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Hybrid Project Management Concepts for Adderssing Negative Attributes of Traditional Project management ; Case study in Construction Project Management in Sri Lanka

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***Abstract*— Construction project performance is criticised for high failure rates due to challenges associated with the complexity, nature and dynamism of environment. The research in this area suggest that practicing better project management methods are essential and urgent. Therefore the research focused on better project management concepts that are capable of addressing deficiencies of Traditional Project Management (TPM) and reduce project failures. The research of project management has turned in to a new era where hybrid concepts are evolving. In this research it is expected to derive a hybrid of lean and agile concepts that can be applied in construction project management.**

This paper use the results of an extensive literature survey on concepts such as lean and agile, hybrid approach of project management and the survey results of the industry regarding expected attributes of a new project management approach. A hybrid conceptual framework is drafted absorbing the strong attributes of Lean and Agile while mitigating the effects of weak attributes of TPM. To build up the relationship between variables "Constructive method or a "problem solving process" which is used in similar research is adopted. The results are used in the main research to propose a new hybrid concept in project management

***Keywords*—construction project management, hybrid concepts, lean, agile**

I. Introduction

All the nations are expecting higher prospects from the construction industry (Basbeth & Primiana, 2016). Unfortunately, the construction industry fails to deliver its desired contribution to the nation as a result of its high failure rates faced due to different constrains , challenges and deficiencies faced by the industry (KPMG, 2015) ((Klynveld Peat Marwick and Goerdeler).

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According to Aziz and Hafez (2013), the productivity of the construction industry worldwide has been declining over the past 40 years. They have cited in their thesis that, the productivity of the USA construction industry has been declining since 1964. And a similar decline in construction productivity has also occurred in other countries. Japan, for example, decreased from 3714 to 2731 Yen/Man/Hours over the period of 1990–2004 (Aziz & Hafez, 2013).

Hafez (2013) states that the success of a construction project mainly depends on two factors; construction project management approach and the technology. Silva etl (2006) concluded in their research in the Sri Lanka construction industry that, improvements in management aspects as a main effective motivator in the industry along with improvement of innovation. (Silva, Rajakaruna, & Bandara, 2006)

New project management approach which can be a solution to the complexities in the construction industry is needed for the improvement of project performance and to reduce the project failures faced by the construction industry of Sri Lanka today. (Davis N. , 2014) (Dolage & Pathmarajah, 2015) (Silva, Rajakaruna, & Bandara, 2006) (Silva, Warnakulasuriya, & Arachchige, 2015).

Pena-Mora etl (2008) has emphasized that the management approach should have the potential to support both the strategic and operational aspects of construction project management and to ultimately help increase project performance. Ofori (2013) indicated that attention must be paid to the 4Cs – communication, commitment, competency, and coordination in order to improve project performance and quality (Ofori, 2013) Javed etl.(2012) has explained the fragmented nature of project management process as planning, implementation and control and he has studied the factors that may integrate these processes towards successful performance of projects (Javed, Mahmood, & Sulaiman, 2012).

Demir (2013) highlighted that the project management approaches has evolved into new dimensions and future will be more to merging, combining different management methods and a better solution.

Considering the need and the trends, in this research it is meant absorption of best principles of new concepts such as lean and agile to overcome the deficiencies in current practice. The term 'hybrid' project management is used defining the combination of best of paradigms agile and lean and apply it in the traditional environment. This is derived referring the literature for this study based on the existing frameworks for hybrid of agile and lean, Leagile and Agilean concepts derived by other researchers and

considering the interview analysis results of experts in the construction industry of Sri Lanka

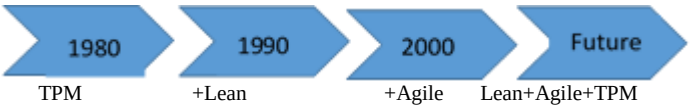

Figure 1- Trends of project management approach (Demir, 2013)

