

# Managerial Challenges Impacting on a TBM Design: A Kingdom of Saudi Arabia Metro Project

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## Abstract

This paper explores the managerial challenges and viewpoints relating to the management of a metro design in KSA, raised by a group of design engineering staff. The paper examines the scope, reflections, and attitudes to the project management and which appear to contribute to the efficacy of the design outcomes between a single group of engineering personnel of thirteen (13) design engineers for a metro development in KSA. The paper advances a conceptualisation from the findings of a diverse range of qualitative personnel opinion into an integrated framework.

Outcomes from this inquiry suggests that the project management show clear issues with the management style adopted to manage this group and explores the derived themes of namely four (4) main themes, namely Management; Project, People; and Technology.

The outcomes shows opinion that the project management are not effectively managing the project corresponding with raised issues of cost/schedule overruns, delays to the project through poor coordination, ineffective leadership of the projects activities, and inadequate project preparation and its managerial execution. The paper further suggests how some of the effects of these identified issues may be reduced or mitigated.

**Keywords:** management, challenges, design, metro, KSA

## 1. Introduction

Project design management practices have progressively developed for many years. Nevertheless, the opportunities and the difficulties associated with project management design practices have continued to change and modify (Crawford, Pollack, & England, 2006). Many writers perceive the need for successful collaboration between contractors and clients in large metro design projects as a contemporary prerequisite (Jaafari, 2003). Further, such large metro projects are often characterised by the development of a culture that focuses on the ambiguous (Engwall, 1998); favouring operational independence (Langfred & Moye, 2004); raising attempts at establishing innovativeness (Rogers, 1995); building entrepreneurship (James, 2011); and exhibiting strong risk management orientations (Chapman & Ward, 1995) through appropriate leadership attributes and behaviours (Keegan and Den Hartog, 2004). However, some large metro projects operate dysfunctionally (Bate, 1994) and project managers and others involved in the management of projects do not appear understand the projects character (Anderssen, 2003); take note of its complexity (Koot & Sabelis, 2002); nor determine the most efficient/effective methodology to manage the life-time cycle of the project. Consequently, many projects appear to exhibit serious issues related to rising costs, haphazard scheduling and programme delivery (Flyvbjerg, Bruzelius & Rothengatter, 2003). The resulting project managerial focus is thus influenced by increased ambiguity (Engwall, 1998); and short-term action goals, increased cost and elevated levels of stress and conflict among the many groups acting on behalf of their project partners (Pena-Mora, Sriram & Logcher, 1995) that lead to misallocation of scarce resources (Flyvbjerg, Bruzelius, & Rothengatter, 2003). Accordingly, when focusing on the TBM design process adopted by some project managers they often appear to exact damaging influences on the design result, cost and timing, and the client project perception (Anderssen, 2003). Further, managerial approaches to project management do not follow exact paths of implementation and are often mired in fuzzy boundaries resulting in chaotic outcomes, which can be costly and time consuming (Jaafari, 2003).

Further, contextualising the design phase as coupled design (Olson & Olson, 2000)—which starts through an analysis of client requirements (Gunasekaran & Love, 1998); often moves on to implying convergence to one

solution quite early in the process (Yoo & Chang, 2013); building the concept phase into a number of sub-phases to be undertaken sequentially (Cohen, 2010); and finally the utilisation of models for stimulating a wider solution outcome, resulting from formal evaluation processes (Thomsen et al., 2009). This aspect of the project is behaviourally characterised adhocratic (Mintzberg, 1980) when team members exhibit conflicting aims, priorities and expectations, and need to build a working culture (Koskela, 2003) that focuses on ways to discover shared goals, objectives and problem-ownership (Hastings, 1995).

