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A Visualized Crises Decision Toolbox for Crises Management

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Abstract-

The new dynamics and the impact of the extreme events but also the complexity of interventions have motivated the researchers to find new efficient solutions for decision making process dedicated for crisis management, Decision problems to be solved are often very complicated and require more powerful and often intelligent support tools. Sometimes, it is useful to time pressure, the complexity of event, the volatility/ rapidly changing of event/ decision conditions, the chaotic surrounding environment ingredient, the human behavior in critical situations. However evolving a convenient intelligent components with visualization aspects in IDSS are big challenges to be developed; but it would provide a muzzy decision taker an insight, preference, and much capability during a decision choice. This paper opt the advanced information visualization schemes for decision's early warning, supporting crises prevention and recovery. It proposes a visualized toolbox for CDSS that integrates crises management and dynamic information visualization within enterprise functionality. Finally this work formulates a viability of implementing such toolbox and presents conclusions. Finally this work formulates a viability of implementing such toolbox and presents conclusions.

Keywords: crises management, crowed management, VCDT

I. INTRODUCTION

A crisis defined as any unplanned event that can cause death or significant injuries to employees, customers, or the public; shut down the business; disrupt operations; cause physical or environmental damage; or threaten the facility's financial standing or public image. [1].

A crisis can be a situations with a high degree of threat and a high degree of time pressure . Generally, the actions and measures taken to neutralize the crisis are dependent on the scale of the crisis and the duration that it will take to manage the crisis. Crisis management is a series of functions or processes aimed to identify, study and forecast crisis issues, and set forth specific ways that would enable an organization to prevent or cope with a crisis[2].

Deciding on which actions to undertake during a crisis situation due to the stress and excitement that couples the situation makes it much more difficult for the stakeholders to work according to laid down rules. A continuous approach of proactive planning is recommended to prepare a manager to deal with the control of unpredictable situations. Occasionally when crises are ignored they quickly spiral out of control. A recommended effort that would go a long way to enhance effective handling of crisis would be preventing such an occurrence at the earliest possible time. Preventive measures deal with sensing potential problems, [3].

Crisis management involves dealing with threats before, during, and after they have occurred. It is a discipline within the broader context of management consisting of skills and techniques required to identify, assess, understand, and cope with a serious situation, especially from the moment it first occurs to the point that recovery procedures start

Before categorizing a process that could be considered to be a potential crisis, there should be a laid down structure to enable easy standardization across many platforms. What is imminently more sensible and much more manageable, is to identify the processes necessary for assessing and dealing with future crises as they arise [4]

The response shall include action in the following areas: Crisis prevention, crisis assessment, crisis handling and crisis termination

The aim of crisis management is to be well prepared for crisis, ensure a rapid and adequate response to the crisis, maintaining clear lines of reporting and communication in the event of crisis and agreeing rules for crisis termination.

Crisis management consists of different aspects including;

- Methods used to respond to both the reality and perception of crises.
- Establishing metrics to define what scenarios constitute a crisis and should consequently trigger the necessary response mechanisms.
- Communication that occurs within the response phase of emergency-management scenarios.

Crisis-management methods of a business or an organization are called a crisis-management plan

During the crisis management process, it is important to identify types of crises in that different crises necessitate the use of different crisis management strategies.[5] Potential crises are enormous, but crises can be clustered.[5]

This process involves planning steps and procedures coupled with decision making techniques that set base for an effective information's system. If well executed it would gather appropriate data from the environment, interpret this data

