Identification of Project Scheduling Constraints Using the Quantitative Approach

Nur Mardhiyah Aziz, Faizul Azli Mohd-Rahim, Loo Siaw Chuing, Ee Wen Le

Abstract: Planning and scheduling is found to be the hardest part of the construction process as they need to deal with uncertainty in the beginning of the project. These 2 factors are interrelated as any mistakes in any of these factors can cause project delay. Thus, thorough planning and scheduling are required to ensure the success of the project. Despite an increased interest in project planning and scheduling, surprisingly, only a few of empirical research on this topic can be found. To deal with this issue, this study aims to identify the constraints of project planning and scheduling in Malaysian construction projects. An initial list of 43 contraints was identified from the literature review. This was followed by a main study comprising a quesstionnaire survey of 205 construction industry practitioners including a diverse range of construction consultancy practice that include Project Managers, Architects, Civil Engineers, Quantity Surveyors as well as contractors. Data obtained were analysed using Relative Important Index (RII) and the Spearman Correlation Coeficient. The analytical result revealed 8 constraints as having the greatest impact on project planning and schedulling. The implication of the findings implies that the organisation should consider the identified.

Index Terms*: *Keywords: Planning and Scheduling, Constraints, Malaysia.

I. INTRODUCTION

Construction industry (CI) plays a vital role in the country's development. However, several researchers however reported that this industry is facing poor performance due to failure in term of time performance and cost performance (Memon and Rahman et al., 2012; Emam and Abdelaal, 2014; and Ali and Kamaruzzaman,2010). According to Chan and Chan (2004), construction project performances are measured in terms of cost and time performance, quality defects and amount of change orders. Endut (2009) reported that only 46.8% of projects in public sector and 37.2% of private sector projects in Malaysia were completed within the estimated budget. On the other hand, only 33.35% of the private sector projects and 20.5% of the public projects were completed within the time frame (Endut, 2009).

Revised Manuscript Received on 04 May 2019

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Project planning and project performance are regarded as two complementary and inseparable issues in project management (Idoro, 2012). According to Luu et al. (2009), project planning and scheduling is significant in order to control the projects performance. Nevertheless, some restriction in implementing project scheduling had been reported, which include difficulty in preparing schedules and hurdles by personnel and authorities as well as high cost in preparation (Alnasseri, H. and R. Aulin, 2016). Ahem et. al., (2014) reported that lack of knowledge due to incomplete project plans, also affecting the project performance. Insufficient planning and scheduling due to poor communication between personnel will also give negative effect to the project performance (Alnuami et al., 2010). In a highly competitive environment, it is crucial for the construction industry (CI) to have a proper planning and scheduling strategy in order to improve their performance. Previous studies were only focusing on problems faced during planning and scheduling without giving much attention on how to overcome the problem. Thus, this research, study will be conducted on identifying the project planning and scheduling constraints that focus on the time and resource-driven.

II. PROJECT PLANNING AND SCHEDULING: DEFINITIONS AND OBJECTIVES

Various definitions for project planning and scheduling in construction field can be found. Baldwin and Bordoli (2014), defined project planning as a process that is more than an assistance that is crucial in order to complete a project successfully. According to Mubarak (2015), project planning is fundamental and involve various related functions such scheduling, control of project and cost estimation. Ideally, project planning is meant to achieve several common factors, which include project resources, criteria of design, health and safety as well as to satisfy stakeholders' expectations Bordoli (2014).

Scheduling on the other hand, were defined as logical sequencing of activities which include its durations (Yang, 2007). According to PMI (2011), project scheduling involves the utilisation of techniques, skills and intuition obtained through experience and knowledge to produce an effective model of schedule. Demeulemeester and Herroelen (2002) state that project scheduling is the development of a base plan that comprises of precedence, resources start and completion dates as well as types of various resources specified with its amount for each time. According to CIOB, 2011, project scheduling is defined as the utilisation of mathematical calculations and logical thinking to predict the place and date for work to be carried out efficiently and effectively. Despite various definitions of project scheduling, its main objective is to coordinate construction activities sequence and timing systematically (Baldwin and Bordoli, 2014).

