



LJMU Research Online

Ranadewa, KATO, Y.G. Sandanayake, YGS and Siriwardena, M

Enabling lean through human capacity building: an investigation of small and medium contractors

<http://researchonline.ljmu.ac.uk/id/eprint/15013/>

Article

Citation (please note it is advisable to refer to the publisher's version if you intend to cite from this work)

**Ranadewa, KATO, Y.G. Sandanayake, YGS and Siriwardena, M (2021)
Enabling lean through human capacity building: an investigation of small and medium contractors. Built Environment Project and Asset Management. ISSN 2044-124X**

LJMU has developed **LJMU Research Online** for users to access the research output of the University more effectively. Copyright © and Moral Rights for the papers on this site are retained by the individual authors and/or other copyright owners. Users may download and/or print one copy of any article(s) in LJMU Research Online to facilitate their private study or for non-commercial research. You may not engage in further distribution of the material or use it for any profit-making activities or any commercial gain.

The version presented here may differ from the published version or from the version of the record. Please see the repository URL above for details on accessing the published version and note that access may require a subscription.

For more information please contact researchonline@ljmu.ac.uk

<http://researchonline.ljmu.ac.uk/>

Enabling lean through human capacity building: an investigation of small and medium contractors

K.A.T.O. Ranadewa and Y.G.Sandanayake

*Department of Building Economics, University of Moratuwa, Sri Lanka,
and*

Mohan Siriwardena

*School of Civil Engineering and Built Environment, Liverpool John Moores University,
Liverpool, UK*

ABSTRACT

Purpose: This paper investigates the lean enabling human capacities and develops a framework integrating individual, organisational and environmental level strategies to build human capacities for successful lean implementation of small and medium contractors (SMCs) in Sri Lanka.

Design/methodology/approach: An interpretivism stance is adopted and a qualitative research approach used. The data collection technique adopted is semi-structured interviews. 24 experts with experience in lean implementation of SMCs were interviewed and data were analysed through code based content analysis using NVivo10.

Findings: Team working skills, critical thinking, leadership, communication skills, work ethics, knowledge and positive attitudes were identified as lean enabling human capacities for SMCs. The framework developed in this study provides individual, organisational and environmental level strategies that can be used to build human capacities necessary for enabling lean in construction SMCs.

Practical implications: The study will be beneficial to construction SMCs, academics, researchers, and government institutions in developing countries, which share socio-economic, demographic or cultural traits similar to Sri Lanka.

Originality/value: A novel lean enabling human capacity building framework is developed with the strategies required for building those capacities in order to accelerate the lean implementation in construction SMCs. This contributes to the body of knowledge as it uncovers individual, organisational and environmental level strategies for enabling lean through human capacity building in Sri Lankan SMCs.

Keywords: Human Capacity Building; Lean Construction; Small and Medium Contractors (SMCs); Sri Lanka.

1. INTRODUCTION

Small and Medium Contractors (SMCs) have recognised that increase of non-value adding activities (NVAA) as a major challenge in construction industry (Tezel, Koskela & Aziz, 2017; Ranadewa, Sandanayake & Siriwardena, 2018), thereby highlighting the importance of SMCs in implementing lean . However, implementation of lean by SMCs is not free from barriers (Ankomah, Ayarkwa & Agyekum, 2020; Tezel *et al.*, 2019; Rymaszewska, 2014; Shang & Pheng, 2014). On the other hand, prior research Koskela, Howell, Ballard and Tommelein, (2014); Aziz & Hafez, (2013); Alves, Azambuja and Arnous, (2016) point out the need of enhancing human capacities for successful lean implementation. Although, lean construction is still at a relatively premature stage within the SMCs in Sri Lanka, Ranadewa, Sandanayake and Siriwardena (2017) emphasised that human capacity building as a key to success in lean implementation of construction SMCs in Sri Lanka. However, there is dearth of research on enabling lean through human capacity building. Therefore, this paper proposes a framework to build lean enabling human capacities in Sri Lankan SMCs. The objectives of the research are to investigate lean enabling human capacities, and identify the strategies to develop them by SMCs.

Firstly, a literature review on why lean implementation fails in, and the need of building human capacities for enabling lean in construction SMCs is presented. Research methodology adopted is presented as the next section, followed by the findings of the research in terms of lean enabling human capacities and strategies for building those human capacities. Finally, a framework for lean enabling human capacity building is developed for SMCs in Sri Lanka.

2. LITERATURE REVIEW

2.1 WHY LEAN IMPLEMENTATION FAIL?

Application of lean concept by construction organisations and construction projects during both design and construction phases is a developing trend. However, prior studies reveal that SMCs do not have the capacity to implement lean concept (Chiarini, 2012; Ankomah *et al.*, 2020). SMCs and the industry as a whole have been criticised for limited collaborative working philosophies, slow uptake of new technologies and processes and issues with organisational management (Miller *et al.*, 2002). Considering the investment levels of the construction industry and the development needs of most of the developing countries, attention to these matters is long overdue. SMCs constitute the largest sub-sector of the construction industry and their performance impacts significantly on the performance of the industry. Nevertheless, there is a notably low rate of adoption of lean principles by SMCs than by large contractors (Rymaszewska, 2014). Supportively, Alkhoraif, Rashid and McLaughlin (2019) stressed that the lean maturity level of micro-sized firms is relatively low when compared with Small and Medium sized firms. Similarly, SMCs were able to gain more benefits from lean practices compared to micro-sized firms as most of the required basic capacities were

available at the SMCs. Yet, most of the SMCs are still unfamiliar with lean concept (Ankomah *et al.*, 2020; Rymaszewska, 2014).

Unlike the manufacturing industry, research that investigate lean implementation in SMCs remains scarce (Antosz & Stadnicka, 2017). Although Rymaszewska (2014) and Chiarini (2012) highlighted the importance of implementing lean in SMCs, it is still at its infancy. Tezel *et al.* (2017) differentiated the current status and future direction of lean construction in SMCs and highlighted that the absence of implementable framework(s) focusing on individuals of the SMCs have hindered lean implementation. Although the challenges of lean implementation in construction and solutions to overcome them have been previously explored (Shang & Pheng, 2014; Aziz & Hafez, 2013; Pérez & Costa, 2018), there is a paucity of research on lean implementation and how to overcome the barriers of lean implementation through effective management of individuals in Sri Lanka (Senaratne & Wijesiri, 2008; Pandithawatta, Zainudeen & Perera, 2019).

According to Koskela *et al.* (2014), lean construction requires changes in individual behaviour. Moreover, building human capacities will accelerate the lean implementation (Ranadewa *et al.*, 2018) and adds value to SMCs to better perform in the industry. Hence, SMCs must identify the necessary capacities to fully benefit from lean implementation. Ohno (1988) and Bhasin (2012) stressed that lean depends on the knowledge and skills of the people. Hence, the transformation towards successful lean implementation in construction industry will lead to changes in the culture and its people (Green *et al.*, 2008) thereby necessitating a considerable attention on human capacity building.

2.2 LEAN ENABLING HUMAN CAPACITIES

Human capacity refers to the will and ability of an individual to set objectives and to achieve them using one's own knowledge and skills (Matachi, 2006). However, Kululunga (2012) specified that contributions at individual level capacity building for construction industry refer to how individuals in the industry are equipped with relevant education, training and continual professional development (CPD). Nevertheless, OECD (2012) defined individual capacity as knowledge and skills to set and achieve objectives. Similarly, Enemark and Ahene (2002) identified human capacities in terms of knowledge, skills, personal and group attitudes for developing and managing certain areas, which ensure long-term sustainability.

