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URBAN HIGH-DENSITY CONSTRUCTION SITES AND THEIR SURROUNDING COMMUNITY: ISSUES ENCOUNTERED AND STRATEGIES ADOPTED BY CONTRACTORS

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Inner city developments are a common feature within many urban environments. Where these construction sites are not managed effectively, they can negatively impact their surrounding community. The aim of this paper is to identify and document, in an urban context, the numerous issues encountered and subsequent strategies adopted by on-site contractors and local people, in the mitigation of factors which negatively impact their surrounding community. The objectives in achieving this aim are to identify what effect, if any, an urban construction site has on its surrounding environment, the issues and resulting strategies adopted by contractors on the factors identified, and also what measures are put in place to minimise such disturbances to the local community. In order to meet the requirements, a mixed methodology is adopted culminating in a literature review, case study analysis, contractor and community interviews, concluding in the development of two specific questions for both perspectives in question. The data is assessed using severity indices based on mean testing in the development of key findings. The results indicate that the main forms of disturbance to the local community from an urban development include noise, dust and traffic congestion. With respect to a contractor on-site, the key issues include damaging surrounding buildings, noise control and off-site parking. The resulting strategies identified in the mitigation of such issues include the implementation of noise and dust containment measures and minimising disruption to local infrastructure. It is envisaged that the results of this study will provide contractors operating in such environments, with the required information which can assist in minimising disruption and therefore, avoiding disputes with the local community members. By consulting with and surveying those most affected, this research will illustrate to on-site management, the difficulties faced by those who accommodate such developments within their living environment.

Keywords: community, confined site, site management, stakeholder engagement, urban development.

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INTRODUCTION

Urban development is not a new phenomenon within the construction sector. With the continued movement of populations from rural to urban conurbations, (United Nations 2011) comes amplified and sustained pressure on local services and amenities to accommodate such population influx (Adams 2012), resulting in overcrowding and congestion (Downs 1981). As of 2007, urban population has surpassed rural growth, thus exemplifying the continued growth and development within urban centres (United Nations 2011). Historically, this issue persisted but with the continued influx of population, this issue is exacerbated further. Such pressure is not only restricted to services but also to the material required in their construction (Brinkman 2011), thus compounding the difficulty and complexities associated with constructing in this inherently congested and complex urban environment. Within these metropolitan areas, construction sites are a common feature with large numbers of construction projects constantly emerging (Hendrickson 1998) and if not managed effectively, can prove disruptive to their surrounding community (Environmental Protection Authority 1996). Hence, this issue has emerged over time and has emerged as a significant issue with the historic levels of population influx experienced in the last decade (United Nations 2011). Various pollution regulations must also be adhered to, but again, it is the management of people within these sensitive environments that takes precedence.

Urban construction sites are very often embedded in a variety of surrounding communities incorporating neighbouring residents, adjoining businesses and members of the general public; thus resulting in increased acrimony and disruption (Gilchrist, et al. 2002). Contractors, who undertake works within an urban environment should, where possible, avoid potential disputes with surrounding community members, thus mitigating acrimony and ill feeling with their various external stakeholders. The aspect of bad practice must also be considered in conjunction with the increased management burden of operating in such an environment. To address this, it is essential from a contractor's perspective, that minimal disruption is caused to the adjacent locality in the form of noise levels, the presence of dust particles and traffic congestion within the vicinity of a construction site (Rojas 2009). To address this aspect of concern, this study provides a critique of the main issues encountered by contractors associated with urban construction sites while also documenting the main strategies to counteract the potential issues faced when constructing in congested urban environments. To complement the viewpoints of contractors, community representatives are also considered, to get a holistic overview from both perspectives. This is achieved through the use of a mixed methodology encompassing qualitative (literature survey and semi-structured interviews) and quantitative (questionnaire survey) data collection and analysis techniques. This mixed method approach aims to merge both research techniques into a single study to achieve a broad perspective (Brannen 2005). From this research, contractors operating within a congested urban environment surrounded and influenced by multiple external stakeholders, can acknowledge the core issues and the suggested strategies in mitigating such concerns. With the significant gap in knowledge identifiable with the limited publication of material on the subject (Gilchrist, et al. 2002), it is essential to address this aspect of stakeholder management. With the advent of Strategy for Sustainable Construction, this has attempted to alleviate the concerns of operating within communities; however, the research suggests that further improvement is necessary (Gilchrist, et al. 2002). On adopting of the results herein, it is envisaged that on-site management professionals operating in a high density environment, can proactively manage one of their most

important resources - the external community. It is envisaged that, where contractors proactively identify the strategies for consideration while also putting in place contingency measures to mitigate or eliminate the occurrence of issues documented.