### *1.1 Challenges for Metro Construction Project Design Management*

A notional but very important issue is the need to engage leadership (Davenport, De Long, & Beers, 1998). This has the effect of ensuring the project is on the right course and defined appropriately. A visible and integrated function is the management of collaboration, which can be difficult to achieve in relation to consensus-based outcomes (Cunningham, 2014); and successful multi-disciplinary interaction (Gunasekaran & Love, 1998) leading to efficient project decision-making (Foley & Macmillan, 2005). Further, in some metro construction projects, management evaluative competencies (Lee, Kim, & Lee, 2011) are used to ensure progressive managerial influences are imposed on technological and project processes (Garvin, 1998) resulting in more favourable dynamic internal operating capability (Teece, Pisano, & Shuen, 2007). These constructive managerial processes appear to enhance collaboration within Lean Construction (e.g. Ballard & Howell, 2003), but is still vexed by the application of negative managerial culture constructs (van Marrewijk & Veenswijk, 2006). Further, this managerial intent, critical disposition and application - assumed to be systematic and continuously applied throughout the entire construction project (Saurin, Formoso, & Guimarães, 2004)—have great influence on project practices (Sausser, Reilly, & Shenhar, 2009). Consequently, there appears uncertainty surrounding the managerial execution of metro construction projects (Young, 1998); perceived as controversial (Lindgren & Packendorff, 2005); appear collectively constrained (Cicmil, 2005); which is overtly associated with project failure (Andersen, Birchall, Jessen, & Money, 2006) through ill-managed projects (Kerzner, 1998).

In large to mega-metro construction projects, an observance can be seen in the application of computational methods to help shape design parameters (Horvath, Rusak, & Duhovnik, 2007)—conditionally imposed through the application of new optimisation methods giving access to enhanced collaborative processes (Gobeli, Koenig, & Bechinger, 1998). This is seen to initiate corresponding control issues (Brown & Eisenhardt, 1997; McAnulty & Baroudi, 2010) leading to the need to manage and off-set operational contingencies (Lynn, 1998) using more focused communication practices (Szulanski, 1996) whilst engaging in attempts at enhancing risk management activities (Derelov, 2008).

This leads to the major research question: *What managerial challenges and problems do design project teams experience when designing a TBM for a metro?*

## **2. Methodology**

To investigate the issues generated within the design context, a deeper, more involved approach was considered appropriate. In order to consider more implicitly these generated issues, this empirical foundation exploited an interpretive approach (Hill, Thompson, & Williams, 1997; Walsh, White, & Young, 2008). This was an attempt to understand the perceptions of design engineers of their tunnel design practices when considering a TBM design. The design engineers were considered specialist knowledge agents and actors (Benn et al., 2008) as their opinions and experiences influenced the effectiveness of TBM design practices, and the development and application of building design knowledge.

The research used a semi-structured interview conducted with design engineers, which provided an appropriate element of context and flexibility (Cassell & Symon, 2004) and this was further aided by applying an inductive/theory building approach (Glaser & Strauss, 1967). Given the lack of appropriately focused research in this area, this methodology is seen as suitable for creating contextual data for the purpose of forming richer theory development (Cayla & Eckhardt, 2007).

The population frame (22) for this study was made up of a specific TBM design group (19) located at one office site, and also included international designers (3) from identified overseas locations—which is considered an existing frame (Ritchie & Lewis, 2003) and delivered an initial means for appropriate sampling assessment with clear boundaries (Coyne, 1997). Given that not all individuals in this group were available for interview – being overseas, the sampling frame was configured from this population as being described as 17 in number, where each respondent was included (Fink, 2000), and no respondent was considered out of scope relative to the research orientation and requirements (Koerber & McMichael, 2008). Consequently, and in line with a qualitative approach (Bryman, 2001), the respondents were chosen through applying the approach of a targeted population of interest (Carman, 1990) and this reflected the criteria of theoretical purpose, relevance and

appropriateness (Glaser & Strauss, 1967). Additionally, using Glaser's (2004) sampling processes, a total of 13 design engineers were thus determined as the resultant sample frame, which could also be considered convenience sampling according to Harrel and Fors (1992) and the sample frame meets the saturation requirements of Guest, Bunce, and Johnson (2006) and thus takes the sample frame beyond the expected level.