According to Baldwin and Bordoli (2014) planning and scheduling tasks cannot be carried out simultaneously. Scheduling process can only be done after planning and it is usually were handled by different people. Mubarak (2010) stated that project planning answers the questions of what should be done? How? Whom? When should we do it? Where to do it? While project scheduling only focuses on ‘when’. This is illustrated in fig. 1 below.

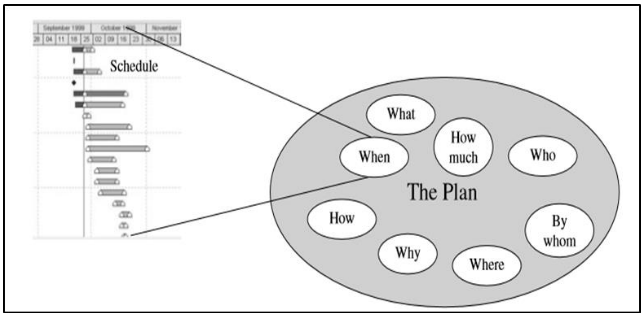

Fig. 1: Planning and scheduling (Mubarak, 2010)

In the perspective of project management in construction, project planning and scheduling are interrelated inputs that are planned with the intention to comply with the assigned objectives. These objectives must be defined carefully so that successful project performance can be achieved. Fig. 2 provides an overview of planning and scheduling to give a general idea on how the related assigned inputs function.

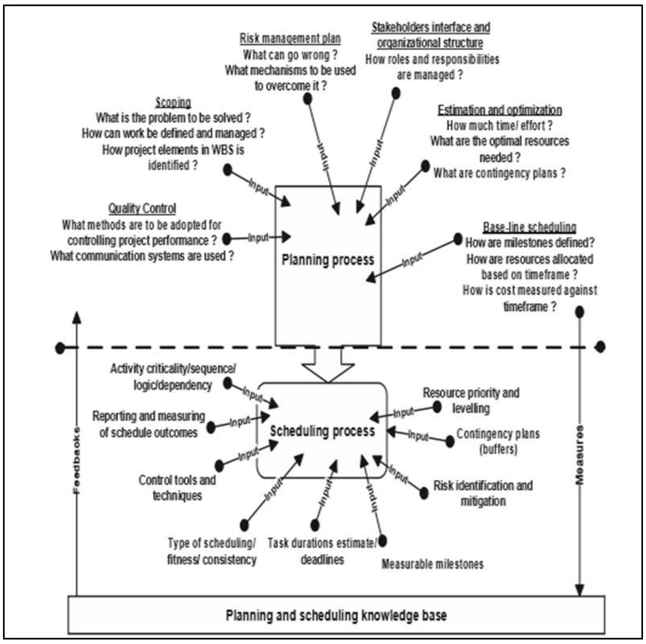

Fig. 2: Overview of project planning and scheduling
Source: Kerzner (2013) and PMI (2008)

III. PLANNING AND SCHEDULING METHODS AND TOOLS

Various methods and tools are used in project planning, which include simple traditional scheduling approach to the advanced complicated method (Al Nasseri et al., 2013; Ahuja and Thiruvengadam, 2004). Traditional scheduling methods includes bar charts that have evolved from paper-based to computer-based whereas modern scheduling methods are those departed from the traditional scheduling concepts (Hajdu, 2011). The examples of traditional methods are Gantt chart, CPM and PERT whereas modern scheduling methods are LPS (Ballard, 2000) and Critical chain project management (CCPM) (Goldratt and Cox, 1984) for instance. Table I below summarise the methods used for project planning and scheduling reported by different authors and researchers.