Lean is not just a set of tools and techniques, but at its heart is the people (Ohno, 1988; Bhasin, 2012), and its people whose knowledge, intelligence and desire to improve that steers organisations to new levels of continuous improvement (Hines *et al.*, 2008; Bhasin, 2012). Therefore, success of lean implementation heavily relies on the skills of the workforce and their responsiveness to change (Sawhney & Chason, 2005). Thus, identification of existing capacities and required capacities of individuals are paramount for successful lean implementation.

In spite of the plethora of research related to human capacities in the construction industry, there is a lack of studies focusing on human capacities required for successful lean implementation. Table 1 presents the human related capacities highlighted in the literature for successful lean implementation.

Table 1: Human capacities required for successful lean implementation

Human Capacities Necessary for Lean Implementation	References (Citations are given below)											
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
Knowledge	X	X	X	X		X		X	X	X	X	X
Relevant education	X	X	X	X		X	X	X		X		X
Technical skills		X							X		X	X
Managerial skills	X	X				X	X	X		X		X
Values and attitudes	X	X		X				X			X	
Willingness to set and achieve objectives		X			X							
Capacity to build relationships	X		X			X						X
Trust and legitimacy		X										
Experience	X	X		X	X					X	X	
Sufficient training	X	X	X	X	X	X	X	X		X	X	X
Continuous professional development	X				X				X			
[1] Achanga <i>et al.</i> , (2006); [2] Alves <i>et al.</i> , (2016); [3] Ankomah <i>et al.</i> (2017); [4] Antosz & Stadnicka (2017); [5] Gao & Low (2014); [6] Chiarini, (2012); [7] Dora & Gellynck, (2015); [8] Jin & Ling (2005); [9] Kululanga, (2012); [10] Ranadewa <i>et al.</i> , (2017); [11] Rymaszewska, (2014); [12] Tezel <i>et al.</i> , (2017)												

Accordingly, Table 1 evidences that relevant knowledge and education are paramount for individuals in SMCs. Similarly, they require improving the managerial and technical skills through appropriate training to accelerate lean implementation. One of the lean implementation barriers is the resistance to change by SMCs (Tezel *et al.*, 2017; Ranadewa *et al.*, 2017). Thus, values and attitudes that promote critical reflection and continuous improvement are required among the individuals of the organisation (Samaraweera, Senaratne, & Sandanayake, 2018). Moreover, access to resources and experiences that can develop individual capacity are largely shaped by the organisational and environmental factors, which in turn are influenced by the degree of capacity development in each individual. Matachi (2006) specified that further reflection and reaction from different parties regarding capacities will undoubtedly alter and enrich the paradigm of capacities.

Kululanga (2012) noted that the majority of indigenous construction companies are small, lack capacities, and thus, problems tend to be exacerbated by the volatile environment in which they operate. Therefore, the enabling environment consists of the construction industry as well as the government institutions that need to support the individuals of SMCs to build their capacities. Therefore identification of human

capacities to be developed by different parties is also vital for successful lean implementation.

2.3 LEAN ENABLING HUMAN CAPACITY BUILDING

Human capacity in a system context can be developed by three level entities, i.e. individuals, organisations and external environment as per Matachi (2006). Hence, lean enabling human capacity building strategies were reviewed under individual, organisational and environmental levels.

2.3.1 Individual Strategies

UNDP (2009) identified that individuals can develop capacities such as skills, experience and knowledge that allow them to perform in their organisations. Individual level capacity building strategies explicitly focus on skill development, building stronger relationships, knowing how, knowing what and co-creation of meaning and understanding (Jennings and Wargnier, 2015) of the employees in the organisation. Supportively, Badurdeen *et al.* (2010) highlighted the importance of lean soft skills development. Thus, building soft skills of individuals can be considered as one of the critical strategy amongst the lean implementation initiatives (Sawhney & Chason, 2005; Ankomah *et al.*, 2020). Thus, SMCs as well as the external environment need to support building lean enabling human capacities.

2.3.2 Organisational Strategies

OECD (2012) defined organisational level capacity building strategies as organisational systems that bring individual capacities effectively together. They refer to the internal structure, policies and procedures that determine the organisation's effectiveness (Kululanga, 2012; UNDP, 2009). Implementing lean enabling human capacities may require SMCs to rethink their business strategies. Lopes and Theisohn (2003) identified training individuals as a strategy to improve the required lean capacities. Kululanga (2012), and Ankomah *et al.* (2020) added training aligned to construction industry needs, life-long learning driven by the individuals, and training supported by the organisation as some of the organisational strategies for building lean human capacities.

2.3.3 Environmental Strategies

UNDP (2009) defined environment level strategies as the broad social systems within which people and organisations function and referred to policy, legal, regulatory, economic and social systems that supports capacity building. However, lean does not receive the necessary attention and support from governments in many countries as reflected in the literature (Kululanga, 2012; Tezel *et al.*, 2019; Ankomah *et al.*, 2020). Formation of such support groups for lean implementation among SMCs at the sectorial or national level (Tezel *et al.*, 2019) can be useful for an increased uptake of lean by construction SMCs.

Although attempts have been made to develop lean frameworks which include capacity building in China (Gao & Low, 2014), Middle East (Al-Aomar, 2012), USA (Paez *et*

al., 2005), UK (Sarhan & Fox, 2013) and India (Ahuja, Sawhney & Arif, 2018) in construction industry, the focus on human capacities in such frameworks is relatively insufficient. Tezel *et al.* (2017) also noted the lack of implementable frameworks focusing on individuals of the SMCs. Sri Lankan research efforts on lean construction to date (Pandithawatta *et al.*, 2019; Ranadewa *et al.*, 2017; Ekanayake & Sandanayake, 2017; Senaratne & Wijesiri, 2008) have address this aspect either. Therefore, a lean enabling framework focusing on the Sri Lankan context and specifically for SMCs is long overdue. Hence, it is high time to investigate how lean can be enabled in SMCs through human capacity building.

3. METHODOLOGY

This research aimed to develop a framework to build lean enabling human capacities of SMCs. A literature review was carried out to explore the theoretical background of lean enabling human capacities. In the absence of prior research, there is a need to ascertain different views of the experts for SMCs on lean enabling human capacities and human capacity building strategies in Sri Lanka. Recognising the importance of valuing and encouraging the free flow of ideas, opinions, perceptions and experience of individuals within the researched environment and human interactions were considered as the main drivers of the study. Hence, the study adopted the ontological assumption of ‘reality is not pre-determined, but socially constructed’, and the epistemological assumption of ‘the knowledge is gathered by examining the views of the people’ as suggested by Saunders, Lewis and Thornhill (2009). Similarly, in terms of the axiology, the study takes the value laden stance as it recognises that the possibility of researchers adding value in a manner that influences the study. Thus, the overall research approach is in line with the interpretivism stance.

The research followed the qualitative strategy advocated by Saunders *et al.* (2009). This research required addressing the question “*How can SMCs enable lean through capacity building?*”. Since the study is of an exploratory nature and requires an in-depth investigation about the phenomenon within its real-world context, it has been argued that qualitative approach is more appropriate. Moreover, SMCs lack knowledge on lean construction, and hence the research required the input of experts with experience in SMCs and lean implementation in construction projects in Sri Lanka. Semi-structured interviews with experts in Sri Lanka selected through snowball sampling was used as the empirical data collection technique. A semi-structured interview guideline was used as it enabled the much needed flexibility to facilitate in-depth investigation and also to retain the control of the interview process. 24 experts were interviewed and their profiles are presented in Table 2.