Each interview was audio recorded for future analysis. Interviews were conducted in English and took approximately one hour. All interviews were conducted through Skype and recorded digitally after gaining explicit permission (following Duranti, 2007) and were later transcribed verbatim using NVivo 11 software using the approach indicated by Bailey (2008). The conduct of the interviews follows a similar process used by Gray and Wilcox (1995), with each individual group being asked the same set of questions—modified through ancillary questioning (probes and follow-ups) in the same way as Balslem (1991). To increase the reliability of the data, the actual transcription was returned to each respondent—via e-mail—for comment, correction, addition or deletion and return, which followed the process of validated referral (Reeves & Harper, 1981). Whole-process validity was achieved as the respondents were considered widely knowledgeable of the context and content associated with the research orientation (Tull & Hawkins, 1990). Each interview was initially manually interrogated and coded initially using the Acrobat software according to sub-themes that 'surfaced' from the interview dialogue—using a form of open-coding derived from Glaser (1992a); and Straus and Corbin (1990). This treatment was also reinforced and extended through the use of thematic analysis conducted using the NVivo 11—qualitative software package (Walsh, White, & Young, 2008). Each interview was treated and coded independently. In this way, no portion of any interview dialogue was left uncoded and the overall outcome represented the shared respondents views and perspectives through an evolving coding-sequence (Buston, 1999). Various themes were sensed from the use of the software packages, as well as from the initial manual-coding attempts. This dual form of interrogation was an attempt to increase the validity of the choice of both key themes and sub-themes through a triangulation process (Onwuegbuzie, Leech, & Collins, 2012). NVivo 11 was further used to explore these sub-themes by helping to pull together each of these sub-themes from all the interviews (Harwood & Garry, 2003). In this way, it was possible to capture each respondent's comments across transcripts (Riessman, 1993) on each supported sub-theme and place them together for further consideration and analysis (Ryan & Bernard, 2003).