A. *Lean Concepts*

The adaptation in lean concepts in the construction industry has proven improvements in the projects performance (Abdelhamid-, 2008) (Aziz & Hafez, 2013) (Bottirov, 2011) (Diekmann, Balonick, Krewedl, & Troendle, 2003) (Dave, 2013) (Hafez, 2013) (Lehman & Reiser, 2004) (Merschbrock, 2009) (Salem, Solomon, Genaidy, & Minkarah, 2006). The Lean enterprise Institute state "the core idea is to maximize customer value while minimizing waste. Simply, lean means creating more value for customers with fewer resources." (LEI, 2016). The Japanese automaker Toyota adopted a change in philosophy in the 1970s that changed the way the world would approach production. Toyota was the first organization to bring "lean principles" into the limelight (Howell, 1999).The lean production philosophy, that had contributed to the manufacturing industry, took the attention of the people in the construction industry as well. Especially, since the early 1990s , a "lean construction" concept has been tried to be created and promoted by means of institutes, governmental reports, construction management scholars, some occupational organizations and so on. (Tezel, 2007). Louri Koskela was the first to introduce the lean movement in manufacturing to the construction industry. Koskela (1992) explains that lean construction include practice of just in time (JIT), use of pull-driven scheduling, reduction of variability in labour productivity, improvement of flow reliability, elimination of waste, simplification of the operation and implementation of benchmarking (Koskela, 1992) . Howell (1999) points out that, essential features of lean construction include a clear set of objectives for the delivery process, aimed at maximizing performance for the customer at the project level, concurrent design of product and process, and the application of production control throughout the life of the product from design to delivery (Howell, 1999) . In addition to that, Abdel Razek, and Abd Elshakour (2007) believe that the core idea of Lean Construction is to reduce or eliminate waste in non-value adding activities and increase the efficiency of value adding activities (Abdel-Razek, Abd Elshakour, & Abd Elshakour, 2007).

B. *Agile Concepts*

Agility in an organization is a cultural change and required dynamic innovation, and appetite for risk and adoption of changes (Medine, 2016)

Agile values which were published in 2001 in the Agile Manifesto for Agile Software Development: (Agilemanifesto, 2001) is explained as,

I. Individuals and interactions over processes and tools. -In Agile method it is considered that defined processes and complicated tools will not contribute enough if there are limited interactions among parties involved..

II. Working software over comprehensive documentation.

III. Customer collaboration over contract negotiation - Good relationship with the Customer is the most important and customer's party is involved throughout the project. Rather than going for conflict resolution, negotiations and arbitrations customer collaboration is maintained.

IV. Responding to change over following a plan - The detailed plans and schedules generated in the initial stage of the project expires its validity in the current dynamic environment. Therefore instead of following a tedious plan, in Agile Project Management, a method of responding to change and adopting to the situation is done.

Demir(2013) suggested in his research that Agile for construction can be viewed under five principles among which iteration is considered as the core. (Ferreira, 2013) explains that Agile methodologies introduce significant changes in relation to classical methods and the most significant change is to develop projects in an iterative cyclic way. Iterations divide the work to be performed by several stages, making deliveries to the customer at the end of each stage.

C. *Hybrid concept*

In the search of literature and the other source for a better Project Management concepts, it is observed that, there are ambiguities and doubts of a clearly defined approach. Some literature emphasized that Agile could be used (Ametepey, Anash, & Aigbavboa, 2014) in construction and some had the opposite. (Adjei & Rwakatiwana, 2009 ; Boehm, 2002) . Similarly there are researchers promoting lean concepts in construction (Aziz & Hafez, 2013), and some are questioning about the real advancement in the industry with the application of lean. (Sarhan & Fox, 2013)

A theory and a framework that combines, Agile and Lean in a traditional management environment would be able to perform better in the construction industry. (Adjei & Rwakatiwana, 2009 ; Chen, Reichard, & Beliveau.Y., 2007 ; Court, Pasquire, Gibb, & Bower, 2016 ; Demir, 2013; Spundak, 2014) Hybrid project management is suggested to derive from literature and applied conventions in existing project management system. The best components of lean and agile are merged to apply in the existing traditional environment as per the expert's views and comments.