Table 2: Profile of Experts

Ref. No	Designation	Awareness of Lean Construction	Current working sector	Experience in construction industry	Experience in SMCs
E1	Chairman	Well aware	SMC	34	20

E2	Managing Director	Aware	SMC	15	10
E3	Managing Director	Aware	SMC	22	10
E4	Project Coordinator	Aware	SMC	17	12
E5	Senior Technical Advisor	Aware	SMC	30	10
E6	Project Coordinator	Aware	SMC	20	10
E7	Managing Director	Aware	Large Contractor	24	20
E8	Managing Director	Aware	Large Contractor	20	20
E9	AGM	Aware	Large Contractor	28	18
E10	Head-contract and procurement	Well aware	Large Contractor	20	15
E11	Senior Quantity Surveyor	Aware	Large Contractor	17	10
E12	Chairman	Well aware	Large Contractor	28	18
E13	Managing Director	Aware	Large Contractor	26	20
E14	Managing Director	Aware	Large Contractor	20	15
E15	CEO	Aware	Regulatory body-Construction	25	10
E16	Chairman	Aware	Regulatory body-Construction	20	10
E17	Director	Aware	Regulatory body-Construction	17	10
E18	Managing Director	Aware	Regulatory body-Construction	30	15
E19	Head of Group Lean Enterprise	Well aware	Construction/manufacturing	15	10
E20	Senior Executive	Well aware	Construction/manufacturing	17	10
E21	Senior Professor	Well aware	Academia/ Construction	32	05
E22	Operational manager	Well aware	Construction/manufacturing	18	10
E23	Managing Director	Well aware	Construction/manufacturing	20	10
E24	Managing Director	Well aware	Construction/manufacturing	17	10

Interviewees included Managing Directors of SMCs, lean consultants, Senior Project Managers and Senior Quantity Surveyors, with more than 20 years' experience in the construction industry. Code based content analysis was used to produce a uniform schema of categories, which facilitated the comparison of factors (Flick, 2009) and NVivo10 was used to analyse the data. This approach enabled effective organising and reducing the time taken for unstructured data analysis.

The coding was carried out using the principles of open, axial and selective coding as advocated by Douglas (2003). The aim of open coding is to begin the unrestricted labelling of all lean enabling human capacities and strategies highlighted by experts. Axial codes identify relationships between open codes, for the purpose of developing core codes. Selective coding requires the selection of the focal core code, that is, the central phenomenon that has emerged from the axial coding process (Douglas, 2003). Table 3 presents the selective codes identified during the content analysis process to identify and establish the relationship between lean enabling human capacities and relevant strategies.

Table 3: Selective codes to establish the relationship between capacities and strategies

Coding categories	Selective codes	Number of selective codes
Lean enabling human capacities	<ul style="list-style-type: none"> • Communication skills • Critical thinking • Knowledge • Leadership • Positive attitudes • Team working 	07 (Refer Figure 1)

	<ul style="list-style-type: none"> • Work ethics 	
Individual level strategies	<ul style="list-style-type: none"> • Training • Learning • Develop soft skills' • Start lean • Use of existing capacity • Monitor and report individual progress 	06 (Refer Figure 2)
Organisational level strategies	<ul style="list-style-type: none"> • Research and development • Training and Learning • Start lean with pilot project • Use of existing capacities • Appropriate recruitment • Strategic investments • Maintain lean culture • Networking • Learning by doing • Monitor and report individual progress 	10 (Refer Figure 3)
Environmental level strategies	<ul style="list-style-type: none"> • Introduce policies and laws • Educating and training • Encourage professional development • Develop lean code of conduct • Financial support 	05 (Refer Figure 4)

Accordingly, 07 selective codes for lean enabling human capacities have emerged from the axial coding process. Moreover, 06, 10 and 05 selective codes were identified as individual, organisational and environmental level lean enabling strategies respectively to enable lean human capacities. These selective codes were named by the researcher to present the more context specific outcome incorporating the rich and in-depth information which helps in developing the strategies. Furthermore, interactive data visualisation tool, Power Bi was used to present the analysed data of the research.

4. RESEARCH FINDINGS

This study investigated the lean enabling human capacities, and strategies to build them in SMCs. Following sub-sections elaborate findings of this research study.

4.1 LEAN ENABLING HUMAN CAPACITIES FOR SMCs

Lean awareness of the experts was confirmed through the questions posed on lean principles, and lean tools for SMCs. The question “what are the capacities required for the employees of SMCs to implement lean” were explored subsequently. Human capacities presented in Table 1 were used as the basis to facilitate a rich exchange of views during the interviews. All experts emphasized the absolute necessity of developing lean enabling human capacities of SMCs in Sri Lanka. The codes were identified through Nvivo10 and used MS Visio to graphically present the mind map. The research findings presented in Figure 1 shows 07 selective codes (highlighted in red) along with the related axial codes.