into opportunities andchallenges, and provide a concrete foundation for strategies that could function as much to avoid crises as to intervene and resolve them.A crisis can be discovered at an earlier stage using a technique called strategic forecasting. **Strategic forecasting** primarily involves predictions that are based on assumptions that the organization is capable of adapting to new situations whenever they will occur. The notion of strategic forecasting is to predict and assess the impact of major or broad trends in a general scenario of crisis management prediction, [7].
The next interest would be how to deal with unexpected scenarios. This is addressed through **Contingency planning.** Where alternative plans are put into place if events do not occur as expected. Also as similar to contingency planning is **Issues analysis;** whose purpose is to alert company decision-makers to be aware of evolving trends in the external environment of an institution. This would be in areas such as environmental protection demonstrating that certain companies will eventually be forced to change methods of production, energy sources used and products manufactured so as to avert crises.Addressing a company's preparedness to crises involves putting in place well laid scenarios that describe framework on how to handle situations that might occur at some unexpected point in time. This could be achieved through scenario analysis. **Scenario analysis** is an attempt to describe in detail a sequence of events which could possibly lead to a prescribed end-state, or alternately, to consider the possible outcomes of present choices. A scenario is a hypothetical sequence of events designed to draw attention to causal processes and decision points. Scenarios may pertain to management succession in the case of a plane crash or death, take-over attempts and other disasters.
Crisis management is important in the mitigation of such unexpected occurrences.There are many systems that have been developed or are still being developed to facilitate crisis management support for communication and decision making.
The decision making of crises management often occurs in a dynamic , rapidly changing and unpredictable environment. In our paper, we examine some crisis management tools' effectiveness in assisting crisis decision makers with the provision of timely information that would enhance effective management of a crisis. We also provide an argument for a crisis management support system that would provide a uniform interface across multiple user applications [8] to allow for its wide use. Most crisis scenarios always involve chaotic scenes that requirecommunication and decisions to be made quickly [9].A structured knowledge based decision support system for crisis handling [10] is needed to assist in such scenarios where the crisis management personnel are under immense pressure to provide guidance in handling an abnormal situation.
An information system for crisis management may be intended to support the coordination of crisis response activities [11] situation awareness [12] time-critical decision making [13], or the visualization of crisisrelated information [10].All these elements depend on time. A problem is how to consider these diverse aspects of time when creating an interface for a crisis management information system.
How to consider time related aspects in the design of interfaces supporting crisis management have been suggested, and this study aims at assessing and improving the design of interfaces. The objective of intelligent visualization is to give everybody the right information at the right time and in the right way. A decision maker should be timely supplied with relevant information that is effectively supplied in a user friendly GUI [10].
In this regard the development of an intelligent visualization should aim to achieve some of the following aspects of information gathering and processing:-

- Reduction of the information load on the recipient by presenting relevant aggregated information with focus on techniques and design whose display ensure quick and accurate recognition of the meaning. Intelligent visualization supposes that both the selection of the relevant information and the subsequent processing, organization, and representation of the selected information are automated.
- Incorporate expert knowledge in the visualization software development using the knowledge base technology in visual displays for data analysis, decision support, and information communication; the process will be similar to the notion of decision-centered visualization [10].

The intelligent visualization should be used for the purposes of building an interactive display to support the work of an analyst, planner, or decision maker, and build an information presentation for a specific recipient.
Recent crises have revealed the need for visualization tools to support time-sensitive collaboration, analytical reasoning, problem solving and decision making in analysis, planning and time-sensitive response activities [14]
Crises, regardless of the initiating event (e.g., nature or technology), are characterized by three distinguishing features: frequency of occurrence, scope of impact, and time pressure. By definition, crises are low frequency events. As a result, those who must prepare for and respond to them often do not have sufficient knowledge or experience to draw upon [15].
Crisis response and crisis management are examples of naturalistic decision making situations that are characterized by time pressure, risk, uncertainty, multiple and changing goals, and multiple organizations.
Managers and politicians seem to desire more computerized decision support to help in both crisis incident planning and response.
Information visualization (IV) became an IS researchable area that has received an increased attentions in developing techniques for exploring databases, attempting to extract a relevant hidden relationships among variables or among causes and effects [17]. The emerging results from IV community can be an important contribution to crises management systems CMS community if it can provide novel techniques enable CMS to utilize a wide range of available information in databases. Unfortunately information visualization is still facing several serious challenges.
During this research, several information visualization works are examined [18 19 and 20]. There are many research efforts have focused on how to transform business process data to shapes whereas decision makers face the challenge of

understanding what underlying finding and how they can draw sensible conclusions for crises . Thus a visualized interface should support and improve the entire crises management phases, not only data transformation.Most of existing decision support systems for crises management, and simulation systems, have built-in functionalities but cannot exposespot environment changing or providepossibilities for negotiation.