Iqbal (2016), a project management practitioner and an expert discuss the possibility and the benefits of combining Lean and Agile in construction industry. He introduces the word as "LeAgile". His discussion is to stir up the minds to the possibility of applying a Lean-Agile or LeAgile method of project management, specifically for construction projects. It suggests using these two methods to enhance performance of each method by determining the differences and similarities (Iqbal, 2016). As it has been referring to the differences and similarities between lean and agile, initially it should be understood that lean is a philosophy whereas Agile is a conceptual framework governed by Agile

Manifesto, 2001. Lean works at reducing waste, giving value to the customer with an integrated and collaborative team. Agile's primary focus is not on value but on customer satisfaction through simple interactions working with a self-organizing team. Where lean would maximize the profitability, agile would maximize the sales by keeping the customer satisfied. Lean needs elaborate planning upfront like in waterfall model and cannot leave things to chance, while agile plans continuously throughout the life of the project in smaller iterations.

Naylor et al.(1997) cited by (Naim, Naylor, & Barlow, 2016) discuss the commonalities and differences between leanness and agility and following definitions are given;

I. Agility means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile market place.

II. Leanness means developing a value stream to eliminate waste, including time, and to ensure a level schedule

The adaptation of agile concepts in the project management system gives improvements of performance. (Adjei & Rwakatiwana, 2009) (Chin, 2004) (Fernandez & Fernandez, 2009) (Owen & Koskela, 2006) (www.pearsonhighered.com/samplechapter)

Application of a system which comprises positive values of lean and agile is more beneficial in the industry to overcome deficiencies in lean and agile. (Adjei & Rwakatiwana, 2009) (Boehm, 2002) (Chen, Reichard, & Beliveau.Y., 2007) (Court, Pasquire, Gibb, & Bower, 2016) (Demir, 2013) (Demir.T, Bryde, Fearon, & Ochieng, 2012) (Elmoselhy, 2012) (Hass, 2007) (Ikbal, 2015) (Rico, 2010). Demir in his Agiliean framework, suggested that PM, Lean and Agile methodologies should be merged into one unit. In this research it is proposed to merge lean and agile concepts for solving deficiencies in current practice and adopt it in the practicing traditional project management method.

II. Hybrid Concept Development

The extensive literature review provided the theoretical basis for developing the framework for this study. Commonly cited negative attributes of traditional project management approach, mostly cited lean and agile concepts are extracted from the literature review. Although they did not represent a complete inventory of factors, they represented the most cited. The interviews with industry experts were analysed to improve the validity of the factors extracted from literature and for deriving the hybrid framework.

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To build up the relationship between variables "Constructive method or a "problem solving process" which is used in similar research is adopted. (Han, 2003), (Kasanen, Lukka, & Siitonen, 1993), (Oyegoke, 2011), (Alsakini, 2012).

The process starts from "problem identification" (factors of failure), "solution development" the concept and possible action for each problem (theoretical/empirical data and practice of Lean and Agile paradigms) to "result evaluation" and "lessons learned" (derive proposed Hybrid Project Management (HPM) concept).

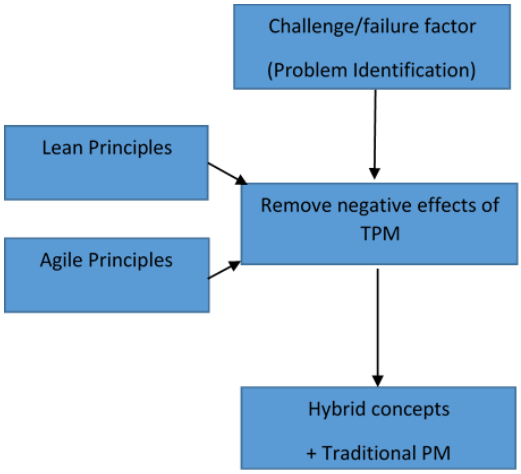

Figure 2- HPM Concept Development

III. Results and Discussion

Given that both Lean and Agile are emerging concepts in the construction industry, a hybrid conceptual framework is drafted absorbing the strong attributes of Lean and Agile while avoiding or mitigating the effects of weak attributes:

A. Hybrid Concept 1

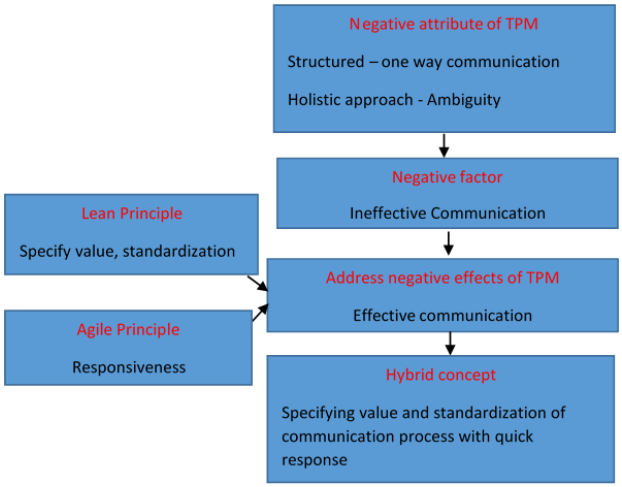

Figure 2- HPM Concept 1

Expected improvement: Effective and reliable communication

Applicable Lean principle: Specify value, standardization

Facilitating Agile Principle: Responsiveness

Hybrid Concept: There is a wide spread of stakeholders involved in conceiving a building project through typical stages such as design, finance, build, manage, upgrade and, ultimately, replacement. There is therefore a major need for communication to be systematic,

understood by all stakeholders or customers and intelligently applied (Aulich, 2013). Basic requirement for the process of Effective communication means understanding real need and value of the customer. Each project team member may be the customer to the member in the next process. Specifying the value, specifying procedures, documentation or standardizing in lean concepts (Perumal & Abubakar, 2011) and immediate and continues responsiveness in agile concepts is considered as the HLAPM concept. This process is considered to be active throughout the project between all the project team members including the end customer. According to Owen and Koskela, (2006) agile processes and methods all emphasize the advantages of communication flows within small teams. Communication is improved through the use of simultaneous broadband paths instead of discrete cascaded messaging; information is consequently rendered more immediate and better targeted. (Owen & Koskela, 2006)..

B. *Hybrid Concept 2*

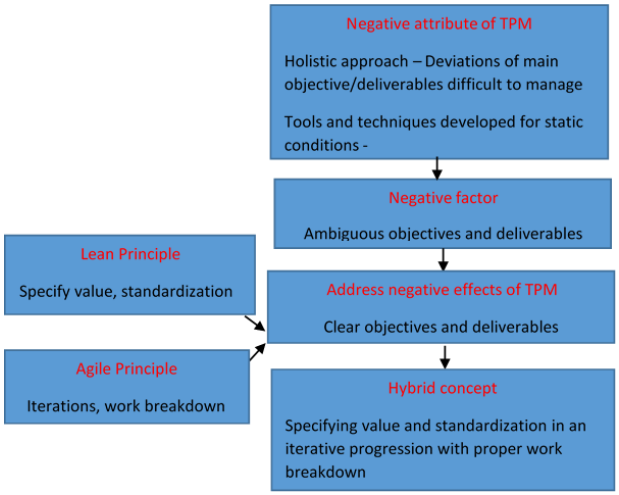

Figure 4- HPM Concept 2

Expected improvement: Clear objectives and deliverables.
Applicable Lean principle: Value, Standardization
Facilitating Agile principle: Iterations, Work breakdown
Hybrid Concept: Clearly defined goals and direction is based on identifying the value. Deciding critical activities that create value and avoiding non value adding activities need proper guidance and directions. For that Value and standardization in Lean concepts can be highlighted. (Diekmann, Balonick, Krewedl, & Troendle, 2003). Planning and organizing and defining goals is further facilitated with the work breakdown and assignment of work. (PMI, 2013) Because of the iterations Agile methodology gives an early view to the final product might look and behave. This helps into finalizing the user requirements and clear deliverables (Shubh. Gandhi)