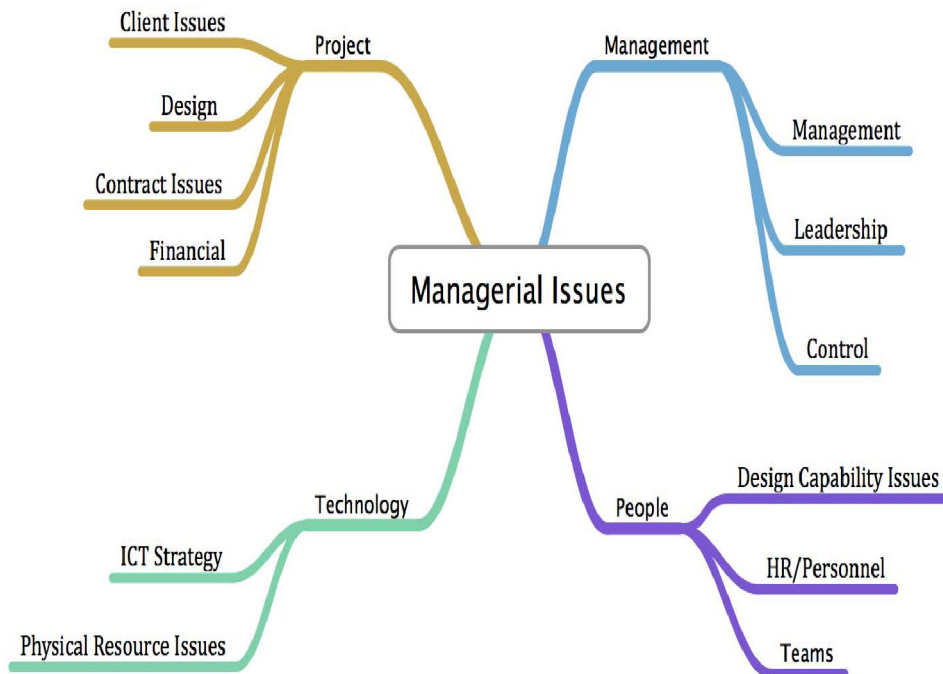


Figure 1. Research outcomes

### 2.1 Illustration of Research Outcomes

The outline of the research outcomes for this study is shown in Figure 1 above. The framework supported by appropriate literature, illustrated below in Table 1, consists of four (4) main themes, and twelve (12) sub-themes. The outcomes are stated below where the discussion focuses on the sub-theme elements within each key theme. The discussion format used in this paper reflects the respondent's voice through a streamlined and articulated approach for reporting. Table 1 and 2 illustrate the respondent references for each sub-theme.

Consequently, the style adopted for reporting and illustrating the data is greatly influenced by Gonzalez, (2008) and also Daniels et al. (2007) and is discussed below, focusing on the raised research question and the resultant themes.

Table 1. Research question, themes and references

| Research Question  | Main Themes              | Sub-Themes               | No. Refs |    |
|--|--------------------------|--------------------------|----------|----|
| What managerial challenges and problems do design project teams experience when designing a TBM for a metro? | Management               | Management               | 15       |    |
|  |                          | Leadership               | 11       |    |
|  |                          | Control                  | 12       |    |
|  |                          |                          |          | 38 |
|  | Project                  | Client Issues            | 18       |    |
|  |                          | Design                   | 14       |    |
|  |                          | Contract Issues          | 11       |    |
|  |                          | Financial                | 13       |    |
|  |                          |                          |          | 56 |
|  | People                   | Design Capability Issues | 14       |    |
|  |                          | HR/Personnel             | 17       |    |
|  |                          | Teams                    | 11       |    |
|  |                          |                          | 42       |    |
| Technology   | ICT Strategy             | 13                       |          |    |
|  | Physical Resource Issues | 16                       |          |    |
|  |                          |                          | 29       |    |

Table 2. Major themes and respondents

| Major Themes | Respondent No.                         |
|--------------|--|
| Management   | 1, 2, 4, 5, 6, 9, 11, 12, 13           |
| Project      | 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 |
| People       | 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 |
| Technology   | 1, 2, 3, 5, 6, 8, 9, 11                |

### 3. Results

The results are presented below using the research question as a pointer and supportive empirical evidence through indicated extractions as in Gonzalez (2008). Consequently, considering the research question—*What managerial challenges and problems do design project teams experience when designing a TBM for a metro?* The results are further indicated below, where each main theme is placed with every sub-theme.

### 3.1 Main Theme—Management

#### Management

In terms of the sub-theme Management, one respondent (R6) indicated that, *...management don't really understand the problems we face. They just want results – whatever it takes.* Another respondent (R11) suggested that, *...It is exceptionally difficult to give them [management] what they want. It can't be done in the timeframe they've given us nor with the resources they give us.* Further, another respondent (R13) stated that, *...I am not sure we are ready as yet. We're still planning. We have very tight timeframes.*

#### Leadership

In terms of the sub-theme Leadership, one respondent (R9) indicated that, *...There's a distinct, and obvious, lack of leadership. We are swinging to one man's tune—and he's aggressive and not experienced enough.* Another respondent (R12) suggested that, *...The tone is to do what he [manager] tells us and by whatever date. That's the leadership here.* Further, another respondent (R4) stated that, *...Our system follows normal ways of working. Do what your told. That's it.* This is compounded by another respondent (R1), who indicated that, *...I am not convinced that management have led any project before. They appear to lack the credibility and lineage of good engineers.*

#### Control

In terms of the sub-theme Control, one respondent (R5) indicated that, *...Unquestionably, the process for control is absolutely centralised. Every decision has to be made through one or two individuals.* Another respondent (R11) suggested that, *...Unfortunately, control rests with a few inexperienced managers. Sad really.* Further, another respondent (R2) stated that, *...If only it worked. It is nonsense. No one can work like this. It's no wonder we are behind schedule.* This is supported by another respondent (R6), who indicated that, *...Control is one thing, but to deliberately create this culture? They don't trust us as engineers.*