Many of Intelligent Decision Support Systems (IDSS) such as Expert Systems (ES), GroupDecision Support Systems (GDSS), Online Analytical Processing (OLAP), and BusinessIntelligence (BI) rely on different types of information visualization techniques. These techniques are more interested in investigating a problem through the use of the static Graphical User Interface GUImanner[21] without considering the visual presentation of information effectively as a steering-set of a decision maker on the front.Static graphsof visualized information would have less effecton a decision maker interaction.

Accordingly interactive visualized information is being worth during decision making activities subject to other limitations in time and cost. Hence, onemay address 2D Interactive Information Visualization IIV for this concern.Compared to using traditional data representations such as two-dimensional data set, a decision maker who uses visualizations should perform better during the entire problem-solving process. In fact, this mustbe the ultimate goal of developing visualizations for better decision-making [22]. A user's satisfaction with the decision outcomes is a very important factor in predicting preference and attitude for different decision support systems.

Information visualization (IV) is an emerging trend that relies on the human's perception and cognitive abilities to visualize data [23]. Incorporating IV techniques to a decision support system is the potential solution to improve system's effectiveness and to provide decision makers with better insights about the data that they are analyzing. In the human-computer-interaction (HCI) and IV literature, the existed differences among individual are always emphasized, whereas adecision-style, which is recognized as one of the key individual cognitive differences that affects system success, has received a little attention in these areas. Decision style reflects the way by which a person thinks and reactswith facts about specific situation. In decision support system (DSS) literature, decision style has been acknowledged to affect decision making performance and one's preferences for human machine-interface [19][24]. Unfortunately, it has been frequently overlooked and rarely been given priority in the DSS design [25] [17].

This research tackles someof these limitations and trying to overcome such DSSshortcomings. Architecting an Intelligent Visualized Crises Decision ToolboxVCDT.

VCDTis the most concern of this research. It mainly originates from focusing on user-specific needs. Therefore, the first aspect of the toolbox is the provision of visualizations in a well understandable way for decision maker.

The new dynamics and the severe impact of the extreme events (natural hazards, terrorism, technological accidents, and economic/financial crises), but also the complexity of interventions have motivated the scientific community to find new efficient solutions for decision making process dedicated for crisis management, especially for solving the following aspects: time urgency, the complexity of event, the volatility/ rapidly changing of event/ decision conditions, the chaotic surrounding environment ingredient, the human behavior in critical situations (emotional stress), the consequences for decision failure, poor data, frequent interruption during the decision making process [.

This paper is approaching options to explorative analysis; its focusing is toadvance interactive graph visualizing rather than upon looking at a hard graph generated from the answered queries. Such a featured VCDT issues to be proper to adaptability and applicability for a wide range of problems, and may be customized for many business as a workable version.

The rest of this paper is organized as follows. Section II discusses visualized elements issues in a related work. Section IIIdiscusses how this researchtackleVCDTproblem. Section IV briefly describes the proposed toolbox andpresentsVCDTprototype.Section V concludes the paper.

II. STATE OF ART AND LITERATURE REVIEW

A crisis Management system can be defined as software that provides data information about a crisis situation to the crisis management authorities. This information in turn helps the authorities in their duty to make decisions that will help manage the crisis the front end systems which immediately communicate with the crisis management systems and update the crisis management authorities. Table 1 shows a summary of the crisis Management systems that we reviewed in terms of their information integration ability.The need for a crisis management support system is important due to time and stress constraints when decisions have to be made within short notice during a crisis. Technically, a structured knowledge based decision support system for crisis handling is needed to assist in restoring functions back to a normal level, and evaluate the response work for the future [10]. The information systems to be developed should be relatively easy to use by crisis management experts .

