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Prof. Joseph Offiong Udoayang
University of Calabar
P.M.B 1115, Calabar. Cross River State, Nigeria.

Prof. Robert Taylor
University of KwaZulu-Natal
Varsity Drive, Westville
South Africa.

Dr. Nazim Taskin
Massey University - Albany
Quad Building A, Room 3.07
Gate 1, Dairy Flat Highway (State Highway 17)Albany,
New Zealand

Prof. João J. M. Ferreira
University of Beira Interior (UBI)
Estrada do Sineiro, Pólo IV 6200 Covilhã,
Portugal.

Dr. Izah Mohd Tahir
Universiti Sultan Zainal Abidin
Gong Badak Campus, 21300 Kuala Terengganu,
Terengganu, Malaysia.

Dr. V. Mahalakshmi
Panimalar Engineering College
7-A,CID Quarters, Mandaveli,Chennai-600028,
Tamilnadu,
India.

Dr. Ata Allah Taleizadeh
Iran University of Science and Technology
Faculty of Industrial Engineering,
Iran University of Science and Technology,
Narmak, Tehran, Iran.

Dr. P.S. Vohra
Chandigarh Group of Colleges, Landran, Mohali, India
#3075, Sector 40 D
Chandigarh, Pin code 160036

Dr. José M. Merigó
University of Barcelona
Department of Business Administration, Av. Diagonal
690, Spain.

Prof. Mornay Roberts-Lombard
Department of Marketing Management,
C-Ring 607, Kingsway campus, University of
Johannesburg, Auckland Park, Johannesburg, 2006,
South Africa

Dr. Anton Sorin Gabriel
Carol I Boulevard, No. 11, 700506, Iasi,
Alexandru Ioan Cuza University Iaşi,
Romania.

Dr. Aura Emanuela Domil
31 Horia Creanga, zip code 300253, Timisoara,
West University from Timisoara,
Faculty of Economics and Business Administration, Romania.

Dr. Guowei Hua
NO. 3 Shangyuancun, Haidian District, Beijing 100044,
School of Economics and Management,
Beijing Jiaotong University, China.

Dr. Mehdi Toloo
Technical University of Ostrava,
Ostrava, Czech Republic

Dr. Surendar Singh
Department of Management Studies, Invertis University
Invertis village, Bareilly -
Lucknow Highway, N.H.-24, Bareilly
(U.P.) 243 123 India.

Dr. Nebojsa Pavlovic
High school "Djura Jaksic"
Trska bb, 34210 Raca, Serbia.

Dr. Colin J. Butler
University of Greenwich
Business School, University of Greenwich, Greenwich, SE10
9LS,
London, UK.

Prof. Dev Tewari
School of Economics and Finance
Westville Campus University of Kwa-Zulu
Natal (UKZN) Durban, 4001
South Africa.

Dr. Paloma Bernal Turnes
Universidad Rey Juan Carlos
Dpto. Economía de la Empresa
Pº de los Artilleros s/n
Edif. Departamental, Desp. 2101
28032 Madrid, España

Dr. Jurandir Peinado
Universidade Positivo
Rua Silveira Peixoto, 306
Zip 80240-120 Curitiba – PR – Brazil

Table of Content

African Journal of Business Management

Full Length Research Paper

Effects of varying factors on performance of construction projects in terrorism hit areas of the world

Waqas Anwar*, Eduardo Munive Hernandez and Mohammad Khurshid Khan

Department of Mechanical and Energy Systems Engineering, Faculty of Engineering and Informatics, University of Bradford, UK.

Construction projects have encountered poor performance due to the insecure environment caused by insurgency and terrorism in the world. The real cause includes lack of desired resource and reluctance of stakeholders/project teams to work in such areas. The project suffers a massive loss of finances, time overrun and poor quality which ends up the project in the midway. In the current research, various risks which affect the productivity of the project due to an insecure environment will be identified. Multiple factors are affecting the objectives of the project; time and cost will be extracted from the literature review and structured interviews from stakeholders who have already work experience in these areas. A model incorporating these factors will be developed. The model will further be validated and verified from the project which has been implemented in such areas. This study will help not only help in increasing the performance of the project but also set a yardstick for development projects implemented in insurgency-hit areas of the world.

Key words: Poor performance, time overrun, cost overrun, man-made disaster areas, terrorism, infrastructure development projects.

INTRODUCTION

Infrastructure development projects are complex in nature. Therefore, these are more prone to risks (Flyvbjerg et al., 2004). These risks are multiplied mani-folds if projects are implemented in man-made disaster areas in many parts of the world. There is a number of stakeholders in a project which includes consultant, client, contractor, local population, government ad-ministration (Ofori, 2002). Coordination amongst all to im-plement interconnected activities on ground compounded with terrorism and insurgency is an intricate preposition (Ran, 2011). This all results in delaying of the project with poor cost performance and compromised quality. Various risks have been identified by many researchers. These include physical, design, implemen-tation, legal, financial and political[4]. Projects are delayed and overshoot regarding cost due to stakeholders, material and equipment, labor, contractual relationship and many other factors (Ahsan and Gunawan, 2010). This paper will primarily focus on the poor performance of the project (time overrun and cost overrun) due to one single factor; insecure environment due to insurgency and terrorism which is considered as *Force Majeure* (Komendantova et al., 2012).Terrorism and insurgency in the various regions of the world, besides causing millions of deaths, have created insecurity amongst the people. This insecure environment has severely affected the performance of

*Corresponding author. E-mail: waqasanwar24@yahoo.com.

construction projects. The resource is minimal regarding material and machinery due to the unwillingness of owners to send machinery to these areas. Stakeholders are not ready to work in terrorism-hit areas due to insecurity (life threats). A minimal literature review is available on project performance in terrorism-hit regions of the world.

RESEARCH MOTIVATION

There are immeasurable causalities in the world due to asymmetric warfare. The examples in the world include hundred thousand deaths in Iraq, Afghanistan, Pakistan, India, and many parts of Africa. The effects of terrorism can be measured by the Global Terrorism Index (GTI) Index (GT, 2015). The consequence of insurgencies in different countries can be measured and compared by using this tool. It also helps the Government to find out that how much insurgency has been contained in the state and either it is more or less in specific communities/ factions. The index is derived from the measure of impacts (both direct and indirect) of insur-gency on the society Index GT, 2015). The implications may include casualties (both life lost and injuries), damage to the property, impacts on businesses and psychological effects on humans (Masciandaro, 2017). Figure 1 shows the Global Terrorism Index of various countries of the world. Most affected regions are South Asia, the Middle East and part of Africa (Masciandaro, 2017). Colour coding in the figure indicate the ranges of GTI. The countries with maroon color have GTI ranges from 6.76 to 10. Similarly, the states with light yellow color coding are least affected by the terrorism their GTI is less than 1.34. The countries with no color coding are not affected by terrorism which is very less.

The countries with the highest number of death casualties in 2016 are shown in Figure 2. Top five countries in the order of death toll are Iraq, Afghanistan, Syria, Nigeria and Pakistan. The law and order situation in these countries remained questionable. In some countries, after military operations, winning the hearts and minds of the people campaigns by uplifting the area was launched.

The campaigns mentioned above include the implementation of infrastructure development projects in affected areas. Initially, these are a quick impact later on projects with long terms impacts are launched (Coyne and Pellillo, 2011). Projects executed in man-made disaster areas are of different categories: roads, shingle tracks, schools/colleges, hospitals, water supply projects, provision of hand pumps, installation of tube wells and dug wells, development of children parks and underground water channels etc. (Perkins, 2016).

Resistive regions having insurgency are far flung from the best parts of the country. To restore peace, it is essential to bring these regions in line with the other parts of the country by carrying out development projects. Re-

construction is the last phase of any operation. The development projects implemented in various countries after carrying out operations by Law Enforcement Agencies are given in Table 1.

The projects implemented in these areas have poorly suffered owing to the insecure environment which results in poor performance of scope, time, cost and quality. After 9/11, Pakistan, Afghanistan and Iraq have suffered more than 200,000 casualties (both civilians and military) from over 40,000 bomb blast, more than 2,000 suicide bomber attacks. These incidences result in creating insecurity amongst stakeholders, affecting projects and bringing these at a halt during the execution stage. Frequent occurrences will create a dilemma for the project managers to complete these projects in time and cost with reasonably good quality. Therefore, project management skills become versatile as the security is the main focus during project management practice. The effects of insecure climate in which project teams work in the remote areas are the low yield of the project regarding cost, time and quality. There are some factors which affect the performance of infrastructure projects in insurgency-hit areas of the world. Five significant factors include environment of the area, social/cultural /ethnicity, economic condition, political factor and Institutional Factor. Military plays its vital role in these areas to stabilize law and order situation which favors the managers to improve the productivity of the projects. The effects of varying factors on the projects is represented using a fishbone diagram as given in Figure 3.

Research Objective

To identify the factors which affect the project productivity in troubled regions of the world due to terrorism concerning time and cost with the view to find out the order of importance of each factor.

Research contribution

The significance of this study was to investigate the leading causes of reduced productivity of the projects in man-made disaster areas of the world. The approach used to address this issue is novel. SPSS package is employed to identify the factors which affect the productivity of the projects.

RESEARCH DESIGN

The design of the study is prospective, retrospective and partially experimental. The survey is carried out by collecting data by using a self-administered questionnaire and structured interviews (Figure 4).

