Attributes Identification for Performance Level Enhancement in Supply Chain Management

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***Abstract*: Globally, Construction Industry plays a fundamental role in the development of all domains of the life, from more than two decades Supply Chain (SC) is the one of most important area in the field of construction engineering. In today's extendable market, competitive globe the demand of 3M (Materials, Manpower & Machinery) management from manufacturer to consumer is increasing day by day. Many types of research have carried out their research work in Supply Chain Management (SCM) but it is still lacking in the subjects of Attributes Identification for Performance Level Enhancement in Supply Chain Management in building construction sector. Hence the purpose of this research is to investigate the factors improving the importance level of construction industry players (Client, Consultant, and Contractor). A detailed literature review has been carried out to identify the factors and the factors are validated by unstructured interviews from the experts working in the industry. The outcome of this study will help to augment the Attributes Identification for Performance Level Enhancement in Supply Chain Management in building construction sector practices in construction projects, total 150 questionnaires were sent to respondents working in the building construction sector and hence 111 received form succeeded respondents the collected data were analyzed through SPSS software for the analyses of mean and standard deviation values according to Rogers Adoption classification Highly Effective (HE) value were taken as 4.1 mean value.**

***Keywords:* Supply Chain Management (SCM), Importance of various attributes influencing SCM, Construction Industry**

I. BACKGROUND

In the modern world, the construction industry plays a pivotal role in enhancing economic growth, in national gross domestic (GDP) and human capital of any country. The Construction Industry of Pakistan is already escalating due to construction activities i.e. infrastructure, rising demand of buildings, roads, repair and rehabilitation work. The construction industry (C.I) is contributing economic growth and infrastructure in the development of any country, it plays a vital role also in the gross domestic product (GDP) and gross national products (GNP). Providing different opportunities in the construction sector in the country (Song, Y, 2005). The prominent subject of a contractor in a project is to complete the project at a defined time, to have an optimized profit and qualitative work. Worldwide supply chain assists in different functions such as purchasing, utilization, production and logistics. Usually, the main elements of global supply chains which are caused by operational problems for example fabrication and effectiveness. Nevertheless, after it was founded in the 19th century for industrial manufacturing, supply chain management has experienced many changes (Wu and Wu, 2015).

Delay in the project schedule and cost overrun is a common issue found in all developing countries' projects by controlling the different attributes of SCM in building construction project sector as defined in this research paper we can deliver projects at the deadline and can be achieved our targets within a budget, defined schedule and with quality.

II. LITERATURE REVIEW

The late 1990s were characterized by a greater drive toward globalization and a shift in market power from manufacturers to retailers. Customers along the supply chain came to expect "more bene*fi*ts for less money" (i.e., increasing customer value) (Min, et al 2019). The emergence of SCM in the manufacturing sector, its adoption in construction has been a gradual build-up from the adoption of JIT, TQM and partnering approaches as strategies for improving effectiveness in the construction delivery process (Ojo & E.M., 2016). This gradual evolution of SCM in construction has also been attributed to reform pressures on the industry towards alternative and innovative methods and systems that can increase productivity (Turnheim, et al 2012). The progression towards SCM in construction can also be tracked to the evolution of procurement approaches between the 1960's and 2000's as well as how such evolutionary changes have influenced relationship types (McGeorge, et al 2012). Since the early nineteenth century, construction was dominated by traditional single-stage procurement which was characterized by short-term and adversarial relationships, fragmented processes and tightly compartmentalized functions and roles (Manu, et al 2014). However, alternative forms of procurement began to emerge in the 1960's in response to changing client needs (Webster Jr, et al 1992). These proactive changes to procurement were mostly driven by well informed and experienced construction clients (Briscoe, et al 2005) and alternative approaches such as two-stage tendering, construction management, management contracting and design and build (D&B) have since emerged through such client-driven improvement efforts (Griffith, et al 2003). These procurement approaches often require reconfiguration of relationships, roles and power differentials in the construction supply chain. Project-specific partnering in the 1980's and strategic-type partnering in the late 1990's - where the focus was on cultivating long-term business relationships – continued to signal further progression towards SCM in construction (Manu, et al 2014).

