

Original Research Paper

A Proposed Mining Based Business Continuity Information System for Educational Institutes

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Abstract: It has become an essential element for all organizations to be engaged in a more deliberate transform for prevention, protection, preparedness, mitigation and reaction to Business Continuity Management (BCM) and recovery. It is becoming risky for the organization to reply of disaster plan which targets to minimize the causes of the disruption. An organization should take a proactive approach to reduce the likelihood as well as the probability of the disruptions. It involves the development of advanced measures and actions that enable the organization to take action in such a way that the critical and essential functions of business could continue according to the predefined level of change and disruption. Recovering from disruptions is a challenge; it relies on an emergency response plan or uses disaster management strategies that were previously used. BCM is considered mandatory to provide a systematic approach towards crisis response in order to increase organizational resilience capability. It is necessarily required by the organization to protect its reputation, brand, value adding activities and stakeholders' interests. This paper proposes an intelligent framework that applies the business continuity management process on an educational institute which reveals the stakeholder awareness of the business continuity level in their organization. In order to successfully formulate the proposed framework, the research went through a set of phases. The research presented the whole process phases for developing the proposed framework which is based on applying the suitable technique in each phase to guarantee a suitable performance with ensuring the results' validity. The research used 93% confidence, $Z = 1.98$ with error margin $E = 0.03$ for sampling selection and the determined association were 94% confidence for 93 rules. Finally, the research discussed the recommendations for successful crisis management process with the support of intelligent techniques.

Keywords: Information Systems, Association Rules, Business Continuity, Knowledge Discovery

Introduction

Today the globalized nature of the business world (Khedr and Borgman, 2007), the fast change in technology and the exponential growth of threats faced by the organization are continuously growing

for the organization which actually operates in a highly uncertain environment (Khedr *et al.*, 2015c). The insecurity can result in adverse damages to their integrity, reputation, viability and financial stability (Caddick and Armstrong, 2008). The organization which is likely to survive must be risk based oriented.

Different fields are targeting the enhancement of the business process in different perspectives, some of these perspectives are: (Hassan and Idrees, 2010; Idrees, 2015; Idrees and Ibrahim, 2018; Sultan *et al.*, 2017; Sayed *et al.*, 2019; Idrees and Taie, 2016). Business Continuity Management (BCM) targets the business' continuous improvement and resilience (Hegazy *et al.*, 2015) (Nazier *et al.*, 2013). BCM is about devising plans and strategies that will enable the organization to continue the business operations and help it to recover disruption. It gives a solid framework to deal with crisis and provides stability and security. Most of enterprises are working on the IT disaster recovery plan through documents analysis which was the focus of different research (Hassan *et al.*, 2014), however, they usually ignore the business process that should include the identification of the threaten risks with the cooperation with all employees as well as all interested parties. This evolution of BCM is best characterized by a series of mind-sets outlined in Fig. 1 (Elliott *et al.*, 2010).

The presented evolution shows that organizations actually have paid attention to the impact of BCM concept with the focus on different stakeholders (Mostafa *et al.*, 2017; Khedr *et al.*, 2015d; Khedr and El Seddawy, 2015). However, it is a vital focus that IT has a great positive impact on the survival of the business process, therefore, adopting data mining techniques for the success of BCM is the focus of this paper. The remaining of the paper presents the main framework for BCM and reveals the awareness of the organizations about the importance of BCM concept and the percentage of applying its phases.

The remaining of the research discusses the business continuity framework in section 2, the impact of IT to the business continuity in section 3 and the previous work in section 4, exploring the proposed framework, the main contribution and the findings for applying mining process to business continuity with findings and recommendations are discussed in the following sections starting from section 5 to section 8 and finally the conclusion summarizing the overall research contribution is in section 9.

Business Continuity Framework

Different researches have focused on Business process (Khedr *et al.*, 2015a; 2017b; Taie and Idrees, 2015; Azhary *et al.*, 2002; Hazman and Idrees, 2015). BCM framework has been presented in different perspectives (Elliott *et al.*, 2010; ISO 22301:2012, 2012). However, these perspectives finally lead to the same paradigm with different representations to the required process steps and details. This research adopts the BCM process presented in (Torabi *et al.*, 2014) which defines BSM process in four stages. The adopted process follows the BCM life cycle to seven stages as shown in Fig. 2.

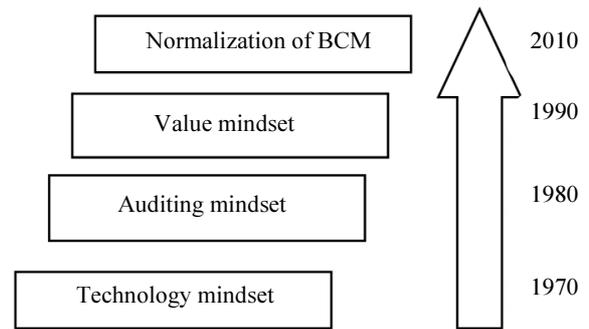


Fig. 1: The Evolution of BCM; Concept and drivers (Elliott *et al.*, 2010)



Fig. 2: BCM Life Cycle

In Program management phase, the organization articulates objectives, sets both the internal and external context for the interested parties which the BCMs strategically working to gain the satisfaction of them and sets the polices of the organization as formally determined by the management team. **Risk assessment phase**, includes a set of steps such as risk identification, analysis and evaluation (Douglas, 1999). The ultimate objective of the risk assessment phase is to provide management with necessary information to further evaluate; or analyze; each identified threat (Patt and Goyal, 2004). Risk assessment must be conducted within the first phases of the implementation cycle to systematically assess the potential impacts of all unexpected events to the organization (Smith, 1995). While assessing risks, it is important to consider all critical elements affecting an organization. Such factors as determining critical information systems, establishing recovery priorities and identifying target recovery times for each application need to be taken into account (Hawkins, 2000; Savage, 2002).

Moreover, In **Business Impact Analysis (BIA) phase**, the Business Impact Analysis (BIA) is defined as the quantitative and qualitative analysis of the current organization situation regarding the crisis effect on the business continuity (Hiles, 2010). It is the most key factor product of the BC lifecycle. The BIA should be property assessed and prioritized (Hiles, 2010). The recovery strategy is a critical stage in the BCM cycle, which will be a chance to be dependent upon those comes about of the BIA. The strategy will help in identifying game plans; which will consequently empower EI; and identify the priorities inside their recovery targets. This strategy ought to secure priority activities and mitigate, respond to impact. **Testing and Exercising** is a key presumptions are the (E&T) that will enhance the probability of succeeding incident management. Furthermore, the BCP oblige incessant testing (Golden and Oblinger, 2007) therefore, a BCP that is not frequently tested and updated is in danger of becoming obsolete. Although the testing is not the ending journey on the BCP, but it's a chain between planning and operation of BCMs. The testing might make possibly a worst-case occurrence alternately an occurrence

well on the way should happen. In US universities (Pirani and Yanosky, 2007), found that 35% conducting tests on the IT business continuity and some them perform the test less than once per year. Finally, **Maintenance** is a regular step to ensure the BCP is up-to-date. This step will need periodic review and will be through many approaches and methods, for example, internal audits and regular management review meetings. Subsequently, organizational performance can be considered as an impression of the efficiency of the individuals from the association or a framework (Herbane *et al.*, 2004).