Table I: Construction project scheduling methods

Construction project scheduling methods	
Precedence diagrams	Grapical Evaluation and Review Technique (GERT)
Critical Path Method (CPM)	Program Evaluation and Review Technique (PERT)
Basic Networks (Activity-On-Arrow, Activity-On-Node)	Last Planner (LPS)
Flow diagrams	Linear Scheduling Method (LSM)
Bar charts (Gantt charts)	Critical chain project management (CCPM)
Rolling Wave Technique	Agile technique
Monte Carlo technique	Minimum moment leveling method
Burgess method for leveling multiple resources	

Source: Baldwin and Bordoli (2014); Mubarak (2010); PMI (2011); Weber (2005); Ballard (2000); Goldratt and Cox (1984)

The popular project scheduling software commonly used in market are Primavera Project Planner, Microsoft Project and Suretrax (Galloway,2005;2006). The study conducted by Memon and Zin (2011) reveals that approximately 65% of construction firms in Malaysia adopt Micorsoft Project as a tool for project scheduling.

Project scheduling methods and tools can be categorized into two groups: resource-driven scheduling and time-driven scheduling (Memon and Mohammad, 2011). In the context of project management, the term of ‘resources’ refers to labour, equipment and materials (Mubarak, 2010). There are five methods of modelling resource-driven schedule which consist of resource aggregation, resource cumulating, resource allocation, resource smoothing and resource levelling. On the other hand, time-driven scheduling refer to the estimated durations of activities and the relations between each acctivities (Mubarak, 2010). Sufficient understanding and correct application of planning and

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scheduling methods and tools is important to optimize resources effectively (Bertelsen et al. 2007). The familiarity of practitioners towards the application of different scheduling methods was limited, which is believed to be one of the reason why they encounter difficulty in scheduling activities of project (White and Fortune, 2002).

IV. CONSTRAINTS IN PROJECT PLANNING AND SCHEDULING

From literature review, constraints in project planning and scheduling were identified. These constraints were then group according to their theme and summarise in table II below.

Table II: Summary of constraints identified

	Constraints	References
COST	• Costly to prepare • Allocation of budget is required	AlNasseri and Aulin (2015), Memon and Zin (2010), Kerzner (2013), Baldwin and Bordoli (2014)
RESOURCES	• Resources allocation and availability/ shortage problems (over-commitment or minimal allocation) • Absence of resource-constrained scheduling for dealing with uncertainty problems • Reassessment of resource requirements for individual activities. • Inability to utilize resources as originally planned	Abbas et al. (2016), AlNasseri and Aulin (2015), Ahuja and Thiruvengadam (2004), Memon and Zin (2010), Kerzner (2013), Abeyasinghe et al. (2001), AlNasseri and Aulin (2015), Elmaghraby et al. (2003), Voth, (2009), Mulholland and Christian (1999)
TIME	• Time-cost optimization • Lack of time/ time-required • Inadequate timeframe provided • Failure of suppliers or contractors to deliver on time.	Ahuja and Thiruvengadam (2004), Abbas et al.,(2016), AlNasseri and Aulin (2015), Kerzner (2013), Baldwin and Bordoli (2014)
KNOWLEDGE/ TRAINING	• Lack of education/ knowledge and training • Incompatibility of planning methods with the project's nature (eg complexity and size) • Poor/ slow decision-making regarding activity criticality • Lack of effective leadership • Inaccurate/ unrealistic/ poor estimates for effort, duration and activity relationships • Deficiencies of understanding / awareness of the concepts, activity criticality and related resources • insufficient expertise of professionals • incorrect perception of professionals	AlNasseri and Aulin (2015), AlNasseri and Aulin (2015), Hameed (2005), Nepal et al. (2006), Venkatesh et al. (2012), Yang et al. (2011), Burke (2003), Jurf and Beheiry (2012), Memon and Zin (2010), González et al. (2014), Hameri and Heikkilä (2002), Muller and Turner (2010), Voth (2009), Ahuja and Dozzi (1994), Kerzner (2013), Abbas et al. (2016), Fowler et al. (1995), Abeyasinghe et al. (2001), Trietsch (2005)
MANAGEMENT ISSUES	• Has no guidance to follow the regarded preparation • Insufficient / lack of support from project stakeholders in planning and preparing schedules • Trivial control and reporting system between management levels (lack of coordination/ communication between constructors & consultants, technical and key personnel) • not getting key stakeholder involve at early stages • inability to handle employee workload imbalances	AlNasseri and Aulin (2015), Memon and Zin (2010), Venkatesh et al. (2012), Abbas et al. (2016), AlNasseri and Aulin, 2015, Davis (2014), Iyer and Jha (2006), González et al. (2014), Hameri and Heikkilä (2002), Muller and Turner (2010), Voth (2009), Ahuja and Dozz, (1994), Kerzner (2013), Lewis (2011)
TECHNOLOGY	• Absence of new technology and software for planning and scheduling • limitations of scheduling tools (eg CPM, PERT)	AlNasseri and Aulin (2015), Mokhtari et al. (2011), Noronha and Sarma (1991), Taroun (2014), Ahuja and Thiruvengadam (2004)
UNCERTAINTY	• Uncertainty value / changes/ unforeseen bottlenecks (eg. activity duration, cost objective, operating policies, construction methods, technical difficulties, environmental conditions) • Absence of schedule contingency	Ahuja and Dozzi (1994), Ahuja and Thiruvengadam (2004), Kerzner (2013), Venkatesh et al. (2012), AlNasseri and Aulin (2015), Hoel (1999), Mulholland and Christian (1999)