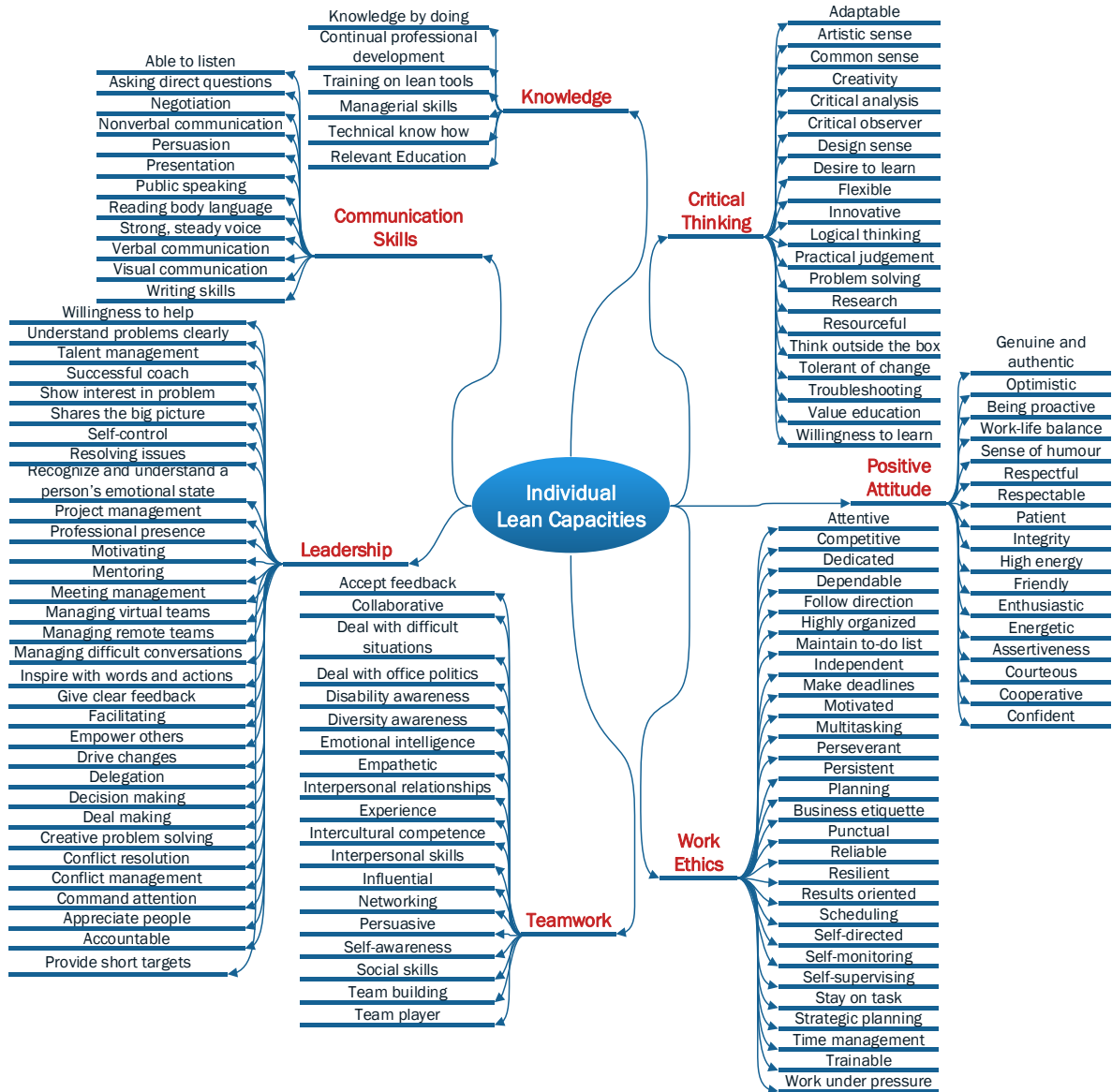


Figure 1: Mind map of lean enabling human capacities

The participants were requested to identify human capacities that enable lean in SMCs. Many of the participants specified that appropriate verbal, non-verbal and visual **‘communication skills’** of employees are essential for lean implementation within the SMCs. Similarly, critical analysis of a problem and deriving a solution are crucial for continuous improvement. Hence, lean experts suggested **‘critical thinking’** as one of the most important capacities that need to be improved by employees. Individuals need to be adaptive to changing conditions and develop divergent thinking.

One of the important lean capacities that individuals in SMCs should have is the **‘leadership’**, which has a major role to play in the individual lean capacity building. E2 highlighted that, *“I want the Project Manager to think and act as the captain of a ship*

who feels responsibility and accountability for the project'. Moreover, E21 commented that, the leader needs to be accountable, appreciate people, drive changes, motivate and shares the big picture with others. Conflict management and willingness to help, were added by E16 as essential qualities of leaders. However, leadership is not limited to senior or middle management levels. As highlighted by E2, even the shop floor (operative) level workers must become self-leaders. Therefore, there is a need to change the work philosophy. Correspondingly, E22 stressed the need to change the way people think and their approach to work. This necessitates fostering **'positive attitudes'** among the individuals. This was further proven by E12 specifying that *'when there is a problem, what I expect from the project manager is to come up with alternatives rather blaming others. These are difficult to change overnight, yet needed'*.

Effective collaboration was also noted as a requirement for lean implementation to succeed. E12 pointed out the need for a higher level of 'attention to detail' than what the 'rule of thumb target' demands, thereby highlighting the need for genuine **'team working'**. Supportively, E6 contended that, employees need to be collaborative, accept feedback and should have the capacity to handle challenging situations, and E19 stressed the need to establish interpersonal relationships and networking with the team members.

The experts highlighted the need of having employees who are dedicated, reliable and results oriented. E2 specified, *'If I had independent, multitasking two employees who follow directions and achieve deadlines, I could have implemented lean tools at site. People are lazy and schedule their day today works'*. Thus, E2 and E19 stressed the need of workers to be self-directed, self-monitoring, self-supervising, stay on task and trainable to achieve the objectives of lean implementation. Failure to do so is likely to hinder, lean implementation from the very outset. Therefore, corporate **'work ethics'** can be identified as another category of human lean capacities of SMCs.

Lean consultants E19 and E20 highlighted the need of lean knowledge and the technical know-how for SMCs. Thus, the employees need to be trained to ascertain knowledge by doing and obtain sufficient training. Therefore, ability to learn by doing and to apply what is learnt are essential. Moreover, E19 contended, senior management should not be very conservative when recruiting employees and must ensure that the selected employees are qualified not only with relevant education, but able to apply them effectively in the projects. Hence, **'sound knowledge'** is identified as another lean enabling human capacity.

In summary, communication skills, critical thinking, leadership, positive attitudes, team working and work ethics can be identified as lean enabling human capacities in SMCs. Whilst literature agreed with the above, Tezel *et al.* (2017), Ankomah *et al.* (2020), Alves *et al.* (2016) and Ranadewa *et al.* (2017) identified knowledge as an essential capacity that enables lean among SMCs. Having identified the lean enabling human

capacities, the next section elaborates the framework that explains strategies to develop the above-mentioned human capacities.

4.2 STRATEGIES TO BUILD LEAN ENABLING HUMAN CAPACITIES

Strategies that contribute to the development of lean enabling human capacities of SMCs are categorised under individual, organisational and environmental level strategies based on the expert opinions.

4.2.1 Individual level strategies to build human capacities for enabling lean

As part of the interview questions, the ways that the employees can build their capacities that support successful lean implementation were explored. The individuals include all employees of the SMCs. Accordingly Figure 2 presents the lean enabling human capacities and the individual level strategies for building lean enabling human capacities. Figure 2 further demonstrates the relationship between the strategies and capacities through a chord diagram.

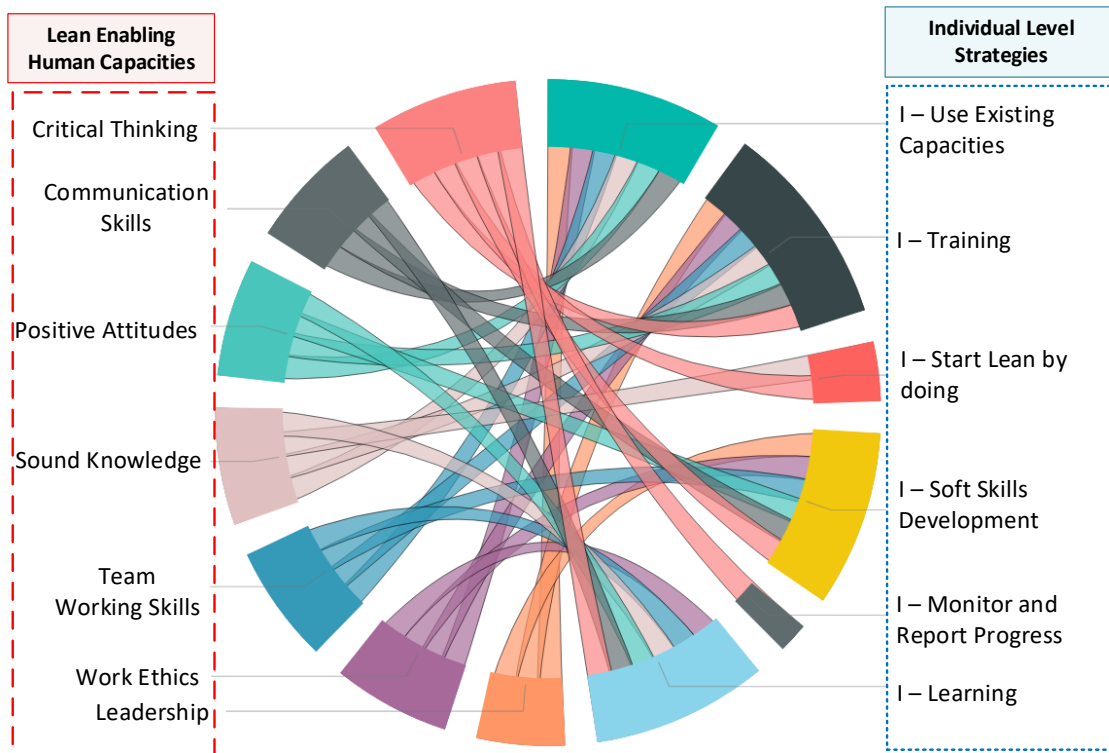


Figure 2: Individual level strategies for lean enabling human capacity building

E15 specified that ‘you cannot ask the way to build the capacities in one way; there are plenty to do to build capacities’. Correspondingly, the experts highlighted the importance of providing relevant training to employees of the SMCs. Therefore, E2 stated that, as SMCs are having few numbers of employees, providing training for them

is stress-free compared to large contractors. However, to build up lean capacities, E19, E21, E22 stressed that SMCs should encourage their employees as well as the senior management to be trained in order to improve their ability to perform functions. On the other hand, E5 mentioned that, it necessitates encouraging the employees to be vigilant to identify the available programs and attend them to gather knowledge. E15, E17, E18 detailed that most of the government programs are conducted free of charge or at very low rates for SMCs. Therefore, they need to obtain such benefits of being SMCs in the construction industry. E19 and E21 highlighted the need of attending CPD programmes. Accordingly, continuous '**training**' was identified as an individual level strategy.