### 3.2 Main Theme—Project

#### Client Issues

In terms of the sub-theme Client Issues, one respondent (R12) indicated that, *...The focus for us are the tangible outcomes. Those outcomes that can be measured against client requirements. Unfortunately, the interpretation by management isn't so great.* Another respondent (R3) suggested that, *...Many client's assume we have everyone on board at the start. But here our asset management process means that we have to "streamline" the body count, as it were. Otherwise, it would become very messy and costly.* Another respondent (R13) suggested that, *...The client usually doesn't totally understand big projects. That's why we're here. We don't have tell them everything.* Further, another respondent (R8) stated that, *...You've got to be client faced in this job. They are seriously important to us. Some staff however, don't think the same way.* However, another respondent (R4) suggested that, *...Our clients know we don't have the manpower on board. It's normal. But it can be extreme when the right personnel are not here or even when the stated individual in the bid document isn't here. It's too late then.*

#### Design

In terms of the sub-theme Design, one respondent (R6) indicated that, *...We have a problem with design to be honest. It has taken an extraordinary amount of time to get where we are.* Another respondent (R9) suggested that, *...It is fragmented. Too many chiefs and not enough people to do the work.* Another respondent (R4) advised that, *...I blame the problem on the sub-contractor. They just don't take it seriously enough. It isn't managed properly here.* In support of this, another respondent (R12) intimated that, *...The design team is everywhere. Not even in this country. It is incredibly difficult to manage. As a consequence we waste an awful lot of time trying to co-ordinate and then the design result is misunderstood.*

#### Contract Issues

In terms of the sub-theme Contract Issues, one respondent (R11) indicated that, *...Our BIM section does a great job of managing. We haven't been caught yet. We have to be very specific about what we can charge the client. It's a question of balance.* Another respondent (R1) suggested that, *...Not everything is reported. There are conditions. Fortunately, not everything has the same requirements – safety, contractual, reporting etc. So something's can be kept out of the limelight.* This is further supported by another respondent (R3) who stated that, *...the contract is difficult o define properly, so we make do. We report what we can, but you know, it isn't exactly clear.*

### Financial

In terms of the sub-theme Financial, one respondent (R13) denoted that, *...We need to ensure that they [staff] design the TBM as cost effectively as possible. But, I cannot see how we can improve our methods. It's difficult as it is.* Another respondent (R1) suggested that, *...Our mission is to make money. Plain and simple.* Another issue was raised by one respondent (R9) who stated, *...Our staff turnover is too much. I don't know how to stop it. It costs us so much. Lucky the client doesn't get the figures. But I'm sure they get it somehow.* This unclear financial situation is further supported by another respondent (R5) who specified that, *...The finance's are controlled by one individual. We don't know what the budget is for our department. It's as if it is a secret.* Underpinning this notion of tight financials, one respondent (R7) stated that, *...We have very little money. This place is screwed. It's illogical what they are doing on such a large project.* To further expand on this issue, another respondent (R10) advised that, *...It is imperative that management show more respect for people and stop the incessant controls on money – personal and the project.*

### 3.3 Main Theme—People

#### Design Capability Issues

In terms of the sub-theme Design Capability Issues, one respondent (R7) indicated that, *...What isn't understood effectively is the transition between signing a design contract and engaging design engineers.* Another respondent (R10) suggested that, *...Are we qualified. That's a good question? Most of our staff are qualified in engineering, but few have any real knowledge about project management. That's the reality.* Supporting this, another respondent (R12) showed that, *...Technically we are sound as a pound. However, there some holes in our offering. You know it's the usual highly experienced and highly qualified individual we desperately need but can't afford or can't get. So we make do.* However, another respondent (R4) indicated, *...I've never been on a project where we have had 100% jobs filled all the time. No, its more like 80%. It's not good. Not good. We are weak as a consequence. It's difficult to progress and deliver.*