BCM and IT

It has become an essential element for all organizations to be engaged in a more deliberate transform for prevention (Idrees *et al.*, 2018a), protection, preparedness (Khedr *et al.*, 2017a; Khedr and Idrees, 2017a), mitigation (Khedr and Idrees, 2017b; Khedr *et al.*, 2015b) and reaction to BCM and recovery. An organization should take a proactive approach to reduce the likelihood as well as the probability of the disruptions.

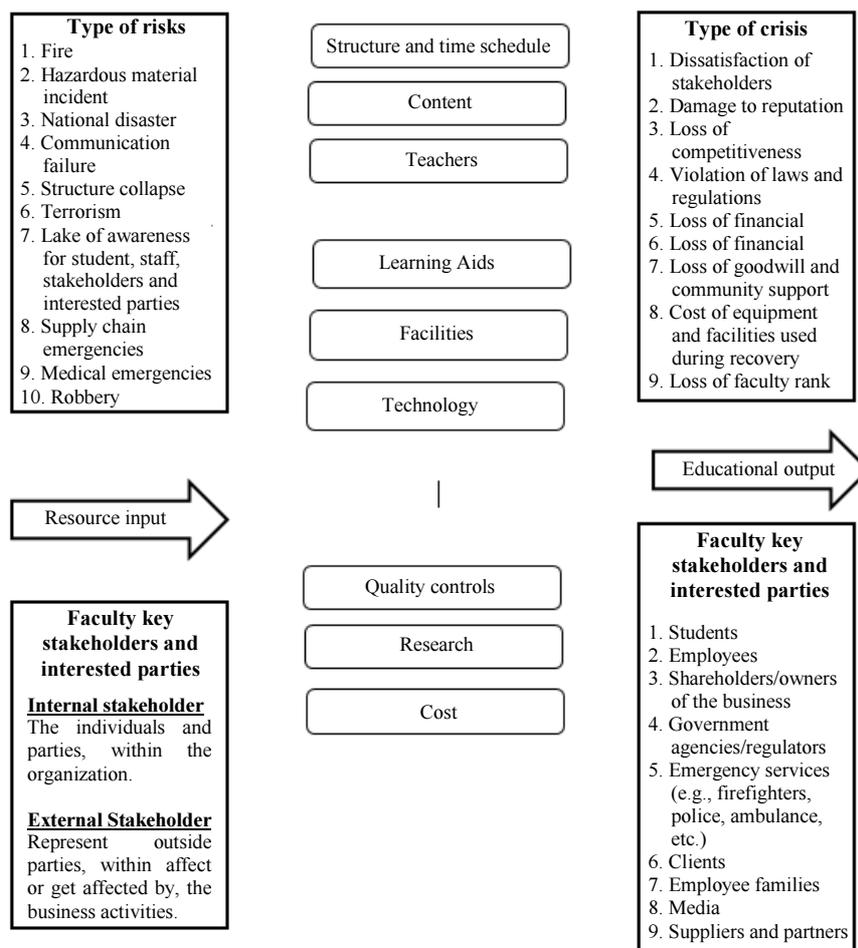


Fig. 3: Education Program Component (EPC)

The National Authority for Quality Assurance and Accreditation of Education “NAQAEE” stand out amongst the principle pillars of the national plan for education change over Egypt, which is answerable for spreading the culture of quality in the Educational Institutes (EI) to instructive establishments of national standard comply with international standard.

Figure 3 for Education Program Component (EPC) stated by the researcher help to find out the types of risks and crisis that Educational Institutes (EI) could expose.

ISO 22301:2102 the world’s first international standard for BCM, has been developed to help organizations minimizing the risk of disruptions. It’s brought together all existing standards and collection of good practices to develop a universal approach to BCM (Wong and Shi, 2015). Also, its guideline ISO 22313, was launched for providing further explanation of the ISO 22301:2102 clauses and their intent. It emphasis establishing a fit-for purpose BCMS that is able to provide an effective response to disruptions and minimizes undesired impacts on the organization. It’s requires management, leadership and adequate resource support in order to manage the BCMS. The BCMS provides the requirements for setting and managing an effective BC capability. It provides guidance to enable an organization to optimize service availability in order to fulfill its objectives and obligations.

Previous Work of BCM and IT

IT in general and Data mining in specific have a high impact in the focus of business continuity. A study by Greer (2003) compared between the contingency planning processes for the higher education community and other organizations (Helmy *et al.*, 2019). The study shows that there is no proper and efficient response neither reflects the higher education contingency planning processes or the policies after the event of September 11. However, some organization updated their IT plan but they did it as the normal routine business of updating the contingency planning processes not specifically after the crisis.

Another study by Wessels (2007) performed an empirical study and mentioned the evolution of the business of BCM. The study highlighted that it was still the BCM focused on IT infrastructure and the impact of IT on the BCM is the IT department. The study revealed that forcing a culture change in organizations has become mandatory, as the role of BC management have become more strategic oriented to ensure a competitive advantage.

Moreover, Valdez and Cecilia (2015) proposed a framework to blend the BC principles with identifying the main components which encourage the best practices in associations. Analysts can look to acquire lessons gained from associations for the BCP usage, suggestions for additionally inquiries about incorporating the

examination on how the impression of hierarchical performing artists adds to improve the association BC and versatility abilities. Another study by Maboudian and Rezaie (2017) proposed a research for business continuity which is applied in the petrochemical field in Iran. The research applied data mining for analysis and extracting the trends in these data and furthermore, highlighted the importance of the risk management phase with the required related stakeholders and regularities. Finally Khasanah *et al.* (2018) applied clustering and associations to identify the business strategies in laundry industry, it aimed to for determine the required catalogue information in the laundry industry which identified the targeted customer segments and the services preferences.

Exploring Business Continuity Activities Relations

Mining techniques have proved a satisfying effectiveness in different fields by the researchers such as in (Khedr *et al.*, 2016), (Hassan *et al.*, 2015) and (Khedr *et al.*, 2014). Moreover, in the educational field such as in (Idrees and Ibrahim, 2018), there are many benefits of using data mining techniques in the integrated information system. One direction is to predict the student performance, another direction is to find the relations between the learning styles and the students’ preferences and other more directions. This research targets ensuring the business continuity in the most suitable situations in general and in educational institutes in specific. Figure 4 proposes the main stages for exploring the required activities and its associated stages. Moreover, exploring the dependencies among activities is targeted for revealing the whole BCM process view.

Data Preparation

Collecting the required data is performed through building the survey and determining the responds of different stakeholders in the institutions. Surveys are distributed to the stakeholders and results are transferred to determine the required analysis. Moreover, main institution data is determined including the facilities, capabilities, stakeholders’ distribution, building maps and others.

Preparing BCM Questionnaires

This section targets discussing the Business Continuity Status Questionnaire (BCSSQ) that is provided to the stakeholders for determining the current situation. The results are analyzed using Statistical Package for Social Science (SPSS) tool (AUC, 2011). Then, a reliability testing is applied and the Cronbach's Alpha "CA" is measured to verify the BCSSQ answers’ consistency. The following sub-sections discuss the details in the data gathering step.

