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Complexities of Smart City Project Success: A Study of Real-Life Case Studies

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Abstract

Over the years, the world has moved towards an unprecedented level of urbanisation as half of the world's total population live in cities. This trajectory of rapid urbanisation has greatly improved the modern economy as well as the standard of living. However, this fast-rising trend has also generated many new problems on the existing city infrastructures and amenities. This includes traffic congestion, waste management issues, scarcity of resources, human health concerns, deteriorating and aging infrastructures. Thus, to prevent the rapid urbanisation from being a crisis, cities have sought to cater for the effervescent needs of city dwellers in an innovative way by making cities smart. Hence, a number of urban cities (e.g. Singapore, Dubai, New York, London, Barcelona, Madrid) have embarked on smart city projects to achieve prosperity, efficiency and competitiveness. These cities have embarked on critical projects such as the Three Gorges Dam, Sydney Opera House, Charles de Gaulle Airport (Terminal 2E) etc. These smart city concept projects consist of a set of coordinated activities with definite start and end dates to bring about a beneficial change or improvement to the problems posed by rapid urbanisation. However, judging these smart city projects have been controversial because it is widely held that project success means different things to different people and as such, it is mind-dependent. In order to substantiate this claim, the study explores the complexity associated with project success using relevant smart city real-life case studies. A significant observation from the explored case studies revealed that most of the projects did not perform excellently when examined using the iron

triangle. It was observed that the positive or negative impacts (post-project benefit realisation) of each case study contributed towards the perception of success. Additionally, the success or failure of the case studies were subjectively defined by critical determinants that are external to the project. These factors were socially constructed around project stakeholders' perception, either during the lifecycle or extended lifecycle of the project. Overall, project success remains a debatable issue because it transcends deterministic parameters but involves a combination of the achievement of project objectives and the satisfaction of project stakeholders.

Keywords: Smart City; Project Management; Project Success

1. Introduction

Within the last three decades, project success has received considerable attention within the project management research literature (Ika, 2009; Cicmil and Hodgson, 2006; Pinto and Slevin, 1988). Whilst this attention has relatively improved the understanding of project success, a degree of complexity and conceptual ambiguity still surrounds the concept and this presents significant problems for researchers (Ika et al, 2012; Thomas and Fernandez, 2008; Hyväri, 2006; Jugdev and Müller, 2005; Baccarini, 1999; Belassi and Tukel, 1996). It is established in extant literature that cogitating a project outcome as a success or as a failure is overly simplistic. The first issue stems from the fact that research studies have not been able to reach a consensus on a definition nor a means for measuring such success (Ika, 2009). Also, another unresolved issued that has been established in the literature is that project success means different things to different people and as such, it is mind-dependent (Todorovic, 2015; Shenhar and Dvir, 2007; Cicmil and Hodgson, 2006; Freeman and Beale, 1992; De Witt, 1988).

For instance, a contractor may consider project success in terms how much profitability he/she retains from the project while an architect may consider project success in terms of aesthetic appearance. This realization led to Baker et al (1974) to argue that there is perhaps no such thing as "absolute success", rather only "perceived success of a project". Thus, success indeed, lies in the 'eyes of the beholder' (Neves et al. 2017). For instance, an accountant may consider the success of a project in terms of budget under-spent while an engineer may consider technical competence delivery as a measure of project success. In order to confirm the highly subjective nature of project success, this study seeks to explore the subjective nature of project success, numerous real-life cases were explored in conjunction with relevant extant literature references. Consequently, this created a robust body of literature to explore the aim of the study, which is to explore the complexity of project success using relevant real-life case studies. Accordingly, the specific objectives of this study are:

1. To identify relevant real-life case studies of successful and failed projects;
2. To investigate the critical parameters that defines successful and failed projects;
3. To present a critique and analysis of the findings of the study in relation to the complexity of project success.