III. RESEARCH METHODOLOGY

From the literature review and published researcher, the attributes which influence the supply chain management in building construction projects have been studied. At initial step Unstructured interview to confirm the relevance with Construction Industry (C I) in Pakistan and to identify additional attributes/ specific attributes to C.I of Pakistan and to identify the level of Importance of various attributes influencing SCM in Project Life Cycle. Questionnaire survey is designed to explore the level of Importance of attributes influencing Supply Chain Management (SCM) in the project life cycle of building construction projects. The grade of contribution was ranked on a five opinion of Likert scale as mentioned: "Very low, Low, Moderate, High, Very high".

The author carried out this research in Pakistan, a total of 150 questionnaires were distributed among different public sector professionals and experts, out of the 111 questionnaires were entertained to determine the critical factors. The data was collected and then analysis in SPSS.

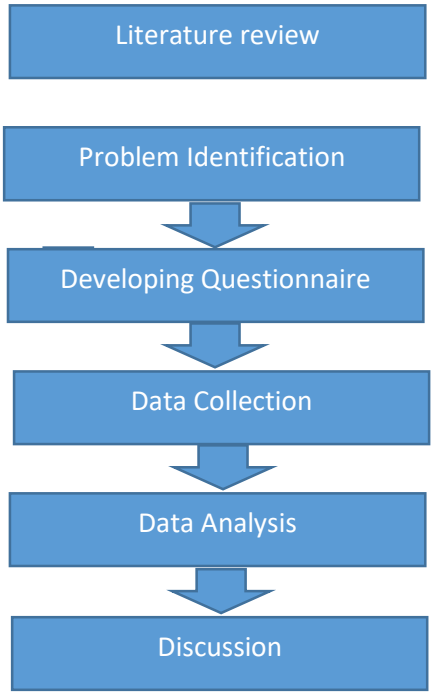

Figure. 1: Methodology Flow Chart

A. Mean and Standard Deviation

Data analysis has been made using software SPSS. Following implements as utilized.

- Mean, Standard Deviation.

In order to choose the appropriate procurement system for examination, the dimension of estimation was known. For every kind of measures, there is an appropriate strategy that can be connected and not others. In this study, Likert scales had used. Likert scale is shown in Table.1 in which ranking data that typically utilize numbers in ascending/descending order. The imported assigned numbers (5, 4, 3, 2, 1) scale shows absolute quantity. They are just numerical marks. Likert scale is given in Table.1.

According to (Rogers,1995 and Bhattacharya, M., 2010) Adoption classification based on Likert scale, Highly Effective (HE) value ranges from 4.1 to 5.0, so we take those attributes of the level of deficiencies with value more than 4.1 and onward and below that value are dropped.

Table 1: Likert scale used for data measurement

Item	Very, important	Important	Moderately, Important	Less, Important	Not, Important
Scale rate	5	4	3	2	1

After collecting respondent data from a questionnaire which separated to different organizations/firms/companies then that data was further analyzed by using SPSS software.

Furthermore, use of the innovation diffusion theory (Rogers (1995) adopter's classification) to clarify the degree of importance to factors. Rogers "five adopters" classification of the Likert scale include the innovators as early adopters, adopters, early majority, late majority and the laggards, with the innovators and laggards (being highest and lowest ranking, respectively) (Manu et al., 2017). As shown in beneath Table.2.

