Commentary: US contractors should be alert to the PWC's clauses relating to change rules since they differ from what they are used to in the US; where contractors have some power in pricing changes. Giving the engineer the power to price changes and disregard price breakdowns by the contractor, without a proper mechanism that ensures fairness is a risk that US contractors must consider.

Extension of Time

Extension of Time under the FAR: The FAR grants the contractor the right to request extension of time in case the owner issues a change order with quantities exceeding 15 percent of the original contract quantities. The contractor also has the right to claim extension of time in cases of excusable delays that are beyond the control of the contractor. The FAR clearly defines excusable delays and provides examples such as acts of God or of the public enemy, strikes, and epidemics. If the delay is excusable, generally, the FAR gives the contractor the right to claim additional compensation. Whether this compensation includes only cost or cost with profit is left for the actual contract between the parties to determine. In general, US and international standard forms of contract are balanced and fair when it comes to compensation for extension of time. The contractor does not have the right for extension of time if the delay is caused by his negligence.

Extension of Time under the PWC: Under the GTL, the contractor is entitled to extension of time if a delay is cause due to reasons beyond him. However, the GTL states that the period of the extension of time should be "proportional to the reasons causing the delay". This is vague and risky because the owner has the power to rule that the extension period requested by the contractor is not 'proportional' to the reasons causing delay. The contractor also has right for extension of time in cases of change orders or in the case the funds are not sufficient to finish the works within the agreed time. Unlike standard US and international contracts, the PWC does not specify the mechanism at which the contractor requests an extension of time, or even how he is going to be compensated. No additional compensation is made for the contractor in cases of time extension; except for change orders and delayed payment. Even in these two cases, the contract is relatively vague to when the contractor is entitled additional compensation. This is risky because in cases of disputes, relevant rulings would not be consistent (See Case no. 304/1/K for 1986 and Case no. 1190/1/K for 1999).

Commentary: The PWC poses two risks on the contractor. The first risk is that there are no provisions to oblige the government authority to act in a timely manner when it receives the contractor's request for time extension. The second risk is that the contractor may only assert claims for time extension after the preliminary handover of the works. With regards to compensation in the case of extension of time, the PWC gives the engineer and the owner the ultimate authority to set the compensation value, while the FAR grants the contractor some negotiation powers.

Liquidated Damages

Liquidated Damages under the FAR: The FAR allows for liquidated damages, which contractors pay in case of delaying the project. Liquidated damages are not punitive, but rather a-priori estimations of losses incurred by the owner. The

liquated damages must be a reasonable amount for the harm that is caused by the project being delayed past the due date in the contract, and only to compensate the government for damages due to delay. As such, for each project, the daily or weekly rate of liquidated damages will be different. The amount of liquidated damages and set it in the contract.

Liquidated Damages (Delay Fines) under the PWC: Since KSA does not follow the common law, liquidated damages could be punitive and not based on estimate losses encountered by the owner. The PWC refers to these amounts as delay fines. The PWC provides an equation for calculating eh delay fines based on the average daily cost of the project. The contract does not consider that actual losses encountered by the owner could be more or less than the numbers provided by the equation. Unlike the FAR, the PWC limits the maximum value of the delay fines.

Commentary: There are two main difference between the FAR and PWC regarding this matter. First, liquidated damages are agreed upon by the parties based on the estimated losses encountered by the owner under the FAR. Under the PWC, the same equation for calculating delay fines is applied for all projects. This might pose risks to contractors. Also, a positive risk in the PWC is that is sets a cap for the total delay fines, unlike the FAR, which is silent regarding this matter.

Differing Site Conditions

Differing Site Conditions under the FAR and the PWC: The FAR provides reasonable risk sharing mechanism when it comes to differing site conditions so that the contractor does not enter the bid with a gambling price. It also provides a clear definition of differing site conditions. The contractor must give notice to the contracting officer about differing site condition. The contracting officer must make an equitable adjustment and the contract shall be modified accordingly. The contractor has similar rights under the PWC. The difference lies in the procedures, but not the relevant risks. US contractors just have to acquaint themselves with the procedures associated with differing site conditions in KSA.