One of the major characteristics of lean implemented organisations is the continuous commitment to '**learning**'. E19 specified, '*learning makes people aware on the available alternatives and gives courage to propose new improvements*'. Similarly, E8 added, '*we need to continue learning not the way we are doing now. It needs to be done in a proper way*'. All the experts agreed that there are opportunities to learn in the construction industry, which will support SMCs in building lean human capacities. Development of soft skills will improve the problem solving skills of employees. Similarly, SMCs can '**develop soft skills**' of employees by organising in-house training programs to develop leadership skills, communication skills, creative thinking and interpersonal skills. As discussed in section 2.1, the most difficult factor to change is the mind set of people. E2 agreed the need of motivation requirement to change the attitudes of people. Thus, there is a need to analyse the ways of motivating the workers to change their attitudes towards lean implementation. During the interviews, lean experts clearly indicated the importance of '**start lean**' with pilot projects. E19 highlighted, '*the implementation should start from the site. At least start with 5S. Then slowly progress to the higher order level tools*'. Therefore, SMCs first need to make better '**use of existing capacity**' to start lean implementation. As articulated by E4, '*we have good workers in the site but reluctant to do a good job. Unless giving a good reward they will not show their colours at the site*'. Thus, the individuals required to develop their existing capacities in the first instance to encourage the lean implementation. Further, SMCs need to '**monitor and report the individual progress**' for continuous improvement. E14 highlighted that it will demonstrate the achievability of these individual level lean capacities. Nevertheless, all the participants undeniably stressed the importance of relevant strategies for SMCs to build individual lean capacities.

In summary, most of the experts identified training, soft skills development and start lean by doing as the strategies that can be easily implemented for building human capacities in individual level to enable lean.

4.2.2 Organisational level strategies to build human capacities for enabling lean

The data collection further discussed how SMCs can help building human capacities necessary for lean implementation. Figure 3 presents the relationship between the organisational level strategies and lean capacities through a chord diagram.

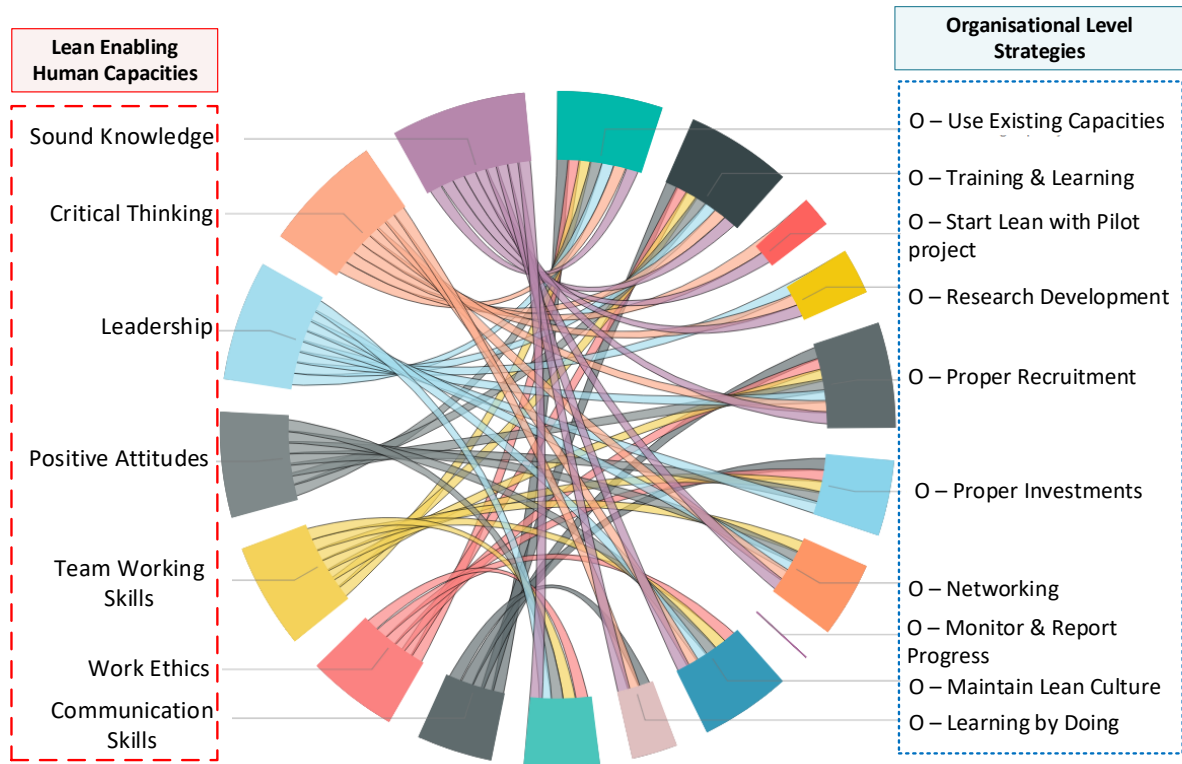


Figure 3: Organisational level strategies for lean enabling human capacity building

As SMCs lack human resources, E3 highlighted the need to employ most suitable people to get the maximum benefit to the organisation. E1 highlighted that there is a need to **‘recruit right people’** who also possesses practical experience. Similarly, E22 specified, *‘the key to get the desired outcomes from the shop floor workers is recruiting a good leader’*. Therefore, senior management’s vital role in this regard during the recruitment process needs to be recognised.

Participants emphasised the need of having a lean expert in the organisation. E22 further highlighted that, this person will be the change agent for the organisation who can develop the pathway towards successful lean implementation. Therefore, to gain more benefits within the organisation, E2, E19 and E22 suggested that senior management need to promote **‘research and development’** in the organisation. Having identified research and development as one of the ways to build lean capacities, E19 noted that collaborative research would be preferable.

E2 added *‘what I feel is they (workers) need to learn by doing at site. Only 20% will add from what you learnt outside the site’*, thereby emphasised the need to foster

'learning by doing' at all levels of the organisation. Thus, similar to strategies at individual level, *'training and learning'* and *'starting lean with pilot projects'* will help to build lean enabling human capacities.

Highlighting the need for *'monitoring and reporting the progress'*, E19 stated, *'our workers need to monitor during the working hours. Otherwise they will not work at their best'*. The need to encourage *'networking'* to learn on the available lean tools and their methods of implementing was also pointed out by the experts. E22 deliberated the need of construction SMCs to discuss with large construction companies on how they implement lean and the problems they faced during the implementation, hence the value of sharing good practices within the organisation as well as with other organisations recognised. Developing working partnerships with others in the same organisation can be a starting point in this respect.

E16 added that, SMCs can further question on how large companies overcome challenges. Correspondingly, E8 added that, organisations need to rethink the *'usage of existing capacities'* for building new capacities. Accordingly, many lean experts expressed the need of *'strategic financial allocation'* to build the lean enabling human capacities. Similarly, E19, E20 and E23 highlighted that, most of the individual lean capacities can be achieved through *'maintaining a lean culture'* within the organisation. This was further proven by E1 stating that *'frank dialogue with employees and collective culture of transparency are essential for successful lean implementation. People expect support from us. So need to provide the expected recognition for them'*. Hence, maintaining a culture that support improvement and in particular a no-blame culture, are paramount to improving the work ethics, team working skills as well as leadership skills of the employees.

