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Mobile visualization: A framework to assist fund management decision-making process

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Abstract

Nowadays, every organization has their own management process, and equipped with information systems to assist them. With the continuous data generation from the system, it is overwhelming for the users to make use of all this information in their problem solving, mainly in process of decision-making. Information visualizations can offer a solution for this problem by visualizing the relevant information for the user to understand promptly. However, information visualization in mobile platform especially in context of decision-making process for fund management have yet to be studied. The mobile devices and platform has found their substantial place in the current world of technology such as Android and iOS platforms. Mobile devices provide us with a huge possibility of doing things that are restricted by mobility previously, with the emergence of developers for mobile application, mobile devices are now considered as trend among these days. These technologies could be utilized to become a tool for supporting certain process such as decision-making; considering that such process requires great deal of data to be interpreted before a decision can be made. An action case research strategy, including observation, prototype and interview were used to answer the research question and will be analyzed to conclude results.

1. Introduction

Particularly nowadays, with the overflowing data accumulated with multiple usages that create a complex relationship among data, the main problems faced by computing society is not the computational power anymore. The continuous collection and generated data presentation, especially for users' understanding that still affect and limit the basic capabilities of computing [19]. This is when data warehousing established to gather all the integrated data, to analyses relationship and help problem

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solving [18]. Our community currently has the system capability of housing the generated data, but we are still facing certain difficulties of exploiting it to help our problem solving [11] such as mobility on its usage. Information visualization is a study of visual representations of abstract information to amplify human cognitive activity [14]. Visualization helps human to understand crucial external information during the decision-making process through organization and representation of relevant data [3]. The study intends to use visualization effectively on mobile platform as an assisting tool for decision-makers in fund management. Previous research regarding visualization system exists in China suggests a concept that can be incorporated in our existing system [10], by visualizing the funding in big projects comprised of small clusters. The study was conducted within an organization in the Ministry of Higher Education, Malaysia by having participants that are decision-makers. The study involves six Head of Clusters from the initiative committee known as Malaysia Global Outreach: New Dimension. The committee composed of six clusters of selected academicians from public universities in Malaysia. Each cluster was funded by the ministry to carry out research projects and has their own role and objectives. These Head of Clusters are the project leaders, the main user of the proposed system using visualization mobile application assisting tools in their decision-making process particularly in managing the fund granted by the government. Each Head of Cluster affiliated with different public universities, and their financial department managed the fund respectively. The project leaders informed of the current status of the fund mostly upon request. The existing system within the financial department effectively utilized the fund accounting to oversee their resources and project progress [13, 16]. However, the system limits the relevant resources accessible by the decision-makers due to reliance towards traditional settings of the system. Users have to access the system via local connection or specific devices. This study propose for possible extension of usability of the system into specialized mobile application equipped with proper visualization tools in assisting fund management following the public sector organization process and settings.

The public sector in Malaysia practiced highly centralized organizational design [1], where decisions made collectively. This research was focused on assisting particular distinct managerial level [8] through analytical hierarchy process [15] which is strategic, actively require organizing knowledge made by top-level managers; in this case, the Head of Clusters. Through observation and interview among the Head of Clusters, the organizational process particularly in fund management, relatively in proposing budget and expenditure was depicted in simple process as in Figure 1.
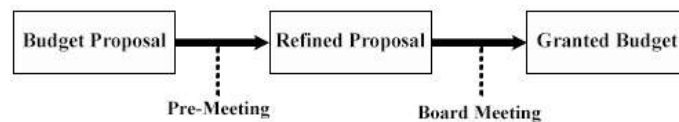

Figure 1: Organizational process in fund management process; budget proposal.

The process starts with budget proposal for each projects planned by the clusters for that year. The early draft will be discussed and refined during pre-meeting within own clusters. The refined proposal then forwarded to the board member to be discussed and approved collectively before presenting to the Ministry. The Ministry will evaluate the proposal according to budget and its justification with recommendation from the board.