URBAN CONSTRUCTION SITES AND THE SURROUNDING COMMUNITY

The surrounding community of any urban site face on-going disputes, traffic delays and most of all noise pollution (Gilchrist 2002). All communities have the potential to be both positively and negatively affected by urban developments, where generally most city centre developers and residents of an urban setting can relate to this particular topic. Due to the nature of construction work within such a congested environment, the surrounding community is likely to suffer from noise pollution, high levels of dust and traffic congestion (Islington Council, 2006). Construction work brings with it uncertainties and the level of noise created is the most common form of nuisance created by a construction site (Ng 2000). Noise can be created by a wide range of sources such as cranes, pumps, hand-held machinery and large machinery. A surrounding community will be forced to deal with such nuisance throughout the construction process and if they are unaware of nor consulted on the noise occurring, they tend to be more willing to dispute the matter (Ministry of Defence, 2010).

In relation to the high levels of dust that can be created from construction sites, surrounding communities are often faced with discolouring of roads and buildings. More importantly the dust created can be harmful depending on the source of level of exposure. Vision can also be impaired by dust levels when driving or walking on the roads adjacent to an urban site (Ministry of Defence, 2010). With regard traffic congestion, most urban settings are already faced with traffic disruptions and with the addition of a construction site, traffic levels become increased, both on and off site (Kim and Kim 2010). Construction sites tend to attract increased traffic volumes to an area due to delivery vehicles entering and exiting site (Pheng and Chaun 2001) in conjunction with congestion caused by employees parking in the vicinity of the site. Additionally, buildings generally are not designed with the consideration of noise and dust levels, and a surrounding community may suffer due to this factor (BRE 2003).

METHODOLOGY

One of the key aspects of this preliminary research is its dual focus; firstly the perceptions of various contractors are obtained and secondly, the viewpoints of numerous external stakeholders as also considered. In doing so, a sequential mixed methodology is adopted and detailed as follows.

Literature survey

To gain a thorough insight into the research in focus while also obtaining an exhaustive list of possible factors for inclusion in the subsequent analysis, a comprehensive desk based literature survey is undertaken. A wide variety of sources are considered including, peer reviewed journal publications, conference proceedings, books, web pages and articles. Such a practice provides grounding on the research in focus while also establishing a core basis of factors and supporting material to aid in the semi-structured interviews which follow. Through incorporating the key findings within the literature, it is possible to compound their importance while also affirming their inclusion in the upcoming questionnaire survey by incorporating deductive reasoning the realisation of core factors for further review. The literature review is used to drive the themes within the research while also supporting the questionnaire.

Semi-structured interviews

To complement the literature survey and to verify the factors identified, nine interviews are undertaken. This also provides a basis on which to explore further factors not considered nor identified in the literature survey. Participants interviewed are a site supervisor, two civil engineers, two health and safety officers, a project manager, two community residents and a business owner. The industry practitioners had on average thirteen years, many of which are accumulated working in confined construction sites in various geographical urban locations. All of the interviews are carried out in person, aiding in the accumulation of data from experienced personnel first hand while also providing the interviewer with an opportunity to obtain the viewpoint of knowledgeable individual's opinions, values and actions (Bond 2006). Semi structured interviews are chosen over structured and unstructured, due to the fluidity and ability of the interviewee to discuss freely, while also providing the interviewer with some control over the direction and focus of the discussion in question. By interviewing nine participants, this also provides an opportunity to ensure the removal of bias and to aid in triangulation of data, to assist in conformity in the qualitative data collection process. Each of the participants are nominated based on selective and convince sampling rather than random sampling, in order to ensure that the participants are knowledgeable and amiable to being interviewed on the topic in question. The interviewees are identified and questioned with respect to their relevant inner city confined construction site. In total, all nine participants are related to a culvert works project, a footpath reconstruction and the construction of a light railway line, all of which are located throughout Ireland in various locations.