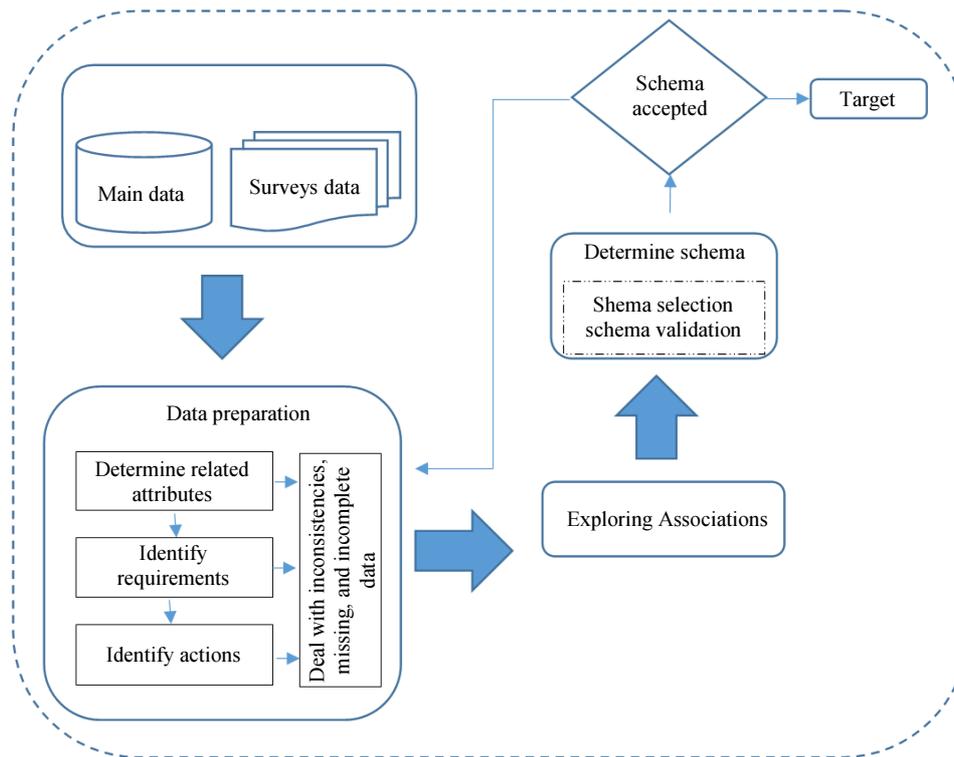


Fig. 4: Framework for exploring business continuity activities relations

Construction of (BCSSQ) Model

The researcher proposed an internal audit checklist for all clauses of the standard and what supposed to exist to ensure the efficiency of the standard. The BCSSQ model was constructed based on successful studies previously constructed in the related field of study (Hassan and Idrees, 2010; Idrees and Ibrahim, 2018). There are three independent variables: Qualifications, Years of work, Job title, each had its own values. While there are three dependent variables: Crisis Causes, Risks Types, BCM barriers.

Selecting the Suitable Sample

Determining the representative sample is currently considered a vital phase which results in highest reliable results. A research provided by (Hassan and Idrees, 2010) presented a set of sampling techniques with comparative criteria representing the current institute description. According to the criteria presented in (Hassan and Idrees, 2010), the research selected to apply the stratified sampling technique (Tipton, 2013). This selection was based on the nature of the selected technique to adopt with the continuous change in the population in addition to its suitability with the predictive (Idrees and Ibrahim, 2015; Castillo, 2004).

In this research focuses on the BCM in the faculty of Tourism and Hotels in Fayoum university. The population is the targeted institution equals 768 samples

while the representative sample is demonstrated in Table 1. The research used 93% confidence, $Z = 1.98$ with error margin $E = 0.03$. Table 2 shows the number of faculty members and administrators in the Faculty of Tourism and Hotels (currently working), Fayoum University. A comprehensive tool was used for all the sample selected, the researchers perform at regular visits for the faculty that performs lots of meeting and interviews with persons, below tables shows the sample and the valid questionnaires and the disregarded one.

Reliability of BCSSQ Model

The model was examined using Cronbach's Alpha "CA" which measures the reliability. The higher CA determines a higher reliability (Mostafa *et al.*, 2017). Moreover, the model is accepted if CA is determined to be over 0.7. Table 1 illustrates the CA coefficients for the independent variables that have values over the acceptable threshold "Qualifications, Years of work, Job title", therefore, it reveals the model acceptance.

The Questionnaire Results and Analysis

In this section, the research introduces the statistics of a set of questions included in the surveys. Tables 2A and Table 2B provide a sample of the included questions and responds considering each BCM stage respectively where the responds range from 1 to 5 as 1 means strongly dis-agree while 5 means strongly-agree.

Table 1: Cronbach's Alpha (CA) for independent variables

Independent variables	N of items	Cronbach's Alpha (CA)
Qualifications	8	0.82
Years of work	4	0.913
Job title	6	0.894

Table 2A: Statistics of the Respondent towards BCM Stages

Items	1	2	3	4	5	Mean	Std. Dev.
Stage One "Project Initiation"							
1 Is business continuity plan includes all the activities of the educational faculty	26.5	44.6	19.6	9.3	--	2.12	0.91
2 Studying the internal and external factors affecting the educational faculty are studied	15.2	57.4	16.7	10.8	--	2.23	0.84
3 Identifying the needs of external entities with a relationship with the educational faculty	20.1	52.9	11.3	11.3	4.4	2.27	1.05
4 The top management support the planning for business continuity	10.3	35.3	29.9	19.6	4.9	2.74	1.05
5 The top management provides the necessary financial requirements for the plan	11.3	24.5	47.1	12.7	4.4	2.75	0.97
6 The top management provided the necessary human resources needed for the plan	2.0	21.1	34.3	42.2	0.5	3.18	0.84
7 Training teams are formed	22.5	35.3	36.3	4.9	1.0	2.26	0.89
8 The tasks and authorities of the teams are determined	22.1	34.8	34.8	7.8	0.5	2.30	0.92
Mean	2.48						
Stage Two "Risk Identification"							
1 The exact definition of the services and activities provided by the educational faculty	7.4	68.6	16.2	7.8		2.25	0.70
Identify the potential risk of each activity within the educational faculty	20.6	55.4	13.7	9.8	0.5	2.14	0.87
Risk is classified by degree of impact on the activities of the educational faculty	20.1	38.2	31.4	7.8	2.5	2.34	0.97
Prioritize risk management in the educational faculty	21.1	22.5	45.1	8.8	2.5	2.49	1.00
The stakeholders were consulted during the identification of risks	8.8	42.2	25.5	18.1	5.4	2.69	1.00
External or consulting entities are consulted during the identification of risks	7.8	31.9	45.1	14.7	0.5	2.68	0.84
Risks are evaluated and their likely to occur	9.3	47.5	38.2	3.4	1.5	2.40	0.77
Mean	2.43						
Stage Three "BIA"							
The maximum period of time to stop work during the crisis is studied	5.4	56.4	26.5	8.8	2.9	2.48	0.85
Alternatives are examined for the continuity of business of the educational faculty during the crisis	11.3	21.1	47.1	19.6	1.0	2.78	0.92
The educational faculty shares with others in dealing with the crisis	15.7	14.2	52.9	16.7	0.5	2.72	0.94
Mean	2.66						
Stage Four "BCP"							
There is a specific and written scenarios for crisis management and business continuity	18.6	17.6	59.8	2.9	1.0	2.50	0.86
The tasks of all parties dealing with the educational faculty are determined	16.7	9.8	63.7	5.9	3.9	2.71	0.95
Students are assessed for the risks they face and included in the plan	15.7	37.3	27.5	17.6	2.0	2.53	1.02
The selection criteria for the team work responsible for the plan are determined	14.7	37.7	32.4	13.2	2.0	2.50	0.97
The electronic tools used to protect educational institute information are continuously updated	16.7	31.4	39.7	2.0	10.3	2.58	1.11
The educational institute reserves the right to keep an updated copy of each document	16.7	14.2	51.0	6.9	11.3	2.82	1.14
Mean	2.62						