C. *Hybrid Concept 3*

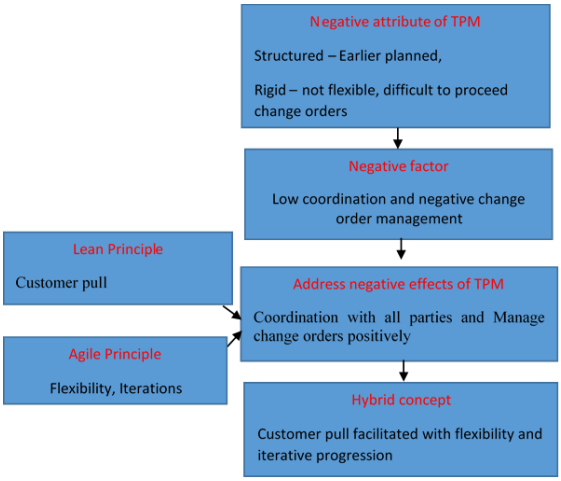

Figure 5- HPM Concept 3

Expected improvement: Coordination with all parties and Manage change orders positively
Applicable Lean principle: Customer pull,
Facilitating Agile principle: Flexibility, Iterations
Hybrid concept:
In a Lean environment change is reluctant and considered as a hindering factor for project success. But if the principle of customer pull is practiced the change orders may be minimized. Customer pull method flow of activities are based on the request of downstream work hence the merging of flexibility and customer oriented principles, change orders may be converted to positive change orders. (HEERY, 2015) Meetings with stakeholders and project teams for feedback on the incremental progress are a regular feature in APM approach to problem solving. (Adjei & Rwakatiwana, 2009). It is seen that in addition lessons learnt and recommendations for future are gathered in these meetings and used to improve the next iteration. Thus the APM principles may further facilitate the factor of positive change orders by its nature explained by Cadle and Yeast (2000) cited Adjei & Rwakatiwana (2009) " instead of trying to develop the whole system in one go, the system is divided into a number of iterations each adding some functionality or perhaps improved performance to its predecessors"
Coordination and positive change order management increase the client involvement and consultation which is identified as a critical factor for project success. In addition to that, client involvement may be improved due to iteration as it may be undertaken to eliminate project risks early in the project, before they can have a chance to sink the project and client will be informed periodically (www.pearsonhighered.com/samplechapter)

D. *Hybrid Concept 4*

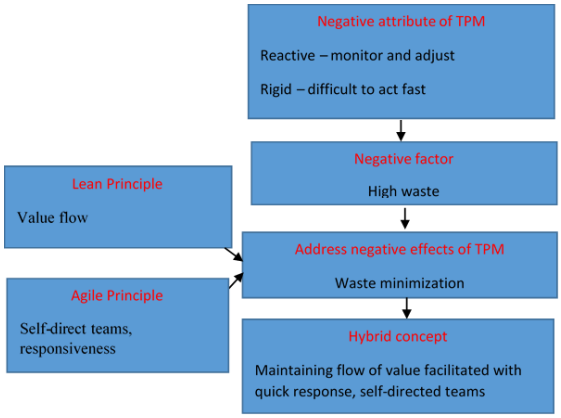

Figure 6- HPM Concept 4

Expected improvement: Waste minimization

Applicable Lean principle: Value flow

Facilitating Agile Principle: Self-directed teams, responsiveness

Hybrid Concept: Most of the lean concepts are oriented towards waste reduction. Eliminate Waste has been divided into four sub-principles; Supply Chain Management, Optimize Production System, Reduce Process Cycle Time, and Optimize Work Content. Optimize Work Content deals with issues associated with the impact of design on the ability to achieve lean performance. (Diekmann, Balonick, Krewedl, & Troendle, 2003).Concepts such as waste and value are not well understood by construction personnel according to Alwi etl.(2002). They emphasis that many people in the project team do not realize that many activities they carry out do not add value to the work. These issues contribute to a reduction in the value of construction productivity and could reduce company performance. Material wastes, time wastes are minimized by proper management methods according to Tezel (2007). He suggests that waste minimization may enhanced by self-directed trained workforce (Tezel, 2007)

E. *Hybrid Concept 5*

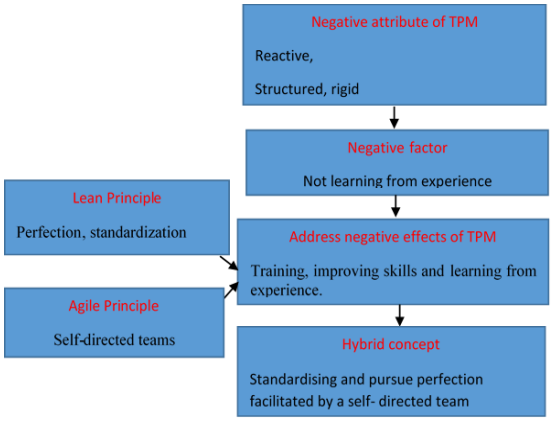

Figure 7- HPM Concept 5

Expected improvement : Training, improving skills and learning from experience.