Three research questions, which will be investigated in the context of public sector management where a cooperative style of decision-making is used [1], are:

- How mobile visualization can assist the decision- making process?
- What are the appropriate visualization techniques that can assist decision-making process?
- What are the relevant data required for decision-making in fund management?

These questions cover the key areas of this research and will serve as a means to evaluate the outcome of the research.
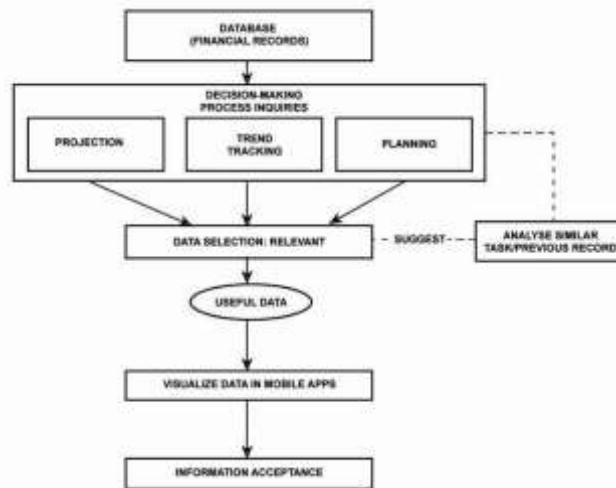
Figure 2: Preliminary theoretical framework

Based on the framework in Fig. 2, four major elements were involved in the research process; the visualization techniques, the decision-makers (the roles), the decision-making process and the data. The framework starts with user relative task such as planning and trend tracking. All data were stored in the database, inquired by specific task command to filter their relevance towards the task request, at the same time the system will provide similar records suggestion. The relevant data then will be visualized for user understanding. The information accepted will provide insight for the user to make informed decision. Visualization unable to go further than decision support due to the final decision still depends on the user, but the least it can help make informed decisions. In the initial study the visualization techniques will be based on the existing published qualitative approach [5, 6, 9, and 12] through the usage of mobile application on the tablet. The data that is associated with the decision-makers in the decision-making process will be specified.

2. Research methodology

This research uses Action Case research methodology that involves two cycles. The research investigates the main information that is required by both decision-makers and fund manager to be embedded in the visualization layout that can support their decision-making process. The research will require these target groups to better understand the requirement and possible improvement for the project in the future. Therefore, the research will be conducted through five phases:

Table 1: Action research phase

Phase	Details
Analyze	• To establish knowledge about visualization concept and techniques that can be implemented and assist the participants' decision-making. • Data collections from the target group that participating in the research and evaluate the feasibility of the research.
Planning	• Understand the requirement from the end user for the development of the application in order to achieve the objectives.

Intervention/execute	• Put plans into action.
	• Knowledge training by introducing visualization to the participants and influence them to use it as assisting tools.
	• Understand the decision-making process in public sector management, information that is required to assist the manager in decision-making
	• The data will be collected and implemented in the design of mobile application systems
Evaluation	• The decision-makers and fund manager will use the mobile application.
	• Small-scale system can be expanded or merged with other domain in the future.
Reflection/capture learning	• Learn about user's experience on how the technique can assist them in decision-making.
	• Improvement of prototypes based on the feedback and result from user's experience.
	• Design a framework on how decision-making process to be implemented in software development specifically for the government sector.

The first cycles involves knowledge training to influence the users about visualization and its potential to assist them in decision-making. The first cycle interview has been conducted that mainly inquires on user's requirement (task, mobile usage behaviour, familiarity towards mobile application), common task assigned to users (user roles, frequent request) and how mobile visualization can assist them (data type, data relevance and proper visualization techniques). The prototype in progress was developed according to the results from this cycle.

The second cycles will mainly learn about user's experience after using the mobile application and how the tools assist them in decision-making. The second interview will be conducted after the testing phase. Triangulation of data from both interviews will be verified through observation in their working environment. The final response will be analysed and used to verify the modified theoretical framework in Fig. 3.

