Sustainable Solutions in Structural Engineering and Construction
Edited by Chantawarangul, K., Suanpaga, W., Yazdani, S., Vimonsatit, V., and Singh, A.

ISBN: 978-0-9960437-0-0

RISKS IN DEPLOYING MOBILE TELECOM SITES

M. MOSTAFA EID[1, 2], MAGED GEORGY[3], and HESHAM OSMAN[1]

[1]*Structural Engineering Dept, Faculty of Engineering, Cairo University, Giza, Egypt*
[2]*Orange Group, Mobinil, Cairo, Egypt*
[3]*School of Property, Construction and Project Management, RMIT University, Melbourne, Australia*

The telecom industry is one of the fastest-growing industries worldwide. Such development has created new activities that overlap with other industries, e.g., construction. This paper investigates the risks in mobile telecom projects in Egypt, where the authors work or have previously worked, and how they differ as per the prime project's type and characteristics. While most telecom sites have a similar construction sequence, i.e., from site acquisition to broadcasting the services, they still differ in their characteristics. Following an extensive literature review and interviews with various stakeholders in the telecom site deployment process, four project types were identified. Each was recognized to have special characteristics that influence the risks that could arise in this particular type. Questionnaire surveys were prepared and disseminated to examine the risks in the four types and the severity recognized in each. A comparison is made to identify the similarities and differences. A critical discussion follows to clarify the results.

Keywords: Risk management, Risk analysis, Mobile telecom sites (MTS), Questionnaire surveys.

1 INTRODUCTION

The mobile broadband is the fastest-growing technology in history, according to a Broadband Commission report (2013). The tremendous sales and usage of mobile phones, along with the marriage of voice, data, and online connectivity in one small set, has led to cell sites becoming more congested. This paper investigates the risks in deploying mobile telecom sites (MTS), e.g., transmission sites connecting sites with no direct Line of Sight (LOS), cell sites using different Radio Frequencies (RF), and repeater sites using similar frequencies (Lee and Shin 2010).

Egypt, where this research was conducted, has been ranked as one of the top 5 countries worldwide in terms of new mobile subscriptions in Q3 2013 (Ericsson 2013). More sites and innovative deployment solutions are needed to meet such a strong demand. Although all sites go through similar phases from site acquisition to construction and installation, integration into the network, and finally broadcasting the services, risks may strongly differ from one project to another according to the dominant project's characteristics and site conditions. Studying these characteristics and identifying the project's inherent risks is essential to prepare an effective risk management plan.

2 MTS PRIME TYPES AND CHARACTERISTICS

There are several factors that may affect the telecom site deployment process, such as its location, client/end user requirements, the main purpose of the MTS, the requested key performance indicators (KPIs), etc. Further, an MTS can be either outdoors or indoors. With regard to the geographical radio-coverage area, the classification can be macro, micro, pico, and femto (NSN 2011, Jain *et al.* 2011, Fujitsu 2013). With such diversity, an extensive literature review and several interviews with MTS deployment experts were conducted by the authors. With regards to project characteristics and their impact on projects risks, the research found that there are four main types of projects:

2.1 Project Type A (PTA)

PTA mainly concerns micro and pico indoor sites, placed in confined locations such as offices, elevators, hyper-markets, airports, etc. According to Ericsson (2013), it is estimated that the majority of traffic served over mobile networks originates and/or is consumed indoors. Deployment of PTA is typically handled in an expedited manner, especially that it may be a result of a VIP customer complaint. Micro sites' typical positioning is below roof tops (RT) (Laiho *et al.* 2006). PTA antennas are relatively closer to the human element than other project types. IFC (2007) recommends camouflaging antennas or disguising alternatives to mitigate the visual impact and health concerns to the audience. Higher technical expertise is needed for PTA. Non-conventional transmission solutions are not uncommon, e.g., High-bit-rate Digital Subscriber Line (HDSL), laser-generated light pulses down the fiber cable, etc. (Winch 1998).

2.2 Project Type B (PTB)

This type of projects is associated with Greenfield (GF) macro sites, and provides the broadest geographical cell coverage. Such MTSs are mostly located in uninhabited or less inhabited regions, e.g., inter-city highways, deserts, etc., ETSI (1998). PTB sites need more strategic resource planning due to challenges with logistics and equipment mobilization. Working at far distances may exhibit conflicts/difficulties with locals (for instance, desert Bedouins). Shortages of proper medical clinics and first aid are not uncommon. Further, PTB towers are the highest in the mobile network, thus requiring special safety procedures when compared to other project types. Working at heights necessitates implementation of a fall protection program and a backup strap when operating power tools (IFC 2007). Due to harsh weather, the tower should be properly galvanized before being transported to site. The risk of not finding qualified tower riggers or contractors is high, so prior agreements should be made during planning. Also, in PTB, the chance of encountering some nearby military establishments in Egypt is much higher, which requires army approvals for work.