HUMAN'S BEHAVIOUR PROBLEM	• Reluctance to allow construction review • Deficiencies of genuine commitment of project stakeholders • Authority does not enforce schedules • Hurdles by personnel/ authorities • Poor morale • Lack of respect of other professionals	Memon and Zin (2010), Venkatesh et al. (2012), Kerzner (2013), Wilkinson (2001), Iyer and Jha (2006)
CONSTRUCTION	• scheduling fast-track construction projects • overly complex or large projects • Hard to prepare plan and schedule/ complexity of schedule • Impediments due to interference • Difficult to update • Exhaustive (can only be solved by using computer software for engineering work bench)	Ahuja and Thiruvengadam (2004), AlNasseri and Aulin (2015), Memon and Zin (2010), Venkatesh et al. (2012), Voth (2009)
OTHERS	• ineffectiveness of the clients' decision when finally approving the detailed scope definition • insufficient adoption of lessons from past projects when developing front end planning for the new project • Shortage of realistic information about the project strategy • continuous readjustments to the WBS primarily from scope changes	Memon and Zin (2010), Venkatesh et al. (2012), AlNasseri and Aulin (2015), Ahuja and Dozzi (1994), Kerzner (2013), Lewis (2011)

Each of these constrints have direct influence on the project performance in term of time, cost and quality. Construction delay can be regard as common phenomenon in Malaysia where the actual progress of construction works is beyond the planned schedule (Hamzah et al., 2011). Delay issues affect negatively on project stakeholders such as owners, construction professionals, designers and others (Faridi and El-Sayegh, 2006). The extension of time given to the contractor in order for him to complete the project usually will require additional cost, thus leading to cost overrun (Faridi and El-Sayegh, 2006). Time overrun and cost overrun will then lead to the poor quality of construction, where the contractor trying to complete his job in the shortest time possible.

V. RESEARCH METHODOLOGY

The initial list of 43 project scheduling constraints were identified from the literature review was used in designing the questionnaire. Respondents were asked to rate these constraints based on five-point Likert-type scales that vary from 1= No Impact to 5= Extremely High Impact. Potential questionnaire respondents' organisations were selected from various databases in order to ensure diversity of view in term of constraints in project planning and scheduling. In this research, the targeted respondents are the Project Managers, Architects (registered under Board of Architects Malaysia), Civil Engineers (registered under Board of Engineers Malaysia), Quantity Surveyors (registered under Board of Quantity Surveyors Malaysia) and Grade 7 contractors registered under category Building Construction under CIDB throughout Malaysia.