Table 2: Interpretation of Rogers Adoption classification based on Likert scale

Description of Likert scale	Range Value Allocation	Innovation Rogers Adoption Status
Not Effective (NE)	0.1 to 1.0	(Laggard)
Less Effective (LE)	1.1 to 2.0	(Late, Majority)
Moderately Effective (ME)	2.1 to 3.0	(Early, Majority)
Effective (E)	3.1 to 4.0	(Adopters)
Highly Effective (HE)	4.1 to 5.0	(Innovators)

IV. DATA COLLECTION AND ANALYSIS

The empirical data was collected in the form of interviews and questionnaire. The interviews were conducted from participants those were related to clients, consultants, procurement specialist, Supply Chain managers and contractors. Later on, size sampling of the questionnaire was done and a questionnaire survey was conducted. The questionnaire survey was based on the level of importance of various attributes influencing SCM in Project Life Cycle, where 150 questionnaires were distributed among different public sector professionals and experts, out of the 111 questionnaires were entertained to determine the critical factors, in the second round the analyses of factors were carried out through SPSS.

B. Respondent's information

The data were collected in two stages. Total 150 questionnaires were distributed to respondents and 111 received successfully are mentioned in figure.2.

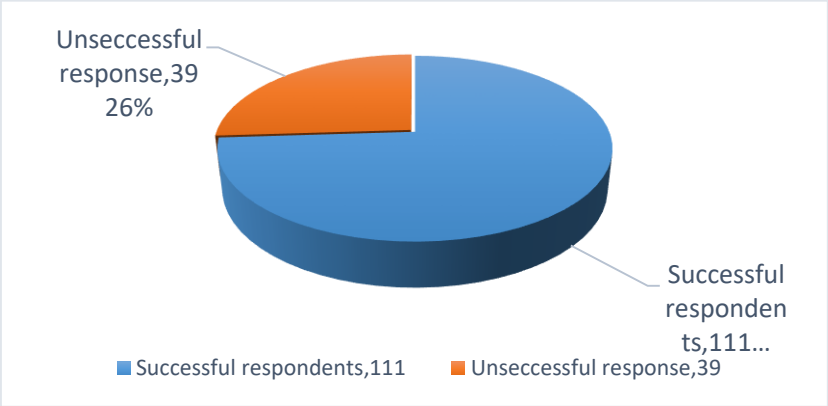

Figure 2: Statistics of the questionnaire

Among the 111 successful received questionnaire 60 from Contractors, 25 from Clients, 18 from Consultants and 8 Others (Procurement specialists, Supply chain managers, research academia etc.) working in building construction projects.

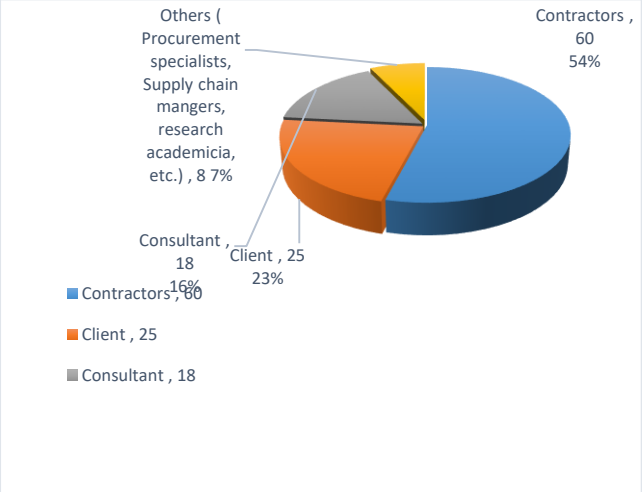

Figure 3: Respondents from different players working in building construction projects.

Figure.3. Shows the percentage of the respondents from different players working in building construction projects.

Table 3: Attributes Identification for Performance Level Enhancement in Supply Chain Management