The remaining sections of the study are structured as follows: Section 2 of the study provides a review of the concept and complexity of project success. Section 3 provides an overview of the research methodology. This is followed by Section 4, which provides a description of the selected case studies. Then, Section 5 presents the discussion and arguments of the subjective judgement of the selected case studies. Lastly, Section 6 concludes the study by re-emphasising the significant issues presented in the discussion and areas of further research.

2. Complexities of Project Success

A project is a unique and temporary process, consisting of a set of coordinated and controlled activities with definite start and finish dates, undertaken to achieve a unique objective conforming to specific requirements, in order to bring about a beneficial change or improvement to the current situation for an

identifiable 'stakeholder' (Cicmil, 2018). This all-encompassing definition of a project considers four key attributes, which include: (1) a project is a temporary process which typically has a defined start and an end date; (2) a project has a unique predetermined set of specifications that must be delivered; (3) a project is typically for a recognisable stakeholder and; (4) a project usually seeks to achieve a positive change. Thus, can the success of a project be construed as the achievement of the above stated project objectives which include delivering to time, meeting client specifications and staying within client budget? Lim and Mohamed (1999) concurs with this viewpoint by defining a successful project as the achievement of pre-determined project goals, which commonly include multiple parameters such as cost, quality, performance, time and safety. However, Liu and Walker (1998) contends that project success is a concept that intrinsically connotes different meanings to various stakeholders with varying perceptions. As such, different stakeholders will have different expectations about a particular project, thus, the success of a project will be determined by the realisation of their respective expectations. Conclusively, this study argues along this line that it is false to entirely construe the achievements of project objectives to be the success of a project. Thus, project success is a complex concept.

Evidence suggests that project success is a concept that is frequently discussed in the literature, and yet rarely agreed upon (Baccarini, 1999). Despite the consensus of commentators on the importance of exploring project success, there is, yet, no strong consensus around a single definition because of its complex meaning. Many commentators have acknowledged that one of the earliest and most common approaches towards exploring what constitutes project success has been to conceptualise project as a uni-dimensional construct concerned with delivering projects within agreed cost, time and quality (Iron Triangle, see Figure 1) (Fortune et al., 2011; Turner, 2009; Müller and Turner, 2007; Hyväri, 2006; Diallo and Thuillier, 2004; Freeman and Beale, 1992).

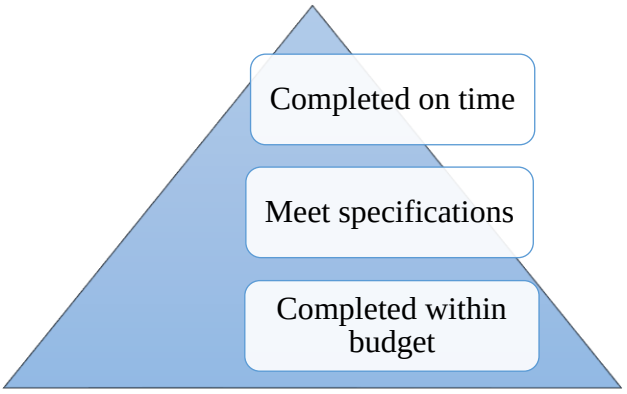

Figure 1: Iron triangle of project success

However, Jo and Barry (2008) argue that project success has evolved beyond the traditional concept of the iron triangle, and now, determining project success is far more convoluted. Although, some projects may be judged on the iron triangle in the short run when time-to-market is critical. However, more often than not, there are many examples where this approach is simply not enough (Jo and Barry, 2008; Frame, 2003; Cicmil, 1997). For example, a project can be considered as a failure in terms of not being completed on time and not staying within budget but may still be considered a success from the perspective of the added value of the project or client satisfaction (Jo and Barry, 2008). Based on this viewpoint and many other real-life case studies, many commentators have conceptualised project success as a complex, multi-dimensional construct encompassing numerous factors beyond delivering projects within the agreed cost, time and quality (Shenhar et al., 2001; Lim and Mohamed, 1999; Atkinson, 1999; Cicmil, 1997). This viewpoint is based on the view that the success of a project is perceived in myriad ways, and as such, becomes subjective. Thus, individuals and stakeholders alike will often interpret project success in different ways because of varying perceptions, and this often leads to disagreements about whether a project is successful or not (Liu and Walker, 1998; Cicmil, 1997).