Dispute Resolution

Dispute Resolution under the FAR: The FAR encourages the parties to utilize Alternative Dispute Resolution (ADR) such as mediation and arbitration in order to avoid unnecessary expenses and provide a smoother project delivery. It also enables the contractor to reject the ADR request by the government agency. Details of the dispute resolution process itself should be written in the contract.

Dispute Resolution under the PWC: The PWC does not enable ADRs. Any dispute that is not amicably settled by the parties should be referred to the Board of Grievances. The Board of Grievances is an independent administrative judicial committee responsible for disputes involving the Saudi Government and government agencies. Baamir (2016) provides comprehensive information of how the Board of Grievances operates and how dispute resolution in KSA works.

Commentary: The PWC does not provide clauses for alternative dispute resolution since it was last updated in the 1980's. As such, if amicable settlement is not achieved, the parties are expected to resort directly to the Saudi Board of Grievances; which might take months or even years to be settled. This risk should be

taken into consideration by contractors. Nevertheless, the PWC encourages amicable settlement, but it neither clearly defines nor elaborates upon its mechanism

UNIQUE PROVISIONS IN THE SAUDI CONTRACT

Table 1 provides a summarized discussion on the provisions that are unique to KSA.

Table 1: Unique Provisions in the KSA

Provision	Discussion
Interest	The right of obtaining financial interest as a remedy for late payment or loss of profit is legal under the FAR. However, it is completely prohibited under the Saudi law because interest is considered Riba (usury); which is prohibited in the Islamic Sharia (Alhudaithy 2006). This risk has to be taken into consideration by US contractors. They might opt to increase their contract price to prevent the risk of not getting paid interest in cases of delayed payment. Intriguingly, interest is adopted by most commercial banks in Saudi Arabia. So, US companies will not find difficulties in obtaining loans and guarantees and performing traditional banking operations in Saudi Arabia since the concept of interest is used there.
Guarantee against Collapse	The PWC obliges contractors to guarantee the constructed structures against whole or partial collapse for ten years starting from the date of project delivery. Parties could also agree on a shorter period. There is no equivalent explicit provision in the FAR. However, the FAR enables government agencies to include warranty clauses in the contract. If the parties do not to specify a warranty period is not stated, then relevant precedent cases will govern. It should be noted that the period of the guarantee against collapse clause in the PWC is different from the maintenance period. Under the PWC, the maintenance period starts from the preliminary handover to the date of the final handover. This is equivalent to the "defects liability period" in the FAR.
Saudization	Firms working in KSA usually prefer to hire foreign workers from central Asia and north Africa due to their relatively cheap wages (Madhi and Barrientos 2003). This has negatively impacted the employment rates of the Saudi citizens. Accordingly, the Saudi government issued the *Saudization* (nationalization or localization) program; which obliges companies to have considerable percentage of the total company's workforce made of Saudi personnel. This percentage is set depending on the size and classification of the company. Nearly 200,000 private firms closed down in a single year for failing to comply with the Saudization program (Abdul Ghafour 2014). Accordingly, US contractors must not fall in the trap of hiring too many foreign personnel.
Delayed Payment	In the FAR, as well as all national and international standard forms of contract, there are provisions outlining the contractor's rights in cases of delayed payment by the owner. Uniquely, equivalent provisions are not present in the PWC. This poses financial risks to contractors since their rights and remedies in case of delayed payment are not specified. These risks are even aggravated knowing that the PWC prohibits contractors from suspending work due to the government representative's failure to pay. As such, it is recommended that these risks to be discussed between the parties prior to commencement. In addition, it is recommended to address these missing links by outlining balanced provisions relevant to delayed payment in contract amendments.