VI. DATA ANALYSIS

The perceived importance of the factors are measured through a 5-point Likert scale with graded item responses ranging from "1=No Impact" to "5=Extremely Important", hence the issues are treated as ordinal variables. The relevant non-parametric tests were used encompass of mean and Relative Importance Index (RII) for data ranking and supported by Pearson correlation coefficient.

Relative Importance Index (RII) was used to rank the factors. The RII was calculated using the following formula:

$$RII = (\sum W)/AN \qquad (1)$$

W is the weighting given for each factors by the respondents range from 1 to 5, A is the highest weight (5 in this case) and N is the total number of sample (in this case N=205). According to Kazaz et. al. (2008), the RII value can be categories as follows: $0.20 \leq RII \leq 0.36$ (not significant); $0.36 < RII \leq 0.52$ (somewhat significant); $0.52 < RII \leq 0.68$ (Significant); $0.68 < RII \leq 0.84$ (very significant); $0.84 < RII \leq 1.0$ (extremely significant). Based on this scale, there are 33 very significant constraints and 3 significant constraints.

The correlation for these factors was then tested to identify their relative importance. For this, Pearson correlation coefficient was selected as it is a common non-parametric method used for correlating factors where:

$$r = \frac{n(\sum xy)-(\sum x)(\sum y)}{\sqrt{[n\sum x^2-(\sum x)^2][n\sum y^2-(\sum y)^2]}} \qquad (2)$$

where,

r is the value for Pearson correlation coefficient, x is the value of the first set of data, y is the value in the second set of data and n is the total number of values. Using a standard table of probabilities, p, for, the usual criterion is adopted in that $p<0.05$ denotes a significant correlation of the respondents' rating of the constraints in project planning and scheduling.

The employment of such a test produces a mathematical value that exhibits the strength of a linear relationship between the factors.

A total of 205 completed questionnaires were received giving a total response rate of 31.5%. The respond received covered the whole Peninsular Malaysia, where majority have 5 to 15 years experienced in construction industry (48.7%). This is beneficial as their experienced are important to provide valid evaluation of strategic measures in answering the questionnaire. About 14.7% of the respondents have 16 to 25 years of experienced, and 13.7% have more than 25 years experienced. Only 22.9% of the respondents have less than 5 years experienced in construction industry. This shows that the response received are reliable and represents Malaysia**.**

The results of these descriptive analyses and ranking of the constraints are shown in Table III. The central tendency of the distribution or the mean is in the ranged from 3.97 to 3.22, while the standard deviation value is in the range of 0.981 to 0.826. All the factors involved in this analysis have a relatively normal distribution since the skewness range value does not exceed the absolute value of -1 to +1. The factors were then ranked using mean and RII formula.

Table III: Ranking of constraints

	Constraints Factor	**RII**	**Rank of Each Factor**
Time	Lack of time	0.757	**5**
	Failure of suppliers or contractors to deliver resources on time	0.787	**2**
	Inadequate timeframe provided for tasks	0.765	**4**
Lack of Knowledge/ Training	Lack of education/ knowledge	0.729	**14**
	Lack of training	0.728	**15**
	Incompatibility of planning methods with the project's nature	0.749	**7**
	Slow decision-making regarding activity criticality	0.793	**1**
	Poor estimates for planning and scheduling	0.780	**3**
	Incorrect perception of professionals	0.734	**12**
project's nature	Scheduling fast-track construction project	0.742	**9**
	Project with large contract amount	0.736	**11**
	Complex schedule is required	0.751	**6**
Management Issues	Has no guidance to follow the regarded preparation	0.711	**19**
	Lack of support from project stakeholders	0.730	**13**
	Poor communication between management levels	0.765	**4**
	Not getting key stakeholder involve at early stages	0.705	**23**
	Inability to handle employee workload imbalances	0.717	**18**
Human's Behaviour	Reluctance to allow construction review	0.698	**26**
	Lack of genuine commitment of stakeholders	0.723	**17**
	Authority does not enforce schedules	0.695	**27**
	Hurdles by authorities	0.737	**10**
Others	Poor morale	0.710	**20**
	Shortage of realistic information about the project strategy	0.723	**17**
	Difficult to update schedule	0.678	**31**
	Rigorous effort required	0.686	**29**
	Continuous readjustments are necessary due to scope changes	0.725	**16**
Resources	Shortage of resources	0.709	**21**
	Unable to utilize resources as originally planned	0.708	**22**
	Need to reassess the requirements of resources for individual activities	0.688	**28**
Uncertainty	Unforeseen bottlenecks	0.700	**25**
	Absence of schedule contingency	0.700	**25**
Cost	Costly to prepare	0.701	**24**
	Require allocation of extra budget	0.682	**30**