3. Research Methodology

After a review of extant literature, it was evident that an epistemology that allows for the exploration of subjectivity is needed for this study. As such, this study adopts a subjectivist epistemology because it involves the comprehension of meaning through interaction between the researcher and subjects of study (Collis and Hussey, 2009) since the meaning given to reality is believed to be inter-subjectively constructed (Burrell and Morgan, 1979). Accordingly, an interpretivist theoretical perspective was adopted in line with Crotty (1998). The motive behind this was to adopt an inductive reasoning (Berger and Luckmann, 1967) to understand the phenomenon by focusing on social construction and reproduction of meanings and languages (Myers 2008; Burrell and Morgan, 1979). The study consequently adopts a qualitative research method of enquiry to offer exploratory approach to knowledge acquisition by reviewing relevant extant literature. This qualitative research method enables the researcher to develop a full understanding of the meaning ascribed to the phenomenon by research subjects (Denzin and Lincoln, 2009; Creswell, 2003).

In a bid to gain detailed understanding (corroboration with extant literature) of the concept under investigation, the study adopts a case study (single or multiple) strategy which involves an in-depth study of events, persons, phenomena or projects (Cohen et al., 2013). To alleviate the criticisms levelled against the adoption of a single case study strategy (see Flyvberg, 2006), this study fittingly adopts a multiple-case study approach to generalise research findings that can be replicated in similar contexts (Yin, 2012). As such, multiple-case studies of four (4) real-life projects were identified for in-depth investigation. These include Sydney Opera House, Microsoft Window's Software, Three Gorges Dam and Charles de Gaulle Airport (Terminal 2E) representative of two different industries as presented in Table 1. Two distinct features defined the selection of these case studies, they include: (1) the multiple-case studies were conveniently selected by the researcher based on the accessibility of the research materials, and (2) the ambiguity involved in judging the multiple-case studies project success.

Table 1: Characteristics of Real-Life Case Studies

No	Project	Industry	Completion
1.	Sydney Opera House	Construction	1973
2.	Microsoft's Windows software	ICT	1985
3.	Three Gorges Dam	Construction	2011
4.	Charles de Gaulle Airport (Terminal 2E)	Construction	2003

4. Real-Life Case Studies

As stated above, there are numerous cases where projects have surpassed its specified time and overran its budget but were deemed successful. As such, this study will reflect on four real-life project case studies to evaluate how projects, despite failing/passing one or more of the scheduled iron triangle objectives (time, cost, quality) can still be considered a failure/success.

4.1 Sydney Opera House

The Sydney Opera House is regarded as the global symbol of Australia as well as one of the most classical buildings in the world (Lim and Mohamed, 1999). The building was designed and constructed by Danish architect - Jørn Utzon, who won the architecture call competition for designing the building in 1957 (Murray, 2003). The project was pre-scheduled for four years, with a budget of AUS $7 million. However, the project ended up expending 14 years (time overspent) to be completed and cost AUS $102 million, 14 times the original budget (budget overrun) (Lim and Mohamed, 1999). As such, it can be easily construed that the Sydney Opera House could be perceived as a disastrous construction project not only from the erroneous project management plan but also from the financial point of view. However, the Sydney Opera House proved successful regarding quality in the long-run as it is seen as an engineering masterpiece which is the most famous landmark in Australia (Lim and Mohamed, 1999)

and no tourist wants to leave Australia without glimpsing it (Shenhar et al., 2001).