SUMMARIZED GUIDELINES

The authors developed a comparative checklist (Table 2) and a summarized opportunities-risks matrix (Table 3) to provides a quick and easy-to-interpret list of commonalities and differences between the two countries with regards to the important contractual provisions. By utilizing these tools and discussions provided in this research, US contractors would avoid various legal problems and be prepared for the imposed contractual risks that are not easily found in the PWC contract. The correctness and the added benefit of the developed checklist and the opportunities-risks matrix were validated by six contract administration experts in top consulting and contracting firms whom have been actively involved in the Saudi public contracting environment. Generally, the experts confirmed that the provided information in Table 2 and Table 3 in their current form is correct. They were asked whether the provisions in the tables represented the most significant matters when it

comes to significant differences between the US and the KSA. Their answer was that they do not see that any provision with equal of higher significance was excluded. Finally, the experts endorsed the usefulness of the outcomes and mentioned that the language and presentation are straightforward.

Table 2: Comparative Checklist

Category	Question	FAR	PWC
Change Orders	– Who has the right to issue change orders? (owner/engineer)	Ow	Ow&En
	– Is there a certain form for the change order?	Yes	○
	– Must the contractor continue performance of the contract as changed?	Yes	Yes
	– Must the contractor submit an itemized price breakdown in the bidding stage so that change orders be priced based on it?	Yes	No
	– Does the contractor have the right to negotiate the pricing of change order?	Yes	Yes
	– Contractor have the right to refuse the change order if it is within the scope?	○	No
	– Is there a price or quantity ceiling for a change order that gives the contractor the right to make equitable adjustments to the overhead?	Yes	Yes
	– Who has the final say and ultimate power in pricing the change order?	Ow	En
	– Are there explicit increase/decrease limits (within the scope) for which the contractor has the right to refuse the change order if exceeded?	○	Yes
Extension of Time	– Contractor has the right to request an extension of time in case the owner/engineer issues a change order that exceeds certain limit?	Yes	Yes
	– Contractor has the right to request an extension of time in events of:		
	– suspension of work by the owner	Yes	Yes
	– inadequate funds by owner to complete the project within time	?	Yes
	– unforeseen circumstances	Yes	Yes
	– Are the unforeseen circumstances listed?	Yes	No
	– Contractor has the right to request the extension of time within a period from the excusable delay-causing event?	○	No
	– Does this right become obsolete after this period?	○	N/A
	– Is the owner obliged to reply in a timely manner?	Yes	No
	– Who has the final power of approving the extension of time?	Ow&En	Ow
	– Contractor has the right to claim for additional compensation in case of excusable delays?	Yes	No
	– Does this additional compensation include cost only or profit as well?	○	○
	– Contractor can claim for extension of time only after the preliminary handover of the works?	No	Yes
Liquidated Damages	– Liquidated damages/delay fines are based on actual estimations of the owner's losses?	Yes	No
	– The liquidated damages/delay fines set on the contractor can be different that those that are set in the contract depending on the actual losses?	Yes	No
	– Is there a cap for the liquidated damages/delay fines?	○	Yes
Deferring Site Conditions	– Is the term deferring site conditions are clearly defined?	Yes	Yes
	– Contractor can claim for extension of time for deferring site conditions?	Yes	Yes
	– Contractor has the right to claim for equitable adjustment in cases of deferring site conditions?	Yes	Yes
	– Contractor must submit this claim within a certain period from the day of facing the deferring site conditions?	○	Yes
	– If the contractor exceeds this period, does he lose the right to claim for compensation?	○	Yes
Dispute Resolution	– Parties are encouraged to utilize alternative dispute resolution methods?	Yes	○
	– If arbitration took place, it becomes binding?	Yes	○
	– Disputes can only be resolved by the Board of Grievances?	No	Yes
Interest	– Do contractors have the right to take loans from banks with interest?	Yes	Yes
	– Do contractors have the right to claim interest on delayed payments by the owner?	Yes	No
	– What is the amount of this interest?	○	N/A
Warranty Against Collapse	– Warranty against collapse is explicitly stated?	No	Yes
	– Period for warranty against collapse is different than the defects liability period?	○	Yes
Delayed Payment	– Contract states the rights of the contractor in case of delayed payment by the owner?	Yes	No
Nationalization	– Are there any requirements for regulating the percentage of local employees in the company/project?	No	Yes*