Table 2B: Statistics of the respondent towards BCM stages

Items	1	2	3	4	5	Mean	Std. Dev.
Stage Five "Select Strategy"							
The plan is ultimately adopted by top management	2.5	17.6	49.5	25.5	4.9	3.13	0.84
The plan clearly shows the sequence of activities carried out by the educational Faculty in dealing with crises and business continuity	5.9	20.1	71.1	2.9	---	2.71	0.62
The plan specifies the internal and external tools of communication during crises	7.4	22.1	63.2	6.9	0.5	2.71	0.72
Specify in the plan the detailed tasks of the working team and its authorities	6.4	45.1	45.6	2.9	---	2.45	0.66
The plan specifies specific times to deal with each stage of the plan	5.4	42.6	50.0	2.0	---	2.49	0.63
The plan has a mechanism to identify all individuals within the faculty	5.4	41.2	52.0	1.5	---	2.50	0.62
Mean	2.66						
Stage Six "Exercising and Testing"							
A training plan is drawn up for those dealing with the BCM.	21.7	46.8	23.2	7.9	0.5	2.19	0.88
The stakeholders are aware of the contents of the BCM and its plan.	3.4	66.7	27.0	2.9	---	2.29	0.58
The team responsible for implementing the BCM is trained	6.9	64.7	22.1	6.4	---	2.28	0.68
The effectiveness of training is evaluated	15.7	36.8	39.7	7.4	0.5	2.40	0.86
Mean	2.3						
Stage Seven Testing Maintaining and Auditing"							
The BCM is tested at intervals of plan	11.3	54.4	27.9	5.9	0.5	2.30	0.77
There is a mechanism to follow up financial allocations to implement the BCM	24.5	19.6	52.9	2.9	---	2.34	0.88
The BCM's weaknesses are being worked out	27.0	19.6	50.5	2.9	---	2.29	0.90
Modify the plan with updated data or any modifications	22.1	24.0	50.5	3.4	---	2.35	0.86
Mean	2.3						

Association Rule Mining

This phase targets determining the associations between the process continuity stages and the main activities for these stages (Dahab *et al.*, 2010; Sultan *et al.*, 2017). Association rule mining approach has been targeted previously in the education field with different perspectives such as in (Mostafa *et al.*, 2017). Following the same approach, applying association mining is considered the main phase for building the proposed business continuity framework. The following subsections discuss the detailed steps in this phase.

Determining Correlations

Determining correlations included six variables, they are Qualifications, Years of work, Job title, Crisis Causes, Risks Types, BCM barriers. Therefore, the target of finding associations is to answer a set of questions such as:

- Is there a significant effect of respondents' scientific qualification on determination of the crisis causes in the Faculty?
- Is there a significant effect of respondents' job of the respondent on determination of the crisis causes in the faculty?
- Is there a significant effect of respondents' experience years on determination of the crisis causes determination in the faculty?
- Is there a significant effect of respondents 'scientific qualification on determination of the risks types in the faculty?
- Is there a significant effect of respondents' job on determination of the risks types in the faculty?
- Is there a significant effect of respondents' experience years on determination of the risks types in the faculty?

As a first step in applying data mining, correlations among BCM barriers and the risks types have been measured, Table 3 presents the revealed measures.

Moreover, a regression analysis has been performed to determine the relation between the personal characteristics of the stakeholders and the causes of the crisis as shown in Table 5.

In Table 4 the R-Square value indicates that the personal data of respondents affects 8% of their Qualification, Years of work and Job on the causes of crisis facing the faculty. This percentage is very limited, with 82% of the effects outside the personal data of the respondents not included in the study may be practical work in contact with top management or interested parties and other influences, this should be considered in the future studies.

Another regression analysis has been performed to determine the relation between the personal characteristics of the stakeholders and the types of risks as shown in Table 5.

According to the statistical data in the Table 5, the personal data of the respondents affects 7% on identifying the risks types that the faculty has experienced before, where $R^2 = 0.07$.

The third regression analysis reveals the relation between the BCM and the institute performance to confirm the importance of the study. Table 6 shows the phases of the business continuity plan affect 56% of the efficiency of the business continuity plan implementation. The data in the table that the efficiency of the performance of the Faculty was more affected by BCM Testing and Training ($\beta = 0.79$, $p < 0.01$). The performance efficiency of the Faculty was also affected by the fourth stage Mitigation Strategy Development ($\beta = 0.23$, $p < 0.01$).

Table 3: Correlation between BCM barriers and risks' types

		BCM Barriers				
		Weak financial allocations	The complexity of governmental and legal procedures	Weak human resources qualified to deal with crises	Weak individual culture of the importance of the speed of continuity of work in the Faculty after the crisis	Lack of community participation with the Faculty
Leak tests or control problems	Yes	116	116	116	116	116
	Chi-Square significance	30.88 0.000	23.1 0.000	22.59 0.000	21.1 0.000	26.78 0.000
Fire/electric shock/ water leakage, etc.	Yes	159		159		159
	Chi-Square significance	5.75 0.06		11.41 0.003		9.36 0.009
Breakthrough of information systems and computers in the Faculty	Yes	124	124	124	124	124
	Chi-Square significance	4.02 0.134	8.26 0.16	8.54 0.014	14.05 0.001	12.53 0.002
Sit-ins and strike	Yes	120	120	120	120	120
	Chi-Square significance	12.16 0.002	14.05 0.001	3.71 0.156	4.7 0.096	24.87 0.000
Low student turnout	Yes					169
	Chi-Square significance					9.79 0.007

Table 4: Summary of the regression model of the impact respondents' personal characteristics on determination of the crisis causes in the faculty