There are many systems that have been developed or are still being developed to facilitate crisis management support for communication and decision making. In this paper, we examine some crisis management tools' effectiveness in assisting crisis decision makers with the provision of timely information that would enhance effective management of a crisis. We also provide an argument for a crisis management support system that would provide a uniform interface across multiple user applications [8] to allow for its wide use. Most crisis scenarios always involve chaotic scenes that require communication and decisions to be made quickly [9].A structured knowledge based decision support system for crisis handling [10]is needed to assist in such scenarios where the crisis management personnel are under immense pressure to provide guidance in handling an abnormal situation.

Decision making in critical or special situations is very complex because the systems are complex, the dynamics is difficult to understand, and adaptability is essential. Even the technologies to cope with the crisis and high risk events

have developed considerably there are some underlying problems that complicate high risk prevention and multiple crisis response: an inadequate communication between different actors and different levels; the relative inadequate data fusion, selection, filtering and standardization impacted information database; the difficulty to update information about the development of the extreme risk (victims damages, rescue team technologies, in the case of natural/man-made hazards, or specific information in the case of financial crushes and crises); the access to existing databases and action plans it is relatively slow [27] .

Most relevant from a crisis management perspective is the description of a visualization technique called 'Showtime', where dynamic networks are animated over time [26].The user is here allowed to control the speed of the animation in diverse ways, which leads to an increased understanding of the presented information. Other researchers focus exclusively on the visualization of time [29],[30].

When it comes to prior research directly addressing crisis management, it is frequently focused on technical issues of the representation of temporality. For example, how to define temporal relationships between response activities, so that they can be presented by a system in way that supports the crisis managers in obtaining an overview of the response work, as discussed by Franke, Charoy, and Ulmer (2010, 2011) [31]. Allen[32].Discusses how to represent temporality for events in general when the duration of an event is unknown, or when a specific time for when an event took place is uncertain.

The graphical and fact finding capabilities of software tools vary from package to package,as demonstrated in this limited investigated domain,five core packages e.g.crises commander, geo chat, Microsoft vine, WIS and CATS aims have static nature since the data is a read once give a hard displays.

However, spotting trends and predicting outcomes by looking at static bar charts or line charts is not always effective due to the limited amount of information that can be displayed, this is particularly true when patterns exist in more than a few dimensions.

The user cannot easily interact with the visualization. Interactive visualizationsIV shouldallow users to get free hand to amend a visualized displays as similar as displayed data.

In the modern literature are presented a lot of applications, procedures and activities capable to anticipate, prepare for, prevent, reduce different types of risks/losses associated to different type of crises, but there are only few integrated frameworks to deal directly with visualized crises information In this case, the decision makers need a huge technical assistance to support decision making process before, during, and after crises.

III. VCDTPROBLEM

A number of authors have identified three stages of crisismanagement figure (1)[28]:1) *Prevention*(mitigation),2) response 3) *Preparedness*, and 3) *Recovery*. They note that crisis prevention involves monitoring, anticipation, and taking pre-emptive actions to avert a crisis. Prevention is most problematic, difficult and expensive for low probability events. Crisis prevention activities can reduce threats. Crisis preparedness involves taking actions to reduce the impact and harm from a crisis when and if it should occur. It is important to identifying vulnerabilities and crisis scenarios. Planners need to identify what might go wrong and what the consequences would be if the worst case situation occurred. Crisis recovery encompasses damage assessment and the accounting, reporting, and allocation of resources. Crisis recovery also offers the opportunity to learn how to respond more effectively to future crises

Although the evolution in information visualization is presenting many technological challenges, but the greatest challenge may be retaining an intimate involvement and understanding by end-users. This challenge is a great issue since IV enables decision makers to fast analyze large quantities of information (hundreds of entities), aiding quick understanding of data distributions and rapid detection of patterns. VCDTwould help users make quickerand better-informingcrisisdecision by spottingon business issues and opportunities in a realtime and inunderstandable manner.

Both time stress of decision problem, and the vague of inarticulabledecision processes that cannot be repeated, are drivingreasons of VCDT problem.