2.3 Project Type C (PTC)

This type can be considered the cornerstone of MTS and the most widespread. PTC involves projects in clustered and populated areas, such as cities, towns, villages and their surroundings. PTC sites are outdoors and can be either macro or micro. Unlike

the previous two types, the possibility of suspending the site deployment process is much higher, due to the concerns of neighboring residents and subsequent actions in regards to the planned MTS establishments. In Egypt, the National Telecom Regulatory Authority's (NTRA) protocol is more demanding for PTC than other types. If violated, the project faces suspension. In comparison with PTA and PTB, PTC projects can largely be affected by political unrest, demonstrations, and strikes.

2.4 Project Type D (PTD)

Egypt is a country of significant historical heritage. Mobile network operators (MNO) cannot exclude such locations from proper coverage, but at the same time must preserve their historical identity. The outdoors PTD are mostly macro sites, whether GF or RT. One of the main characteristics of PTD sites is its great reliance on camouflaging. Camouflaged structures take the form of flag poles, lamp posts, Roman pillars, obelisks, palm trees, etc. Antennas are hidden behind artificial coverings. Special equipment is typically needed and the installations require highly proficient technicians and riggers. As PTD are mostly deployed at tourist resorts, sightseeing monuments, heritage and cultural locations, etc., work hours and mobilization routes are highly restricted.

3 PRELIMINARY RISK IDENTIFICATION AND QUALITITAIVE ANALYSIS

Some degree of risk always exists in a project (Kerzner 2003). Hence a proper risk-management process starts with identifying the potential risks to influence project. Risk identification is the process of determining which risks may affect the project and documenting their characteristics (PMI 2013).

Interviews were held with several domain experts in Egypt to discuss the risks of deploying MTS. The unstructured/semi-structured strategy was adopted in order to give interviewees space to express their opinions and reflect on their experiences in regards to the subject matter. Experts represented different stakeholder groups, including MNO engineers, civil consultants, and contractors.

A global risk list was constructed and used to develop a questionnaire form to consolidate the findings of this research stage. A questionnaire survey inquired about the likelihood and impact of each risk in the global list using a 5-point Likert scale, i.e., very high (VH), high (H), moderate (M), low (L) and very low (VL). The survey was conducted in mid-2012. A total of 39 respondents sent back their feedback and analysis followed. Based on Heldman (2005), a risk score (RS) was calculated as follows:

$$RS_i = \bar{I}_i \times \bar{O}_i \quad (1)$$

where, RS_i is the Risk Score for risk i, $\bar{I}_i$ is the mean degree of Impact for risk i, $\bar{O}_i$ is the mean probability of Occurrence for risk i. Full details of the analysis can be found in other publications by the authors. Based on the criterion of 3-Sigma, 68% of risks can be considered for further analysis. Risks with the highest RS values—that is, a total of 30 MTS-related risks—were selected. The Relative Standard Error (RSE) was less than 25% for all results, which is acceptable according to the Australian Bureau of Statistics (ABS 2005). It is understandable that these risks still differ when factoring in the prime project type and conditions.

4 RISK MAPPING ONTO MTS PROJECT TYPES

To better understand the mapping of risks to each of the four project types presented earlier, a second questionnaire survey was conducted. The purpose was to inquire about the relevance of each identified MTS risk to the four project types in question. The link was described as being one of the four descriptors: *Common*, *Sometimes*, *Rare*, or *Not Applicable (N/A)*. Based on the 3-Sigma rule, "Common" assumes the risk to appear more than six times in ten sites, "Sometimes" assumes three to six times every ten sites, and "Rare" to associate with two or less occurrences every ten sites. Results of the second questionnaire are presented in Table 1.

Table 1. Project types and risks relation.