Coefficients	Model	Unstandardized coefficients				
		B	Std. Error	Beta	t	Sig.
	(Constant)	1.456	0.073		20.000	0.000
	Qualification	0.103	0.036	0.414	2.859	0.005
	Job title	0.107	0.071	0.216	1.498	0.136
	Years of experience	0.008	0.019	0.035	0.434	0.005
Model Summary	R	0.280 ^a				
	R Square	0.079				
	Adjusted R Square	0.065				
	Std. Error of the Estimate	0.220				

a. Dependent variable: Crisis causes

Table 5: Summary of the Regression of the impact of respondents' personal characteristics on determination of the risks types in the faculty

Coefficients	Model	Unstandardized Coefficients				
		B	Std. Error	Beta	t	Sig.
	(Constant)	1.506	0.073		20.622	0.000
	Qualification	0.056	0.036	0.223	1.535	0.126
	Job title	0.114	0.071	0.230	1.593	0.113
	Years of experience	0.039	0.019	0.167	2.039	0.043
Model Summary	R	0.265 ^a				
	R Square	0.070				
	Adjusted R Square	0.056				
	Std. Error of the Estimate	0.221				

a. Dependent variable: Risks types

Table 6: The regression of the stages of the BCM on the efficiency of the performance of the faculty

Coefficients	Model	Unstandardized coefficients				
		B	Std. Error	Beta	t	Sig.
	(Constant)	1.446	0.181		8.010	0.000
	Project Initiation	0.100	0.098	0.104	1.023	0.307
	Risk assessment	0.328	0.103	-0.319	3.197	0.002
	Business Impact Analysis	.094	0.059	-0.106	1.595	0.112
	Mitigation Strategy Development	00.227	0.058	0.293	3.917	0.000
	Business Continuity Plan Development	0.083	0.087	0.073	0.951	0.343
	BCM Auditing and Maintenance	0.148	0.079	0.171	1.875	0.062
	BCM Testing & Training	0.798	0.081	0.805	9.840	0.000
Model Summary	R	0.746 ^a				
	R Square	0.556				
	Adjusted R Square	0.540				
	Std. Error of the Estimate	0.442				

a. Dependent variable: Effectiveness of the plan/efficiency of the performance of the Faculty

Exploring Associations and Determine Schema

Exploring associations is performed through running Waikato Environment for Knowledge Analysis "WEKA" tool (Aksenova, 2004), selecting the explorer application and loading dataset into "WEKA" tool. Before applying the data mining techniques, "WEKA" tool accepts determined format, therefore, the training data set should be transformed into one of the accepted format. In this step, the dataset transformed into Attribute-Relation File Format (ARFF). The transformation process is performed through the WEKA tool as a preparatory step for the phase "Exploring Associations". ARFF is useful to see the information that provides to WEKA. It consists of three parts, (1) @relation line gives the dataset a name within Weak (Ass_Rule). (2) @attribute

lines declare the attributes in the dataset (Note: The attribute type in the case of the numeric attribute but the values in the attributes description). Each line specifies an attribute's name and the values it may take. (3) @data lines declare the values in the dataset) as following:

- @relation Ass_Rule
- @attribute Risks' Types {EC, Fire, BTI,SS,... }
- @attribute WorkingYears {Less5, 5to10, 11to15, More15}
- @attribute Qualifications {UnderB, Bachelor, Diploma, MSc, PhD}

For example, the distribution of the working years class is:

- Less than 5: (10.8%)
- From 5 to 10: (30.9%)
- From 11 to 15: (31.4%)
- More than 15: (27.0%)

Applying the Apriori Algorithm for association rules discovery which achieves the relationships between Qualifications, Years of work, Job title, Crisis Causes, Risks Types, BCM barriers, Moreover, determining the number of generated rules, therefore, an initial number of generated rules is set to be equal 1000000 rules. This number is the maximum allowed number is determined to avoid losing any information.

Apriori algorithm is applied for exploring association rules via WEKA tool. Moreover, determining the rules number equal 1000000 rules for the dataset which contained 17683 records, Table 7 provide examples of the extracted rules. The following points clarify the results:

1. Dataset generated 27373 rules for all schema, there are 38 schemes generations. Examples of the generated schema is illustrated in Table 8 such as: (Qualifications, WorkingYears) and (JobTitle, WorkingYear)
2. After filtration the rules according to the required schema; $\{BCMBar (...) Qualifications (...) \implies RiskType (...)\}$ which suggests the main barrier and the crises cause to a determined risk. Another schema which was found to be effective is $\{BCMBar (...) WorkYears (...) JobTitle (...) \implies RiskType (...)\}$
3. The results showed that the dataset generated 2337 rules

4. After calculating confidence and selected required schema greater than or equal 80%. This percentage is greater than percentage studies previously in the related field of study. The results showed that there are 93 rules which achieved confidence greater than or equal 80% and 94% confidence average.

Table 8 introduces the results summary of research applying in the faculty of Tourism and Hotels, Fayoum University, Egypt.

Regression Analysis for the Effect of the Automated BCM Implementation on the Efficiency of the Organization Performance?

To what extent that automating BCM will improve the quality performance of educational institutes? To measure this hypothesis, regression analysis was used to measure the impact of seven independent factors that represent the stages of BCM on a single factor that is the efficiency of implementing a business continuity plan as shown in Fig. 5.

Where:

- [1] Project initiation
- [2] Risk assessment
- [3] Business impact analysis
- [4] Mitigation strategy development stage
- [5] Business continuity plan development
- [6] Business continuity management, auditing and maintenance
- [7] Business continuity management testing and training

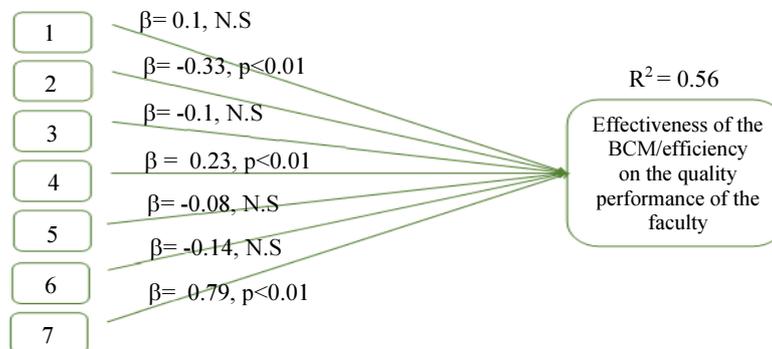


Fig. 5: The Regression of the Stages of the BCM on the Efficiency of the Quality Performance of the Faculty

Table 7: Examples of generated associations

#	Schema	Example
1	BCMBar (...) Qualifications (...) \implies RiskType (...)	BCMBar (WF) Qualifications (UnderB) \implies RiskType (BreakThroughInf) conf: (0.89)
2	BCMBar (...) WorkYears (...) JobTitle (...) \implies RiskType (...)	BCMBar (WQH) WorkYears (Less5) JobTitle (Adm) \implies RiskType (Sit-ins and strike) conf: (0.92)

Table 8: Results summary

Rules Count	1000000 rule
Generation	27373 rule
Required Schema	2337 Rule
Confidence \geq 80%	93 Rule
Conf.AVG	94%

Proposed IT Based Business Continuity Framework

The main aim of the proposed framework is to discover the vital interesting patterns between the main business activities and the BCM actions. These relations further provide the required recommendations for the institution which consequently ensures high performance.