Theoretical Framework

An intense literature review was carried out to identify the factors/variables which affect the performance of the projects due to
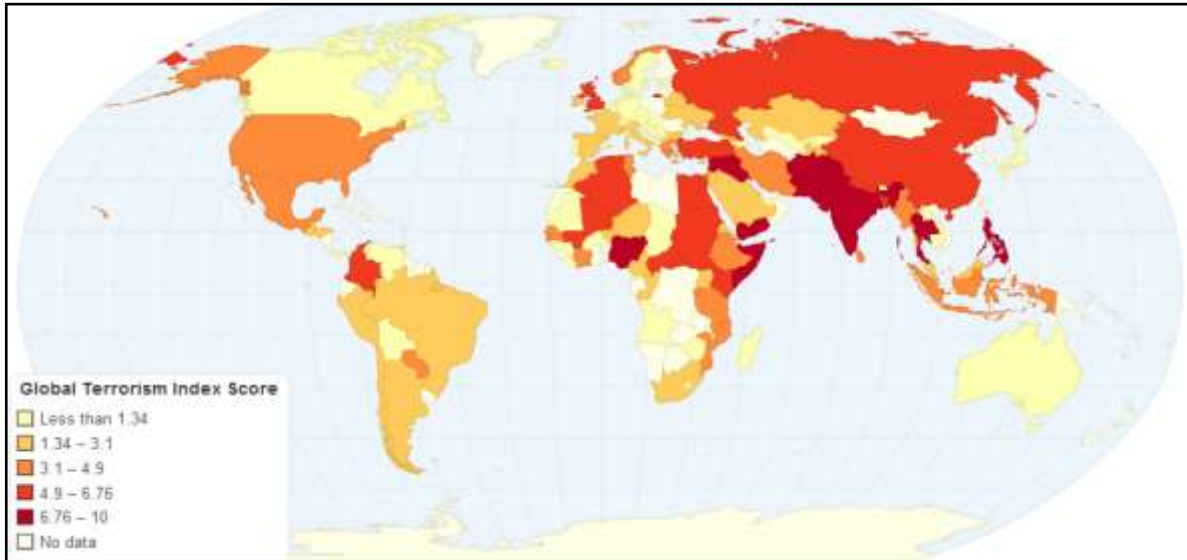
Figure 1. Map showing Global Terrorism Index (GTI) of various regions of the world in 2017(Masciandaro , 2017).
Source: Masciandaro (2017).
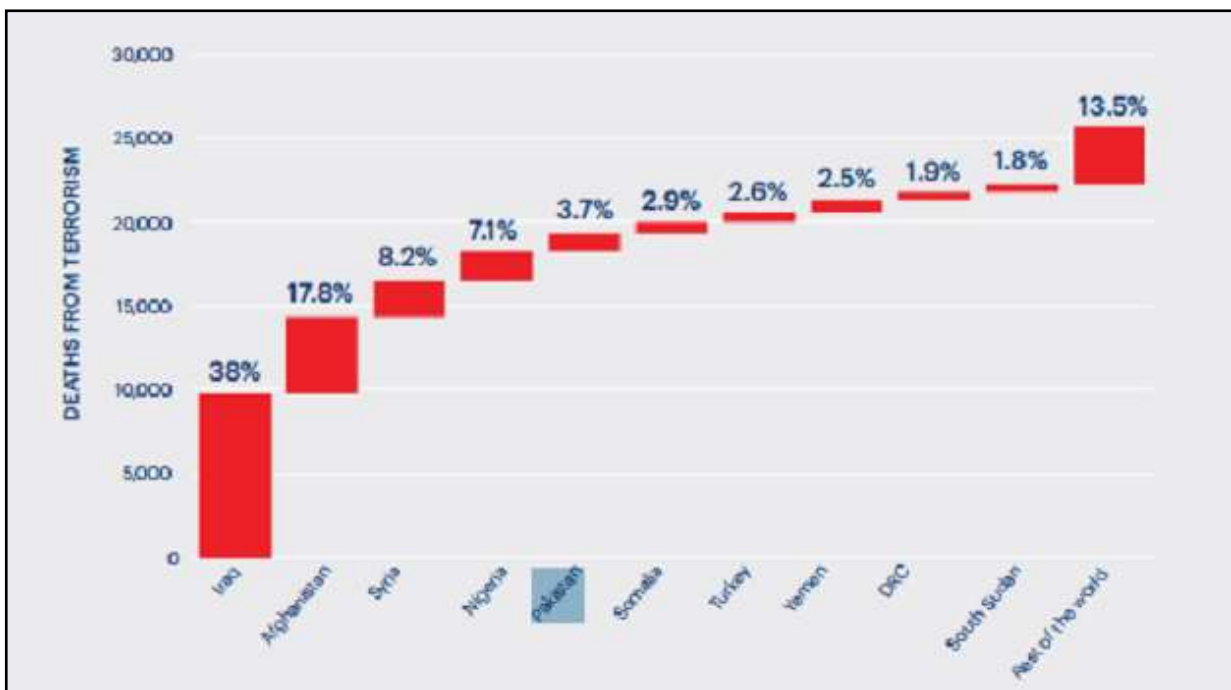
Figure 2. Graph showing the death toll of top countries (in percentage) of the world in 2016
Source: Masciandaro (2017).

questionnaire incorporating all variables was developed and distributed to collect the data. Secondly, interviews of thirty-one stakeholders including representatives of consultants, clients, contractors and locals who are either from terrorism-hit areas or worked in these areas were conducted. The factors which affect the performance of the project both regarding time and cost due to an insecure environment owing to terrorism are given in Figure 5.

Research approaches

Mixed approach (quantitative and qualitative) were used (Neuman, 2013). The causes of low productivity of infrastructure projects mentioned in the fishbone diagram (Chang, 2015) helped in developing the questionnaire which ascertained the impacts of risk factor which are responsible for terrorism on construction projects.

Table 1. Infrastructure Development Projects Implemented in Terrorism Hit Regions of Pakistan, Afghanistan and Iraq.

Projects	Countries					
	Pak*	SL*	Afg*	India*	Iraq*	WA*
Road (all types) (km)	1015	965	1550	1750	1435	2015
Shingle tracks (km)	1610	1098	2015	3014	1765	3024
School / College buildings	121	97	201	250	345	440
Water supply projects	51	50	62	40	44	73
Hospitals / Health units	15	19	18	16	13	45
Tube wells/ Hand pumps/ Dug wells	6550	5643	7321	4430	5321	4325
Playing grounds / Parks	95	50	60	105	45	70
Underground water channels	15	18	10	20	9	35

*Pakistan, Sri Lanka, Afghanistan, India, Iraq, Western Africa.
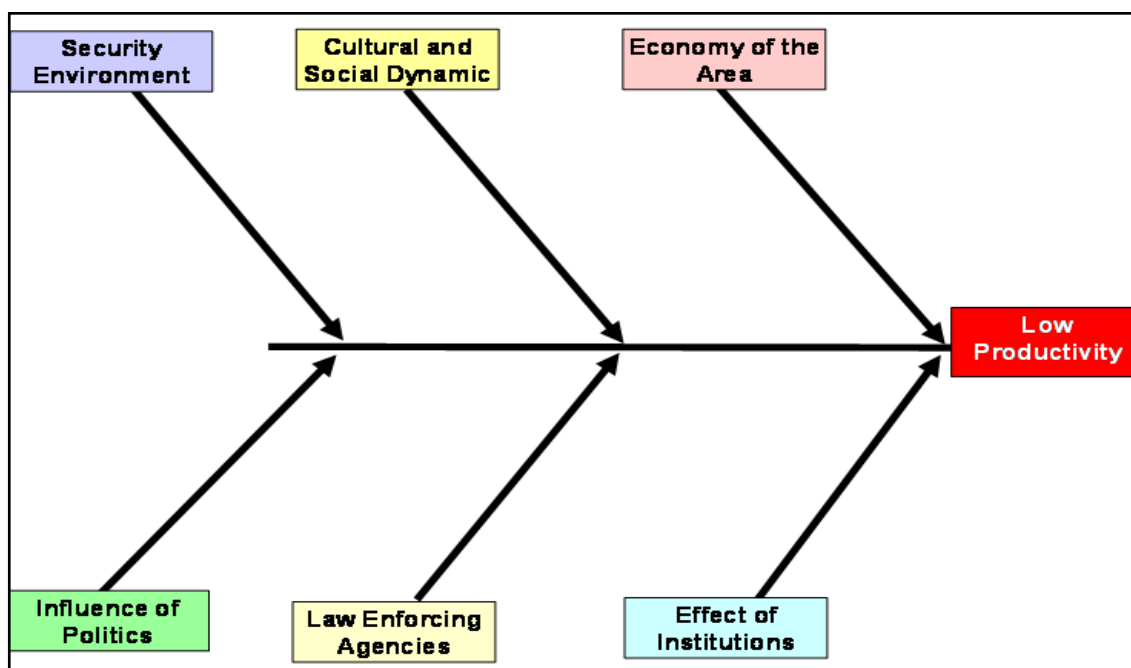
Figure 3. Figure showing primary factors affecting the performance of the project in terrorism-hit areas
Source: Chang (2015).

The research will state that the questionnaire is fit for the purpose. To measure the risk criticality of each factor, the five-point Likert scale was used as shown in the table below.

Face/content validity of the research was carried out by three academics and four field experts. However, the construct validity of the project is verified through SPSS Package. Principal Component Analysis was employed to check the validity of inter-items (Kerzner and Kerzner, 2017).

The sample size of the population was kept flexible depending upon the judgment of the researcher. The sample was taken from terrorism affected areas of the world. The effects of terrorism have percolated almost every region of the country directly or indirectly. Therefore, it was decided to take the sample from all over the world depending upon the severity in each country (Croucher, 2018). The country-wise data of various terrorist acts is given in Table 2.

Based upon the terrorist incidents, different regions of the world can be categorized as high risk, medium risk and low risk. Data was collected proportionately from each region depending upon a number of incidents. Keeping in view Table 3, primary data was collected from three countries; Pakistan, Afghanistan and Iraq. Western Africa has a substantial number of incidents, but it has more than 16 countries. The countries mentioned above can be categorized as: High Risk- Iraq; Afghanistan and Pakistan (70%); Medium Risk-India and Sirilanka (20%); Low Risk-Western Africa (10%).

The sample population constitutes stakeholders of infrastructure development projects which include clients, consultants, contractors, local population and government administration. The sample was collected as per the matrix is given in the Table 4.

The sample population was distributed and explained the questionnaire through detailed notes. A pilot study was carried out by keeping the sample size of 35 individuals. 345 questionnaires

Stages of Research

Introduction

| Man-made Disaster Areas | Infrastructure Projects |

Literature Review

| Project Performance | Factors Affecting Performance |

Data Collection

| Mixed Method Approach | Quantitative / Qualitative |

Data Analysis and Discussion

| Multivariant Analysis | Statistical / Thematic Analysis |

Main Findings

| Data Processing | Linear Model |
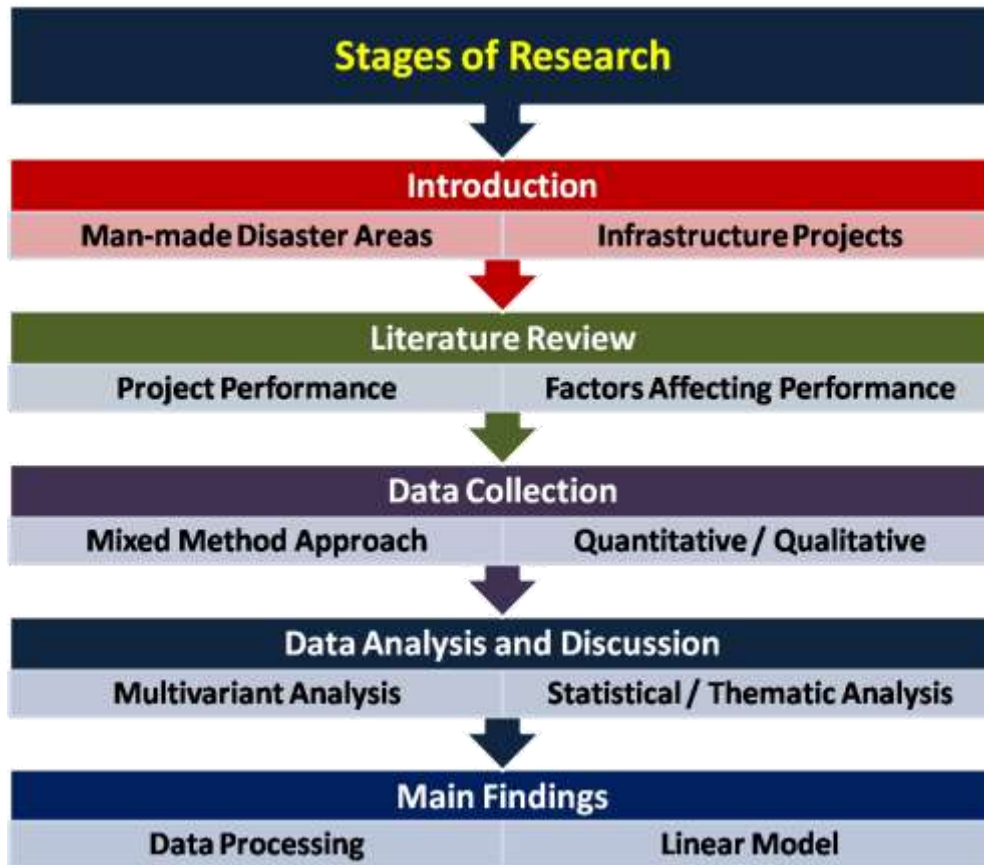
Figure 4. Research stages leading to objectives of the study.