3. Data analysis & discussion

The research begins with the review of the state of the art in related research for the development of information visualization in supporting decision-making. Based on the reviewing done on related research, the difference between mobile and traditional visualization directly affect towards how the development of system conducted [2, 7], but the purpose of visualization still fulfilled. Interview has been chosen as the data generation method due to its satisfactory in understanding user requirements and experience. Based on the data that has been gathered, the earlier preliminary theoretical framework has to be modified.

Table 2: Data collection results

Key factors	User's Input		
Task	Overview	Comparison	Projection
Mobile usage behavior	Simple	Intermediate	Complex
Familiarity	Basic	Accustomed	Expert
Frequent request/inquiries	Balance and records	Spending and categorization	Manipulate projected data
Data type	Overall	Between data sets	Complex of data
Data relevance	Simple	Filtered and related	Filtered and created
Proper visualization techniques	• Pie charts • Bar chart • Color	• Line chart • Stacked bar chart • Color	• Stacked bar chart • Color

Based on the conducted interview as shown in Table 2, most of the users was accustomed with mobile application and very perceptive towards introduction of this research. Three main tasks have been identified from the users according to task flow, which are overview, comparison, then projection, perfectly fits the visualization mantra [17]. These tasks also composed of inquiries and frequent request such as fund balance and records, with users giving hints of preference for proper visualization techniques used. The generated data have been categorized according to the mantra [4] and implemented in prototype design. The previous preliminary framework has been modified with these feedbacks.
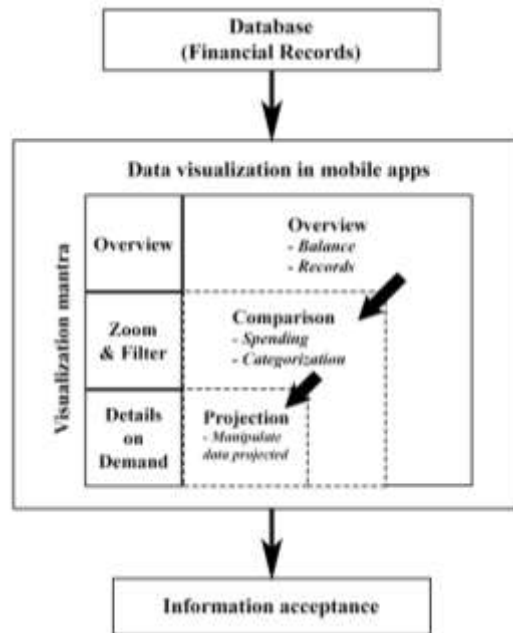

Figure 3: Modified theoretical framework

Centralized to visualization mantra as core design, the functions in the mobile application prototype will definitely meet the user requirement. Overview the data first, then user can do comparison and tracking, and will have idea on projecting data for planning. A prototype in progress will be developed based on the results from the first interview and confirm the framework design. The prototype have three main functions implemented based on the inquiries and relative task. An overview function shows balance and percentage of expenditure, with usage of color and pie chart. The color will emphasize level of awareness regarding current status of the fund. Next function is to do comparison and tracking with usage of bar chart to display progressive expenditure throughout the year. The development process still ongoing, involving creating function for projection with user interactivity to manipulate projected data.

The second cycle interview expected to be conducted after the completion of the prototype. The second interview will inquires on user experience (usability and functions), effectiveness in assisting (providing insights, proper techniques used, effect on decision-making) and future improvement (elevate involvement of managerial level to include whole clusters).

4. Conclusion

In the end, visualization and mobile application can be favorable and practical tools to assist the decision-makers and fund manager in managing the information and the organization's fund. With the

visualization implemented in mobile applications, time efficiency and mobility can be achieved in carrying out their task. This research's goal is to design a framework for providing an assisting tools for the decision-makers and fund manager to better help them in their decision-making that can be accessed anywhere and anytime. To bring forward to this research, it can be expanded into higher level, such as the emergence of small branch of the department or the private sector so that mobile visualization will bring to a wider perspective and range of use.

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