To determine the suitable type of relations, an extensive review of data mining methods has been performed (Idrees *et al.*, 2018b; Mohsen *et al.*, 2016a). So, it is concluded that the most suitable types of relations are either associations or clustering. However, as it is found that the problem of research has high dimensionality, therefore, research targeted

to find the associations between the business activities and BCM tasks with determining the involved stakeholders.

According to the determined associations, the research proposed a BCM framework which included the required activities with the suitable arrangements according to the revealed dependencies. The proposed framework which is illustrated in Fig. 6 is inspired following all clauses that are relevant to BCM in the ISO 22301:2012.

Moreover, The Business Impact Analysis (BIA) defined as “the management level analysis by which an organization assesses the quantitative (Financial) and qualitative (nonfinancial) impacts, effects and loss that might result if the organization were to suffer a Business Continuity Emergency, incidents or crisis”.

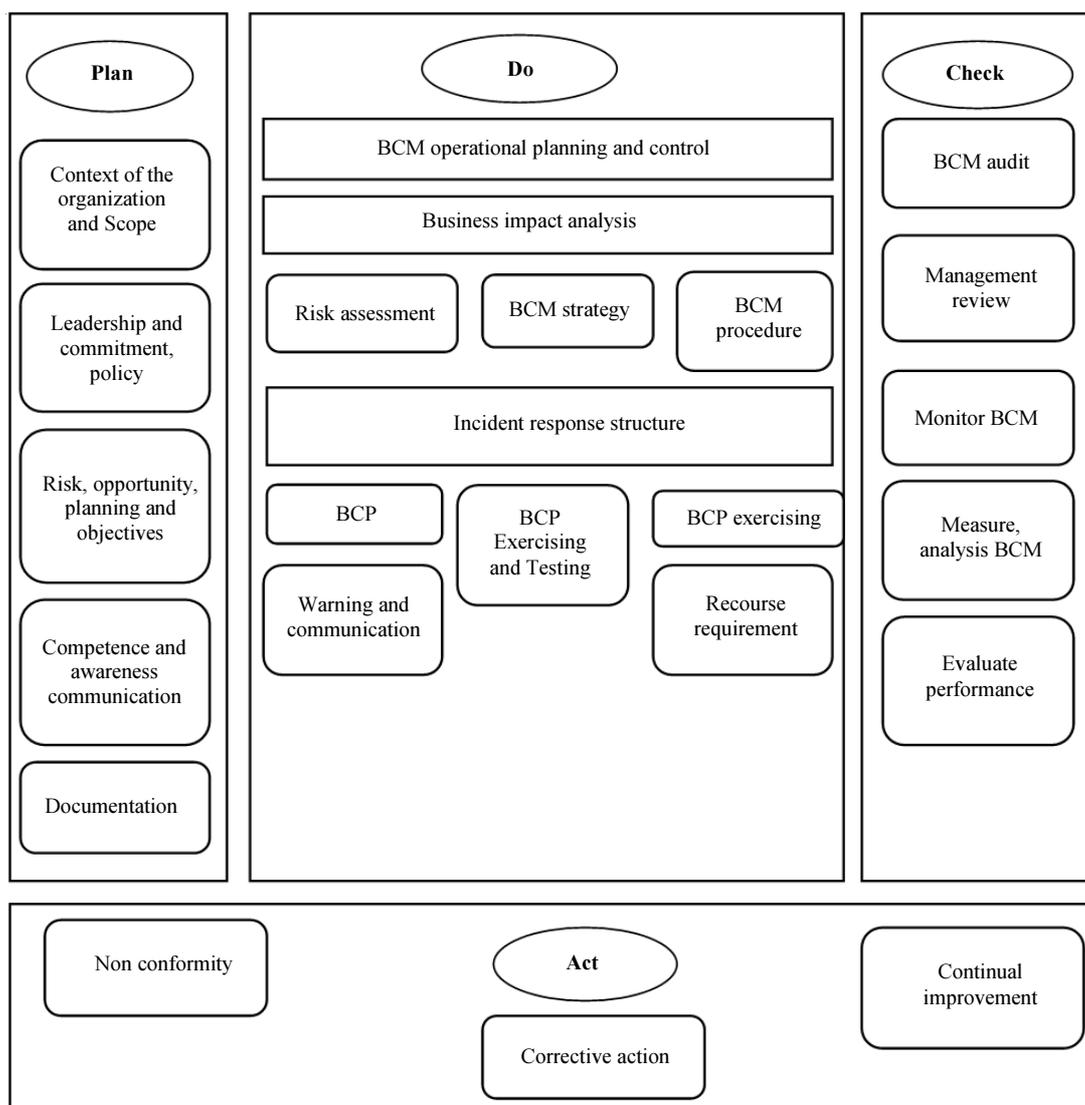


Fig. 6: BCM framework (Source: By the Researcher Adopted from the ISO 22301:2012)