Table 2. Likert scale used to measure risk criticality.

Rating	Risk criticality
5	Most significant
4	More significant
3	Significant
2	Less significant
1	Very less significant

were distributed, and responses of 245 respondents were received.

Multi-variant analysis

Multi-variant analysis of collected data was carried out by processing it through SPSS package (Green and Salkind, 2016). Following tests were employed as under:

1. Reliability Analysis (RA).
2. Principal Component Analysis (PCA).
3. Sample population mean.
4. Standard Deviation (Std Dvn).
5. Relative Importance Index (RII).

RESULTS AND ANALYSES

Reliability analysis

Reliability analysis was carried out to check the internal consistency of the data received from various respondents (Tavakol and Dennick, 2011). Internal consistency of each scale was assessed and analyzed using the SPSS package. Value of Cronbach's alpha (overall) = 0.876. Time overrun = 0.895, Cost Overrun = 0.896. The value of Cronbach alpha is more than 7 which means data is reliable.

Table 3. Year wise terrorist incidents in different terrorism affected countries of the world.

Year	Countries					
	Pak*	SL*	Afg*	India	Iraq	WA*
2006	250	119	363	233	352	315
2007	280	201	452	313	472	314
2008	291	213	551	243	313	344
2009	340	254	601	213	311	302
2010	338	210	360	223	295	323
2011	331	167	413	343	432	322
2012	252	176	333	203	470	312
2013	273	201	412	201	317	333
2014	284	185	404	239	322	331
2015	211	210	401	313	350	310
2016	191	113	296	243	353	318
2017	150	115	398	123	351	302
Total	3191	2164	4984	2090	4338	3826

*Pakistan, Sri Lanka, Afghanistan, Western Africa.

Table 4. Sample matrix.

Country	Client	Contractor	Consultant	Locals	Government administration
Pak* (25%)	25	25	25	15	10
SL* (10%)	27	31	27	10	5
Afg* (25%)	25	25	25	15	10
India (10%)	27	31	27	10	5
Iraq (20%)	25	25	25	15	10
WA* (10%)	27	31	27	10	5

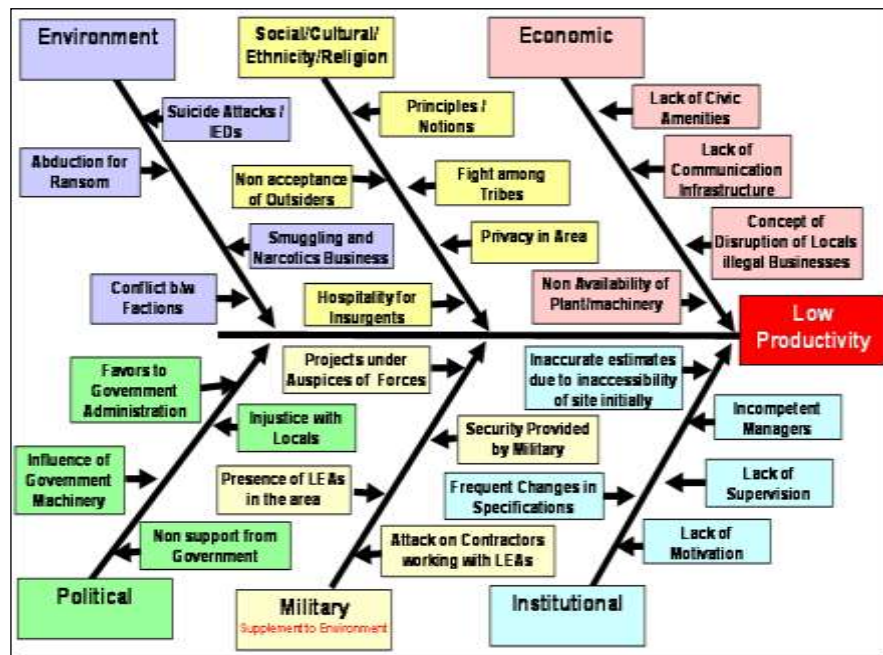*Pakistan, Sri Lanka, Afghanistan, Western Africa.

Figure 5. Figure showing both primary and secondary factors affecting the performance of the project in terrorism-hit areas.

The degree of importance of each identified risk

The risk/factor is given importance/ranking basing upon the mean score and their relative weight (Field et al., 2012). The weight of each variable is given in Table 5.

Knowledge-based model (KB)

KB model was developed using collected data by processing it through SPSS Package. The model is given below as:

$$Z = 0.31 + 0.26A + 0.21B + 0.23C + 0.18D$$

Where, Z = Project performance (cost, time will be calculated using unity method); A is overall environment due to security; B is the economy of the Affected Regions; C is social, cultural, ethnicity and religion; factor D is the effect of political factor.
    The model can deviate 10%, which is acceptable. There can be three or four scenarios:

1) High-risk countries - Scenario A

In high-risk countries, where the insurgents have taken over control of the area. The writ of the government has been compromised. Operations by Law Enforcement Agencies (LEAs) are being planned.
    In those regions, the values of factors may be taken as the maximum. Values of A =1, B=2, C=1.
Z = 1.19 = 119%.
    The above results mean that the cost of the project will increase 119 per cent in the worst case in high-risk countries. If the time of the project is 4 years and cost is 15 billion Rupees in settled areas than in worst case, the cost will increase up to 32.85 billion, and it will take 8.75 years to complete this project.

Medium risk countries - Scenario B

In medium risk countries, where the insurgents have taken over only the contested control of the area. In some areas, the writ of the government has been compromised. Operations by Law Enforcement Agencies (LEAs) are being carried out. Presence of forces has moved the terrorists away from the cities. Sporadic attacks in the form of improvised explosive devices are being carried out by terrorists. In those regions, the values of factors may be taken as the moderate. Values of A =0.5, B=0.5, C=0.5.
Z = 0.75 = 75%.
    The above results mean that the cost of the project will increase 75 per cent above in moderate conditions in medium risk countries. If the time of the project is 4 years and cost is 15 billion Rupees in settled areas than in worst case, the cost will increase up to 26.26 billion, and

it will take 7 years to complete this project.

Low-risk countries - Scenario B

In low-risk countries, where the Law Enforcement Agencies (LEAs) have taken over of the area. The writ of the government has resorted 80%. Operations by Law Enforcement Agencies (LEAs) has been carried out. Presence of forces has moved the terrorists away from the cities. Sporadic attacks in the form of improvised explosive devices are being carried out by terrorists. In those regions, the values of factors may be taken as the moderate. Values of A =0, B=0, C=0. Z = 0.31 = 31%
    The above results mean that the cost of the project will increase 31% above in moderate conditions in medium risk countries. If the time of the project is 4 years and cost is 15 billion Rupees in settled areas than in worst case, the cost will increase up to 19.65 billion, and it will take 5.24 years to complete this project.

Validation of Model

A case study of Road Project N-85 in Pakistan was taken by the researcher as a pilot study. Baluchistan Province is considered as the high-risk area of Pakistan. Owing to the adverse security environment, the scenario may be taken as antagonistic. The project was initially started in 2007 and was abandoned by the principal contractor due to political and security reasons. The project was restarted in 2010. The contract cost of the project is Rs 6.3 Billion and time is 3 years. The project was completed in Rs 14.5 Billion and completion time is 6.5 years. The difference in %age cost and time is 115 and 123 respectively. Also per model, the cost should be 119% more than the actual cost and similarly the time should reciprocate the same. There is 8% variation in cost and 3% variation in time. 10% variation is acceptable. Hence, the model is verified and validated.

CONCLUSIONS AND RECOMMENDATIONS

Minimizing terrorism and insurgency- Managing Risk

The terrorism hit countries of the world have adverse effects on the construction industry. The projects face delays owing to frequent stoppages due to damages to personnel and material. The decrease in terrorist acts will improve the performance of the project both time and cost wise. The insurgent's activities need to be checked. The projects are to be implemented under the umbrella of Law Enforcing Agencies (LEAs). This will give better performance results.

Gaining local population support

Lack of inhabitants support will have adverse effects on

Table 5. Mean score and degree of importance of each factor (n=26).

Risks / Factors	Mean	Std Dvn	RII	Rank
Overall environment due to security				
Project stoppages due to terrorist actions	4.76	0.5	0.94	1
Periodic changes in scope and site both	4.1	0.93	0.75	25
Repair / Reworks due to intense insurgent activities	4.60	0.54	0.90	3
Kidnappings for ransom	4.55	0.91	0.90	4
Threats to project teams	4.41	0.81	0.87	10
Re-contracting due to leaving of the site by contractors	4.36	0.80	0.86	11
The economy of the affected regions				
Overstretched chain supply	4.26	1.04	0.84	15
Usage of old vintage plant machinery and equipment	4.50	0.72	0.89	5
Skilled labor Deficiency	4.24	1.06	0.83	16
The unwillingness of proficient contractors to work	4.27	1.05	0.86	13
Delays in reaching material at the site	4.27	0.90	0.86	12
Delays in reaching plant and machinery at the site	4.49	0.73	0.89	6
Social, cultural, ethnicity and religion factor				
Altered work scope due to locals	4.26	1.05	0.85	14
Indecisiveness by project managers	4.5	0.77	0.88	8
Less acceptability of allied contractors	4.67	0.53	0.88	7
Inhabitants interference	4.20	1.00	0.82	18
The dispute between Managers and inhabitants of the area	4.46	0.79	0.87	9
Lack of inhabitants support	4.65	0.73	0.93	2
Effects of institutional factor (consultant and client)				
Inaccurate estimation due to inaccessible locations	4.11	1.11	0.79	21
Overambitious Planning due to inexperience	4.06	0.90	0.78	22
Frequent design changes	4.04	0.91	0.77	23
Infrequent visits on sites by consultant resulting in untimely inspections	4.16	1.01	0.81	19
Limited pool of contractors	4.23	0.93	0.83	17
Lack of willing Project managers	4.15	1.13	0.80	20
Effect of political factor				
Indecisive Government Administration	4.04	1.12	0.76	24
Unambiguous Requirements of Government Administration	4.1	0.93	0.75	26

the performance of the projects. To understand and then respect the culture of the locals is vital for the project managers to work in these areas. Winning the hearts and minds, campaigns though will cost something but will make the task of the project managers easier. The locals will be asking demands to let the project teams work. Demands involving minimal cost compared with the overall cost of projects may be met to generate a good will. Local people must be included in the project in the form of petty contractors and laborers.