4.2.3 External environmental level strategies to build human capacities for enabling lean

The last part of the interview was focused on how the external environment helps in building the lean enabling human capacities. Figure 4 illustrates the relationship between the external environmental strategies and lean capacities through a chord diagram.

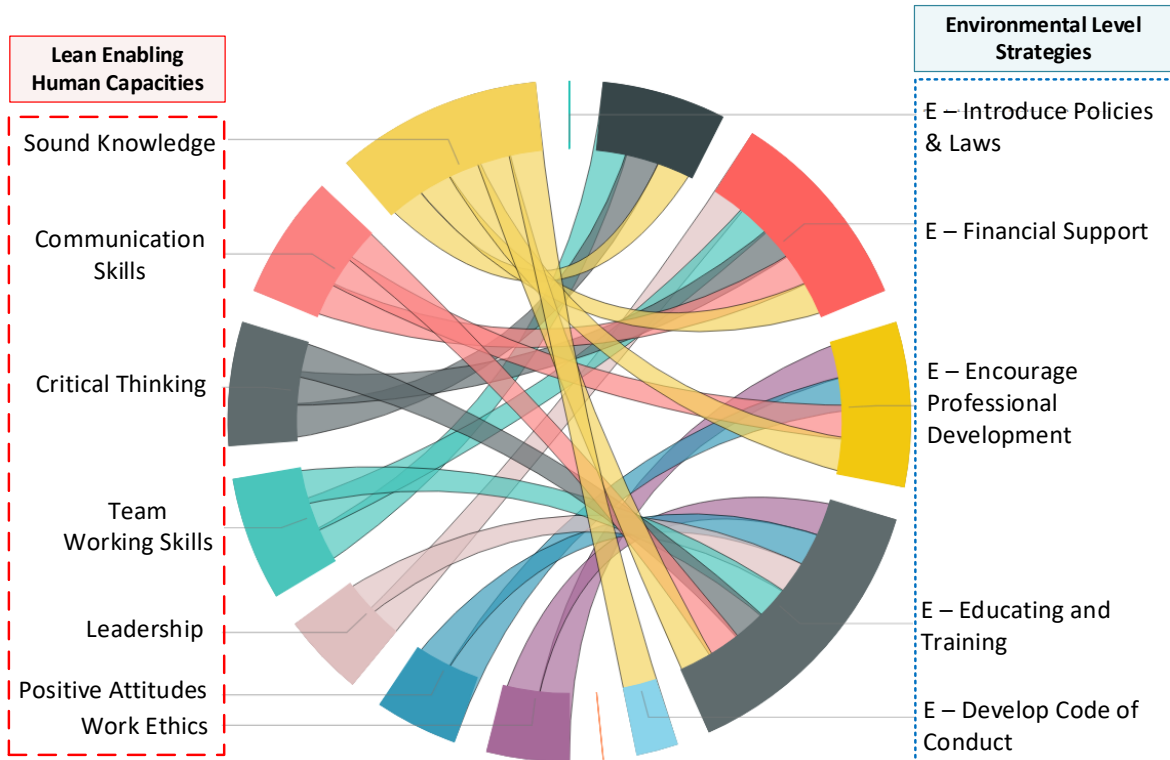


Figure 4: Environmental level strategies for lean enabling human capacity building

The experts agreed that lean enabling human capacity building in SMCs can be driven by the construction industry through ‘*introducing policies and laws*’, by entities including Construction Industry Development Authority (CIDA), professional institutes, large construction organisations as well as the government. ‘*Educating and training*’ of construction workforce is one of the prominent strategies that was highlighted by experts. Yet, E22 mentioned that, ‘*we can find programs naming lean. But I have doubts on quality of these programs*’. Similarly, E3 doubted about the quality of programs conducted at the industry level by articulating ‘*we want to learn from lean experts. Do we have enough trainers? find experts, then we are happy to attend*’. E6 contended the lack of CPD in the construction industry, necessitating to ‘*encouraging the professional development*’. Moreover, human capacities can be built by encouraging inter/intra-industry research activities. E10 and E15 highlighted that, researches conducted on lean construction need to be publicised to identify the new trends and solutions offered for lean constructions through conferences, seminars and workshops.

A lean consultant, E19 specified ‘*manufacturing industry has lean institute. So why can’t we have one for construction to regulate the lean practices*’. Hence, it is vital to establish a lean institute for Sri Lankan construction industry. E2 added the importance

of developing a code of good working practice for sites and particularly developing a '*lean code of conduct*' for SMCs to guide towards lean implementation. E14 highlighted that government must '*financially support*' lean enabled SMCs. Accordingly, E12 and E15 noted that, the relevant authorities can allocate funds for lean awareness programmes and take initiatives to provide loans at concessionary interest rates for SMCs interested in implementing lean. However, it is preferable that such loans/grants are coupled with appropriate performance monitoring mechanisms and targets to ensure the effectiveness of such schemes..

5. DISCUSSION OF THE FINDINGS

As the final step, this research mapped the lean enabling human capacities with the strategies required for building those capacities. Figure 5 is a chord diagram that presents the framework developed by mapping lean enabling human capacities with strategies that can be taken by individuals, organisations and external entities to build capacities.

According to Figure 5, individual employees of SMCs can improve lean enabling human capacities such as critical thinking, positive attitudes and work ethics by attending in-house and outbound training programmes on leadership, team building, communication, technical and soft skill development to name a few. Moreover, the individuals should develop the desire and the initiative to attend training programs available to them. Hence, voluntary learning, with genuine commitment and interest will contribute to the individuals' acquiring the required lean capacities. As per the findings of the research, government and non-government organisations as well as professional institutes with the support of large firms are willing to assist SMCs to implement lean. The importance of training for improving lean capacities such as critical thinking, positive attitudes and work ethics were highlighted by Lopes and Theisohn (2003), Alves *et al.* (2016), Ankomah *et al.* (2020) and Kululanga (2012). Thus, training, soft skills development and start lean by doing can be considered as highly influential individual level strategies for building lean enabling human capacities of SMCs.