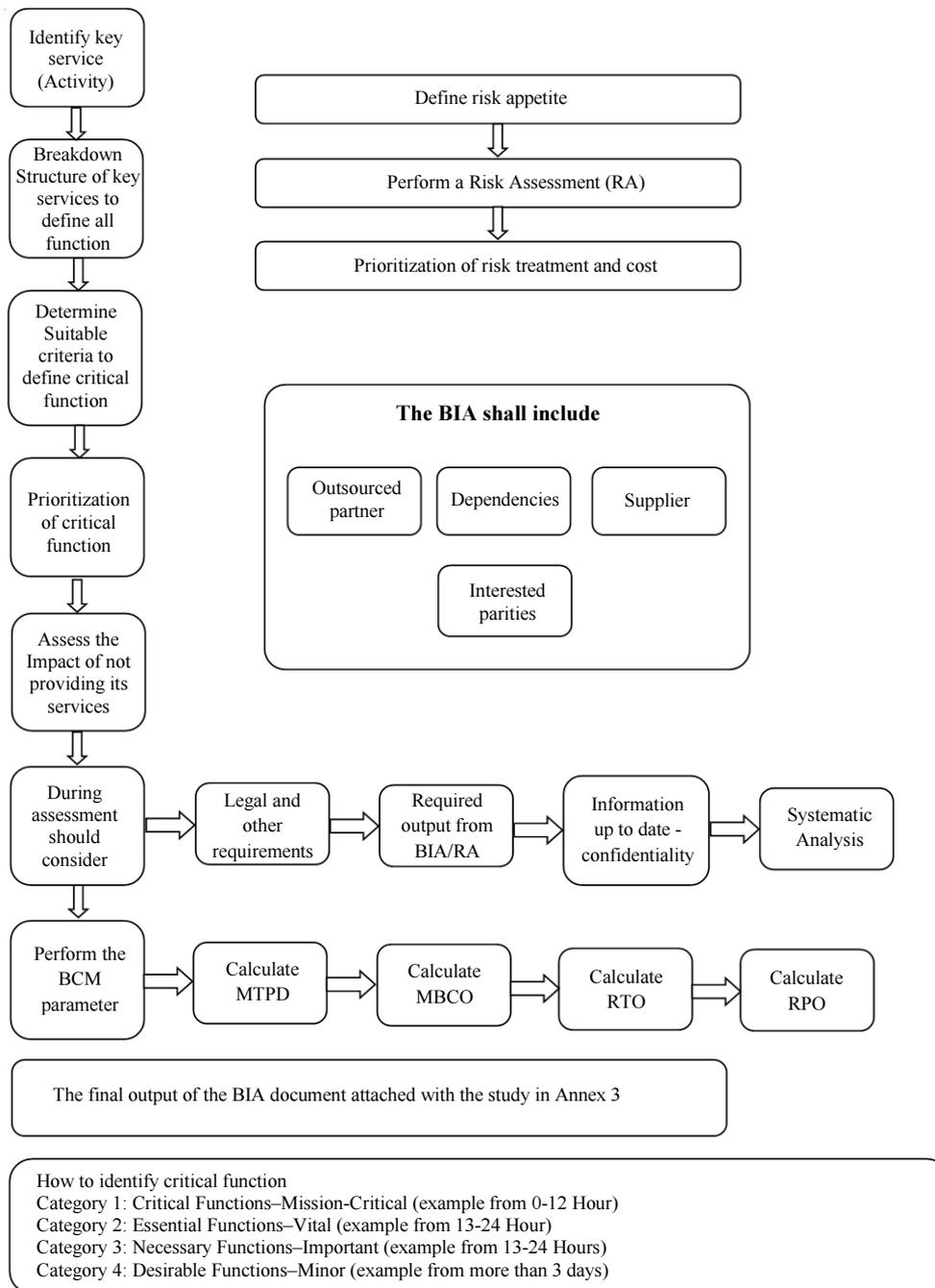


Fig. 7: Proposed business impact analysis framework

BIA is structured to be an input to the BC plan(s). However, the position and role of BIA in this process start with the identification of business functions/process structure. Using strategic planning or business process re-engineering documents to identify such business process. The BIA consists of analytical methodologies that assess the function whose failure would most immediately threaten product and service delivery and have significant

impact on the organization". The researcher concludes the steps of the BIA as illustrated in Fig. 7 and set the BIA forms and questioner, a sample of the questions are needed to implement it in any organization as well as the educational institute the subject of the study such as:

- Is this function dependent on any technology (hardware or software)

- Does this function depend on any outside services or products for its successful completion?

What is the maximum amount of time this business process could be unavailable?

Case Study Analysis

Although the experimental phase in researches can use benchmark resources (Othman *et al.*, 2018; Othman *et al.*, 2016; Mohsen *et al.*, 2016b), however, applying the proposed approach on a real case highly prove the approach effectiveness (Khedr, 2012; 2013). This research study had focused on an existing working institute to confirm its practical applicability. The research been performed in the faculty of Tourism and Hotels, Fayoum University which is one of the governmental universities in Egypt. Fayoum University is ranked as the 2467th according to the “Web metrics Ranking of world Universities is an initiative of the Consejo Superior de Investigaciones Cientificas (CSIC)” in Spain in 2017 Concluding this part the BCM is not mentioned clearly in the international ranking methodology of universities but the researcher found that BCM is part of the quality of education, the national legislation Egypt for Educational institutes NAQAAE.

NAQAAE standout amongst the principle pillars of the national plan for education change over Egypt, which is answerable for spreading the culture of quality in EI to instructive establishments of national standard comply with international standard. This principle will be through restructuring EI and improving the quality of their processing and services delivered.

That will increase the confidence of the society, competitiveness and providing continued quality and development in Egypt.

NAQAAE's billet, developing (NARS) for higher education comes on the top of its priorities. NARS are

intended to set out clearly the graduate attributes and academic characteristics expected to be achieved in the academic programs of different disciplines. According to law number 82 for year 2006, (NAQAAE) a legalization mandatory for all universities and educational institutions. However, this research argues that there are points of gaps that should be further covered in order to reach a satisfying BCM process in the universities.

While analyzing the BCM framework and the NAQAAE requirements, the researchers reached a conclusion that there is no any correlation between them which is one of the focus in this research, however, there are common elements could build the system which are demonstrated in Table 9, Moreover, Table 10 demonstrates the overall BCM awareness in the targeted institution.

According to the analysis of the current situation of the faculty, 53.4% of the faculty sample believe that dealing electronically with the crises will be an effective step while 32.4% are not sure and the remaining prefer the traditional method. Moreover, 96.6% finds that automatic management to the BCM will lead to an effective control to the expected crises. Moreover, Table 11 presents the possible risks percentages in the faculty.

However, the researcher reviewed the mechanisms and tools for preparing the faculty strategic plan (2016-2020) and the self-study of the Faculty (2015/2016). Although, it demonstrated many relationships and community meetings held by the faculty to prepare the faculty strategic plan, but the fact is that the faculty has focused heavily on the needs of the community academically and professionally. However it has to a certain extent overlooked community participation in crisis management/problems related to information protection and human resources discipline in working hours. The majority of the focus of the faculty strategic plan on crises/problems associated with the decrease in the number of students enrolled in the Faculty and demonstrated in Table 12.

Table 9: Common Elements between NAQAAE and ISO 22301:2012

Common elements	NAQAAE	ISO 22301:2012
Context of the organizational	Institutional capacity	Clause 4
Risks and opportunity planning	Institutional capacity	Clause 6.1
Roles and responsibilities	Organization a structure	Clause 5.4

Table 10: Responsibility awareness of NAQAAE accreditation of the faculty

	Percent		Percent
NAQAAE Accreditation Responsibility		Employee number in crisis management department	
Quality department workers	4.4%	Less than 5	56.4%
Faculty members and administrator	4.4%	5-10	2.0%
External parties	0%	5-11	0%
All of the above	91.2%	Don't know	41.7%
Crisis Plan Responsibility		Activity type of crisis management department	
Crisis management department	10.8%	Set the crisis management plan	86.8%
Top management	23.0%	Follow the implementation of the plan	32.8%
Quality department	1.5%	Team responsible for the implementation	10.3%
All of the above	39.2%		
Don't know	25.5%		

Table 11: Statistics of the respondent towards risks types that the faculty could expose

Items	Yes (%)
Risks types that the faculty could expose	
Exams corruption and problems in controls	56.9
Firs/Short Circuit/water leak... etc.	77.9
Breakthrough information systems and computers in the faculty	60.8
Sit-in and Strike	58.8
Shortage in faculty members	20.6
Low turnout of student to faculty	82.8
Crisis reasons that the faculty could expose	
Legislation and laws relating to the application of crisis management systems and tools	36.8
Weak Financial and moral support from the top management to face crisis	22.5
Lack of knowledge in the human resources of the faculty on how to deal with crisis	70.1
Weak cooperation of the faculty with external bodies specialized in dealing with crisis	64.7
Weakness of the electronic management mechanisms and tools at the faculty	60.8
Lack of mechanisms and tools to follow the discipline of employees and faculty staff	63.2
Weakness of the students' follow up tools in the faculty	69.1