	SCM level of Importance of various attributes												
S. NO	**Project Planning & Feasibility**	**M**	**S.D**	**Design & Engineering**	**M**	**S.D**	**Construction**	**M**	**S.D**	**Hand over & Acceptance**	**M**	**S.D**	**Ranking**
1	Sampling of materials before purchasing all products	4.51	.876	Clarity of drawings	4.39	.716	Clarity of drawings	4.49	.638	Clarity of drawings	4.41	.758	1st
2	Clarity of drawings	4.46	.812	Ensuring quality of design	4.30	.811	Sampling of materials before purchasing all products	4.38	.840	Trust between SCM partners	4.31	.712	2nd
3	rules and regulation of the Government	4.35	.798	Involvement of experienced staff in the procurement process	4.30	.762	timely supply of materials	4.38	.766	Clearly assuring expiry date on products	4.31	.789	3rd
4	Scope of work	4.35	.833	rules and regulation of the Government	4.29	.772	Trust between SCM partners	4.34	.771	Suitability of Partnership	4.27	.827	4th
5	Involvement of experienced staff in the procurement process	4.34	.855	Scope of work	4.28	.730	Adoption of proper safety & Security measures	4.31	.925	rules and regulation of the Government	4.14	.918	5th
6	Commitment of SCM partners towards continuous improvement	4.27	.827	Justified/realistic estimate	4.27	.672	Commitment of SCM partners towards continuous improvement	4.29	.759	Ensuring quality of design	4.14	.806	6th

7	Required specification of materials	4.26	.848	Application of modern technology	4.21	.900	Scope of work	4.29	.720	Effective communication between SCM partners	4.13	.801	7th
8	Effective communication between SCM partners	4.22	.812	Commitment of SCM partners towards continuous improvement	4.18	.798	rules and regulation of the Government	4.29	.867	Justified/realistic estimate	4.13	.797	8th
9	Ensuring quality of design	4.19	.738	Clarity in contract conditions	4.16	.837	Required specification of materials	4.28	.717	Commitment of SCM partners towards continuous improvement timely supply of materials	4.12	.804	9th
10	Application of modern technology	4.12	.988	suitability of Partnership	4.13	.946	suitability of Partnership	4.26	.788		4.10	.842	10th
11	Involvement of relevant partners in SCM processes	4.11	.847	*Involvement of relevant partners in SCM processes*	4.13	.772	Clearly assuring expiry date on products	4.25	.879	*Required specification of materials*	4.10	.757	11th
12	*Clearly assuring expiry date on products*	4.10	.887	Sampling of materials before purchasing all products	4.09	.956	Application of modern technology	4.23	.815	Scope of work	4.09	.670	12th
13	suitability of Partnership	4.09	.826	Required specification of materials	4.07	1.007	Effective communication between SCM partners	4.20	.793	Clarity in contract conditions	4.09	.946	13th
14	Clarity in contract conditions	4.05	.969	Effective communication between SCM partners	4.07	.816	Size of the company	4.18	.747	Adoption of proper safety & Security measures	4.08	.784	14th
15	Integration between SCM Partners	4.03	.853	Clearly assuring expiry date on products	4.06	.868	Involvement of relevant partners in SCM processes	4.17	.743	Size of the company	4.07	.779	15th
16	Size of the company	4.03	.743	Integration between SCM Partners	4.03	.853	*Involvement of experienced staff in the procurement process*	4.12	.804	Involvement of experienced staff in the procurement process	4.04	.775	16th
17	Preloading inspection of products	4.03	.886	Size of the company	4.01	.704	Justified/realistic estimate	4.08	.809	Sampling of materials before purchasing all products	4.04	.955	17th
18	Proper transportation and handling of materials	3.99	.919	Adoption of proper safety & Security measures	4.01	.818	Appropriate warehouse Management system	4.08	.784	Appropriate warehouse Management system	4.03	.897	18th
19	Application of Geographic Information System(GIS) in SCM	3.90	.865	Trust between SCM partners	3.99	.865	Preloading inspection of products	4.07	.810	Proper transportation and handling of materials	4.02	.903	19th
20	Appropriate warehouse	3.88	.840	Proper transportation	3.98	.710	Timely Payments	4.03	.821	selection of goods supply	3.99	.908	20th