#### HR/Personal

In terms of the sub-theme HR/Personal, one respondent (R7) specified that, *...We can only speculate on having the right people on board. Sometimes, we trick ourselves by only having a CV but no body. It can be extremely frustrating.* Another respondent (R2) suggested that, *...At the start of the project we gave our trust that we can do it. Our staff will make sure we meet their approval.* Another respondent (R13) submitted that, *...We are sometimes moved to take risks, even those that are considered professionally unsound. They revolve around putting people's CV's on our bidding documents that won't be available. Or, using people's names to boost our project.* However, supporting this again, another respondent (R1) stated, *...It is obvious, but no one tells the clients, that not all named people will be on the ground. We just say, things have changed in their circumstances. It's easy to blame them, rather than us.* Adding to this notion, another respondent (R8) indicated that, *...We're always in a flux with engineers. You can't keep them all, and there is always those who feel they need to move on. It's difficult to manage.* On the notion of training, one respondent (R9) affirmed that, *...No. We never train. They should already have done everything they need to be on the project. No. I think that training is very useful. Just not here and not now. We don't have the time. Training costs money and time off project. We make safety an issue, but even then, training is not carried out if it interferes with our main line of working.* However, another respondent (R6) indicated unequivocally that, *...Money is tight. We know that. So we have to manage our budget carefully. Sometimes that means making some cuts or not paying someone's expenses or delaying it until we can. We don't have a choice.*

#### Teams

In terms of the sub-theme Teams, one respondent (R11) directed that, *...We have to form a unified team as soon as possible. This is a big task considering that here, there will be hundreds of people involved.* Another respondent (R5) indicated that, *...Unfortunately, we are a bunch of individuals. I really don't know how to improve the situation – it is too arduous. It's a very big job, I know that.* This aspect is supported by another respondent ((R4), who stated, *...We are a team. We work together don't we? Since we are in a number of buildings separated across the city, only knows when we will be a team. Perhaps never.* However, another respondent (R7) clearly indicates the cause of issue, *...It is management's fault we aren't a team. They do everything to prevent it. They move one against the other here. It's very personal and negative.*

### 3.4 Main Theme—Technology

#### Physical Resource Issue

In terms of the sub-theme Physical Resource Issue, one respondent (R5) specified that, *...Our accommodation is*

*first class. What the staff don't understand is that it is an awful lot of money that's been invested in it. And they don't want to be in it.* However, This is supported by another respondent (R2) directed that, *...We are in separate buildings. Maybe being housed in one location may help.* Another respondent (R9) stated that, *...Our technology is fragmented. It's very chaotic. We don't have the time to settle in, it's all go and no amount of technology will help us.* This is also supported by another respondent (R3) who stated that, *...We have new technology – computers, phones, cars. Unfortunately, they don't work together very well and we don't have the right software. It's just a mess.*

#### ICT Strategy

In terms of the sub-theme ICT Strategy, one respondent (R8) indicated that, *...We have inherited the office site. It isn't ideal for our purposes. We could easily move to better office space, but the decision rests with someone in another country.* Another respondent (R6) suggested that, *...There is no communication design. It's very ad-hoc. We are insignificant really. We can't work like this. It's like we are in the middle of a desert, with no connection to the world.* However, another respondent (R11) states that, *...The IT strategy here is to create blocks. That's what I see. Nothing is more clearer. We get computers which breakdown within 24 hours, no software, no standardisation. I have to use my own personal computer in order to get anything done. It's very chaotic to work here.* This is supported by another respondent (R1) who indicated that, *...There is no viable software strategy. Poor really. We cannot do our jobs here. Printers are unconnected and abandoned. It's no wonder we can't deliver the planned scope.*

#### **4. Discussion**

In order to take this inquiry forward, the discussion concentrates on the raised question to help address some of the outcomes. Consequently, the main focus for this discussion are the characteristics revolving around the main themes—Management, Project, People and Technology.

