitability level	**CP1:** Nr. Of reject products per year	**IPP6**: Capacity utilization	**LGE14:** Number of training hours per employee
FF15: Revenues from product /year	**CP2:** Nr. Of defect products per year	**IPP7**: Effective of master production schedule	**LGE15:** Level of information sharing
FF16: Revenues per employee /year	**CP3:** Nr. Of new items inter first to market	**IPP8**: % of failure during manufacturing	**LGE16:** Corporate social responsibility
FC1: Material acquisition cost	**CP4:** Price relative to competitors	**IPP9**: % of orders delivered according plan	**LGE17:** Cultural compatibility
FC2: Non- quality cost	**CP5:** Offering excellent selection of products	**IPP10**: Number of finished products	**LGPD1:** Product development cycle time
FC3: Warehousing/ storing cost	**CP6:** Nr. Of products/ distribution channel	**IPP11**: Changes in schedule	**LGPD2:** Product innovation rate
FC4: Manufacturing/operating cost	**CP7:** Maximizing sales of new products	**IPP12**: Adherence to schedule	**LGPD3:** % of sales from new product
FC5: Carrying inventory cost	**CP8:** Level of quality product	**IPP13**: Plan utilization	**LGPD4:** Time to develop next generation
FC6: Transportation cost	**CP9:** Meeting capacity per target production	**IPP14**: Opportunities identification.	**LGPD5:** Process time to maturity
FC7: Distribution cost	**CP10:** Damaged shipment	**IPI1**: Material inventory	**LGPD6:** New product introduction vs. competition
FC8: Logistic cost	**CD1:** Accuracy of company's delivery forecast	**IPI2**: Material quality	**LGPD7:** Completion of loaded work
FC9: Energy cost	**CD2:** Deliver products with zero defect	**IPI3**: Finished goods inventory turn	**LGPD8:** Product variety
FC10: Labor cost	**CD3:** On – time delivery	**IPI4**: Stock keeping units	**LGPD9:** % of new product development
FC11: Total supply chain cost	**CD4:** Responsiveness to urgent delivery	**IPI5**: Number of stock out	
FC12: Saving activity of supplier cost	**CD5:** Delivery reliability	**IPI6**: Total inventory cost	
	CD6: Quality of delivery goods		
	CD7: Lead time		

3.1 descriptive analyses

The total KPIs are (112), selected from them (24). Following figures illustrate selecting and ranking of key performance indicators according to its classifications in order to identify the supply chain performance

3.1.1 Financial perspective

This perspective includes (28) KPIs, containing (2) types of indicators namely (financial and cost). Selected from them only (6) KPIs; (3) from each type as following:

1) Financial type: Selected KPIs are: (Control of margin - earning before interests and taxes - net price of product). See figure (1).
2) Cost type: Selected KPIs are :(Operation cost - material acquisition cost - transportation cost). See figure (2).

3.1.2 Customer perspective

This perspective includes (30) KPIs containing (3) types of indicators namely (customer satisfaction, products and delivery). Selected from them (6) KPIs; (2) from the first type, (2) from the second type and (2) from the third type as following:

1) Customer satisfaction type: Selected KPIs are: (Number of satisfied customers - responsiveness to customers). See figure (3).
2) Products type: Selected KPIs are: (level of product quality - meeting capacity per target production). See figure (4).
3) Delivery type: Selected KPIs are: (Quality of delivered goods - delivery of products with zero defects). See figure (5).

3.1.3 Internal processes perspective

This perspective includes (28) KPIs contain (3) types of indicators namely (cycle time, production and inventory). Selected from them (6) KPIs; (2) from the first type, (2) from the second type, (2) from the third type as following:

1) Cycle time type: Selected KPIs are: (Supplier cycle time - purchase order cycle time). See figure (6).
2) Production type: Selected KPIs are: (Accuracy of production planning - capacity utilization). See figure (7).
3) Inventory type: Selected KPIs are: (Material quality - material inventory). See figure (8).

3.1.4 Learning and growth perspective

This perspective include (26) KPIs containing (2) types of indicators namely (Employees and products development). Selected from them (6) KPIs; (3) from the first type, (3) from the second type as following:

1) Employee type: Selected KPIs are: (Employee productivity - employee capability - corporate social responsibility). See figure (9)
2) Products development type: Selected KPIs are: (Completion of loaded work - percentage of sales from new product - process time to maturity). See figure (10).