○ : Contract or Law is silent about the matter, N/A: Not applicable, Ow: Owner, En: Engineer
* Not stated in the PWC, but rather in the Saudi's Ministry of Labour

Table 3: Opportunities-Risks Matrix of the FAR and PWC

	Opportunities to Contractor	Risks to Contractor
FAR	*Change Orders:* • Have to be administered through a standard form. • Contractor has the right to negotiate pricing. *Change Orders:* • Pricing new changes is made in a fair manner. *Extension of Time (EoT):* • Cases that enable the contractor to claim for EoT are clearly defined. • Owner must respond to the EoT request in a timely manner. *Liquidated Damages:* • If the actual value of losses to owner are significantly less than what is agreed upon, contractor can claim to compensate the owner for the lesser amount. *Deferring Site Conditions (DSC):* • Contractor has the right to claim for compensation in the case of DSC. *Interest:* • Contractor has the right to claim interest for delayed payments by the owner. *Dispute Resolution:* • Encourages alternative dispute resolution mechanisms.	*Change Orders:* • No caps are specified for change orders. *Extension of Time (EoT):* • Contractor must submit the request for EoT with a certain period from the delay-causing event. *Liquidated Damages:* • There is no specified cap for liquidated damages. *Interest:* • The value of interest is not stated in the FAR.
PWC	*Change Orders:* • Owner is must not exceed a certain cap for change order. • Contractor has the right to negotiate pricing. *Extension of Time (EoT):* • Cases that enable the contractor to claim for EoT are clearly defined. *Delay Fines:* • There is a cap for the delay fines. *Deferring Site Conditions (DSC):* • Contractor has the right to claim for compensation in the case of DSC.	*Change Orders:* • Pricing the change orders does not follow a certain rule or breakdown, so the engineer has the ultimate power in pricing the change order. *Extension of Time (EoT):* • Contractor may only assert claims for time extension after the preliminary handover of the works. • Contractor does not have the right to claim for additional compensation in case of excusable delays. *Delay Fines:* • Are not based on actual estimates, but rather a single equation for all projects. *Deferring Site Conditions (DSC):* • Contractor must submit his claim within a certain period from facing the DSC or he loses the right for compensation. *Interest:* • Contractor does not have the right to claim interest for delayed payments by the owner. *Saudization:* • Certain percentage of the contractor's employees must be Saudi citizens. *Warranty against Collapse:* • 10 years. *Dispute Resolution:* • No arbitration or alternative dispute resolution mechanisms. Disputes are settled only at the Board of Grievances.

CONCLUSION

The planned Saudi investments in public works as well as its current legislative facilitations provide attractive opportunities for foreign contractors to pursue works in KSA. This research aims at helping US contractors understand the contracting environments in KSA as well as the corresponding legal requirements so that they could avoid and mitigate the associated risks. The paper presented contract administration guidelines for US contractors partaking, or intending to partake, in public works projects in the KSA throughout analyzing the relevant statues of the United States Federal Acquisition Regulation (FAR) and the provisions of the Saudi Public Works Contract (PWC). The paper also exhibited provisions that US contractors would find unique in the Saudi's construction market such as interest, warranty against collapse, Saudization, and delayed payment. It was concluded that

contracting in KSA poses more contractual risks than contracting in the US. For example, in KSA, the contractor does not have the right to claim interest in case of delayed payment by the owner. Contractors will find this research beneficial as it will result in enhancing their understanding of the contractual environment in KSA. This enhanced understanding will not only improve their performance and minimize risks, but also will promote their strategic presence in the Saudi market.