##### *4.1 Management*

The influence of project complexity (Kaming, Olomolaiye, Holt, & Harris, 1997), which appeared to show managerial decision incongruence and personal divisory reactions from inexperienced or intransient project management, may underpin the consequent delays to the project schedule through poor coordination (OGC, 2010). Further, inadequate and improper project preparation (Oyegoke, 2001) and its operation resulted in the ineffective programme management of the project activities to date (Owen et al., 2010). However, it would appear that there is also an inadequate managerial execution (Wainaina, 2008) through an authority-compliance leadership style (Vroom & Jago, 1988), which is not considered appropriate by staff. Consequently, the level of project competency (Global Alliance for Project Performance Standards, 2007) shown by the project management in terms of context and personnel collaboration (Kadefors, 2011) appears to be disruptive, intransient and incapable of leading to an effective project outcome (Latham, 1994). This complex construction project requires additional management competencies (Ahadzie, Proverbs & Olomolaiye, 2008) to control the project. Consequently, the project management have not been observed to hold, embrace or articulate and present management behaviour which is seen as proactive, appropriate or relevant to project requirements or personnel needs (Anvuur & Kumaraswamy, 2007). In order to help with this management failing, directing the project more effectively through scenario planning may help (Lindgren & Bandhold, 2003).

Project leadership demands more than just resource focus and attention to programme details (Carter, 1988). It demands an engagement with engineering staff passions and communication (Geaney, 1995). In terms of this project, there would appear to be reluctance by project management to provide appropriate leadership (Morris and Pinto, 2004) and the application of proper project skills (Engwall, 2003) leading to staff perceptions of mistrust and scepticism (Adler, 2005).

##### *4.2 Project*

Client knowledge of the project only comes through the project managers and this is perceived as a major barrier to operationalising the project effectively through a negative management culture (Clegg, 1989). In essence, the way the project is run managerially has implications for client demands (Appel, 1993) and for the project outcomes and the client-project management relationships (Davis & Pharro, 2003). Design considerations appears to be compromised by inadequate project management (Morris, 1994); leading to contractual failures; which may be mediated through more effective client relationships (Dyer & Singh, 1998)—thus increasing the time schedule and costs of the project and also leading to further conflict (Hunter & Hoenig, 1992) requiring resolution. Further, it would appear that a more pertinent and focused project recruitment process should be introduced (Loosemore, Dainty & Lingard, 2003) which also considers and examines how staff are treated when

on-site (Huselid, 1995).

Another major issue is the management behaviour in terms of hiding project outcomes from the client – a predisposed dysfunctional culture (Bate, 1994) – giving the illusion of managerial flexibility (Markish & Willcox, 2003). This happens in many construction projects and is a managerial behaviour that carries significant risk for the client (Chapman, 2001) whilst attempting to recognise the need for the designer to maximise return on investments of capital assets (Pennanen, Ballard & Haahtela, 2011). Consequently, this must be modified in line with good project management practices (Koskela, Huovila & Leinonen, 2002).

#### *4.3 People*

As a result of this inquiry, the perceived impact of the possible negative effect of the developed project management culture (Hofstede & Hofstede, 2005) has to be taken into account along with the reduced quality of team interaction (Sacks, Koskela & Dave, 2010) between project management and the design engineers. This needs to be addressed using more integrated management processes (Badreddine, Romdhane & Amor, 2009) such as teambuilding (James, 2005); project management training in strategy project engagement (Artoa, Kujalab, Dietrichb, & Martinsuo, 2008); in order to meet the established needs of project engineering staff (Roberts, 2005). Further, by utilising appropriate program management techniques in order to reduce project confusion and enhance financial and process efficiency (Martinsuo & Lehtonen, 2007a) this will reduce the impact of a traditional project hierarchal/patriarchal approach (Kerzner, 2003).