Information visualization provides powerful trend to communicate and navigate through outcomes from intelligent visualization processes.There are five important roles for information visualization in thecrisis Management system [20]:

1- Alert, attract attention to something unexpected like an impending threat;
2- Inform: what, where, when happens and how evolves;
3- Suggest, e.g. some action to take or additional information to consider;
4- enable: analysis, reasoning, decision making, or action planning;
5- explain or justify, e.g. a proposed solution or a decision made.

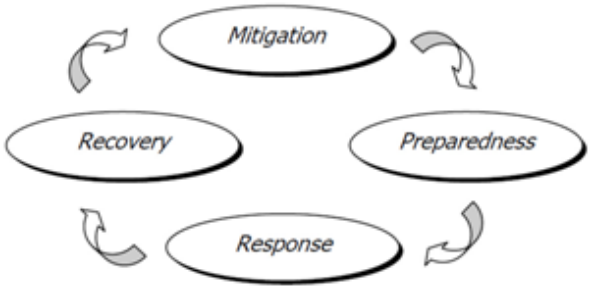


Figure 1 Crises Management Cycle

IV. VISUALIZED CRISES DECISIONTOOLBOX (VCDT) Field study

This section show howVisualized Crises Decision ToolboxVCDTComponentsfor decision makerare identified. SectionAcontains field Study summary, section B presents building blocks architecture and the functionality of the proposed IVDT services.

A. Field Study Summary

For identifying decision-involvers needs, Joint Application Development (JAD) methodology and a focused group are used to answer what is really decision-involvers need. The acquired information help very must in architecting VCDT prototype. The interrogated focused group is 27 of respondents out of 67 acquired users. Table (1) gives the summative results of this filed study.

Table (1) VCDT Summative Focused-group

Involvers		*Most Data source*	*Needed response of **VCDT***	*Decision style*	*How do they see IVTD look like*
Mgt levels	#				
High	5	Database (DB)	Slow Monitoring	Heuristic	Simple indicator
Tactical	11	Data Warehouse	Slow Interactive	Analytical	Interactive GUI
Operational	7	Direct injecting DB	Fast reaction	Model-base	Smart Auto-reaction

Decision takers' styles became more close to the fact represented in figure 2.

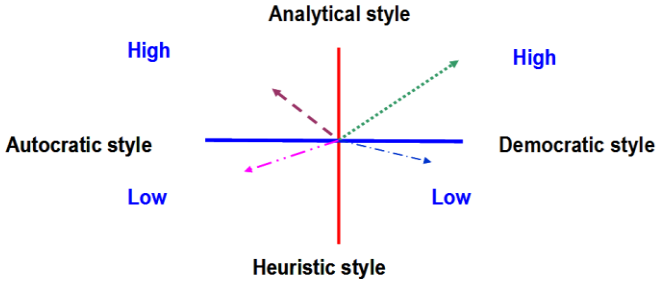
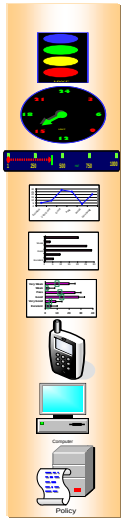


Figure (2) Decision Style

This field analysis thoroughly conducted the next process of architecting VCDT as given in figure 3 next.

Control Shape	***Control Description***
	Blue, Green, Yellow, and Red *ON/OFF* lights. They contain light and light degree due to decision maker request (fuzzy light)
	Two-direction O'clock indicator
	Scaled ***x-y*** Progress indicator
	Simulated Curve
	Simulated Bar
	Simulated time-line
	Do-mobile Action
	Do-remote computer action
	Do-remoter Deriver Action

Figure(3) Crises Decision maker Toolbox

B. IVDT Architecture and Functionality

VCDT is composed of three comments:

1- On-the-spot component: it is a set of indicators that can instantaneously show the status of the underlying database, itsfunctionalityisto monitor the decision variables comes from database that help prevent some crisis incidents by providing a monitoring capability: gathering, collecting, organizing, and reporting on the status of incident indicators. Based on insights gathered in the monitoring phase, appropriate action steps can be taken to prepare for the crisis incident. and taking pre-emptive actions to avert a crisis. Crisis prevention activities can reduce threats They are

presented figure 4, this set is composed of three programmable controls: (1) Blue, Green, yellow, and Red, each color would associate with strength of light value(fuzzy light),(2) two-direction counter that can represent the flow volume of a specific attribute, and (3) Progress of ***x-y*** Scale to alert the user at cross border boundaries.