Table 12: Respondent about information about crisis management department

Activity type	Percent
Set the crisis management plan	86.8%
Follow the implementation of the plan	32.8%
Team responsible for the implementation	10.3%
Employee number	
Less than 5	56.4%
5 - 10	2.0%
Don't know	41.7%
Deal Electronically	
A complete division	6.9%
Responsible employee	7.4%
None	53.4%
I don't know	32.4%

Table 13: Statistics of the Respondent on the Efficiency of Quality Performance and BCM Implementation Obstacles

Items	1	2	3	4	5	mean	Std. Dev.
Efficiency of Quality Performance							
Dealing with the crises as per the BCP and BC Scenario	7.4	33.3	54.4	4.9	---	2.57	0.70
The organization restart work after crisis as per the target time in the BCP	12.7	28.9	50.0	8.3	---	2.54	0.82
The stopping time during the crises are settled	14.7	36.8	42.6	5.4	0.5	2.40	0.82
Mean	2.51						
BCM Implementation Obstacles							
Weak financial allocations	2.5	9.8	7.8	66.7	13.2	3.78	0.88
The complexity of governmental and legal procedures	4.4	1.0	10.8	70.6	13.2	3.87	0.82
Weak human resources qualified to deal with crises	4.9	1.0	13.7	46.1	34.3	4.04	0.98
Lack of individual culture of the importance of the speed of continuity of work in the faculty after the crisis	3.4	2.0	9.8	40.2	44.6	4.21	0.95
Lack of community participation with the educational faculty	5.4	2.9	14.7	39.7	37.3	4.00	1.06
Mean	3.98						

Table 14: Students' feedback on their information about the Crisis Management Unit in the Faculty

Items	Yes (%)
Did you know that there is a unit to manage crises in Faculty?	86.3
Did your faculty administration raise your awareness of the role of unity in the Faculty?	10.4
Do you know the powers of the crisis management unit?	34.2
Did you know who the department head of crisis management unit is?	65.8
Have they taken your views on the risks that may affect the performance of the Faculty	26.3
Is there a science-based article about crisis management?	32.5
Have you been trained to deal with the risks that affect faculty performance?	19.6
Do you know if the training is internally or externally?	23.8

Reference to the interview with crisis management department manager in the faculty, the employees in the department is 5 employees (department manager, vice of manager, 2 administrator and 1 security employee), rather than the result in the Table 14 shows the conflict in the respondent answers. When asking the head of crisis management unit, he replied that there is no need to know the number of employee but they should know the location of the department, the services provided by the department and the communication channels between them.

Also the results shows in the crisis management department activities type that (86.8%) of the respondent agrees on the responsibility of the crisis department in setting the plans to deal with crisis that the majority of the respondents have a good level of awareness about the role of the department. On the other hand the faculty needs to work with the lack of awareness of (25.5%) from the respondent as they don't know the responsible for the preparation of the business continuity plans:

1. In spite 96.6% from respondent admit that there is no electronically dealing process with the crisis and accordingly a reasonable percentage (53.4 %) replied that there is no unit to deal electronically with the crisis, but there is a critical percentage (32.4%) of respondent replied that they don't know that indicates a lack of communication between the faculty team specially the administrators and the crisis management department
2. According to the interview with the head of Integrated Managements System Unit (IMSU), the most risky percentage is the element of the breakthrough information systems and computers in the faculty which is (60.8%) specially the faculty depends on the information networks in many activities as (student log/exams/results/controls ... etc.) and the faculty assigned a complete IMSU unit for it. On the other side the low percentage of shortage in faculty members (20.6%) from the opinions of respondent and that agree with the self-study of the faculty (2015/2016) and strategic study of the faculty (2016/2020) that shows the superiority of the faculty members number on the students number
3. Reference to the interview with crisis management department manager in the faculty, the employees in the department is 5 employees (department manager, vice of manager, 2 administrator and 1 security employee), rather than the result in the Table 13 shows the conflict in the respondent answers. When asking the head of crisis management unit, he replied that there is no need to know the number of employee but they should know the location of the department, the services provided by the department and the communication channels

between them. Also the results shows in the crisis management department activities type that (86.8%) of the respondent agrees on the responsibility of the crisis department in setting the plans to deal with crisis that the majority of the respondents have a good level of awareness about the role of the department. On the other hand the faculty needs to work with the lack of awareness of (25.5%) from the respondent as they don't know the responsible for the preparation of the business continuity plans

4. On the other side the low percentage of shortage in faculty members (20.6%) from the opinions of respondent and that agree with the self-study of the faculty (2015/2016) and strategic study of the faculty (2016/2020) that shows the superiority of the faculty members number on the students number

Findings Analysis and Design

The study concludes that the crisis management department not playing the role of protecting the faculty from potential distribution. The most critical elements in this study is the percentage of uncertainty of 50% about restarting work after crisis as per the target time in the BCP, even its an evidence that the emergency performance in the crisis management department have no time objectives to control the quality performance during and after the disruptive incidents.

The study concludes that years' experience level of respondent affecting significantly in evaluating the risks types and crisis's that faculty could expose that will lead to different approaches:

1. The criteria for selection of the crisis management team in the faculty need to be enhanced as upon the study and consider the years of experience
2. The training programme will be performed need to consider the years of experience of the team
3. The study concludes a significant effect of the weakness of the culture of individuals in the importance of the speed of continuity of the work of the faculty after the crisis, also a training program and a top management well to embed the culture of being risk-based oriented will lead to efficient detention for the type of risks and the crisis's case and that will be the input for the organization context. Also, the lack of community participation with the faculty significantly impact all types of risks and the study shows that unless the faculty is accredited from NAQAAE but still need to work harder on the interested parties needs and expectations
4. The study concludes that there is no systematic schedule for the element in the emergency preparedness plan of the faculty, for example, the

student is experiencing an evacuation drill and they relied on that they satisfied with the result unless there is no setting time for testing the emergency plan. Although given slightest need it is vital for EI to have inspectors to approve the test outcomes about as it makes the test goal and results more tenable. Additionally, the EI should revise all contractual commitment with the supplier to restructure the legal engagement with them in the case of crisis and how the EI will adjust the supply chain issues. And this replies on the hypotheses number 4 "Is there any correlation between crisis management unit in the educational institute's implementation and the requirements"

Conclusion and Recommendations

Upon the result performed on the Faculty of Tourism and Hotels in Fayoum University accredited form NAQAAE and working on the ISO 9001:2015 and with comparison with the literature review that there is a weak relation between the national legalization in Egypt and the business continuity ISO 22301:2012 requirements. The study was performed by an accredited faculty including practical and theoretical field in in order to get representing results to help further studies to consider other elements did not include in the study.

The study explored the associations between BCM activities and its impact on different risk types. Moreover, a business continuity framework is proposed which is based on determining these associations. The study recommends the EI should perform BCMs to ensure the preparedness of the faculty and proper standing in any potential risks could face the EI.

As a future direction, we can focus on e-continuity to ensure the continuity and sustainability of the system in case of any event. If the educational services are chain of relationship between the faculty and all interested parties so the e-business and the e-continuity as well should be applied to the chain to ensure that they are all associated and merged in the BCMs of the EI.

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Author's Contributions

All Authors contributed in all the stages of the research.

Ethics

The authors have no conflict of interests. There is no ethical issues.

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