The highest index represents the most significant constraints whereas the lowest index represents the least importance of constraints towards the project performance. According to Kazaz et. al. (2008), the value of RII can be group as: 0.20 ≤RII ≤0.36 (not significant); 0.36<RII ≤0.52 (somewhat significant); 0.52<RII ≤0.68 (Significant); 0.68<RII ≤0.84 (very significant); 0.84<RII ≤1.0 (extremely significant). Project constraints that have a very high impact on the project success were then shortlisted based on the RII value of more than 0.68.

The correlation for these factors was then tested to identify their relative importance. For this, Pearson Correlation Coefficient was selected as it is a common non-parametric method used for correlating factors (Leech et. al., 2011). The using of this test will produce a mathematical value that shows the strength of linear relationship between the factors. Table IV presents Pearson's correlations coefficient between the 33 factors, indicating all factors to be significantly positively correlated, p**>**0.200, p (two-tailed) **<**0.05.

Table IV: Pearson Correlation Coefficient

		Require allocation of extra budget	Need to reassess the requirements of resources for individual activities	Failure of suppliers/ contractors to deliver resources on time	Inadequate time frame provided for tasks	Not getting key stakeholder involve at early stages	Inability to handle employee workload imbalances	Absence of new tech & software for planning & scheduling	Absence of schedule contingency	Project with large contract amount	Rigorous effort required
Costly to prepare	ρ	.751**									
Unable to utilize resources as originally planned	ρ		.721*								
Lack of time	ρ			.701	.702*						
Lack of support from project stakeholders	ρ					.710*					
Poor communication between management levels	ρ						.712*				
Limitations of scheduling tools (eg. CPM, PERT)	ρ							.711*			
Unforeseen bottlenecks	ρ								.813*		
Complex schedule is required	ρ									.758*	
Difficult to update schedule	ρ										.718**

Legend:

ρ = Spearman's correlation coefficient
Significance (p) = 0.00

**. Correlation is significant at the 0.01 level (2-tailed)
*. Correlation is significant at the 0.05 level (2-tailed)

It is apparent table IV that all correlation pairs have significance of less than 0.05 (p<0.05) except 5 pairs. These five pairs have a significance ranging from 0.60 to 0.90. In this case, accept the null hypothesis of no statistically significant relationship between the constraints as their significance exceeds 0.05. The most striking result to emerge from the data is that most of the correlation pairs are statistically significant with p value less than 0.05. However, since there are 650 correlations which is very large, the odds are increased that one could be statistically significant by chance Leech et. al. (2011).

VII. DISCUSSION

Based on the above analysis, attention should be given to the top 8 constraints; “slow decision-making regarding activity criticality”, “failure of suppliers or contractors to deliver resources on time”, “poor estimates for planning and scheduling”, “inadequate timeframe provided for tasks”, “poor communication between management levels”, “lack of time”, “complex schedule is required” and “incompatibility of planning methods with the project’s nature” respectively according to sequence.