Repairs / reworks due to intense insurgent activities

Owing to insurgent activities, a lot of time is wasted to carry out the re-works. A party comprising all types of tradesmen is detailed to take on the affected works.

Damaged works take more time than new construction. Thus the performance of the projects is affected. The completed projects or activities must be taken over by the local administration and can be further handed over to the concerned department for preservation.

The kidnapping of contractor teams for ransom

The insurgents kidnap contractors and members of project teams due to two reasons. One; to deter, so that project teams abandon the project. Second; kidnapping for ransom.

   In both ways, the performance of the projects is affected. The project must incorporate some of the se-curity paraphernalia. The members of the project teams

teams must have a collective plan for moving in and out of the project site.

Usage of old vintage plant machinery and equipment

The plant machinery contractors are reluctant to bring new equipment in man-made disaster areas. There is no option except to use the old vintage plant. There is a number of breakages. Maintenance of plant and equipment in these areas is an arduous task. Virtually the productivity of the projects is reduced. Projects are delayed and also not cost effective. It is recommended to give incentives to the machinery owners regarding cost so that they bring better-advanced machinery.

Managing long logistic chain

The insurgent affected areas are far flung from major cities. Deliberate efforts are required to mobilize plant and machinery in the project area. The plant is needed to be moved under protection from a specific area. If hired machinery is to be brought in, the safety of equipment will pay rich dividends in attracting other owners of machinery.

Managing locals to accept allied contractors

Locals do not accept allied contractors. They want themselves to be incorporated into projects in any capacity. The allied contractors are not conversant with the local culture. The local people do not have expertise and capital to become outsourced contractors. Therefore, to improve the performance of the project, it is recommended to either incorporate the locals in the project with outsourced contractors as employees or as a petty contractor.

Decision making by project managers

The managers working in insecure environments remain indecisive due to the impromptu situation. The decision should be taken by the managers by bringing all stakeholders on board. A bold and firm decision is expected from managers all level to execute projects in time and within contract cost.

LIMITATIONS OF RESEARCH

The study was carried out in terrorism/insurgencies hit areas of the world. The data was collected from different stakeholders who have actually worked in these areas. Basing upon this data, results were drawn by processing the data in a Package. Although, the sample was gathered from different parts of the world which represents

diverse cultures so the results may be inflated owing to common source bias.

Conclusion

Owing to an insecure environment, productivity (time and cost) of infrastructure development projects are likely to be affected. Varying factors contributing to the low performance of the project was identified, studied and analyzed. In previous studies effects of insecurity due to insurgency has been considered as force majeure and no worthwhile study has been conducted earlier. Twenty-six factors were identified from the detailed literature review and opinion of experts. The data was collected from a sample population through a structured questionnaire. The gathered information was processed, and the weight of each variable was ascertained. All variables were ranked keeping in view the weight. Top eight variables were discussed, conclusions drawn and recommendations are made. The findings of this study will facilitate in improving the performance of the projects in terrorism-hit areas of the world. For future research, the common factors which affect the performance of projects executed in any environment must also be clubbed with the factors due to terrorism and insurgency. A wholesome new model will be formulated which will help project managers to improve the performance of projects incorporating all types of factors.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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The joint effect of firm capability and access to finance on firm performance among small businesses: A developing country perspective

Peter Turyakira[1], Sendawula Kasimu[1*], Pedson Turyatunga[2] and Saadat Nakyejwe Kimuli[3]

[1]Department of Marketing and Management, College of Business and Management Sciences, Makerere University, Kampala, Uganda.
[2]Eastern and Southern African Management Institute, Arusha, Tanzania.
[3]Department of Entrepreneurship, Makerere University Business School, Kampala, Uganda.

The purpose of this paper was to establish the joint effect of access to finance and firm capability on small businesses' performance in Kampala, Uganda. The study adopted a cross-sectional design with a sample of 384 small businesses. Self administered questionnaires were used in data collection and data was collected from August to November 2018. The study utilised SPSS to perform correlation and regression. The study found out that access to finance, firm capability and firm performance are positively related. Regression analysis also revealed that access to finance and firm capability equally account for 41.8% change in small business performance. Conversely, access to finance was found to be the most influential factor in predicting firm performance as compared to firm capability. Therefore, the study recommends that policies and programs to improve small business owners' capabilities should be implemented to enhance the performance of their firms; small business owners need government support to get finance characterised by low interest rates; no collateral security and as such, their performance will gradually improve. Small business owners also need to establish long-tern relationships with customers, suppliers and employees to improve their services and products to better the performance of their firms.

Key words: Firm capability, access to finance, firm performance, small businesses.

INTRODUCTION

Small businesses are recognized by researchers as engines for economic growth and development. Globally, small businesses significantly contribute to innovation, income distribution and poverty reduction (Abaho et al., 2017; GEM, 2003), contribute approximately 75% of the gross domestic product (GDP) and employ about 2.5 million people (Osunsan et al., 2015; Harash et al., 2014; Sendawula et al., 2018a). They also serve as breeding ground for entrepreneurs, ehnance economic conversion and have an extraordinary potential for enhancing sustainable development (Harelimana, 2017; Sendawula et al., 2018b). Given the role of small businesses, countries such as Uganda are trying to promote small businesses to ehnance their performance. However, Uganda, a developing country, is experiencing poor performance of small businesses with approximately 75%

of the established businesses failing before completing a year in operation (Nangoli et al., 2013). In addition, few small businesses exist for more than five years (OECD, 2010). This suggests poor performance of small businesses in Uganda.

Previous studies indicate various predictors of firm performance (Eniola and Entebang, 2016; Adomako and Danso, 2014; Abaho et al., 2017; Harash et al., 2014). According to Mulyono (2013), performance of small businesses is dependent on the resources and the capabilities that these businesses control. Nangoli et al. (2013) also reveal that the failure of small businesses could be a result of inadequate supervision, insufficient managerial skills, high competition, low saving culture, poor financial discipline, high taxes and limited commitment to running the business. Furthermore, Vijay and Ajay (2011) reveal that entrepreneurial competencies are vital in enabling small businesses to interact effectively and efficiently with both the internal and external environment to achieve desired performance. Relatedly, firm capability is a source of superior performance for small enterprises and may result in sustainable performance (Ambrosini et al., 2009). Barney (2001) reports that capabilities accumulated over time may act as a driving force for small businesses to undertake several opportunities (Vijay and Ajay, 2011). Access to finance is also fundamental in promoting firm performance (Harash et al., 2014). As such, businesses that access finance are likely to perform better than their counter parts.

It should be noted that extant literature has focused on established large organizations, with less emphasis on small businesses. Additionally, there seems to be limited research on the joint effect of firm capability and access to finance on firm performance. This gap in the literature is puzzling because small businesses need distinct skills, knowledge and finance to enhance their performance. Hence, this paper is aimed at establishing the effect of access to finance and firm capability on business performance in Uganda.

LITERATURE REVIEW

This study adopted the Resource Based Theory (RBV) (Wernerfelt, 1984) and Dynamic Capability Theory (Teece, 2014) to explain the joint effect of firm capability and access to finance on performace of small businesses in Uganda. According to the RBV, firms perform differently because they control different resources and capabilities (Barney, 1991) that enhance business performance. This theory also contends that firms that have resources that are unusual, treasured, unique and difficult to substitute can realize competitive advantage through undertaking strategies that generate value that cannot be replicated by competitors (Barney, 1991).

According to Penrose and Penrose (2009), resources, skills and knowledge enhance internal growth of the

business. Accordingly, organisational resources are critical to the success of any organisation. Similarly, Barney (1991) asserts that resources and capabilities are equally dependant aspects since their acquisition constitute capabilities of a firm. Conversely, valuable resource accumulation may not warranty a superior business's performance because firms utilise resources at their disposal differently to achieve greater performance (Sánchez, 2011; Eisenhardt and Martin, 2000; Teece et al., 1997). The relevance of the RBV theory in this study is to describe how access to finance promotes small business performance in Uganda. Nevertheless, this theory does not present what businesses need to attain sustainable performance, addressed by the dynamic capability theory (Helfat and Peteraf, 2003; Teece et al., 1997).

The theory of Dynamic Capability stresses the role of business processes in linking the firm to the external environment (Teece, 2014). Capability refers to the capacity to utilize resources to perform a task or an activity, against the opposition of circumstance (Teece, 2014). From the strategic point of view, a firm's capability refers to the actions, processes, systems and relationships that the company can carry out with its own resources (Sánchez, 2011). A firm's capability focuses on strategy perception and implementation, which is consistent with the role of firm resources and capabilities in strategy (Wang et al., 2009). As such, firm capabilities in terms of employee knowledge and skills, physical technical system, management system, values and norms promote performance of small businesses through customer satisfaction, internal process and learning and growth. To this extent, the dynamic capability theory is relevant in explaining performance of small businesses in Uganda.

Firm performance

Performance empasizes how well a firm can utilise its assets to generate profits (Marimuthu et al., 2009). Performance is also conceptualized as "the accomplishment of stated business objectives measured against known standards, completeness and cost" (Harash et al., 2014). Given the significant role of small businesses in promoting economic growth worldwide, their performance is crucial. Harash et al. (2014) reveal that small business performance involves the degree to which small business owners manage to realize its purpose and goals. Conversely, Richard et al. (2009) indicate that performance of small businesses involves three aspects of a firm outcomes: financial performance, market performance and shareholder return. Firm performance can also be measured using financial and non financial meseaurement. In this study, non-financial measures will be adopted since they supplement on the financial measures and present data on the improvement relative to customer needs, competition as well as

employees (Osunsan et al., 2015). Scholars such as Sebikari (2014) adopted financial measures in predicting firm performance and less attention to non-financial measures.