Risk Code	Risk Name	PTA	PTB	PTC	PTD
R1.1	Wars, strikes, or demonstrations at nearby sites.	N/A	N/A	Sometimes	Rare
R1.2	Military delay to issue permits.	N/A	Common	Rare	Rare
R1.3	Military refusal of permits.	N/A	Sometimes	Rare	Rare
R2.2	Stop working order, due to police reports submission.	N/A	N/A	Sometimes	Rare
R2.4	NTRA certificate not issued due to protocol violations.	Rare	Rare	Rare	Rare
R3.1	People / residents' resistance or opposition to telecom site.	Rare	N/A	Common	Rare
R3.2	Extra charges and special treatment for Bedouins nearby.	N/A	Common	Rare	Sometimes
R3.4	Need for special camouflages.	Sometimes	N/A	Rare	Sometimes
R4.3	No Line of Sight due to environmental factors.	N/A	Sometimes	Rare	Rare
R5.1	Unacceptable lease rental value.	Rare	Rare	Sometimes	Sometimes
R5.2	Increase in price of materials.	Rare	Rare	Sometimes	Sometimes
R5.3	Currency exchange rate fluctuations.	Rare	Rare	Rare	Sometimes
R6.2	Building structurally unsafe.	N/A	N/A	Rare	Rare
R6.3	Unsafe destination tower.	Rare	Rare	Rare	Rare
R7.1	Special excavation equipment/methods	N/A	Rare	N/A	Sometimes
R7.2	Need of telescopic boom crane.	N/A	N/A	Rare	Common
R7.3	Generators required.	N/A	Common	Sometimes	Sometimes
R7.4	Special telecom equipment devices required.	Rare	Rare	Sometimes	Common
R8.1	High VSWR occurrence.	Rare	Rare	Sometimes	Rare
R8.2	Low quality of installation materials.	Rare	Sometimes	Sometimes	Rare
R8.3	Materials shortage.	Sometimes	Rare	Rare	Sometimes
R8.4	Faulty telecom equipment.	Rare	Rare	Sometimes	Rare
R8.6	Special installation of camouflage.	Common	N/A	N/A	Sometimes
R8.7	Weak tower galvanization.	N/A	Rare	Rare	Rare
R9.2	Suppliers or vendors or subcontractors late delivery.	Rare	Sometimes	Sometimes	Rare
R9.3	Unavailability of first aid.	Rare	Sometimes	Sometimes	Rare
R9.4	Unprofessional management teams.	Rare	Sometimes	Sometimes	Rare
R10.1	Low productivity rate.	Rare	Sometimes	Sometimes	Rare
R10.2	Insufficient experience.	Sometimes	Rare	Rare	Sometimes
R10.3	Unavailability of skilled labor.	Rare	Common	Sometimes	Sometimes

The majority of risks (16 risks) were shared between the four types but with different levels of significance. Further, 6 risks overlapped between PTB, PTC & PTD and 3 risks between PTC, PTD & PTA. Meanwhile, 4 risks overlapped between PTC and PTD, whereas just one risk, R7.1, was shared between PTB and PTD. Representing Table 1 in four radar charts, Figure 1, it can be seen that all risks are present in PTD, while the most "N/A" risk status exists in PTA. The highest count of "Common" status was found in PTB.

Some risks are worth discussing. For instance, R10.3 is considered *rare* in the case of PTA, as specialized teams are typically assigned and the duration of any PTA is relatively shorter than the other types. This allows teams to shift smoothly and quickly

to new sites. The only *common* risk in case of PTA was R8.6 (which concerns camouflaging). Strict client requirements and always attempting to avoid visual nuances drives the project team to act more creatively, including the use of camouflaging. A telescopic boom is usually needed in PTD sites. They have a high rental cost, and proficient crane operators are needed to prevent any damage during installation. Such risk is *not applicable* for PTA and PTB, while it is considered *rare* for PTC.

A *common* risk in the case of PTC was public resistance to site deployment, while this risk was *N/A* in PTB. However, the latter type faces another risk related to Bedouins. The risk of building unsafe structures (R6.2) was considered *N/A* for PTA as well as PTB, while *rare* for PTD.