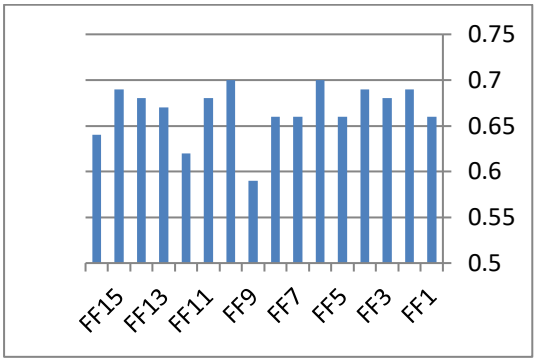

Figure (1): Ranking of Financial indicators type

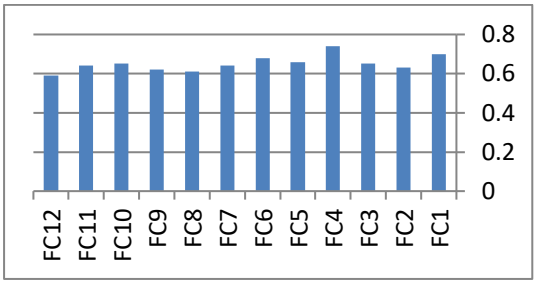

Figure (2): Ranking of cost indicators type

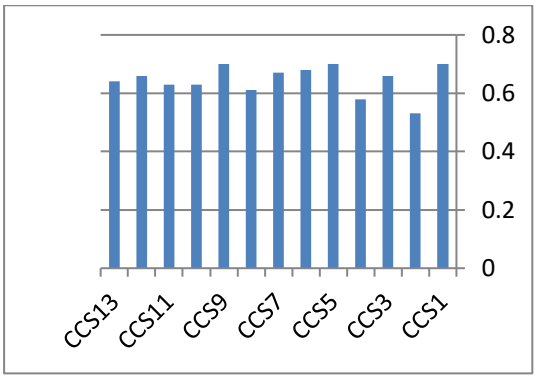

Figure (3): Ranking of customer satisfaction

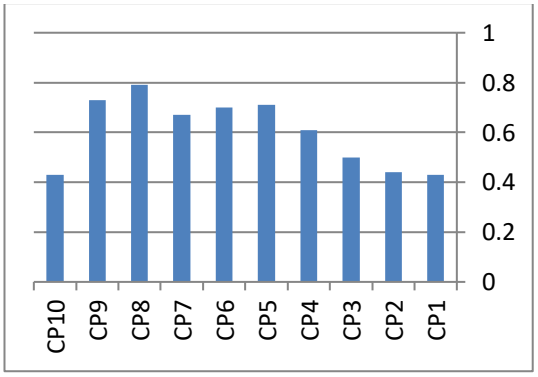

Figure (4): Ranking of products indicators type

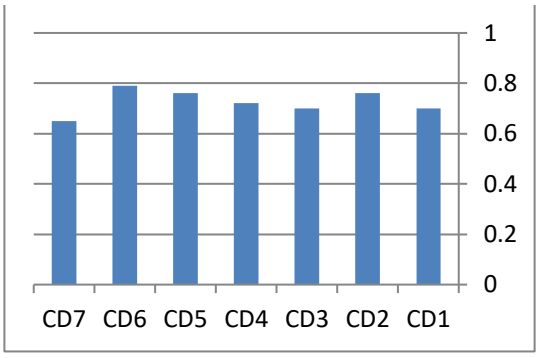

Figure (5): Ranking of delivery indicators type

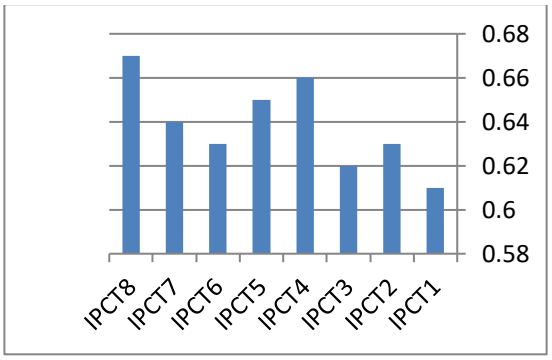

Figure (6): Ranking of cycle time indicators type

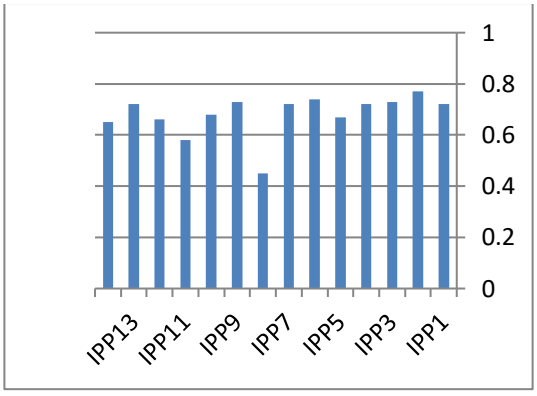

Figure (7): Ranking of production indicators type

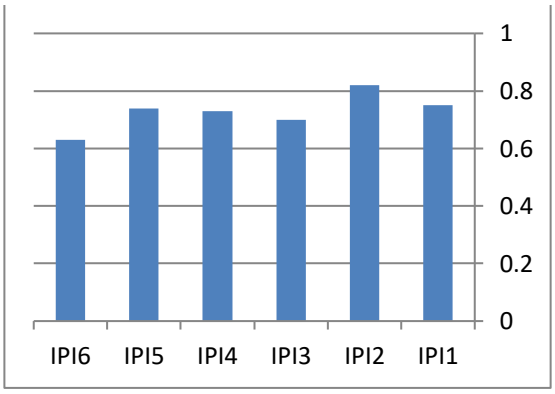

Figure (8): Ranking of inventory indicators type

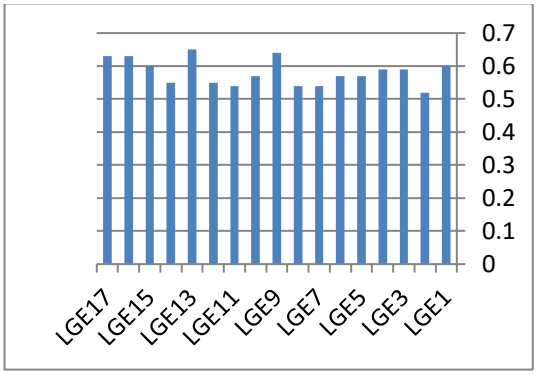

Figure (9): Ranking of employee's indicators

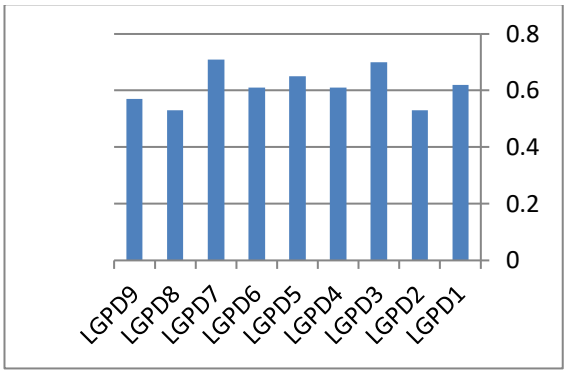

Figure (10): Ranking of products development

IV. Results and discussion

In order to achieve a reasonable results that include ranking of the KPIs, a descriptive statistical analysis and factor analysis were been conducted.

4.1 Discussion of descriptive analysis

The results of this analysis were (24) KPIs, (6) from each perspective. Following section illustrate that:

The first perspective (financial perspective): This perspective contains total number of (28) KPIs, including two types of KPIs which are financial and cost KPIs. The financial type comprise (16) and the cost type comprise (12) .The researcher had chosen (3) KPIs from each type according to their higher weights, which means a total number of (6) KPIs from the financial perspective .Regarding the financial type following KPIs were chosen (control of margin 70% , earning before interests and taxes 70% , and net price of product 69%) .On the other hand the selected KPIs of the cost type were (operation cost 74%, material acquisition cost 70%, and transportation cost 68%).

The second perspective (customer perspective): This perspective contains total number of (30) KPIs, including

three types of KPIs which are customer satisfaction, products and delivery KPIs. The customer satisfaction type comprise (13) and the products type comprise (10) whereas the delivery type comprise only (7) . According to their highest weight, the researcher had chosen (2)KPIs from the first type, (2) KPIs from the second types and (2) KPIs from the third type, which means total number of (6) KPIs from the customer perspective .Regarding the customer satisfaction type following KPIs were chosen (number of satisfied customers 70% , and responsiveness to customers 70%). The selected KPIs of the products type were (level of product quality 79%, and meeting capacity per target production 73%). Finally, the delivery type contains (quality of delivered goods 79%, and delivery of products with zero defects 76%).