The top ranked most impactful constraints as perceived by the respondents is “slow decision-making regarding activity criticality”. This result is consistent with those of other studies and suggest that poor or slow decision making is the most significant constraints among the rest (González et. al., 2014; Hameri and Heikkilä, 2002). It can thus be suggested that the stakeholders couldn’t make decision whether each of the activities is critical or not in an efficient way. Ackoff (1970) stated that project planning is regarded as a decision-making process performed followed by action that aims to achieve an intended future. According to Mubarak (2010), it is crucial for project managers to determine project milestones. This is due to the fact that delay of any of these critical activities causes delay of whole project which in turn leads to poor project performance. Although focus is given on the critical path of a logic network diagram due to its criticality and direct impact on the project finish date, however, failure in making decision on which activities are actually ‘driving’ the schedule may lead the planner to focus on wrong direction.

Next, the constraint of “failure of suppliers or contractors to deliver resources on time” was ranked as 2nd. The findings of the current study is consistent with those of Alaghbari et. al. (2007) who found that the materials, plant and equipment transportation delay was ranked as third (top three). This is due to the fact that transportation is very important and it should be done on time in projects. This finding suggested that without materials, plants and equipment delivery on time, construction work will be influenced and most probably delayed. Thus, late delivery of resources causes poor project performance doubtlessly.

Nevertheless, “poor estimates for planning and scheduling” was ranked as 3rd most impactful constraint. This finding corroborates the ideas of Ali and Kamaruzzaman (2010) who ranked inaccurate or poor estimation as the top most impactful barrier. Project scheduling is the process of determining how long an activity is likely to take and between what dates (Elias and Ismail, 2012). However, Mubarak (2010) postulated that the estimation of activities’ duration is based on previous experiences, with adjustments for current job conditions such as weather condition and soil type. Moreover, the estimation of duration for some activities are totally subjective and it is left to the responsible person to ‘guesstimate’. In this case, low capability and poor judgement of planners lead to poor and inadequate estimation in planning and scheduling projects. Meanwhile, Nega (2008) claimed that some parties have underestimated the costs for their projects. It is a serious issue that will impact the project performance in terms of cost. In addition, Elias and Ismail (2012) argued that wrong estimation of the activity start date also has an substantial cost implications. For instance, when the duration of a project is miscalculated, the rental of a large crane can cost more. It can be therefore assume that poor estimation in project planning and scheduling can bring serious repercussions to the project performance.

The 4th RII ranking would go to the “inadequate timeframe provided for tasks”. The ranking of this constraint factor is the same as the finding of AlNasseri (2015) who ranked inadequate timeframe provided for front-end planning as 4th. Mubarak (2010) regarded time frame as when the project is expected to start and end. An adequate duration of time must be allocated to every job. Mubarak (2010) further explained the timeframe of activities taking utility pipe installation project as an example, trench excavation requires 6 days, finishing subbase requires 7 days, laying pipe requires 4 days, backfilling requires 3 days and compaction requires 2 days. Theoretically, all five activities of these can be conducted simultaneously. However, in practice, some amount of preceding activity must be completed before carrying out another activity. Careful thought must be given by the project planners and schedulers on the logical timeframe needed for each task.

Besides, “poor communication between management levels” was also ranked as 4th. This is regarded as the poor control and reporting system between management levels as well as the lack of coordination between constructors and consultants, technical and key personnel. This finding is in agreement with Iyer and Jha (2006), Mulholand and Christian (1999), Venkatesh et. al. (2012) who found that poor communication or coordination is one of the significant constraint in project planning and scheduling that leads to poor project performance. Meanwhile. Sambasivan and Soon (2007) argued that it is crucial to establish proper communication channels between various parties during planning stage. This is because a construction project involve many parties (client, consultant, contractors and sub-contractors). Hence, any problem with communication among the parties may lead to severe misunderstanding and hence, delays in the project execution. Mubarak (2010) pointed out that in some cases, there could be an ‘authority battle’ between the project manager and main office. This will in turn impact the project performance. Therefore, poor communication is considered as a significant constraint in project planning and scheduling.