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Urban Crisis Detection Technique: A Spatial and Data Driven Approach Based on Latent Dirichlet Allocation (LDA) Topic Modeling

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Abstract

Social networking platforms have been widely employed to detect, track, and visualize physical events in population-dense urban areas. They can be effective tools to understand when, where, and what happens retrospectively or in real time. Correspondingly, a variety of approaches have been proposed for detecting either targeted or general events. However, neither type of event detection technique has been developed to detect urban disasters in specific geographic locations and with unpredictable characteristics. Therefore, we propose a spatial and data-driven technique for detecting urban disasters. The method addresses both geographical and semantical dimensions of events (geo-topic detection module) and evaluates their crisis levels based on the intensity of negative sentiment (ranking module). Our approach was designed specifically for georeferenced tweets. To demonstrate the system, we conducted an experiment with 4-h of geotagged tweets in London. Our urban crisis detection technique successfully identified the Grenfell Tower fire among all the candidate geo-topics. Our future work focuses on enabling online-mode detection with high scalability in large-volumes of streaming data. The completed research will contribute to efficient disaster informatics and urban resilience regarding crisis detection and tracking, situation awareness, and information diffusion.

INTRODUCTION

Newly available and massive sets of data have played an increasingly important role at different stages of crisis/disaster management (i.e. early warning, monitoring and evaluation), especially in forming bottom-up perspectives in understanding the evolving process of events (Ford et al. 2016). Currently, diverse sources of digital data have brought enormous opportunities in the research area of urban resilience. These sources mainly include cell phone (Lu et al. 2012), and a few social networking platforms (Wang and Taylor 2017). Among them, Twitter is suitable for emergency environments in terms of its open design, wide usage, geo-enabled function and limited message lengths environments (Kryvasheyeu et al. 2016). Geo-referenced tweets can document geographical locations and collective reactions to crises unfolding at both spatial and temporal scales. Specifically, crisis detection is an emerging topic, where disaster managers can take advantage of the crowdsourced data from social networking platforms to enhance situation awareness. Early detection is crucial because it enables immediate responses and helps to reduce potential casualties and damage (Li et al. 2017). Early detection also contributes to characterize an event in terms of spatiotemporal scale, collective emotions, semantic topics, and its dynamic evolving process over time.

An increasing number of studies concerning event detection techniques in the context of Twitter have been recently published. Some studies focus on targeted events with supervised methods (Sakaki et al. 2010; Sun et al. 2016) while others intend to identify general events which

burst in contents, time and space (Maurya et al. 2016; Xie et al. 2016; Yu et al. 2017; Zhang et al. 2016). These proposed detection techniques can be built based on clustering, supervised classification, Latent Dirichlet Allocation (LDA) or hybrid ways. However, few have explored the context of urban disasters (e.g. infrastructure failure, building fires, city bombing, natural disasters, etc.). Compared to other events, urban disasters can be regarded as more "targeted", but also unpredictable in types and forms. It is difficult to employ current supervised techniques for targeted events to identify an un-characterized disaster. Moreover, detection approaches for general events have not stressed the distinct characteristics of disasters in terms of their geographical and thematic impact, and high-intensity of negative sentiment. Therefore, to address this methodological gap, we propose a data-driven technique to detect urban disasters with a focus on geotagged tweets from a Twitter Streaming API. We describe the system as the Urban Crisis Detection technique to highlight its specification in detecting crises occuring in the confined physical locations of cities.

BACKGROUND

Event detection from Twitter streams has witnessed a mounting number of publications in the literature. We classified the most cutting-edge approaches based on their detection objectives into two types: targeted event detection and general event detection. Existing techniques for general event detection were either retrospective or real-time. We exclusively discussed the latter since most real-time methods were built based on retrospective methods, and our final goal is to enable real-time detection.