The third perspective (internal processes perspective): This perspective contains total number of (28) KPIs, including three types of KPIs which are cycle time, production, and inventory. The cycle time type comprise (8), the production type comprise only (14), and the inventory type contains (6) , The researcher had chosen (2) KPIs from the first type, (2) KPIs from the second type, and (2) KPIs from the third type according to their highest weight, which means a total number of (6) KPIs from the internal processes perspective. The selected KPIs concerning cycle time type were (supplier cycle time 67%, and purchase order cycle time 66%). Production type had included (accuracy of production planning 77%, and capacity utilization 74%). On the other hand inventory type had comprised (material quality 82%, and material inventory75%).

The fourth perspective (learning and growth perspective): This perspective contains total number of (26) KPIs, including two types of KPIs which are employees and products development. The employee's type comprises (17), the products development type comprises (9). According to their higher weight, the researcher had chosen (3) KPIs from the first type and (3) KPIs from the second type, which means total number of (6) KPIs from the learning and growth perspective. The selected KPIs concerning employees' type were (employee productivity 65%, employee capability 64%, and corporate social responsibility 63%). Concerning products development type, these KPIs were selected (completion of loaded work 71%, percentage of sales from new product 70%, and process time to maturity 65%). Finally, selected KPIs were put in a model in order to use them in evaluating and measuring supply chain performance, figure (11) illustrate that.

V. Conclusion

Libyan industrial organizations attempt to increase their performance as a requirement for survival in the recent globalized working environment. Measuring the supply chain performance is essential for self-assessment, benchmarking, and implementing the corrective action that satisfies the pre-established strategic directions. The current paper aims to rank a suitable (KPIs) that can be used to measure the performance of the different sectors of the supply chain. The results was developed relying on statistical analysis in which the different key performance indicators for each perspective of the BSC were collected and discussed with the industry experts. The industrial experts who are practising in the different sectors of the supply in Libyan organizations are asked to give an importance level for each KPI of the BSC. Regarding descriptive analysis a number of (24) KPIs were selected for the total number (112). The selection of KPIs was according to the weight gained by respondents, the researcher had chosen the highest percentage of KPIs weight and put them in a model to facilitate the performance measurement process. The industry in Libya is still suffering from many problems due to the war from 2011 till these days and the connections with the world is weak and this lead to shortage in resources and lack of information between the Libyan organizations and the other country specially those which are considered as progressed country.

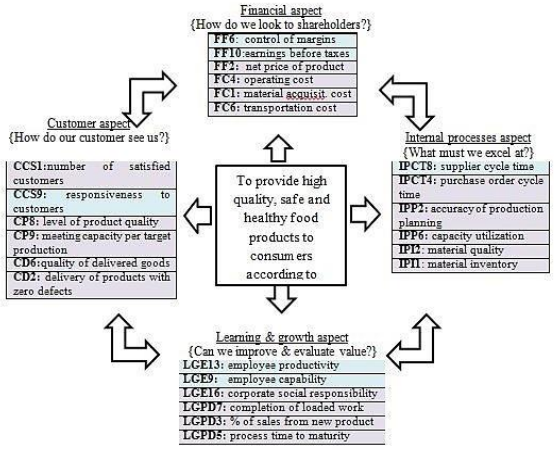

Figure (11) The most important KPI for performance evaluation of Industrial supply chain in Libyan industrial organizations

References.

[1]Azfar, Khan Rai Waqas, Nawar Khan, and Hamza Farooq Gabriel. 2014. "Performance Measurement: A Conceptual Framework for Supply Chain Practices." *Procedia - Social and Behavioral Sciences*, 10th International Strategic Management Conference 2014, 150 (September): 803–12. https://doi.org/10.1016/j.sbspro.2014.09.089.

[2]Bhagwat, R., and M. K. Sharma. 2007. "Performance Measurement of Supply Chain Management Using the Analytical Hierarchy Process." *Production Planning & Control* 18 (8): 666–80. https://doi.org/10.1080/09537280701614407.

[3]Bigliardi, Barbara, and Eleonora Bottani. 2010. "Performance Measurement in the Food Supply Chain: A Balanced Scorecard Approach." Edited by D. Amaratunga, U. Kulatunga, and C. Liyanage. *Facilities* 28 (5/6): 249–60. https://doi.org/10.1108/02632771011031493.

[4]Cai, Jian, Xiangdong Liu, Zhihui Xiao, and Jin Liu. 2009. "Improving Supply Chain Performance Management: A Systematic Approach to Analyzing Iterative KPI Accomplishment." *Decision Support Systems* 46 (2): 512–21. https://doi.org/10.1016/j.dss.2008.09.004.