The RII ranking is then followed by “lack of time” which is placed in 5th. This is not surprising since majority of the respondents are involved in project management with heavy workloads. For a project manager, time is more of a constraint (Kerzner, 2006). In

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contrast to earlier findings, however, the constraint of "lack of time" has been placed in 1st place by Abbas et. al. (2016) who found that lack of time is the main barrier to pre-construction planning. A possible explanation for this is that the respondents in the research of Abbas et. al. (2016), there were only 3 respondents with experience of more than 10 years and it was conducted in Pakistan. However,46.4% of the respondents of this current research have more than 10 years of experience and it was conducted in Malaysia. Planning and scheduling is considered as time consuming as it is a detail job. According to Mubarak (2010), there are some factors that need to be considered while breaking down the project into individual activities. They are nature, of work, location, duration of activities, timing, responsibility as well as phases. Heavy workloads of respondents with limited time causes them to perceive lack of time as 5th most impactful constraint.

Furthermore, the 6th impactful constraint would go to "complex schedule is required'. Sears et. al. (2015) asserted that the schedule for a small project doesn't mean that it is not complicated. He further explained that this is because the nature of building construction can be very complex even though it is a small project as it includes building shell, structural, mechanical, electrical systems and interior finishes. Moreover, the work breakdown structure would be even more complicated. It can thus be suggested that the requirement of complex schedule makes planning and scheduling job tougher for authorities as perceived by the respondents.

The RII ranking is then followed by "incompatibility of planning methods with the project's nature" which is placed in 7th. This finding further support the idea of Jurf and Beheiry (2012) and Burke (2013) who found that one of the barriers faced in planning and scheduling constraint is the problem of incompatibility of planning methods with project's nature. As discussed earlier, there are different types of project nature. Therefore, a suitable method of planning to be adapted according to nature of project is an issue to be concerned. As claimed by Baldwin and Bordoli (2014), a planning method statement is required for complex projects. This statement is used to records the assumptions that have been made in the process of risk management, planning and scheduling. If a complex project is not planned and scheduled 's accordingly, the planning method is said to be incompatible with the project's nature.

VIII. CONCLUSION

The relative importance of human factors in determining the success or otherwise of IT/IS implementation in business has received much attention from researchers and practitioners over the years. An extensive literature review supported by interview with selected representatives from Malaysia has identified 23 human factors. Findings from this study shows the most important human factors are perceived to be motivation, training/skills, top management support, willingness to process change, IT staff roles and responsibilities, user involvement and management style.

This catalogue of human factors is a helpful addition to the wider literature but also offers a significant contribution to this subject especially in Malaysia. Identification of this list on its own however was not considered sufficient in contributing to improve IT/IS implementation, thus a survey was used to rank those factors to determine the most important. This study thus provides insights in a number of ways. First, a deeper appreciation of the perceived relative importance of human factors in the successful implementation of IT/IS can assist the higher education sector and professional bodies to identify relevant learning outcomes and skills requirements. This may require development of ongoing training needs. Second, given the ranking, this reveals that management style and training/skills are important as IT/IS skills per se. Indeed it appears to be the 'softer' or 'cultural' qualities that are critically important with user involvement, willingness to process change identified as important attributes for personnel. This highlights that training and support is important depending on one's role and responsibility. This means that human resources need to be sensitive of different training and support needs. Third, the ranking offers insights into how organisations may need to provide enough support for their staffs when investing in IT/IS facilities.

This study also has significant implications for managers by identifying the priorities among human factors so as to help the organisations maximise the probability of success. Thus, this will further enhance the manager's knowledge on the human factors and help organisations to identify possible difficulties and eventually to enable them to avoid the potential risks. The findings can also serve as a guideline for the organisations and form the basis for their future planning. Furthermore, human factors framework or model can be devloped which can be used by specific system such as for Enterprise Resource Planning (ERP), Database Management System (DBMS), Building Information Modelling (BIM) and others.

ACKNOWLEDGMENT

This research is supported by the University of Malaya Bantuan Khas Penyelidikan (BKP), grant number BK028-2016.

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