4.2 Microsoft Window's Software

Microsoft is a world-leading digital transformation provider for delivering intelligent cloud and an intelligent edge. In response to the growing interest in Graphical User Interfaces (GUI), Microsoft introduced its first Operating System (OS) named Windows in 1985 (Bellis, 2018). However, the time-sensitive delivery of the project to market against its Apple counterpart was marred by considerable delays which resulted in continuous flow of resources and additional staff (Shenhar et al., 2001). In the eventual delivery of the project, Windows received mixed reviews as it was contended that it grounded its innovation on the use of a relatively new concept (mouse) for navigating its interface and poor performance when running applications simultaneously (Bellis, 2018). Despite these impediments, Microsoft Windows went on to become a force to be reckoned with by upstaging its counterpart, Apple. Coupled with this, Windows became a major source of revenue for Microsoft, and approximately 90% of all PCs in the world now use the Windows operating system (Shenhar et al., 2001).

4.3 Three Gorges Dam

The Three Gorges Dam is considered as a civil engineering wonder functioning as the world's largest power station in terms of installed capacity (22,500 MW). The plan for the Dam was conceived in the early 1950s and officially approved in 1958 (Shenhar and Holzmann, 2017) as a result of the need to utilise the water power which causes floods almost every other year and increase the navigability of the Yangtze River (Fu et al., 2010; Ma, 2010). However, the project did not kick-start until 1993, with construction scheduled to take place between 1994 and 2009 (Ma, 2010). Despite the lengthy timeline for completion, the dam was not fully operational until 2011 (time overspent) (Xu, et al., 2013). Also, the initial estimation for cost of the project was set at US$22.5 billion, however, at the time of completion, the cost was US$27.6 billion (budget overrun) (Xu, et al., 2013). Despite these setbacks, the dam has been beneficial to the environment by replacing the use of finite coal for electricity to the cleaner use of water power for electricity (hydroelectricity) (Ma, 2010). Equally, the dam controlled downstream flooding and saved many communities. Conversely, in light of the global sustainability agenda of environmentalists, the dam has been culpable of a number of significant environmental, ecological, and socio-economic implications. Ecologically, the dam disrupted fish migrations and this lowered fish populations. Also, the dam also displaced over 1.3 million people from their long-standing communities (Xu, et al., 2013).

4.4 Charles de Gaulle Airport (Terminal 2E)

Charles de Gaulle Airport is the world's eighth-busiest airport in terms of passengers served. In response to the increasing number of passengers commuting via the airport, the construction of a new terminal was envisaged (Torres, 2004). Similar to all the previous terminals at the Charles de Gaulle Airport, the newly proposed terminal was contracted to renowned architect, Paul Andreu (Torres, 2004). The project commenced in 1997 and the terminal was opened to the public in 2003 after some delays in construction (Kamari et al., 2015). Shortly after its commissioning in 2004, the concrete arcs of the terminal fully tore away from the lateral walls, collapsing onto the terminal below in which four individuals died in the process (Rowe, 2017; Kamari et al., 2015; Torres, 2004). According to Ishak et al., (2007) an investigation into the fatality revealed that the design itself had little margins of safety. Equally, Kamari et al., (2015) discovered that signs of impending collapse (creeping and shrinking of the concrete) were observed during the construction cycle of the terminal. However, these warning signs were scorned as not "showing any undue concern" (Kamari, et al., 2015, p. 89). It was also revealed that the project was rushed because it was a month behind schedule (Kamari et al., 2015).