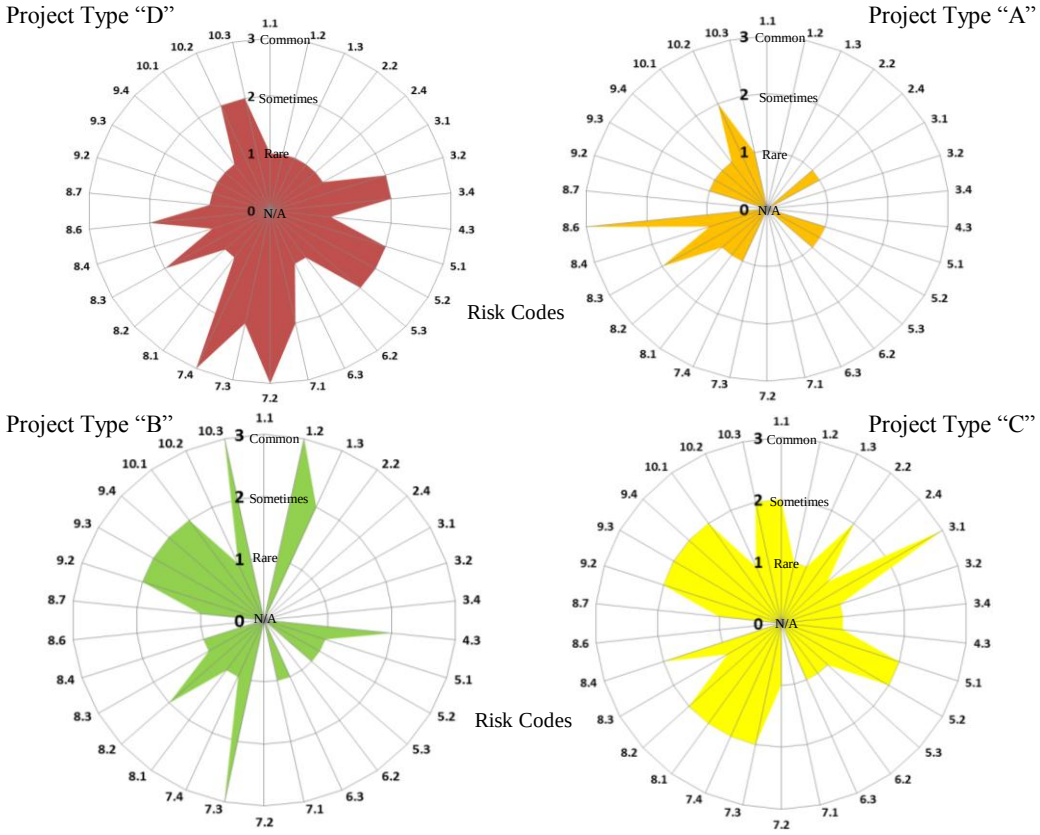

Figure 1. Radar charts for risks at each project type.

5 CONCLUDING REMARKS AND RECOMMENDATIONS

There are four basic project types for deploying mobile telecom sites in Egypt. This classification is not only based on technical aspects, e.g., tower type, method of installation, etc., but rather on the project context as a whole. There are other types that may present as subcategories, for instance, Cell-on-Wheel, inter-operator site sharing, and so forth.

In Egypt there is a lack of project record keeping. Organizations involved in the process of deploying MTS need to devise better means for knowledge transfer amongst projects. Also, effort must be made to collate lessons learned from past projects, so the knowledge can be made available to those involved in an MTS project. This will help us understand the types of risks encountered and shed light on the best strategies for their handling and management.

References

Australian Bureau of Statistics (ABS), *Labor Force Survey Standard Errors, Catalogue No.6298*, Canberra, Australia, 2005.

Broadband Commission, The, *The State of Broadband 2013: Universalizing Broadband*, Geneva, September, 2013.

Ericssson Mobility Report on the Pulse of the Networked Society, Stockholm, Sweden, November, 2013.

European Telecommunications Standards Institute (ETSI), *Digital Cellular Telecommunications System, Global System for Mobile Communications (GSM); Radio Planning Aspects V6.0.1*, Valbonne, France, 1998.

Fujitsu Network Communications, *High Capacity Indoor Wireless Solutions: Picocell or Femtocell*, Texas, 2013.

Heldman, K., *Project Manager's Spotlight on Risk Management*, 136-138, SYBEX, Inc., USA, 2005.

International Finance Corporation (IFC), World Bank Group, *Environmental, Health and Safety Guidelines for Telecommunications*, 3-4, Pennsylvania, April, 2007.

Jain, R., Katiyar, S. and Agrawal, N., Hierarchical Cellular Structures in High-Capacity Cellular Communication Systems, *International Journal of Advanced Computer Science and Applications (IJACSA)*, 51-57, Vol. 2, No. 9, 2008.

Kerzner, H., *Project Management a Systems Approach to Planning, Scheduling and Controlling, 8th ed.*, John Wiley & Sons, Inc., Hoboken, New Jersey, 2003.

Laiho, J., Wacker, A., and Novosad, T., *Radio Network Planning and Optimisation for UMTS, 2nd ed.*, John Wiley & Sons, Inc., Chichester, England, 2006.

Lee, P., and Shin, J., Interference management in LTE femtocell systems using fractional frequency reuse, *Proceedings of the 12th International Conf. on Advanced Communication Technology (ICACT)*, Phoenix Park, South Korea, 7-10, Feb, IEEE Publishing, 2010.

Nokia Siemens Networks (NSN), *Designing, Operating and Optimizing Unified Heterogeneous Networks*, Finland, 2011.

PMI, *Project Management Body of Knowledge Guide, 5th ed.*, Project Management Institute (PMI), Inc., Pennsylvania, 309-333, 2013.

Winch, R. G., *Telecommunication Transmission Systems, 2nd ed.*, McGraw-Hill, Inc., 1998.