Applicable Lean principle: Perfection,

Facilitating Agile Principle: Self-directed teams

Hybrid Concept: Perfection or Continuous improvement is an essential factor for project success and it is a basic philosophy of Lean approach. There are four sub-principles that define perfection according to Deikmen's explanations in 2013. These are, Error Proofing, Response to Defects, Metrics, and Organizational Learning. Each one of these sub-principles adds to the notion that quality should be inherent in a project, and that the quest to attain this level of near perfection should be an on-going and continuous pursuit. The first sub-principle, Error-Proofing, deals with taking proactive measures to eliminate improper assembly or installation. Response to Defects is the effective resolution to problems, and the retention of those solutions for use in the future. The quicker a problem is identified and resolved, the less time is lost to rework and other wastes. The next sub principle under Continuous Improvement the final sub-principle in this category is Organizational Learning. This sub-principle is a necessary tool for the continuous improvement. The research team's definition of Organizational Learning is the assimilation, retention, and transfer of knowledge throughout the company to enhance continuous process improvement. (Diekmann, Balonick, Krewedl, & Troendle, 2003) Always pursue perfection through learning and collaboration is enabled and enhanced by the self-directed team principle in Agile.

IV. Validation

A quantitative analysis mainly focused on determining the perception of the project managers and practitioners and validating the conceptual framework derived for the possible hybrid concept. The non-biased sample of the study 218 no was selected from the professionals currently employed in projects under Urban Development Authority (UDA) of Sri Lanka. The validation process includes descriptive and inferential statistical analysis.The questionnaire for getting the perception of respondents consist of ten questions which represent five concepts derived

TABLE 01 – DESCRIPTIVE STATISTICS HYBRID FRAMEWORK VALIDATION

	N	Mean	Std. Deviation	Variance	Median
Concept Q1	218	3.88	.746	.557	4.00
Concept1Q2	218	3.92	.793	.629	4.00
Concept2Q1	218	3.63	.800	.640	4.00
Concept2Q2	218	3.63	.861	.741	4.00
Concept3Q1	218	3.84	.746	.556	3.50
Concept3Q2	218	3.79	.787	.619	4.00
Concept4Q1	218	3.81	.656	.430	4.00

Concept4Q2	218	3.54	.750	.563	3.00
Concept5Q1	218	3.71	.708	.501	4.00
Concept5Q2	218	3.73	.722	.521	4.00
Valid N (listwise)	218				

The table 1 shows that all the items has gained an average rating higher than 3.56. In most of the items median is 4.00. The concept wise breakdown further clarifies the rates as shown in table 2 to table 6 below.

Concept 1

Concept 1, regarding specifying the value, standardization and responsiveness in order to achieve systematic communication are, explained in question one and question two.

TABLE 02- RESPONSE FOR CONCEPT1

Perception	Question1		Question2	
	Response	%	Response	%
Strongly disagree	0	0	0	0
Disagree	3	1.3	3	1.4
Neutral	66	28.3	69	31.7
Agree	103	44.2	89	40.8
Strongly agree	46	19.7	57	26.1

According to the results it is observed that more than 65% of respondents has rated agreed in both questions hence concept 1 is validated.

Concept 2

Concept two is regarding the merging of lean concepts such as value and standardization with agile concept iteration. The outcome of the respondents answers suggest that more than 50% is respondent as agree or strongly agree. However 41% and 42% of respondents has marked neutral or disagree in those two questions.

TABLE 03- RESPONSE FOR CONCEPT 2

Perception	Question1		Question2	
	Response	%	Response	%
Strongly disagree	0	0	0	0
Disagree	14	6	18	7.7
Neutral	83	35.6	82	35.2
Agree	91	39.1	81	34.8
Strongly agree	46	12.9	57	15.9

Concept 3

Concept three is derived as deficiency of low coordination and negative change order management existing in current practices due to the rigidity and structured nature of TPM. Respondents have approved the customer pull concept in lean incorporated with flexibility and iterative concepts in a higher rating of above 60% as depicted in the table 4.