Questionnaire survey

The catalogue of factors identified are reviewed, with repetitions factors reviewed and included in a questionnaire survey. In order to gain the perspective of both on-site management and that of the various external stakeholders, two variations of the questionnaire survey are designed, to gain a comprehensive insight into each viewpoint. The questionnaire is circulated using selective and convenience sampling to ensure that potential recipients have the prerequisite knowledge and applicable environment on which to complete the questionnaire. Each of the questionnaires is circulated electronically and manually, to improve return rates while also aiding in the quantification of the data within. Each factor was ranked using the Likert Scale from 1 (Not Important) to 5 (Most Important). Accumulated responses from both questionnaires located in the Republic of Ireland (58%), Northern Ireland (12.5%), England (7.5%), Scotland (11%) and Wales (11%) were recorded, with Table 1 documenting the return rate per survey and the overall total number of questionnaires with usable data. Although the response rate is low, it meets the requirements for data analysis using SPSS™, therefore beneficial for further scrutiny. Due to the location of the researchers and associated contacts, the responses are focused on the island of Ireland with significant difficulty encountered in acquiring community participants outside of this geographical location.

Table 1: Breakdown of responses by location for each of the questionnaires returned

	Rep. of Ire.	Northern Ire.	England	Scotland	Wales	Total q'naires
Contractor q'naire	44%	13%	13%	20%	10%	52
Community q'naire	72%	12%	2%	2%	12%	35

ANALYSIS

Relating to the contractor questionnaire survey, a total of 51 factors are identified and included in two core sections; strategies in minimising disruption to the surrounding community (29 factors) and issues facing a contractor in an urban setting (22 factors). In addition, 18 factors are incorporated in the questionnaire circulated to external stakeholders, to obtain their viewpoint on the overall effect of urban construction sites on the surrounding community. Each of the factors posed is ranked based on the perceptions of the respondent in question. From the resultant means testing, it is possible to identify the top three factors in each applicable section of the two questionnaires circulated. The top three most prominent factors are illustrated in table 2, 3 and 4; all of which are subjected to further discussion. Due to the limitations on space and considering two separate questionnaires for discussion, it is only possible to review the most prominent factors in each aspect. This provides a platform on which to develop the topic further at a later date.

Table 2: Leading Contractor Issues

	N	Mean	Std. Deviation	Std. Error Mean
Damage to surrounding buildings	51	4.000	.774	.108
Noise levels difficult to control	51	3.922	.996	.139
Providing off-site parking for construction workforce	51	3.843	.833	.116

Table 3: Leading Contractor Strategies

	N	Mean	Std. Deviation	Std. Error Mean
Implementation of noise mitigation systems	51	4.294	.831	.116
Implementation of dust containment measures	51	4.284	.672	.094
Non obstruction of local business entrances	51	4.216	.756	.105

Table 4: Leading Community Issues

	N	Mean	Std. Deviation	Std. Error Mean
Duration of road closures is curtailed	35	4.143	1.00	.169
The presence of physical obstacles is minimised	35	4.000	.907	.153
Pedestrian walkways provided and maintained	35	3.942	1.08	.183

DISCUSSION

Leading Contractor Issues

Damage to surrounding buildings

The leadings issue documented from the questionnaire survey is the issue of damaging adjacent structures while operating and constructing in a city centre congested site environment. Three quarters of the respondents either agreed or strongly agreed that this posed a significant issue in the management of an urban project, with respect to the surrounding community. Regardless of the project in question, any work located within an urban environment has the potential to cause harm to neighbouring structures. Even at the outset of an urban development where underground activities

are considered, Sterling and Godard (2002) further exemplify the dangers present when working in the vicinity of other structures. Tweed and Sutherland (2007) acknowledge such an issue by even looking beyond structural issues by considering pollution and other factors while Tao and Zhang (2012) consider damage due to piling works on-site. This illustrates the importance and multitude of sources of damage to surrounding building which must be considered, specifically when operating in a confined construction site within an urban context.

Noise levels difficult to control

The second most problematic issue encompasses the difficulty in controlling the level of noise emitted from site. Again almost 65% of contractor respondents agreed or strongly agreed with the severity of this issue, thus its high mean score (3.922). This issue is problematic on the vast majority of sites within an urban environment, but it is exemplified where residential occupants are located within the vicinity of a project. Armagh City and District Council (2011) argues that increased noise levels in the vicinity of an urban construction site have been found to be second most problematic issue of nuisance caused to a surrounding community, hence the importance of mitigating this issue on-site. Where noise levels are not monitored and controlled, it is inevitable that conflict will materialise. Cushman, et al, (2001) compounds this point by articulating that noise levels are considered to be the main form of disputes between a contractor and a surrounding community.