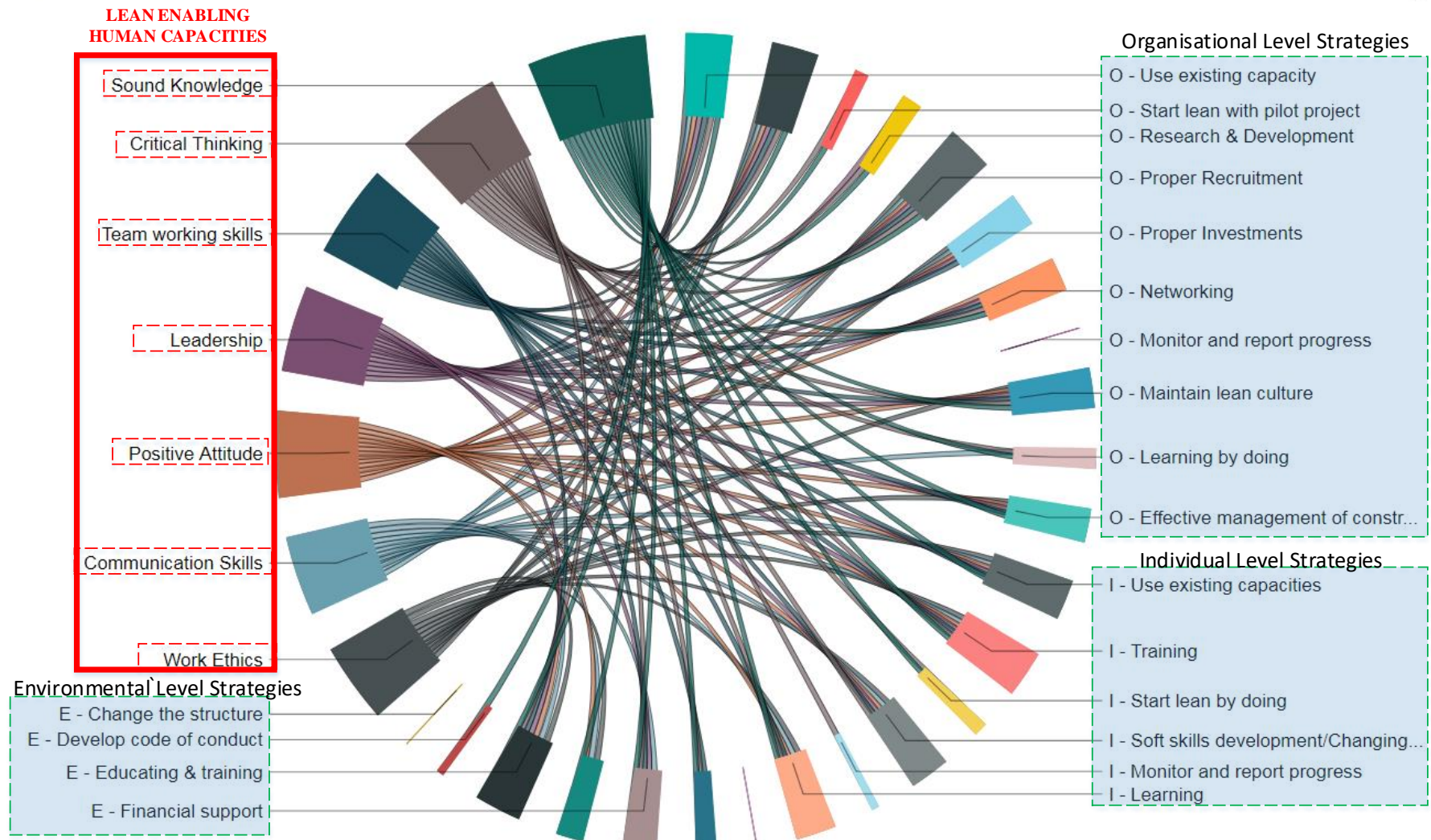


Figure 5: Framework for lean enabling human capacity building

As suggested by Kululanga (2012) and Ankomah *et al.* (2020), the employees require relevant learning through training. Thus, SMCs need to take necessary actions to provide training to build all seven lean enabling capacities identified in this research. Similarly, optimum use of existing capacities in the organisation and appropriate recruitment of employees will enable the SMCs building all seven human capacities. Moreover, targeted outcome based investments by SMCs, maintain a lean culture within the organisation and continuous networking with other organisations will enable building critical thinking, leadership skills, positive attitudes, team working skills as well as knowledge on lean construction. Figure 5 further highlighted encouraging employees at SMCs to learning by doing and initiate lean with pilot project will build critical thinking skills as well as sound knowledge of the individuals.

Conducting research and development is a paramount requisite to enable lean (Tazel *et al.*, 2019). Leadership and critical thinking skills are some of the necessary focus areas in building the required knowledge. Moreover, experts valued continuously maintaining the acquired skills and knowledge to build human capacities as confirmed by Badurdeen *et al.* (2010). However, the findings highlighted that monitoring of the progress of lean implementation after individuals' attend lean awareness programs is important. Yet, it is difficult to examine the progress after attending skill development program as it is time consuming and organisations need to maintain an adequate mechanism to monitor and report the progress of individuals in the firm. Thus, use of existing capacities, appropriate recruitment, strategic investments, maintain lean culture, networking, and learning by doing can be considered as highly effective organisational level strategies to build the identified lean enabling capacities.

As discussed by Kululanga (2012) and Ranadewa *et al.* (2018), external environment can assist the SMCs to build the required lean enabling human capacities. Similar to the findings offered by Tezel *et al.* (2019), the suggestion to form a steering committee at sectorial/national level to look into lean implementation at SMCs is emphasised by the findings of this research. Government financial assistance to SMCs for organising and attending workshops, conferences and seminars is necessary to build the required knowledge, communication, critical thinking, team working and leadership skills. Similarly, encouragement for professional development by government enables individuals to build communication skills, positive attitudes, work ethics as well as knowledge on lean. Developing a lean code of conduct by professional institutes will further accelerate the SMCs to improve their lean practice. Therefore, in order to enhance the lean knowledge of individuals, provide education and training, and offer financial assistance for SMCs were recognised as the most influential environmental level strategies.

6. CONCLUSIONS

There has been a notable growth in lean implementation in construction industry. To implement lean in SMCs, there is a need to identify the lean enabling human capacities.

This paper investigated the lean enabling human capacities for SMCs and the strategies to build the identified capacities. Current literature provides an abstracted version for lean enabling human capacities in other countries. However, this research has produced a comprehensive list of lean enabling human capacities applicable to SMCs. Furthermore, the research contributes to the area of lean enabling strategies for SMCs in Sri Lankan context. The study identified critical thinking, leadership, positive attitudes, team working skills, work ethics, and thorough knowledge as the lean enabling human capacities for SMCs in Sri Lanka. However, these capacities need to be built with the help of individuals, SMCs as well as the external entities. Training, learning and using existing capacities were identified as the most influential individual level strategies. The findings further highlighted that the use of existing capacities, appropriate recruitment, strategic investments, maintain lean culture, networking, and learning by doing as organisational strategies, where educating and training, and financial support for SMCs were recognised as the external environmental level strategies that can be used to enhance the lean implementation.

The framework developed in this study will guide the SMCs to understand the strategies to build lean enabling human capacities and therefore, to accelerate the successful lean implementation of SMCs in Sri Lanka. Moreover, the environmental level strategies will be beneficial for policy makers particularly for Construction Industry Development Authority and relevant Ministries. This aspect can be further incorporated in the secondary, tertiary and vocational education syllabuses to increase the lean awareness among students. The findings will also pave the path to investigate the organisational and environmental lean capacities for successful lean implementation among SMCs, which will be the focus of the next phase of the research. The findings of this study will be beneficial to the construction SMCs in Sri Lanka as well as the construction industries of the developing countries similar to Sri Lankan construction industry, who have shared the same socio-economic, demographic or cultural traits.

7. REFERENCES

- Achanga, P., Shehab, E., Roy, R., and Nelder, G. (2006), "Critical success factors for lean implementation within SMEs", *Journal of Manufacturing Technology Management*, Vol.17 No.4, pp.460-471.
- Ahuja, R., Sawhney, A. and Arif, M. (2018), "Developing organizational capabilities to deliver lean and green project outcomes using BIM", *Engineering, Construction and Architectural Management*, Vol.25 No.10, pp.1255-1276.
- Al-Aomar, R. (2012). "Analysis of lean construction practices at Abu Dhabi construction industry", *Lean Construction Journal*, Vol.2012, pp.105-121.
- Alkhoraif, A., Rashid, H. and McLaughlin, P. (2019), "Lean implementation in small and medium enterprises: Literature review". *Operations Research Perspectives*, Vol.6, 100089.