Targeted event detection

Targeted event detection requires pre-defined keywords and mainly adopts supervised detection techniques. For example, Sakaki et al. (2010) proposed a targeted event detection system that monitored tweets and delivered prompt notifications. Their system was specifically applied in reporting *earthquakes* with Japanese tweets. They firstly devised classifiers to classify event-related tweets and unrelated tweets. Then the related tweets were used to develop a probabilistic spatiotemporal model for event detection and location/trajectory estimation. Sun et al. (2016) designed a novel method to detect and locate power outages from Twitter. The system was based on a heterogeneous information network, which includes time, locations, and texts. Supervised LDA was then used to compute the probability of the topics of tweets that were related with a power outage. Gu et al. (2016) proposed a real-time traffic incident (TI) detection approach based on tweet texts. Each imported tweet was mapped into binary vector of a dictionary and classified as TI-related or not. The TI-related tweets were further geo-coded and classified into different incident categories.

Detection techniques for distinct targeted events are effective in identifying specific events with pre-envisioned and pre-defined characteristics. However, due to the diverse types of urban disasters, it may require a large volume of keywords to describe different types of potential events, not to mention unexpected types of events. Therefore, it is impractical to employ a supervised approach to detect any general and unknown disaster without pre-defining its specific characteristics.

General event detection

Clustering-based approaches. Cluster-based approaches include threshold-based online approaches, graph-based clustering algorithms and other new approaches. For example, Yu et al. (2017) proposed a real-time emerging anomaly monitoring system over microblog text streams, named RING. The system was based on a graph stream model. It was able to detect events at an early stage, to conduct correlation analysis between emerging events, and to track evolution of events over time. Specifically, the graph regarded keywords as nodes, their co-occurrence in each tweet as edges, and an accumulated frequency as weights of edges. A k-clique percolation method was then employed to identify communities (events) in the built graph. SigniTrend is a scalable detection technique developed by Schubert et al. (2014), which measured significance of terms to detect trending words based on their co-occurrences, and used hashing technique to track all the keyword pairs. The final stage of this approach was to cluster the detected keywords into larger topics. This method was used to detect emerging topics early before they become "hot tags". Some techniques included geolocations as a main dimension to capture real-world occurrences. EvenTweet (Abdelhaq, et al., 2013) identified localized events using geotagged tweets. It extracted keywords based on the burstiness degree of words, and then computed the spatial density distribution (spatial signature) over a keyword in a spatial grid. The event keywords were further partitioned based on the cosine similarity of their spatial signatures. Finally, the clusters were scored to uncover the real-world local events. GeoBurst (Zhang et al. 2016) was also designed to extract local events from streams of geotagged tweets in real time. It identified candidate events based on both geographical and semantic impact between each pair of tweets, and ranked the candidates according to their spatial and temporal burstiness. However, most of the clustering based approaches used co-occurrences of keywords to measure the semantic relationship between documents and, as such, they cannot reveal the latent structure of topics underlying the text corpora.

LDA-topic-model-based method. Latent Dirichlet Allocation (LDA) is a basic probabilistic topic model, which analyzes the words of the original texts to reveal the underlying themes and their connections (Blei 2012). More recently, researchers have explored the advantages of LDA in allowing for the examination of multiple topics within a document and generating a probabilistic distribution of words under a topic. This has been employed using LDA as a basis to extract thematic content from social networks for event detection. For example, Semantic Scan (Maurya et al. 2016) used a contrastive topic modeling based on LDA to identify new topics in text stream, it then used statistical scanning to find the spatially localized events. The proposed technique has been tested on Yelp and Emergency Department datasets, and the moving window size is three days, which is too long for detecting emergencies from Twitter. Moreover, the method requires a pre-defined number of topics for both background corpus and foreground topics. Topic Sketch (Xie et al. 2016) was designed to detect bursty topics from Twitter, with the assumption that each tweet is only related to one latent topic. Topics were generated based on sketch-based topic modeling using Singular Value Decomposition of word pair frequency matrices or tensor decomposition of word triple frequency matrices. It also employed a hashing-based dimension reduction technique, and conducted an effective sketch maintenance based on acceleration of words.

These methods only included time and semantic dimensions in the detection process, without considering the geographic dimension. However, in terms of urban disasters, the physical locations and spatial pattern of an event are as important as text contents and time. Current LDA-based event detection methods have not been tailored to detect disasters, which are