Providing off-site parking for construction workforce

The third factor is the issue of off-site parking for the workforce, where 72% questioned, concurred with the severity of this factor. Each of the residents interviewed expressed significant concern with regard to this aspect, as employees working on the adjacent site tend to park on the surrounding roads, thus occupying parking places normally reserved and assigned to the local residents. This point is further articulated by the residential interviewees who also note that road closures or block parking bay through their acquisition to accommodate site parking or other amenities as being particularly frustrating, thus leading to further disruption (Gannapathy 2009). Where such issues arise, contractors should be willing to seek alternative means of transportation for their workforce. By implementing a car-pooling system between employees, this will reduce the number of vehicles in the surrounding area of the site or by subsidising the workforce for parking away from the site and using public transit or shuttle buses to travel to the site. By subsidising employees to undertake these measures it will reduce the number of vehicles on the surrounding roads of the site (British Research Establishment, 2003).

Leading Contractor Strategies

Implementation of noise mitigation systems

Of the respondents surveyed, an overwhelming 84% concur that the leading strategy in the reduction of community strife while operating and constructing in an urban confined construction site is noise mitigation. This corresponds with the need to mitigate the severity of the issue documented earlier. Generally contractors will install temporary noise mitigation systems to reduce the impact on the surrounding community (Schexnayder and Ernzen 1999) on an urban construction site; however these generally are inadequate where proactive and sustained contingencies are considered. Mitigation of undesired sounds should consider source control, path control, and receptor control. It is the case however that a majority of contractor's tend to ignore this fact and put mitigation systems in place that are ineffective and

inadequate. By implanting effective systems, contractors are showing to the surrounding that they are in fact taking necessary precautions to reduce noise levels. On the other hand by using inadequate systems they will be deceiving the various stakeholders who may contend with the matter (US Department of Transport 2008).

Implementation of dust containment measures

The second most strategic approach in the mitigation of community issues when constructing in an urban city centre environment, is the use of dust containment measures (for example, watering down, debris netting, alternative construction techniques, etc.). In this instance, the vast majority of respondents agree that this strategy is of paramount importance, with in excess of 92% either agreeing or strongly agreeing with the introduction of this measure with Griffiths and Griffiths (2007) further emphasizing its importance. Contractors should aim to ensure that there is no health risk posed due to the emission of dust from a particular construction site to the immediate surrounding environment. Dust suppression systems are the main form of dust containment (Environmental Protection Agency 1996) and principally incorporate watering down procedures, particularly during demolition and removal of material from site. To compound the importance of this strategy, two interviewees from a single urban development articulate the importance of this countermeasure, by indicating that management often underestimate the importance of and the effectiveness of watering down, particularly during demolition and site clearance.

Non obstruction of local business entrances

This is one of the core strategies identified, both in the literature (McFadden 2010) and from each of the interviewees; particularly from the business owner. McFadden (2010) argues that direct sales of shops and businesses can be affected by the presence of construction sites in the vicinity of the premises. The business owner who is interviewed expresses a significant distain for works which block or obstruct his entrance. The interviewee acknowledges the findings of McFadden (2010) in that his sales are adversely affected. However, particularly in the case of a convince store, the interviewee is swift to argue the point of there being any advantages. The construction site workforce will generally pass trade to a local business, especially in the case of a convenience store. However the business owner is not convinced that this compensates for loss of trade due to the presence of a construction site. In this case, the interviewee would like to see more proactive measures been taken by management of adjacent projects to mitigate the business lost while also minimising disruption to the customers who frequent the various adjacent business. This point is particularly evident where Jaraiedi, et al. (1995) outlines issues where entire road networks are closed, inhibiting customers from accessing local businesses and amenities.