	Management system			and handling of materials						centers/stations to be nearer			
21	Timely Payments	3.88	.896	Preloading inspection of products	3.97	.864	Integration between SCM Partners	4.01	.704	Involvement of relevant partners in SCM processes	3.99	.770	21st
22	selection of goods supply centers/stations to be nearer	3.88	.867	timely supply of materials	3.96	.787	Application of Geographic Information System(GIS) in SCM	3.96	.934	Integration between SCM Partners	3.91	.802	22nd
23	Justified /realistic estimate	3.85	.868	Timely Payments	3.95	.949	Unforeseen situation	3.93	.938	Application of modern technology	3.88	.862	23rd
24	Adoption of proper safety & Security measures	3.82	.845	Unforeseen situation	3.93	.779	selection of goods supply centers/stations to be nearer	3.86	.897	Preloading inspection of products	3.87	.881	24th
25	Unforeseen situation	3.79	.878	Application of Geographic Information System(GIS) in SCM	3.90	.909	Clarity in contract conditions	3.63	.947	Timely Payments	3.82	.976	25th
26	Trust between SCM partners	3.78	.924	Appropriate warehouse Management system	3.87	.837	Proper transportation and handling of materials	3.60	.954	Unforeseen situation	3.79	.797	26th
27	timely supply of materials	3.72	.875	selection of goods supply centers/stations to be nearer	3.72	.939	Ensuring quality of design	3.53	.981	Application of Geographic Information System (GIS) in SCM	3.73	.988	27th

I. RESULTS AND DISCUSSIONS

According to the experts, the Attributes Identification for Performance Level Enhancement in Supply Chain Management SCM in Project Planning & Feasibility phase in public/private sector Building construction projects Sampling of materials before purchasing all products was first ranked with an average score of 4.51. clarity of drawings was ranked second with an average score of 4.46. The third-ranked rules and regulation of the government with 4.35. scope of the work was ranked as fourth with an average score of 4.35. The fifth involvement of the experienced in the procurement process with an average score of 4.34. External Factor Commitment of SCM partners towards continuous was ranked as sixth with a 4.27 average score. All other attributes are ranked accordingly.

According to the experts Attributes Identification for Performance Level Enhancement in Supply Chain Management SCM in design & Engineering phase in public/private sector Building construction projects. Clarity of drawings was first ranked with an average score of 4.39. Involvement of experienced staff in the procurement process was ranked second with an average score of 4.30. Ensuring quality of design ranked as third with average vale 4.30. rules and regulation of the Government ranked as fourth with an average value of 4.29. scope of the work was ranked as fifth with 4.28 average score. All other attributes are ranked accordingly. According to the experts, the Attributes Identification for Performance Level Enhancement in Supply Chain Management SCM in the Construction phase in public/private sector Building construction projects Clarity of drawings was first ranked with an average score of 4.49. timely supply of materials was ranked second with an average score of 4.38. The third Sampling of materials before purchasing all products with 4.38. The forth Trust between SCM partners with an average score of 4.34. Adoption of proper safety & Security measures was ranked as fifth with 4.31 average score. Scope of work continuous was ranked as sixth with 4.29 average score. All other attributes are ranked accordingly.

According to the experts, the Attributes Identification for Performance Level Enhancement in Supply Chain Management SCM in Hand Over & Acceptance phase in public/private sector Building construction projects Clarity of drawings was first ranked with an average score of 4.41. Clearly assuring expiry date on products was ranked second with an average score of 4.31. The third

Trust between SCM partners with 4.31. The forth Suitability of Partnership with an average score of 4.27. Ensuring quality of design was ranked as fifth with 4.14 average score. All other attributes are ranked accordingly.

II. CONCLUSION AND SUGGESTION

It was concluded that in building construction industry of Pakistan Most of the projects are not completed on time due to gaps in SCM by adopting the attributes which gave by respondents will increase the identification of the attributes for performance level enhancement in supply chain management will outcome to deliver the project within defined budget on schedule and quality. This research different attributes which came from the literature review and expert's responses that considering the identified level of different main criteria which will help public sector of Sindh, Pakistan.

I. FUTURE DIRECTIONS FOR FURTHER RESEARCH

In future, further researches may be conducted to inquire about more factors affecting on the performance level of SCM and level of deficiencies in Supply chain and its effects on the project. Similarly, future research may examine the performance level and level of deficiencies other than building construction projects in Pakistan.

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