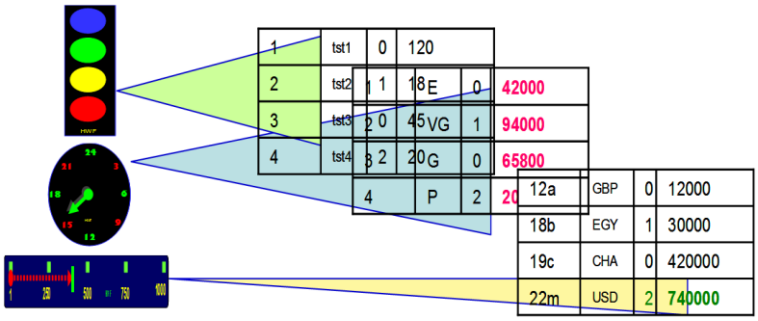


Figure (4) On-The-Spot Monitoring set

2- Simulated Shapes: Simulated Shapescomponent: it is a set of simulated shapes that can interactively simulate the underlying data warehouse (cube), its functionality is to guide what-if scenario based on decision variables comes from data cube.Crisis preparedness involves taking actions to reduce the impact and harm from a crisis when and if it should occur. It is important to identifying vulnerabilities and crisis scenarios. Planners need to identify what might go wrong and what the consequences would be if the worst case situation occurred. They are presented figure 5, this set is composed of three programmable controls: (1) line, Bar, and time-line.

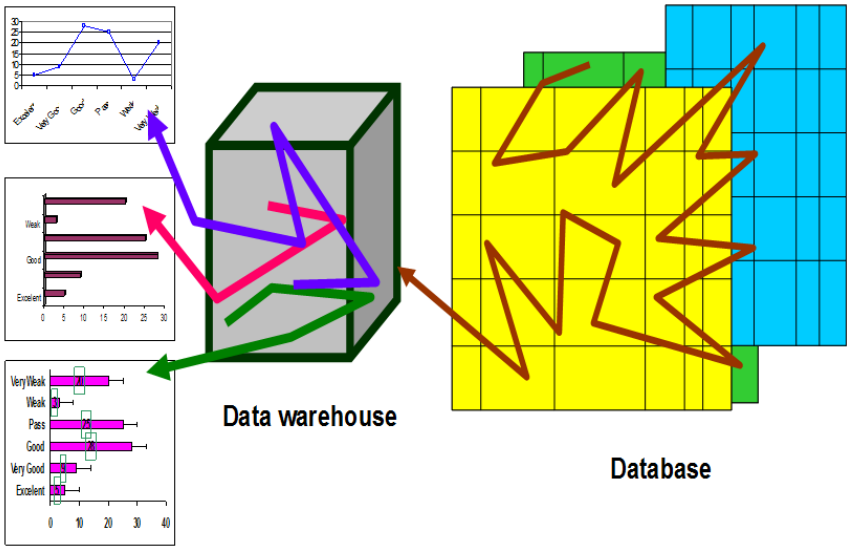


Figure (5) Simulated Shapes

3- Action-Decision shapescomponent: it is a set of controls that can trigger a certain action depending of cause-action attribute value of the underlying direct-database, its functionality is to smartly react as user-agent with other environment smart-drivers.This setis presented figure 6, this set is composed of four programmable controls:(1) tuner to offset or adjust a database value, e.g. do account transfer, close a dormant account, etc. (2) Send-to-mobile control, e.g. send massage, (3)manage a remote-computer-resourcescontrol, e.g. shut-downa computeand (4) trigger an order to another business, e.g. reorder point, stop a stolen credit card etc.