Community Issues

Duration of road closures is curtailed

The first and most striking issue evident from the results is the aspect of road closures and not noise as stipulated by Cushman, et al, (2001). In this instance, over 77% of respondents either agreed or strongly agreed with this issue being the most severe. Gannapathy (2008) agrees with the severity of this issue due to the lack of information often provided with respect to road closures. Interestingly, on further examination using regression analysis, this issue emerges again as the leading contentious issue raised (43% of the overall variance explained), when considering how to minimise the overall disruption caused by an urban project on the local community. Both the site manager and project manager interviewed also articulate this issue and highlight that,

where possible, this factors is mitigated against through effective project management and scheduling work packages around the feasibility of road closures. Downs (2004) also reiterates the importance of mitigating this issue, identifying that where management proactively alleviate such occurrences, it is perceivable to assume that disturbances caused by urban projects will be minimised substantially.

The presence of physical obstacles is minimised

The second most contentious issue identified from a community perspective is the need to eliminate the presence of physical obstacles around site. Again over 73% of community correspondents agreed or strongly agreed with the need to mitigate or eliminate the presence of such obstacles. Examples of obstacles in this context include barriers, hoarding, fencing, unnecessary signage, temporary works material, etc. Physical obstacles littered around a construction site are often not considered by a contractor; however they can have a direct effect on the surrounding community. Site perimeters generally consist of plywood sheeting or mesh fencing units, most frequently for security purposes only, but it must be erected, monitored and maintained to ensure that it is not providing an unnecessary burden on the local community (excluding general site security and for the safety of those in the vicinity). The overall aesthetics of these obstacles do not appeal to the surrounding environment and local community, therefore to mitigate the adverse effect, temporary fencing should not be left unattended for long periods of time where they may become vandalised and in-turn, become an eye-sore on the surrounding community. The existence of such obstacles inhibits the flow pattern of passer-by's, resulting in congestion on foot pavements and overcrowding, resulting in increased acrimony among the general public and the neighbour community.

Pedestrian walkways provided and maintained

The third and final community identified issue is that of pedestrian walkways. Within this aspect, it not only considers providing the walkways, but also maintaining these structures for the duration of the works. With this factor, 76% of the respondents agreed or strongly agreed that this is a pertinent issue that contractors in urban develops often fail to address. In the case of a variety of projects, pedestrian pathways are included to alter footpaths and walkways and in-turn, prohibit people from entering an area under construction. Where this occurs, measures must be taken to mitigate the disruption caused in conjunction with ensuring proper maintenance of the structure throughout the works. Many contractors identify the importance of effective walkways to protect bystanders and the local community, but the key point argued by the community based interviewees is the lack of upkeep of these structures. However, such structures are often the key factor in serious and in one case, fatal accidents (Moncarz and Taylor 2000), further justifying the importance of not only providing but maintaining such structures. Two of the interviewees provide supplementary argument to the necessity of providing and maintaining such structures, by articulating that with the constant movement of pedestrians around the site perimeter, residents are often faced with the daily task of walking on different types of surfaces and gradients.

CONCLUSION

In essence, this study focuses on urban construction sites and their capability of providing a variety of disruptions to their surrounding community. Urban areas tend to be difficult to operate within, due to high volumes of pedestrian and vehicular traffic along with highly populated residential areas. Therefore the addition of a construction site within an urban setting can prove highly disruptive to a surrounding community

and contractors must effectively manage the level of disturbance caused by their presence. Inevitably contractors will aim to avoid disputes with local community members, but in order to do so they must consider a number of points. Firstly identify a number of issues which must be acknowledged and effectively management and secondly, possible strategies to counteract such issues must also be identified, considered and where appropriate, implemented, to mitigate such issues. To supplement the viewpoint of contractors, community representatives are also considered in order to identify the issues which they feel require redress. To summarise, the top three contractor issues are; damage to surrounding buildings, noise levels difficult to control, and providing off-site parking for construction workforce, while the corresponding leading strategies are; implementation of noise mitigation systems, implementation of dust containment measures, and non-obstruction of local business entrances. From the aspect of the community representatives, the leading issues for redress are; duration of road closures is curtailed, the presence of physical obstacles is minimised, and pedestrian walkways provided and maintained. As articulated, the continued development of our urban centres is of paramount importance and is unrelenting, but with this development comes strife and discontent among its inhabitants. Contractors working within such an environment are encouraged to take note of the findings and to proactively manage the various core issues documented in conjunction with those identified by community members. Through adopting an array of strategies, three of the most prominent of which are discussed, it is anticipated that through proactive management, project managers can successfully complete their project in question, with a minimum of disruption on their most influential external stakeholder - the local community.

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