Firm capability and business performance

There is no consensus among the scholars on the meaning of firm capability as several scholars perceive the concept differently. Krammer et al. (2018) view firm capability as actions, processes, and systems and associations' businesses may undertake using it available resources. As such, Barney and Arikan (2001) assert that firm capability includes factors that enhance small business' awareness of strategic prospects/threat and its ability to undertake strategies. Weinstein and Azoulay (1999) add that firm capability involves the efficiency of a business in solving problems in specific operational areas. In this study, firm capability entails the use of knowledge, skills, technology and intelligence of markets and demand. Previous studies reveal that capbilities and firm performance are significantly related (Tuan and Yoshi 2010; Ismail et al., 2012). According to Tuan and Yoshi (2010), firm capabilities such as relationship building and employee abilities are foundation of competitive advantage that translates into sales and market share growth. Despite the existence of research at the macro level, there are few empirical studies about capabilities at the firm level such as how organizational capabilities contribute to firm performance. This is so important because it helps in understanding why some firms perform better than their counterparts (Ismail et al., 2012).

The RBV theory reveals that businesses have resoures, skills and knowledge that are different among firms (Barney, 2001). This in turn results into competitive advantage that leads to improvement in firm performance (Harash et al., 2014). This is in agreement with Sánchez (2011) who asserts that internal capabilities which are rare and difficult to imitate enhance firm performance. The implication is that small businesses need to effectively utilize their organizational capabilities such as managerial systems, employee knowledge and skills, values and norms (Eikelenboom, 2005). This will translate into improved workers welfare, behaviour and efficiency that ultimately contribute to high performance of small businesses in Uganda. Thus, the hypothesis:

H₁: Capability and performance of small businesses are positively related.

Access finance and performance of small businesses

Accessing resources has been alluded to as one of the important factors in promoting firm performance (Fowowe, 2017). Similarly, inadequate finance limits firm performance (Malhotra et al., 2005). Finance involves a situation where businesses need capital from different sources to enhance maintenance and their performance. Kyophilavong (2011) also views finance as "the total amount of money that owners invest in their businesses". Access to finance is the ability of business to obtain financial services such as credit, deposits, payment and insurance (Adomako and Danso, 2014). Access to financing facilitates firm expansion, innovation and acquiring new technology, recruiting and retaining employees (OECD, 2006). Extant studies indicate that small businesses face many challenges in accessing finance as compared to large and well established organizations (Nangoli et al., 2013). Yet, these businesses are vital in enhancing economic growth of both developed and emerging economies through employment creation, income distribution and poverty reduction. In view of the role they play, it is important for the government and financial institutions to support small businesses in accessing finance to promote their performance.

In developing economies such as Uganda, access to finance is among the greatest challenges limiting small business performance. A study conducted by Harash et al. (2014) reveals that small businesses are unable to access finance from financial institutions due to their inability to meet requirements such as collateral securities. This suggests that banks are eager to offer credit facilities to small businessess, but most small businesses lack the requirement to access loans, this in turn limits their performance. In addition, Harelimana (2017) reports that access to finance by small businesses improves their profitability and efficiency, prevents liquity problems, improves solvency as well as increasing asset quality. This indicates that small businesses which access finance, especially bank loan, are likely to perform better than other businesses that have limited financial access. Hence, the hypothesis:

H₂:Access finance and perfomance of small businesses are positively related.

The impact of financial accesss and firm capability on performance of small businesses

Firm capability is vital in accessing financial resources to enhance small business performance. Small business owners need capabilities such as knowledge, skills and experience to get finances from both formal and informal sources. In small businesses, decision making is an important capability that entrepreneurs need to evaluate different sources of finance and be able to select the most appropriate source of financing their businesses (Eniola and Entebang, 2016). Furthermore, Wachira and Kihiu (2012) reveal that capabilities such as financial

knowledge, create pressures on financial institutions to provide reasonable financial services. This is achieved by making comparison between banks, asking important questions and ultimately negotiating for better rates. This translates into access to finance by firms that have such capabilities and ultimately contributing to better performance of small businesses in Uganda.

Garman and Forgue (2011) also assert that firm capability creates awareness on individual income and how such funds have to be used and managed efficiently. This suggests that businesses without knowledge and skills of personal financial management may find it difficult to access finance from external sources such as financial institutions. Firm capabilities also enable businesses to appreciate the available financial products and know where to source for help as well as taking effective measures to enhance their financial position (Miller et al., 2009). Wachira and Kihiu (2012) report that firm capabilities such as financial knowledge enables entrepreneurs to solve challenges related to accessing finance. This indicates that financial information enables entrepreneurs to get ready for tough financial times and develop strategies that minimize such situation like savings and investing in assets which contribute to performance of small businesses in Uganda. Thus, the hypothesis:

H3: Firm capability and access to finance positively affect firm performance.

MATERIALS AND METHODS

The study used a cross-sectional and correlational approach to establish the joint effect of access to finance and firm capability on small businesses' performance in Kampala, Uganda. A cross-sectional design involves examining variables under investigation at one point in time (Salkind, 2011). The approach is considered to be the most appropriate because the phenomenon under study are measured as they naturally occur without being manipulated. In addition, this approach is selected because it is flexible in both qualitative and quantitative data collection. Correlational design on the other hand is a quantitative method that involves establishing relationship between study variables. As such, data was collected from August to November, 2018. The study population involved 108,534 registered businesses in Kampala (Uganda National Bureau of standard, 2012), and a sample of 385 small businesses were investigated comprising of 287 businesses from trade, 61 from hotel and restaurant as well as 37 from the manufacturing businesses (Krejcie and Morgan, 1970). A rotary approach was used to select the subjects. Small businesses were the study's unit of analysis, owners/managers were the unit of inquiry.

Operationalization of study variables and questionnaire design

A likert scale of five points was developed to determine the extent to which respondents agree or disagree with the statement used to measure study variables. The study employed a self-administered questionnaire with the help of research assistants in collecting data from the small business owners or managers. The questionnaire was designed based on existing literature on firm capability, access to finance and firm performance.

Analysis of data

This was performed using SPSS in order to summarize the data and to allow quick interpretation of results. Specifically, quantitative data generated from the questionnaire through data coding was analysed to get descriptive statistics that involved determining frequencies, percentages, mean variance and standard deviation in order to get general response to the question in the likert scale. Pearson correlation coefficient was done to investigate the association between the predictor and dependent variable (firm performance). Regression analysis was conducted to determine the joint effect of the independent variable to the predictor variable.

RESULTS AND DISCUSSION

The study revealed that most of the respondents (51%) were female. This suggests that small businesses in Uganda are mainly dominated by female as compared to their male counterparts. Regarding age, the study indicated that majority of the respondents are in 25 to 29 years age bracket (47%), followed by those in 18 to 24 years age bracket (22%). This evidently shows that on average, people who are mostly involved in small businesses in Uganda are below the age of 40 years. Concerning the marital status, the study discovered that majority of the respondets (52%) were married. This shows that married people are actively involved in small businesses to earn a living and be able to look after their dependents (family members). For the education level, it was revealed that majority of the participants (50%) have a bachelors degree. This implies that respondents were knowledgeable as far as issues under investigation are concerned. Moreso, results revealed that most of the business owners (52%) participated in the study.

Firm characteristics

The findings of this study indicate that majority of the small enterprises (84%) are registered while 16% operating illegally. Furthermore, it was discovered that many small enterprises in Kampala (57%) are sole proprietorships followed by the partnership businesses (29%) and then limited liability enterprises (14%). The study also discovered that majority of the small enterprises (58%) have been in existance for fewer than 5 years. Moreso, most small businesses (54%) in Kampla have less than 50 employees. Regarding business type, it was revealed that majority of the businesses (59%) are involved in trading ventures, followed by manufacturing businesses (25%). This implies trading businesses are easy to establish in Uganda.

Descriptive statistics

Here, present the descriptive statistics of the study variables (as depicted in Table 1) regarding the extent to which respondents were in agreement with the statements

Table 1. Number of respondents rating various attributes with a particular score of 1 (low) to 5 (high).

Attribute	N	1	2	3	4	5	Mean	Median	Modal
Firm performance	371	0	13	50	278	30	3.88	30	4
Firm capability	371	0	20	27	128	196	4.35	27	5
Access to finance	371	5	10	6	96	254	4.57	10	5
Credit terms	371	5	10	11	115	230	4.49	11	5
Access to credit	371	5	10	2	111	243	4.55	10	5
Customer satisfaction	371	2	8	82	230	49	3.85	49	4
Internal process	371	2	25	98	202	44	3.70	44	4
Learning and growth	371	0	16	43	208	104	4.09	43	4
Knowledge and skills	371	0	15	16	157	183	4.37	16	5
Physical technical system	371	10	26	57	160	118	3.94	57	4
Management system	371	10	15	23	126	197	4.31	23	5
Values and norms	371	5	16	50	138	162	4.18	50	5

put to measure study variables. The study reveals that the mean scores for statements put to the respondents meant to measure firm performance is 3.88 out of a maximum of 5. The median for firm performance is 30 while the model score is 4. This implies that 278 businesses investigated agreed that they are high performing firms in Kampala Uganda. However, 63 small businesses are low performing firms since their score are below average. The study also indicated that the mean rating for firm capability is 4.35 out of a maximum of 5. The median for firm capability is 27 while the model score is 5. This finding suggests that 196 of the investigated businesses strongly agreed that they have enough capabilities such as knowledge, skills and improved management systems that are vital in enhancing performance of their businesses.

In addition, the study found out that the mean scores for statement measuring access to finance is 4.57 out of 5. The median score for access to finance is 10 yet the model score is 5. This implies that 254 businesses studied strongly agreed that they have access to finance such as bank loans, personal saving among others. This finding is not surprising because the government has launched several programmes aimed at helping entrepreneurs in Uganda to access capital to boost their businesses like the youth funds among others.

Correlation analysis

Pearson correlation analysis was undertaken to measure the strength of the linear relationship between study variables and is indicated by r. Results in Table 2 revealed that firm capability and performance of small businesses are positively related (r= 0.597**, p<0.05). The study also indicates that all measurement items of firm capability such as employee knowledge and skill, physical technical systems, management systems, values and norms are all independently associated with firm performance. Therefore, small business owners should enhance their capabilities to achieve sustainable performance. Moreso, access to finance and performance of small businesses are positively related (r = 0.628**, p<0.05). Thus, small businesses that have access to finance in terms of favourable credit terms and conditions can access credit anytime, the performance of their businesses in terms of satisfying customers, improved internal process, learning and growths will ultimately improve.

Regression analysis

The study was conducted to establish the joint effect of access to finance and firm capability on firm performance. Therefore, a linear regression was performed to test the effect of independent variable on the dependent variable. This was done to determine the extent to which firm capability and access to finance predict the firm performance as indicated in Table 3.