From an HR perspective, the capability of the design team is seriously brought into question by constant movement of engineers into and out of the project – raising distributed team issues (Hinds & Bailey, 2003). This indicates little time for strengthening of relationships, building trust and communication (Lau & Rowlinson, 2011); and providing appropriate administrative project support.

An obvious managerial discontinuity is the lack of training maintained by the project managers possibly through indifference to developing personnel further signifying “non-interoperability” inhibitors affecting the efficacy of the project (Moore & Dainty, 2001). In terms of the project requirements, the project appears to lack the collective knowledge and skill sets for the discovered project tasks resulting from inappropriate team decisions (Raiden, Dainty & Neale, 2004). Particular care needs to be given by the project management to teambuilding activities (Lewis, 2004) in order to secure a more effective design outcome. This is especially so as the leadership prerogative of the project management (Levy, 2007) is to engender a sense of togetherness and purpose, seen empirically lacking by the project engineering staff.

Further, collaboration between the client, the PMC and the contractor is a difficult situation to manage (Eriksson, Nilsson, & Atkin, 2008) as negative responses surrounding trust, scheduling and power were raised. This can be mitigated using appropriate culture/knowledge management methodologies (Kane, Ragsdell, & Oppenheim, 2006) that seek to enhance the experiences of staff and to ensure an equitable working environment, whilst building teamwork (Walker, 1996).

#### *4.4 Technology*

Management appears to support the notion of utilising an incomplete ICT system that nurtures division and provides little in terms of an effective platform for work co-ordination (Brewer & Gajendran, 2009). Further, of possible concern is the relationship to the defined ICT use (contained in the bidding document) and the actual presentation of such resources. The client could expect better ICT involvement (Linderoth & Jacobsson, 2008) in order to underpin design strategies. The ICT strategy (Blochle et al., 2013) needs to be reaffirmed, developed and applied to ensure the capability of the design teams. ICT is often the central resource connecting different disciplines of the project together (Gunasekaran et al., 2001). In this project, it has been reported that this aspect is compromised, and this affects the efficacy of the management of the project and its investment (Ekstrom & Bjornsson, 2003) and is considered wholly questionable (Dadayan, 2006) in its scope and application.

Further, there does not appear to be a defined human resource development strategy (Raiden & Dainty, 2006) that ensures the changing HR demands of the design and construction of the metro are met consistently, resulting in reduced employee turnover (Arthur, 1994); enhanced personal skill portfolio (Maloney, 1997); and a more effective workforce (Brandenburg & Byrom, 2006).

### **5. Conclusion**

The project managers of this large metro project are engaged wholly with persistent established practices and routines (Green & May, 2005) that could be seen as out-dated, unbending, patriarchal, and destabilising to the project as a whole. This also illustrates clearly that the project is managed in a dominant blame-culture (Martin, 2002). The project management's responsibility to prepare, design and bring to bear appropriate solutions



(Sambasivan & Soon, 2007) to solve the issues at site. In so doing project management will provide a more enriched managerial environment (Doloi, 2013) for engineers to trust and rely on, whilst undertaking fairly difficult and complex jobs in the design of a metro.

Physical resources are also brought into question by the staff. Issues of multi-site approach with groups of engineers are in different places, or even different members of the same group. This explains why team-building is an issue, the management of human resources is difficult and that managing ICT is not upto expected standards.

The project management may need to point to contemporary developments in project management in order to understand how design-engineers need a more engaged system of operation (Nassar & AbouRizk, 2014) and need to plan and develop how to use human capital and other resources to equitably deliver a successful project outcome.

## 6. Further Work

Since this inquiry assessed the little known area of TBM design engineer's perceptions of a metro project management, the research orientation could be extended to include all engineers for their views of the project management. Further implications could be drawn from such work and evaluations made as to how these could be mitigated in the present structuring and management of construction projects.

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