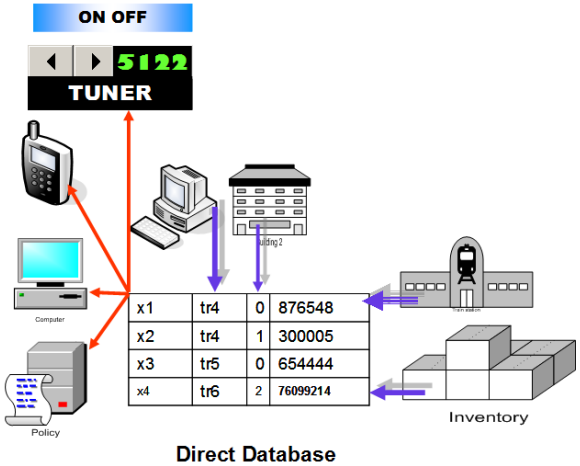


Figure (6) Action-Decision shapes

IIV.VCDT: Crowed Management Case Study

The **Hajj** is an annual pilgrimage by Muslims to Makkah, Saudi Arabia and it is one of the largest annual pilgrimages in the world. To date, about three million pilgrims all over the world participate in this event. During this period, crowd-control techniques become very critical and there is always room to improve the existing crowd control systems.

Data from the RFID readers will be sent to a VCDT, which will store, collect, process and display real-time data on the pilgrim's location. Pilgrims with RFID tags having mobile smartphones will be able to install and use a mobile app to take advantage of location based services. These services would include finding the location of family and friends within the Hajj area, sending emergency requests, receiving alerts/notifications from the system and a searchable mapped Hajj area with all important locations and facilities. The mobile user would also be transmitting his/her location while the mobile app is running. This would increase the real-time tracking and position accuracy of a mobile user pilgrim. All data of transmission and receiving from a mobile user is again dealt by VCDT.

VCDT will consist of the following features:view the location of Pilgrims (RFID/Mobile) on a map.

2) Being able to search for the location of pilgrims' on the map based on the pilgrims' profile for example nationality, blood type, age etc.

3) Being able to receive emergency requests from the pilgrims that are mobile app users.

4) Being able to view the location of these emergency requests on the map.

5) Being able to send notifications and alerts to mobile app users.

6) Storing and maintaining the user profile of every pilgrim. The profile will contain his/her name , family emergency contact, email , blood type, nationality , age, passport no/National ID card no., address , phone number international and local Saudinumber if present.

7) A history of the location of the pilgrims will be stored for the entire Hajj. This can be used later on by the Hajj ministry for analysis and research.

8) Adding, maintaining, viewing and searching for locations on the map. Examples of locations are important Hajj places, facilities, RFID reader locations, hospitals, bathrooms, bus stops, train stations etc. These locations will also be used to populate the map in the mobile application.

9) Being able to setup and manage RFID readers.

10) Being able to view a mobile app user's friends' list.

V. CONCLUSION

In this research an Visualized Decision Toolbox (VCDT)is introducedfor Decision Maker.VCDT requirements assessment is based on both JAD methodology and focused group to answer what is really decision involvers need.The acquired information help very must in architectingVCDT prototype. The introduced VCDT is reviewed and highly accepted. VCDT implementationwould greatly exploit the new capabilities in object oriented programming rather than click-and-drop static graphs, it is very easily extendable, and can be basically integrated by extending the tools menu of the main window.

VCDT may cope with the progression in both: users' cognitive needs and the modern visualization computing power. It considers a continuous beak time of decision makers by incorporating inference logicalong with associate option-base visualization and can interactivityenhance a decision process.As in any experimental work, this studyhas several limitations. The validation of theproposed toolbox was conductedon a case work setting, and hence the internalvalidity is high, but the external validity hasto be tested further with other types of crises.However, the use of airplane hijacking crisis,which is ranked high in representing nationalcrises as a case study, was reasonable to testthe validity of the conceptual design. Despitethese limitations, the study indicates that theproposed design of the VCDT isworth pursuing. By combining the conceptualdesign with a test of validity and evaluation,the study has provided some useful informationto build upon.

However this research is a direct responsiveness to decision making style and user satisfaction, it is a step forward to improve VCDTeffectiveness implementation and popularity.

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