Results in Table 3 indicate that firm capability and access to finance have a significant contribution on firm performance (β = 0.260, p <0.05) and (β =0.418, p <0.05), respectively. This implies that firm capability and access to finance are significant predictors of firm performance. From the aforementioned results, a unit change in employee knowledge and skills, physical technical systems, management system, values and norms (firm capability) will bring about a 0.260 change in firm performance. On the other hand, a unit change in access to credit and credit terms and condition (access to finance) will bring about a 0.418 change in firm performance indicated by customer satisfaction, internal processes as well as learning and growth. Furthermore, a combination of access to finance and firm capability on the performance of small businesses accout for 41.8%. This finding suggests that there are other factors that explain firm performance apart from access to finance

Table 2. Correlation results.

Correlation	1	2	3	4	5	6	7	8	9	10	11	12
Credit terms (1)	1											
Access to credit (2)	0.892**	1										
Access to Finance (3)	0.979**	0.966**	1									
Knowledge and Skills (4)	0.770**	0.758**	0.786**	1								
Physical and technical system (5)	0.665**	0.579**	0.644**	0.610**	1							
Management system (6)	0.658**	0.564**	0.634**	0.666**	0.816**	1						
Values and norms (7)	0.839**	0.739**	0.817**	0.763**	0.661**	0.591**	1					
Capability (8)	0.822**	0.737**	0.806**	0.845**	0.911**	0.895**	0.835**	1				
Customer satisfaction (9)	0.521**	0.478**	0.516**	0.444**	0.333**	0.410**	0.359**	0.436**	1			
Internal process (10)	0.383**	0.311**	0.361**	0.250**	0.419**	0.502**	0.270**	0.425**	0.405**	1		
Learning and growth (11)	0.565**	0.625**	0.608**	0.599**	0.382**	0.483**	0.510**	0.548**	0.520**	0.294**	1	
Firm performance (12)	0.624**	0.594**	0.628**	0.541**	0.484**	0.595**	0.478**	0.597**	0.838**	0.744**	0.746**	1

**Correlation is significant at the 0.01 level (2-tailed).

and firm capability. Overall, access to finance was found to be the most influential factor in explaining firm performance (β = 0.418, p <0.05) as compared to firm capability (β =0.260, p <0.05).

DISCUSSION

The findings of this study reveal that firm capability in terms of employee knowledge and skills, physical technical systems, management system as well as values and norms significantly affect performance of small businesses in Kampala, Uganda (β = 0.597, p <0.05). This implies that firm capability significantly explains performance of small businesses. This finding is not surprising because a firm that has capabilities such as skilled employees that know what and how to undertake their duties and responsibilities in the business, automatically translates into better performance of such a business. This finding is consistent with the findings of Abaho et

al. (2017) and Desarbo et al. (2007) who indicated that firm capabilities such as competent firm management, market linkages and marketing capabilities promote firm performance. This is because a firm that has a competent management will ensure that all business activities are well planned, recruits rightful persons to undertake these activities and ultimately execute them effectively and efficiently. This will result into high productivity and reduced operational costs, indicating good firm performance. Lau and Ngo (2004) also support the findings of this study and as such, the authors reported that increased organizational capabilities significantly explain the increased performance of small businesses. In their study, they argue that a small business with innovative capability, quality-enhancing capability and cost-reduction capability will be in position to perform better than its counterparts. This implies that firms which have innovative capability are able to create new methods of performing tasks which automatically improves on the efficiency

and effectiveness in firm operations which ultimately brings about better performance. Also, quality-enhancing capabilities enable firms to produce products and services of value to their customers which will attract and retain customers thereby generating more sales and ultimately bringing high performance of firms. Additionally, small businesses that are able to operate with minimal costs achieve higher levels of profitability which implies better performance in the market. The study findings also agree with Tuan and Yoshi (2010) who found out that firm capabilities enhance small business performance; thus increased sales and market share growth. In their study of Vietnam SMEs, they revealed that when a firm possess capabilities, this results into competitive advantage in the industry which will in turn lead to greater small business performance. No wonder firm capabilities are a source of competitive advantage. It is also important to note that capabilities such as cost reduction and quality are significant contributors of competitive

Table 3. Regression results.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.497	0.124	-	12.119	0.000
	Access to finance	0.311	0.050	0.418	6.218	0.000
	Firm capability	0.178	0.046	0.260	3.868	0.000

R= 0.646[a]; R^2= 0.418; Adjusted R^2= 0.415; DF1= 2; DF2= 368; F Change= 132.039. [a]Dependent Variable: Firm performance.

advantage which collectively lead to good firm performance.

Additionally, the research findings indicated that access to finance significantly impacts firm performance (β = 0.628, p <0.05). This findings is in agreement with Fowowe (2017) who asserts that firms that can access finance have better chances to perform better than those that are constrained in terms of accessing finance. This implies that growth of a firm comes as a result of access to finances. This further means that access to finance enables small businesses to cater for short-term and long-term obligations which makes them operate effectively and efficiently thereby facilitating growth and ultimately better performance. Conversely, small businesses which do not have access to finance are constrained in meeting their short-term, medium and long-term obligations and thus cannot perform competitively in their respective industries thereby affecting their overall performance. Harash et al. (2014) also indicated that firms that can access adequate levels of finance achieve considerably better performance. Firms that access finance get better credit terms and have access to credit that enables them to operate efficiently and effectively. A small business is said to have better credit terms if it can afford the interest rates charged by financial institutions, it has sufficient collateral to get credit, good credit history facilitates credit access. Moreover, financial credit access is facilitated if it easily gets credit from financial institutions, if it gets a loan size it needs at any time, and if the amount of credit got from the bank is on the increase. These scenarios collectively improve on the small business' access to finance which will eventually culminate into improved firm performance.

The study further revealed that firm capability and access to finance jointly have a significant positive effect on firm performance (β = 0.260, p <0.05) and (β =0.418, p <0.05), respectively. This implies that firm capability and access to finance are significant predictors of firm performance. As such, a unit change in firm capability will bring about a 0.260 change in firm performance. On the other hand, a unit change in access to finance will bring about a 0.418 change in firm performance indicated by customer satisfaction, internal processes as well as learning and growth. Furthermore, the joint effect of firm capability and access to finance on firm performance is 41.8%. However, access to finance was found to be the most influential factor in explaining firm performance (β = 0.418, p <0.05) as compared to firm capability (β =0.260, p <0.05). These finding are in agreement with Carmeli and Tishler (2004) who revealed that capabilities such as perceived organizational reputation, management skills, organizational culture and organizational communication enable industrial firms to access finance and as such enhance their performance. This finding is not surprising because such capabilities determine whether a firm can access finance through borrowing or not. As such, organizational culture that indicates the values, beliefs and principles of the organizational management determine the ability of a firm to access finance through borrowing. Therefore, small businesses with a culture that allows its management to borrow money from financial institutions always find it easy to access credit to effectively and efficiently undertake its operation, thus high performance as compared to small businesses whose culture that does not allow management to borrow money from financial institutions to finance business operations. In addition, management skills that involve the ability of managers to understand the economic potential of the organization. Thus, a management team that is skilful in resource mobilization will always find it easy to identify financial institutions that can offer credit to the business and as such, they will negotiate to get favourable terms and conditions to access finance cheaply, thus high business performance. Barney and Arikan (2001) also revealed that firms possess and control resources, skills and knowledge that are different among firms. This suggests that small business owners can use their own resources such as retained earning to achieve superior performance as compared to those that luck such resources and capabilities.

CONCLUSIONS AND RECOMMENDATIONS

The study findings show that access to finance and capability enhance the performance of small businesses. Specifically, when businesses access finance that is characterised by favourable terms and conditions, as well as loans being available and easily accessible, it enables them to acquire all the necessary facilities that are needed to enhance the performance of their businesses. This finding suggests that business owners need to have

access to finance for their businesses to attain sustainable performance. Regarding the effect of firm capability on firm performance, it can be further concluded that firm capabilities positively affect firm performance. This is an indication that when small businesses have unique capabilities in terns of knowledge and skills, effective management systems, pricing and advertising programs, control quality cost and manage relationships with customers and suppliers, small businesses will retain customers which increases customer acquisition and retention leading to increased profits, sales and market share. Therefore, small business owners should enhance capabilities of their staff through learning and growth to spur performamce of their businesses. Concerning the joint effect of firm capability and access to finance on firm performance, it can be concluded that both variables affect the performance of small businesses.

Intrinsically, firm capabilities especially learning and growth provide an opportunity for both the small businesses owners and their employees to acquire new skills and knowledge; which are important in achieving effective management and operation of small businesses. Therefore, small business owners need to improve on their capabilities to promote acces to credit and translate into high performance indicated by customer satisfaction, internal processes, learning and growth and employee retention.

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

However, this study has some limitations and future studies should be conducted to address these gaps. First, the study covered small business in Kampala district only. This suggests that a similar study can be carried out in other parts of the country to verify whether what was observed in Kampala district represent the characteristics of all small business in Uganda in general. Second, since this study focused on only three sectors: manufacturing, trade and restaurants and hotels, similar studies can be carried out in other sectors such as the service sector.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Full Length Research Paper

Estimating the maximum probable annual losses due to flooding

Emad A. A. Ismail[1,2*] and Fuad A. A. Awwad[1]

[1]Department of Quantitative Analysis, College of Business Administration, King Saud University, Saudi Arabia.
[2]Mathematics and Insurance Department, Faculty of Commerce, Cairo University, Egypt.

This paper aims to estimate the maximum probable annual losses to the risks of flooding. While examining the frequency of the event, it was observed that, at least one accident occurred periodically, which resulted in maximum losses. This is an empirical study and it is based on maximum losses due to floods per year, as obtained from the International Disaster Database and Munich Re. The analysis is based on 66 extreme flood events in the world between 1906 and 2015. The complementary risk method has been used in deriving a mixed probability distribution, which expresses the number of floods and the maximum losses realized, where zero-truncated Poisson distribution is used for frequency distribution and Last order Weibull distribution for losses. The maximum of flood losses was fitted with compound truncated Poisson-Weibull distribution. Probabilities have been calculated for extreme flood losses, which are less than specific descriptive measures, and expected values have been calculated for extreme flood losses, which exceed the specific descriptive measures. The results from the study indicate that the maximum probable losses are greater than the maximum actual losses. This paper contributes to the risk of extreme floods pricing; and it also helps the governments of the countries in calculating the financial reserves to cover the extreme flood losses.

Key words: Risk management, extreme flood, complementary risk, truncated poisson distribution, last order weibull distribution, expected losses.