- Alves, T.C.L., Azambuja, M.M. and Arnous, B. (2016), "Teaching lean construction: a survey of lean skills and qualifications expected by contractors and specialty contractors in 2016". In *24th IGLC, Boston, USA on 20-22 July*, pp.13–22.
- Ankomah, E. N., Ayarkwa, J., and Agyekum, K. (2017), "A theoretical review of Lean implementation within construction SMEs", In *6th International Conference on Infrastructure Development in Africa*, (August), 71–83.
- Ankomah, E.N., Ayarkwa, J. and Agyekum, K. (2020), "Status of lean construction implementation among small and medium building contractors (SMBCs) in Ghana", *Journal of Engineering, Design and Technology*, Vol.18 No.6, pp.1691-1709.
- Antosz, K. and Stadnicka, D. (2017), "Lean philosophy implementation in SMEs - study results", *Procedia Engineering*, Vol.182, pp.25–32.
- Aziz, R.F. and Hafez, S.M. (2013), "Applying lean thinking in construction and performance improvement", *Alexandria Engineering Journal*, Vol.52 No.2013, pp.79–695.
- Badurdeen, F., Marksberry, P., Hall, A. and Gregory, B. (2010), "Teaching lean manufacturing with simulations and games: a survey and future directions", *Simulation & Gaming*, Vol.41 No.4, pp.465–486.
- Bhasin, S. (2012), "An appropriate change strategy for lean success", *Management Decision*, Vol.50 No.3, pp.439-458.
- Chiarini, A. (2012), "Lean production: mistakes and limitations of accounting systems inside the SME sector", *Journal of Manufacturing Technology Management*, Vol.23 No.5, pp.681-700.
- Dora, M., and Gellynck, X. (2015), "House of lean for food processing SMEs", *Trends in Food Science & Technology*, Vol.2015. dx.doi.org/10.1016/j.tifs.2015.03.008.
- Douglas, D. (2003). "Inductive theory generation: A grounded approach to business inquiry". *Electronic Journal of Business Research Methods*, Vol.2 No.1, pp.47-54.
- Ekanayake, E.M.A.C. and Sandanayake, Y.G. (2017), "LiVE approach: Lean integrated Value Engineering for construction industry", *Built Environment Project and Asset Management*, Vol.7 No.5, pp.518-533.
- Enemark, S. and Ahene, R. (2002). "Capacity building in land management—implementing land policy reforms in Malawi", In *FIG XXII International Congress, Washington, USA*, pp.19-26.
- Flick, U. (2009), *An Introduction to Qualitative Research*, 4th ed. Sage publications;London.
- Gao, S., & Low, S. P. (2014). "The Toyota way model: an alternative framework for lean construction". *TQM & Business Excellence*, Vol.25 No.5-6, 664-682.

- Green, S.D., Harty, C., Elmualim, A.A., Larsen, G.D. and Kao, C.C. (2008), "On the discourse of construction competitiveness", *Building Research and Information*, Vol.36 No.5, pp.426-435.
- Hines, P., Found, P., Griffiths G. and Harrison, R. (2008), *Staying lean: thriving, not just surviving*, Lean Enterprise Research Centre:Cardiff.
- Jennings, C. & Wargnier, J. (2015). *Effective Learning with 70:20:10;The new frontier for the extended enterprise*. Cross-Knowledge. available at: www.crossknowledge.com/ (accessed 19 July 2019).
- Jin, X. and Ling, F.Y.Y. (2005), "Model for fostering trust and building relationships in China's construction industry", *Journal of Construction Engineering and Management*, Vol.131 No.11, pp.1224-1232.
- Koskela, L.J., Howell, G.A., Ballard, G. and Tommelein, I. (2014), "*The foundations of lean construction*" Design and Construction: Building in Value, pp.211-226.
- Kululanga, G. (2012), "Capacity building of construction industries in Sub-Saharan developing countries: case for Malawi", *Engineering, Construction and Architectural Management*, Vol.19 No.1, pp.86-100.
- Lopes, C. and Theisoan, T. (2003), *Ownership, leadership and transformation: can we do better for capacity development?*, Earth Scan Publications, UNDP, New York.
- Matachi, A., (2006). *Capacity building framework;UNESCO-IICBA*. United Nations Economic Commission for Africa, Ethiopia.
- Miller, C.J., Packham, G., Pickernell, D. and Morse, L. (2002), "Increasing entrepreneurial capacity through E-Learning: An opportunity for small construction firms in South Wales", *WEI Working Paper Series Paper 28*, Pontyprid,Welsh Enterprise Institute.
- OECD. (2012), "*The challenge of capacity development: working towards good practice*", OECD Publication Service, Paris.
- Ohno, T. (1988), "*Toyota production system-Beyond large scale production*", Productivity Press, New York.
- Paez, O., Salem, S., Solomon, J., & Genaidy, A. (2005). "Moving from lean manufacturing to lean construction: Towards a common socio-technological framework", *Human Factors and Ergonomics in Manufacturing & Service Industries*, Vol.15 No.2, pp.233-245.
- Pandithawatta, T.P.W.S.I., Zainudeen, N. and Perera, C.S.R. (2019), "An integrated approach of Lean-Green construction: Sri Lankan perspective", *Built Environment Project and Asset Management*, Vol.10 No.2, pp.200-214

- Pérez, C.T. and Costa, D. (2018), "Developing a taxonomy of transportation waste in construction production processes", *Built Environment Project and Asset Management*, Vol.8 No.5, pp.434-448.
- Ranadewa, K.A.T.O., Sandanayake, Y.G. and Siriwardena, M. (2017), "What does lean capacity mean? 6th World Construction Symposium 2017, Colombo, Sri Lanka, pp.485-494.
- Ranadewa, K.A.T.O., Sandanayake, Y.G. and Siriwardena, M. (2018), "Enabling Lean among Small and Medium Enterprise (SME) Contractors in Sri Lanka", In: *26th IGLC*, Chennai, India, 18-20 July, pp.392–401.
- Rymaszewska, A.D. (2014), "The challenges of lean implementation in SMEs", *Benchmarking: An International Journal*, Vol.21 No.6, pp.987-1002.
- Samaraweera, A., Senaratne, S. and Sandanayake, Y.G. (2018), "Nature of construction project cultures in the public sector: case studies in Sri Lanka", *Built Environment Project and Asset Management*, Vol.8 No.5, pp.557-568.
- Sarhan, S., and Fox, A. (2013), "Barriers to implementing lean construction in the UK construction industry", *The Built & Human Environment Review*, Vol.6, pp.1–17.
- Saunders, M., Lewis, P. and Thornhill, A. (2009), *Research methods for business students*, 5th ed, Pearson Education, Essex.
- Sawhney, R. and Chason, S. (2005), "Human behaviour based exploratory model for successful implementation of lean enterprise in industry", *Improvement Quarterly*, Vol.18 No.2, pp.76-96.
- Senaratne, S. and Wijesiri, D. (2008), "Lean construction as a strategic option: Testing its suitability and acceptability in Sri Lanka", *Lean Construction Journal*, Vol.4 No.1, pp.34-48.
- Shang, G. and Pheng, L.S. (2014), "Barriers to lean implementation in the construction industry in China", *Journal of Technology Management in China*, Vol.9 No.2, pp.155-173.
- Tezel, A., Koskela, L. and Aziz, Z. (2017), "Lean Construction in SMEs: An Exploration of the Highways Supply Chain", In *25th IGLC*, Heraklion, Greece, 9-12 Jul 2017, pp.845–851.
- Tezel, A., Taggart, M., Koskela, L., Tzortzopoulos, P., Hanahoe, J. and Kelly, M. (2019), "Lean Construction and BIM in SMEs in Construction: A Systematic Literature Review", *Canadian Journal of Civil Engineering*, Vol.47 No.2, pp.186-201.
- UNDP. (2009). *Capacity development: A UNDP primer*. United Nations Development Programme; New York.