Table 2: Smart City Case studies success/failure assessment

No	Project Name	Product	Cost[a]	Time[a]	Quality[a]	Critical Determinant[b]	Success/Failure?[c]
1.	**Sydney Opera House**	Architectural wonder of performing arts in Australia	✗	✗	✓	State-of-the-art and lasting quality	Success
2.	**Windows**	Operating System	N/A	N/A	✗	Long-term impact	Success
3.	**Three Gorges Dam**	World's largest hydroelectric dam	✗	✗	✓	Environmental issues	Failure
4.	**Charles De Gaulle Airport (Terminal 2E)**	International airport to handle 79 million passengers per year	✗	✗	✗	Safety issues (Collapse of the structure and loss of life)	Failure

[a] *Quantifiable success factors (Iron triangle)*
[b] *Subjective critical determinant assessment of success/failure –* ***highly debatable***
[c] *Subjectively determined –* ***highly debatable***

5. Discussion and Arguments

After an in-depth exploration of existing literature on project success and its associated ambiguity, an assessment of the success/failure of real-life case studies further intensifies arguments surrounding project success. In the case of the Sydney Opera House, despite failing two out of three quantifiable success factors (time overspent and budget overrun), the project can still be typified as a successful project in terms of quality. This viewpoint benefits from 'post-project benefit realisation' under the extended lifecycle of the project in the sense that the Sydney Opera House stands today as an iconic landmark that consists of multiple performance venues which together hosts more than 1500 performances annually which are attended by more than 1.2 million people (Morgan, 2007). Furthermore, its importance has been exemplified by the UN declaring it as a UNESCO world heritage site that centers on music, culture and architecture. On the other hand, the Microsoft Window's software project did not have a defined end date nor budget, thus, it was not applicable to judge the project by those quantifiable factors. In terms of quality, the Windows OS had some inadequacies, such as poor performance when running applications simultaneously (Bellis, 2018). Conversely, as depicted in Table 2, the project can still be considered as a success from the viewpoint of 'post-project benefit realisation'. This is because the Windows OS served as a stepping stone for further improvement of the OS, which ultimately gave Microsoft a competitive advantage over Apple in terms of OS development. Likewise, due to the preliminary Windows OS, Windows is a significant contributor of revenue for Microsoft, and approximately 90% of all PCs in the world now use the Windows OS (Shenhar et al., 2001).

As evident in Table 2, the Three Gorges Dam, which failed two out of three quantifiable success factors (time overspent and budget overrun) can be typified as a failure based on a number of reasons. In terms of 'project culpability' during the lifecycle of the project, the project resulted in the displacement of over 1.3 million people, destruction of many historical excavation sites and the declining fish population of the area (Xu, et al., 2013). Similarly, the most catastrophic risk of the project lies in the possibility of the dam failing due to seismic activity which is rampant in the Asian continent. The effect of this probable eventuality would be devastating (Xu, et al., 2013). In the case of the Charles de Gaulle (Terminal 2E) project, as apparent in Table 2, this project can be epitomised as a failure. Firstly, the project exceeded time and, in a response, to hasten the project, the quality of the project was affected. This eventually led to the collapse of the terminal 2E which resulted in the loss of life. More so, the fact that early warning signs were brushed aside adds to the more reason why the failure is typified as a failure.

6. Conclusion

Project success is a complex (uni-dimensional and multi-dimensional) concept as a result of the complexity of projects in size, uniqueness and participants. Thus, the deterministic quantifiable success factors and stakeholders' expectations differs from projects to projects. A significant observation from the explored case studies revealed that most of the projects did not perform excellently when examined using the iron triangle as shown in Table 2. For instance, it was observed that the positive or negative impacts (post-project benefit realisation) of each case study contributed towards the perception of success. Additionally, the success or failure of the case studies were subjectively defined by critical determinants that are external to the project. These factors were socially constructed around project stakeholders' perception, either during the lifecycle or extended lifecycle of the project. Overall, project success remains a debatable issue because it transcends deterministic parameters but involves a combination of the achievement of project objectives and the satisfaction of project stakeholders. Thus, what are the critical determinants of a successful project? Does project success transcend the mere achievement of time, cost, and quality? This further intensifies the arguments on project success complexities. However, this study, therefore recommends that it is pertinent for contracted-organisations to have a holistic picture of the quantifiable success factors (iron triangle) and the success criteria of stakeholders involved in the project. This is particularly crucial because this is what the

contracted-organisation will be judged on.

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