INTRODUCTION

A number of natural disasters occur around the world year after year. These natural disasters usually happen unexpectedly. Even for those that are expected, such as floods, hurricanes, and volcanos, their expectation usually comes only a few days or hours before the occurrence. Consequently, there is often no sufficient time to prepare to manage or mitigate the damages and losses resulting from the disaster. Undoubtedly, natural disasters are considered the most dangerous risks that threaten human lives and properties. The impact of these disasters may even threaten the existence and survival of property and even countries, due to the heavy losses that usually result from them. In addition, there are some natural disasters, such as earthquakes, that are difficult to predict in time and place, and this worsens the damages and losses that result from them. Even if we are capable of expecting the occurrence of some natural disasters and we can control the amount of expected

damage, especially the loss of human lives, the actual losses will still be huge and may exceed the potentials of some countries and continents.

The Centre for Research on the Epidemiology of Disasters (CRED) defines natural disaster as "the event that overburdens the local capabilities and necessitates the importance of seeking national or foreign aid. It is an unexpected event and is often unpredictable. It causes huge damages and heavy losses as well as human suffering."

An event is considered to be a disaster if at least one of the following criteria applies to it:

1) The death of 10 persons or more;
2) Harm to a hundred persons or more;
3) Announcement of a state of emergency;
4) Calling for international aid.

As a matter of fact, 2004 was the costliest natural catastrophe year so far in insurance history. The most expensive losses were those caused by hurricanes in the Caribbean and the United States and typhoons in Japan. The overall economic losses amounted to over US\$ 145bn. Almost two-thirds of this total is attributable to windstorms and a third to geological events, in particular the Niigata earthquake in Japan and the earthquake and tsunami catastrophe in South Asia [Munich Re, 2005]. In 2005, insured losses from Hurricanes Katrina, Rita, and Wilma alone are estimated at over \$85 billion (including the \$23 billion for flood claims paid by the government-run and -funded National Flood Insurance Program). The U.S. federal government provided over \$120 billion in federal relief which is another historical record [Michel-kerjan and Morlaye, 2008]. Natural disasters pose a serious risk to humans and represent a huge economic challenge to the state. They may also sometimes lead to destruction and human suffering whose impact may last for many years. Table 1 shows the events of losses of the 10 costliest floods between 1980-2015. Maximum economic losses are US\$ 59,000 million and insured losses are US\$ 16,000 million, where the overall losses are US\$ 43,000 million, without coverage by traditional insurance. This gap needs coverage by securitization tools in the capital markets or any suitable methods.

This paper aims to estimate the maximum probable losses as a result of the occurrence of the risk of extreme flooding. The estimated expected losses from the occurrence of flooding contribute to determine the gap between the non-covered losses to the economy and insurance losses. This helps determine the amount of loss that will be covered by the capital market such as Insurance-linked Securities [ILS]. In addition to the development of the ability of insurers to price extreme floods, it also rationalizes the reinsurance agreements. Michel-Kerjan and Morlaye (2008) have discussed some of the main drivers of the radical shift that happened in the insurance-linked securities (ILS) market after the

2005 hurricane season in the Atlantic basin, which has rapidly become one of the world peak zones in terms of exposure? They explain why, despite this very encouraging evolution, the market has not expanded significantly (contrary to credit derivatives, for instance).

LITERATURE REVIEW

Having good planning and estimating the expected losses, as a result of natural disasters, can be challenging. Countries throughout the world need to estimate the necessary financial reserves required to cope with these losses. Extreme weather-related events (such as hurricanes, floods, and ice storms) are certainly important elements of the "insurance and finance meeting with climate change" phenomenon [Michel-kerjan and Morlaye, 2008]. Acccording to the Fourth Assessment Report prepared by the Intergovernmental Panel on Climate Change (2007) [Climate Change, 2007], warming of the climate system is "unequivocal" and extreme events have increased in frequency and/or intensity over the last 50 years. It is also stated that there is high agreement and much evidence that with current climate change mitigation policies and related sustainable development practices, global greenhouse gas emissions will continue to grow over the next few decades. This highlights the need for improving the methods for estimating the maximum possible losses as a result of occurrence of the risk of extreme events as well as the associated expected losses. Noy (2009) and Strobl (2012) have examined the macroeconomic implications of natural disasters and finds that natural disasters considerably deteriorate the welfare of society [Noy, 2009; Strobl, 2012].

Born and Klimaszewski-Blettner (2013) have analysed the crucial factors that drive insurers' willingness to offer coverage in catastrophe-prone lines of business (Born and Klimaszewski-Blettner, 2013). They have suggested certain policy implications for overcoming availability constraints with regard to improving insurance against catastrophic threats. Based on the disaster risk management programs in Mexico, Saldana-Zorrilla (2015) indicates that there is a deficit of central planning from the Mexican public sector to manage disaster risks. He has provided a comprehensive view of government risk management and also put forth a set of policy suggestions for integrating risk management and increasing risk reduction measures and planning. Chang and Berdiev (2013) examined the relationship between natural disasters, political risk and insurance market development in a panel of 39 countries over the period 1984-2009 using a dynamic panel two-step system generalised method of moments model. They have established that that the incidences of natural disasters and deaths caused by natural disasters lead to greater total insurance, as well as life insurance and non-life

insurance consumption. Further, there seems to exist an inverse relation between the levels of political risk and insurance consumption. The incidences of natural disasters and deaths attributable to natural disasters contribute to insurance market development under the tenure of a government with lower levels of political risk. Therefore, it should be emphasised that natural disasters, political risk, and their interaction effects are important determinants of insurance market development.

The high complexity of insurance markets with equally high potential for catastrophic loss, calls for improved estimation of the probable losses as a result of the occurrence of natural disasters. Gao et al. (2016), while discussing the difficulties in precisely estimating catastrophe risk, have applied the modeling framework to a full-scale case study for hurricane risk (flood and wind combined) for residential buildings in eastern North Carolina. The results indicated that the level of concentration in the primary insurance market can lead to significant differences in the firm's operational decisions (for example choice in reinsurance and retained or capped surplus). Further, results suggested that encouraging catastrophe reserves for insurance companies can reduce their likelihood of insolvency. Davidson (1998) presented alternative approaches to funding US natural catastrophe exposures; existing and evolving private and public funding arrangements are evaluated, and public policy changes are identified and recommended to encourage insurers to pre-fund catastrophe losses, use a broader array of capital, and encourage loss prevention to minimize the tragic consequences of natural disasters. Changes in federal tax policy are recommended to encourage "policyholder safety reserves" to enhance existing private market efforts to fund catastrophe losses. Bouriaux and MacMinn (2009) discussed the technical and regulatory issues that could be crucial to market growth and recommended new private and public initiatives aimed at boosting the use and efficiency of CAT-linked securities and derivatives.

Substantial growth in coastal populations has led to a dramatic increase in the consequences of natural disasters (Roth and Kunreuther, 1998). Hence, the risks due to extreme flooding needs emphasis. Management of the catastrophes of extreme floods depends mainly on the efficiency of the governmental administration at all levels in a country. When overwhelming floods take place, the governmental financial aid and social donations can be used to compensate people for the losses resulting from the catastrophe. However, these compensations usually cover only a small part of the losses resulting from such catastrophes. Catastrophe losses tend to be highly correlated in space and characterized by "fat tail" distributions, making it especially difficult for an insurer to avoid the possibility of insolvency (Kousky and Cooke, 2012). Designs and simulations on the pricing based on the extreme flood data in China during 1961 to 2009, using quantitative

analysis method were carried out, combining with the non-life insurance actuarial method and the Wang-double-factor model (Chen et al., 2013). The results show that the price of the catastrophe bond is increasing with the increase of the value for triggering points. The results provide guidance for the pricing of extreme flood catastrophe bonds.

There is an urgent need to redistribute the flood disaster risk in the social system. Here the importance of the securitization of the catastrophe risks that protects the capital and the insurance market could be realized as the risk can be transferred to the capital market via the catastrophe bonds, which are considered an effective method of distributing risks. Pricing catastrophe bonds is considered the most important technical process for the issuance of these bonds. Nevertheless, scientific researches related to the designing and issuing of the destructive flood catastrophe bonds are limited. Risks with large maximum probable losses also stress the capacity of traditional insurance and reinsurance markets. For such risks, securitization may be the most efficient solution. As the costs resulting from covariability, skewness, and high-potential losses increase, securitization begins to substitute for reinsurance but, for the very highest level of risk, reinsurance may be uneconomic and hence reinsurance and securitization are complementary [Cummins and Trainar, 2009].

Cummins and Weiss (2009) provided a survey and overview of the hybrid and pure financial market instruments and provide new information on the pricing and returns on contracts such as industry loss warranties and Cat bonds. Bouriaux and Tomas (2014) analyzed the reasons for failure of exchange-traded insurance-linked derivatives like catastrophe insurance futures and options to attract interest from financial market participants. They also showed that, when analyzing large storm estimates, a long development period may not be crucial to the success of exchange-traded derivatives.

Since growth in coastal populations has led to a dramatic increase in the consequences of natural disastersdue to extreme floods and also since there is a paucity of studies on estimates of natural disaster losses, this paper proposes models for the number of floods and the maximum losses. This paper contributes to the risk of extreme floods pricing; and it also helps the governments of the countries in calculating the financial reserves to cover the extreme flood losses.

METHODOLOGY

Extreme flooding has a low recurrence rate but huge economic losses that may overwhelm individuals and nations.

Empirically, the distribution of damage amount from disasters, as a rule, is governed by laws of the heavy tail of the distribution (Rodkin and Pisarenko, 2008).

Ismail (2016) has been used the complementary risk method to determine a mixed probability distribution to express the number of accidents and the maximum realized losses (Ismail, 2016). The

Table 1. Comparison between overall losses and insured losses of flood loss events worldwide 1980-2015.

Date	Event	Overall losses ın US$ m	Insured losses ın US$ m
8-15.11.2011	Floods, landslides	43,000	16,000
12-22.8.2002	Floods, flash floods	16,500	3,400
25-30.6.2007	Floods, severe storms	4,000	3,000
30.5-19.6.2013	Floods	12,500	3,000
20-23.7.2007	Floods	4,000	3,000
10-14.1.2011	Floods, flash floods	3,200	1,900
20-28.8.2005	Floods	3,300	1,800
19-24.6.2013	Floods, severe storms	5,700	1,600
October-November 2000	Floods	2,000	1,500
27.6-15.8.1993	Floods	21,000	1,300

Source: Munich Re, NatCatSERVICE (2016).

Table 2. Descriptive statistics of floods maximum losses ($ Billion).

Minimum	1st Qu.	Median	Mean	3rd Qu.	Maximum	Percentiles	
						90%	95%
0.00023	0.3875	1.4650	4.9704	8.0456	40.317	15.61	18.654

zero-truncated Poisson distribution represents frequency and Last order Weibull distribution, the losses (Maximum Risk). Louzada, Francisco et al. (2012) proposed a new three-parameter long-term lifetime distribution, induced by a latent complementary risk framework with decreasing, increasing and unimodal hazard function, and the long-term complementary exponential geometric distribution [Louzada et al., 2012].