TABLE 04- RESPONSE FOR CONCEPT 3

Perception	Question1		Question2	
	Response	%	Response	%
Strongly disagree	0	0	0	0
Disagree	6	2.6	9	3.9
Neutral	62	26.6	68	29.2
Agree	110	47.2	101	43.3
Strongly agree	40	17.2	40	17.2

Concept 4

The concept carries the questions relating to the possibility of merging flow of value with responsiveness in order to apply just in time techniques etc. effectively.

TABLE 05- RESPONSE FOR CONCEPT 4

Perception	Question1		Question2	
	Response	%	Response	%
Strongly disagree	0	0	0	0
Disagree	0	0	11	4.7
Neutral	71	30.5	101	43.3
Agree	117	50.2	83	35.6
Strongly agree	30	12.9	23	9.9

Concept 5

The fifth concept was about the improvement in the quality and the culture of pursuing perfection.

TABLE 05- RESPONSE FOR CONCEPT 4

Perception	Question1		Question2	
	Response	%	Response	%
Strongly disagree	0	0	0	0
Disagree	5	2.1	3	1.3
Neutral	80	34.3	85	36.5
Agree	106	45.5	98	42.2
Strongly agree	27	11.6	32	13.7

This concept too has validated by more than 55% of total agreement and strongly agreement.

One of the salient value in the analysis is that no respondents have completely rejected or disagreed to any of the concepts. For all the questions totally disagreement has not mentioned by any of the respondents.

v. Conclusion

The derivation of possible hybrid concepts is based on the literature survey findings as well as the results of the qualitative analysis. Five hybrid concepts were derived considering strengths of lean and agile which is capable of reducing weakness of TPM. The constructive approach used in similar researchers is used for this process. (Han, 2003), (Kasanen, Lukka, & Siitonen, 1993), (Oyegoke, 2011), (Alsakini, 2012)

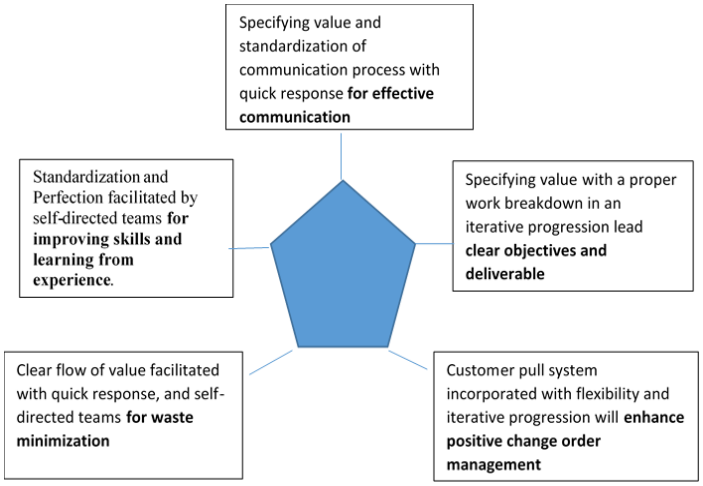

Figure 02- Hybrid Project Management Concept

Perception of respondents regarding hybrid framework - descriptive statistics Mean is above the average in all the five concepts. Since it implies that most of the practitioners have agree to the concepts presented in framework. Hence it can be concluded that, all the concepts are approved and validated by the practitioners.

References

Abdel-Razek, R., Abd Elshakour, M., & Abd Elshakour, M. (2007). Labour productivity: benchmarking and variability in Egyptian projects. International Journal of Project Management, 189-197.

Abdelhamid-, T. (2008). Lean construction overview. USA: Michigan State University.

Adjei, D., & Rwakatiwana, P. (2009). Application of traditional and agile project management in consulting firms. Ghana: Umeå School of Business.

Alsakini, W. (2012). Two models for managing the virtualisation of construction management firms in the context of Finnish construction markets. Espo, Finland: Aalto University.

Alwi, s., Hampson, k., & Mohomed, S. (2002). Waste in the Indonesian construction projects. 1st International Conferences of CIB W107

Agilemanifesto. (2001). agilemanifesto.org/. Retrieved from Manifesto for agile software development: http://agilemanifesto.org/

Ametepey, S. M., A. S., & Aigbavboa, C. (2014). Awareness and prospects of agile project management in the Ghanaian construction industry. Johanarsberg: University of Johanarsberg.