[5]Chan, F. T. S. (2003) 'Performance Measurement in a Supply Chain', *International Journal of Advanced Manufacturing Technology*, Vol. 21, pp.534–548.

[6]Dwivedi, Rishi, Kanika Prasad, Nabankur Mandal, Shweta Singh, Mayank Vardhan, and Dragan Pamucar. 2021. "Performance Evaluation of an Insurance Company Using an Integrated Balanced Scorecard (BSC) and Best-Worst Method (BWM)." *Decision Making: Applications in Management and Engineering* 4 (1): 33–50. https://doi.org/10.31181/dmame2104033d.

[7]Essajide, Lhassan, and Rachidi Ali. 2017. "Planning and Modelling of Pharmaceuticals Wholesale-Distributors Supply Chain Using SCOR Model: A Moroccan Case Study." SSRN Scholarly Paper ID 2947573. Rochester, NY: Social Science Research Network. https://papers.ssrn.com/abstract=2947573.

[8]Farajpour Khanaposhtani, Ghassem, Seyyed Shahrokh Jafari, Farhad Ariana, Amir Alaie, and Hamed Salimi. 2017. "Formulating the Supply Chain Strategy of Automotive Industry in Iran Using Balanced Scorecard, System Dynamics, and Game Theory." SSRN Scholarly Paper ID 3343282. Rochester, NY: Social Science Research Network. https://papers.ssrn.com/abstract=3343282.

[9]Gunasekaran, A, C Patel, and Ronald E McGaughey. 2004. "A Framework for Supply Chain Performance Measurement." *International Journal of Production Economics*, Supply Chain Management for the 21st Century Organizational Competitiveness, 87 (3): 333–47. https://doi.org/10.1016/j.ijpe.2003.08.003.

[10]Gunasekaran, A., C. Patel, and E. Tirtiroglu. 2001. "Performance Measures and Metrics in a Supply Chain Environment." *International Journal of Operations & Production Management* 21 (1/2): 71–87. https://doi.org/10.1108/01443570110358468.

[11]Kaplan, Robert S., and David P. Norton. 1992. "The Balanced Scorecard—Measures That Drive Performance." *Harvard Business Review*, January 1, 1992.

[12]Kirwan, James, Damian Maye, and Gianluca Brunori. 2017. "Acknowledging Complexity in Food Supply Chains When Assessing Their Performance and Sustainability." *Journal of Rural Studies* 52 (May): 21–32. https://doi.org/10.1016/j.jrurstud.2017.03.008.

[13]Lambert, Douglas M., and Terrance L. Pohlen. 2001. "Supply Chain Metrics." *The International Journal of Logistics Management* 12 (1): 1–19. https://doi.org/10.1108/09574090110806190.

[14]Maestrini, Vieri, Davide Luzzini, Paolo Maccarrone, and Federico Caniato. 2017. "Supply Chain Performance Measurement Systems: A Systematic Review and Research Agenda." *International Journal of Production Economics* 183 (January): 299–315. https://doi.org/10.1016/j.ijpe.2016.11.005.

[15]Mathiyalagan, P., K. Mannan, and P. Parthiban. 2014. "Performance Evaluation in Supply Chain Using Balanced Scorecard." *International Journal of Advances in Mechanical & Automobile Engineering (IJAMAE)* 1 (1): 4–10.

[16]Mishra, Deepa, Angappa Gunasekaran, Thanos Papadopoulos, and Rameshwar Dubey. 2018. "Supply Chain Performance Measures and Metrics: A Bibliometric Study." *Benchmarking: An International Journal* 25 (3): 932–67. https://doi.org/10.1108/BIJ-08-2017-0224.

[17]Otto, A. and Kotzab, H. (2003), 'Does supply chain management really pay? Six perspectives to measure the performance of managing a supply chain', *European Journal of Operational Research*, Vol. 144, No. 2, pp.306-320.

[18]Qazi, Abroon, Alex Dickson, John Quigley, and Barbara Gaudenzi. 2018. "Supply Chain Risk Network Management: A Bayesian Belief Network and Expected Utility Based Approach for Managing Supply Chain Risks." *International Journal of Production Economics* 196 (February): 24–42. https://doi.org/10.1016/j.ijpe.2017.11.008.

[19]Rajabzadeh Ghatari, Ali, Gholamhossein Mehralian, Forouzandeh Zarenezhad, and Hamid Reza Rasekh. 2013. "Developing a Model for Agile Supply: An Empirical Study from Iranian Pharmaceutical Supply Chain." *Iranian Journal of Pharmaceutical Research : IJPR* 12 (Suppl): 193–205.