Data description

International Disaster Database (EM-DAT) provides data on the number as well as the total damages due to floods for the period 1900 to 2016. The maximum loss within the research sample was selected from the flood losses recorded in each year. Table 2 shows the descriptive statistics of maximum losses resulting from floods. It can be observed that highest losses were about $ 40.317 billion.

Frequency distribution

Conceição et al. (2014) envisaged modified truncated zero poison distribution for determining the probability of occurance of a flood. The probability distribution is given by:

$$P(N) = \frac{e^{-\lambda}\lambda^N}{N!} \ , \ \ N = 0,1,\dots \text{ and } \lambda > 0 \tag{1}$$

Where, N is discrete random variable represents the number of floods and λ is avarege number of floods.
   The probability of occurance of at least a flood is given by:

$$\sum_{N=1}^{\infty} P(N) = 1 - P(0) = 1 - e^{-\lambda} \tag{2}$$

$$\frac{\sum_{N=1}^{\infty} P(N)}{1-e^{-\lambda}} = 1 \tag{3}$$

Thus, the truncated Poisson probability distribution is given by:

$$P(z) = \frac{e^{-\lambda}\lambda^z}{z!(1-e^{-\lambda})} \ , \ \ z = 1,2,\dots,\infty \tag{4}$$

This probability distribution is used for predicting occurrence of at least one flood.

Losses distribution

Considering the random variable y expressing the maximum losses due to floods. Nadarajah et al., 2013 and Ismail 2016 have established that it follows the last order Weibull (Maximum Risk) distribution and has a probability density function given by:

$$f(y) = \alpha \left(\frac{1}{\theta}\right)^{\alpha} y^{\alpha-1} \tag{5}$$

Where, θ is the scale parameter and α is the shape parameter. Let:
$$Y = \max(y_1, y_2, \dots., y_n)$$

In general, the last distribution for any continuous variable is given by:

$$f_1(y/z) = z\, f(y)[F(y)]^{z-1} \tag{6}$$

Where, f(y) is the probability density function and F(y) is the cumulative density function.
The joint distribution between y and z are obtained by multiplying (4) and (6) as follows:

$$f_2(y,z) = P(z)f_1(y/z) \tag{7}$$

Table 3. Probabilities of extreme flood losses Classes.

Classes of maximum losses		Probability
Less than minimum		0.00291
Less than 1st Qu.		0.16595
Less than Median		0.38159
Less than mean		0.70028
Less than 3rd Qu.		0.81844
Less than Percentiles	90%	0.93175
	95%	0.95099
Less than maximum		0.99225

$$f_2(y,z) = \frac{e^{-\lambda}\lambda^z}{z!(1-e^{-\lambda})} \times z\, f(y)[F(y)]^{z-1} \tag{8}$$

$$f_2(y,z) = \frac{\lambda e^{-\lambda} f(y)[\lambda F(y)]^{z-1}}{(z-1)!(1-e^{-\lambda})} \tag{9}$$

The Marginal distribution for Y is given by:

$$g(y) = \frac{\lambda e^{-\lambda} f(y)}{(1-e^{-\lambda})} \times \sum_{z=1}^{\infty} \frac{[\lambda F(y)]^{z-1}}{(z-1)!} \tag{10}$$

Where,

$$\sum_{z=1}^{\infty} \frac{[\lambda F(y)]^{z-1}}{(z-1)!} = e^{\lambda F(y)} \tag{11}$$

$$g(y) = \frac{\lambda e^{-\lambda} f(y) e^{\lambda F(y)}}{(1-e^{-\lambda})}, y > 0 \tag{12}$$

Where,

$$f(y) = \alpha \left(\frac{1}{\theta}\right)^\alpha y^{\alpha-1} e^{-\left(\frac{y}{\theta}\right)^\alpha} \tag{13}$$

$$F(y) = 1 - e^{-\left(\frac{y}{\theta}\right)^\alpha} \tag{14}$$

Thus, the PDF of a compound truncated Poisson Weibull distribution is given by:

$$g(y) = \frac{\lambda \alpha \left(\frac{1}{\theta}\right)^\alpha y^{\alpha-1} e^{-\left(\frac{y}{\theta}\right)^\alpha} e^{-\lambda\left(\frac{y}{\theta}\right)^\alpha}}{(1-e^{-\lambda})} \tag{15}$$

Where, θ is the scale parameter and λ, α are the shape parameters. In general, the CDF is defined as follows:

$$G(y) = \frac{e^{-\lambda[1-F(y)]} - e^{-\lambda}}{(1-e^{-\lambda})} \tag{16}$$

Where,

$$1 - F(y) = e^{-\left(\frac{y}{\theta}\right)^\alpha} \tag{17}$$

$$G(y) = \frac{e^{-\lambda e^{-\left(\frac{y}{\theta}\right)^\alpha}} - e^{-\lambda}}{(1-e^{-\lambda})} \tag{18}$$

Where, $G(0) = 0$ and $G(\infty) = 1$

$$E(y) = \int_0^\infty y \cdot g(y) \cdot d_y \tag{19}$$

$$Var(y) = \int_0^\infty [y - E(y)]^2 \cdot g(y) \cdot d_y \tag{20}$$

RESULTS AND DISCUSSION

Estimation of parameters

The maximum likelihood estimators of the parameters are $\hat{\lambda} = 2.93275$, $\hat{\alpha} = 0.4841$ and θ is the scale parameter equal 1000000000 and λ, α are the shape parameters.

Goodness of fit

Kolmogorov-Smirnov test was used to test the following hypothesis:

H0: Maximum of maximum losses of flood fit with Compound Truncated Poisson-Weibull Distribution.

The results of the test are presented in the Appendix (Ismail, 2016). It can be observed that the value of the test statistic is 0.161, Critical Value is 1.311619 and P-Value is 0.064; which results in non-rejection of the null hypothesis at 5% level.

Application of model

Using Equation 18, the probabilities of extreme flooding losses as well as the quantum of expected extreme flooding losses for a given cumulative probability can be calculated. Table 3 shows the probabilities for extreme flood losses for various classes of maximum losses. It can be observed that the probability that the extreme flood losses are less than median losses (less than $1.4650 billion) is 0.38159, and the probability that the extreme flood losses are less than actual maximum losses (less than $ 40.317 billion) is 0.99225. Further, it is observed that the probability of maximum probable annual losses of flooding, equalling $188.852 billion, is 0.99999.

Using Equation 19, the expected value that exceeds some descriptive measures or any other values of extreme flooding losses can be calculated. Table 4 illustrates the expected losses for extreme flood losses with a maximum actual loss of $ 40.317 billion and with a maximum probable loss of $ 188.852 billion, which is less than specific descriptive measure. For example, the expected extreme flood losses more than median loss (more than $1.4650 billion) is $ 4.317 million under actual maximum losses and $ 4.755 million under probable maximum losses. In addition, Table 4 shows the expected losses more than maximum actual losses equal $ 0.376 billion under maximum probable losses.

Descriptive statistics showed that the maximum actual loss of extreme flooding losses was $ 40.317 billion and using the proposed model, it was found that the probability of extreme flooding losses less than this value was 0.99225. Conversely, it was found that the maximum probable loss of extreme flooding losses, which corresponds to a cumulative probability of 0.99999, was $ 188.852 billion. The maximum probable loss of extreme

Table 4. Expected maximum losses of flooding ($Billion).

Classes of maximum losses		with maximum actual loss of 40.317	with maximum probable loss of 188.852
More than minimum		4.531	4.968
More than 1st Qu.		4.506	4.944
More than median		4.317	4.755
More than mean		3.388	3.826
More than 3rd Qu.		2.640	3.077
More than percentiles	90%	1.388	1.825
	95%	1.060	1.498
More than maximum		0	0.376

flooding losses are greater than actual because they correspond to a higher cumulative probability. Table 4 shows the expected values of maximum flood losses with a maximum actual loss of $ 40.317 billion, and one more time considering the maximum probable loss $ 188.852 billion. The differences between expected values actual vs probable losses are the gaps between the non-covered losses.

On the practical level, the actual contribution of this paper is estimating the maximum probable loss of extreme flooding losses and comparing them to the actual losses and then determining the losses that are not covered. Which governments must cover by creating financial reserves or financing them to the capital market. On the scientific knowledge, the actual contribution of this paper is to propose a statistical model is mixed probability distribution to express the number of floods and the maximum realized losses. The zero-truncated Poisson distribution represents frequency and Last order Weibull distribution and goodness of fit was condcuted.

Conclusion

The proposed model is based on a complementary risk for estimating the maximum probable loss of extreme flooding losses, where zero-truncated Poisson distribution represents the frequency and Last order Weibull distribution for losses. Using the model, the maximum probable losses as a result of the occurrence of the extreme flooding was estimated and the results indicate that the maximum probable losses are greater than the maximum actual losses. Applying the proposed model, the gap between the non-covered losses of the economy and insurance losses can be estimated and also determine the amount of loss that will be covered by the capital market. This paper contributes to the risk of extreme floods pricing and helps the governments of the countries in calculating the financial reserves to cover the extreme flood losses.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Appendix. Goodness of fit with Compound Truncated Poisson-Weibull Distribution Kolmogorov-Smirnov test

$i := 0..n - 1$

$Y1 := sort(Y)$

$$pv(x) := 2 \cdot \sum_{k = 1}^{100000} (-1)^{k-1} \cdot e^{- 2 \cdot k^2 \cdot x^2}$$

$$Z_i := \frac{i + 1}{n}$$

$$F(i) := \frac{e^{-\lambda 1 \cdot \left(1 - pweibull\left(Y1_i, \alpha 1\right)\right)} - e^{-\lambda 1}}{1 - e^{-\lambda 1}}$$

$F(i)=$

0.0029	0.1555	0.3083	0.6145	0.9366
0.0244	0.1694	0.3526	0.6346	0.9389
0.0277	0.1694	0.3715	0.7569	0.9484
0.0285	0.1795	0.3914	0.7979	0.9523
0.0363	0.1903	0.4004	0.8184	0.9851
0.0476	0.1953	0.416	0.8186	0.9923
0.0626	0.1966	0.4558	0.829	
0.0715	0.2027	0.4558	0.8478	
0.0715	0.2146	0.4726	0.8488	
0.1023	0.2335	0.4915	0.8629	
0.109	0.2452	0.5064	0.8892	
0.1092	0.2529	0.5415	0.8985	
0.1159	0.2675	0.5428	0.9266	
0.141	0.2836	0.5961	0.9268	
0.1547	0.2981	0.6024	0.9295	

$d_i := \left| Z_i - F(i) \right|$

$D := max(d)$

$D = 0.161$

$K := D \cdot \sqrt{n}$

$K = 1.311619$

$PV(K) = 0.064$

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