Aulich, H. (2013). The role of effective communication in the construction industry. Australasian Journal of Construction Economics and Building.

Aziz, R., & Hafez, H. (2013). Applying lean thinking in construction and performance improvement. *Alexandria Engineering Journal*, 679-695.

Boehm, B. (2002). Get ready for agile methods with care. IEEE Computer, 35(1), 64-69.

Bottirov, O. (2011). Lean construction in construction company. VIA University College.

Cadle, J., & Yeates, D. (2008). *Project Management for Information Systems* . England: Pearson Education Ltd.

Chen, Q., Reichard, G., & Beliveau.Y. (2007). Interface management- A facilitator of lean construction and agile project management. Proceedings IGLC-15. Michigan, USA: 57-66.

Chin, G. (2004). Agile project management; how to succeed in the face of changing requiement. New York: Amacom Publisher.

Court, P., Pasquire, C., Gibb, A., & Bower, D. (2016, 06 05). Design of lean and agile construction for a large and complex mechanical and electrical project. Dave, B. (2013). Developing a construction management system based on lean construction and building information modelling.

Demir, S. (2013). *Agilean project management- A unifying strategic framework to manage construction projects.* UK: Liverpool John Moores University.

Demir.T, Bryde, D. J., Fearon, D. J., & Ochieng, E. G. (2012). Re-conceptualizing lean in construction environments –. *48th ASC Annual International Conference Proceedings.* Associated Shools of Construction.

Diekmann, J., Balonick, J., Krewedl, M., & Troendle, L. (2003). Measuring lean confermance. Michigan ,USA: Project Director, Washington Group International.

Elmoselhy, S. A. (2012). Implimetation of the hybrid lean-agile manufacturing system strategic facet in automotive sector. International Journal of Advances in Engineering & Technology.

Fernandez, D., & Fernandez, J. (2009). Agile project management- agilism vs traditional PM. The Journal of Computer Information Systems.

Han, F. (2003). Defining and evaluating agile construction management for reducing time delays in construction. Beiging, China: Beijing University of Technology.

Howell, G. (1999). What is lean construction. Research Gate.

Ikbal, S. (2015, July 22). Lean and Agile Construction. Kasanen, E., Lukka, K., & Siitonen, A. (1993). The constructive approach in management accounting research. Journal of managament accounting research, 241-264.

Medine, L. (2016, 06 06). Agile Portfolios: A 3-D Approach. Retrieved from

Merschbrock, C. (2009). Lean production construction –. Reykjavic University.

Naim, M., Naylor, J., & Barlow, J. (2016, 06 29). Developing lean and agile supply chain in the UK

Owen, R., Koskela, L., Henrich, G., & Codinhoto, R. (2006). Is Agile Project Management Applicable to Construction? *Proceedings IGLC-14, July 2006,* , (pp. 51-66). Santiago, Chile.

Oyegoke, A. (2011). The constructive research approach in project management research. International journal of managing projects in business, 573-595.

Perumal, V., & Abubakar, A. (2011). The need for standardization of documentation towards an efficient communication in construction Industry. World Applied Science Journal. Retrieved 10 10, 2016,

Salem, O., Solomon, J., Genaidy, A., & Minkarah, I. (2006). Lean construction: from theory to implementation. *Jounal of Management in Engineering*, 168-175.

Sarhan, S., & Fox, A. (2013). Barriers to implementing lean construction in the UK. The Built & Human Environment Review, 6.

Shubh. Gandhi, P. (n.d.). SWOT analysis for agile methods. UACEE International Journal of Computer Science and its Applications, 2(1).

Silva, N., Rajakaruna, R. C., & Bandara, K. (2006). Challenges faced by the construction industry in Sri Lanka: perspective of clients and contractors. University of Moratuwa, Sri Lanka.

Spundak, M. (2014). Mixed agile/traditional project management methodology – reality or illusion? *Procedia-Social and Behavioral Sciences*, 939-948.

Tezel, B. A. (2007). A statistical approach to lean construction implementation in Construction Industry in Turkey. Middle East Technical University.

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