[20]Rasolofo-Distler, Fana, and Frédéric Distler. 2018. "Using the Balanced Scorecard to Manage Service Supply Chain Uncertainty: Case Studies in French Real Estate Services." *Knowledge and Process Management* 25 (3): 129–42. https://doi.org/10.1002/kpm.1572.

[21]Reddy. K, Jagan Mohan, Neelakanteswara Rao. A, and Krishnanand. L. 2019. "A Review on Supply Chain Performance Measurement Systems." *Procedia Manufacturing*, Digital Manufacturing Transforming Industry Towards Sustainable Growth, 30 (January): 40–47. https://doi.org/10.1016/j.promfg.2019.02.007.

[22]Robert S. Kaplan and David P. Norton, Using the balanced scorecard as a strategic management system, Harvard business review, 74(1):75, 1996.

[23]Sharma, Janpriy, Mohit Tyagi, and Arvind Bhardwaj. 2020. "Parametric Review of Food Supply Chain Performance Implications under Different Aspects." *Journal of Advances in Management Research* 17 (3): 421–53. https://doi.org/10.1108/JAMR-10-2019-0193.

[24]Sufiyan, Mohd, Abid Haleem, Shahbaz Khan, and Mohd Imran Khan. 2019. "Evaluating Food Supply Chain Performance Using Hybrid Fuzzy MCDM Technique." *Sustainable Production and Consumption* 20 (October): 40–57. https://doi.org/10.1016/j.spc.2019.03.004.

[25]Thanki, Shashank, and Jitesh Thakkar. 2018. "A Quantitative Framework for Lean and Green Assessment of Supply Chain Performance." *International Journal of Productivity and Performance Management* 67 (2): 366–400. https://doi.org/10.1108/IJPPM-09-2016-0215.

[38]Venkatesh, V. G., Abraham Zhang, Eric Deakins, Sunil Luthra, and S. Mangla. 2019. "A Fuzzy AHP-TOPSIS Approach to Supply Partner Selection in Continuous Aid Humanitarian Supply Chains." *Annals of Operations Research* 283 (1): 1517–50. https://doi.org/10.1007/s10479-018-2981-1.

[26]Wong, Wai Peng. 2009. "Performance Evaluation of Supply Chain in Stochastic Environment: Using a Simulation Based DEA Framework." *International Journal of Business Performance and Supply Chain Modelling* 1 (2–3): 203–228. https://doi.org/10.1504/IJBPSCM.2009.030642.

[27]Xia, De, Qian Yu, Qinglu Gao, and Guoping Cheng. 2017. "Sustainable Technology Selection Decision-Making Model for Enterprise in Supply Chain: Based on a Modified Strategic Balanced Scorecard." *Journal of Cleaner Production* 141 (January): 1337–48. https://doi.org/10.1016/j.jclepro.2016.09.083.

[28]Yadav, Sanjeev, Dixit Garg, and Sunil Luthra. 2020. "Development of IoT Based Data-Driven Agriculture Supply Chain Performance Measurement Framework." *Journal of Enterprise Information Management* 34 (1): 292–327. https://doi.org/10.1108/JEIM-11-2019-0369.

[29]Yang, Jianhua. 2009. "Integrative Performance Evaluation for Supply Chain System Based on Logarithm Triangular Fuzzy Number-AHP Method." Edited by Mian-yun Chen, Yi Lin, and Hejing Xiong. *Kybernetes* 38 (10): 1760–70. https://doi.org/10.1108/03684920910994277.

[30]Yontar, Emel, and Ersöz Süleyman. 2020. "Investigation of Food Supply Chain Sustainability Performance for Turkey's Food Sector." *Frontiers in Sustainable Food Systems* 4 (June): 68. https://doi.org/10.3389/fsufs.2020.00068.

[31]Zuniga, Raul, Gabriel Icarte, John Griffiths, Juan Lopez, and Juan Quezada. 2018. "Modeling of Critical Products Supply Chain Required to Affected People on Earthquakes and Tsunamis Through Use of SCOR Model." In *Dynamics in Logistics*, edited by Michael Freitag, Herbert Kotzab, and Jürgen Pannek, 53–57. Lecture Notes in Logistics. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-74225-0_7.

[32] Knoema. (2018) libyan food production index , 1960- 2020 Retrieved June 12,2021 from Knoema website : https://knoema.com//atlas/Libya/Food-production-index.