

Research Publication System for Middle Management

Prototype Development of Research Activity System (ReAct System)

Muhammad Munzir Faizal

Malaysian Institute of Information Technology (MIIT)
Universiti Kuala Lumpur (UniKL)
Kuala Lumpur, Malaysia
munzirfaizal@gmail.com

Shahrinaz Ismail

Malaysian Institute of Information Technology (MIIT)
Universiti Kuala Lumpur (UniKL)
Kuala Lumpur, Malaysia
shahrinaz@unikl.edu.my

Abstract—The importance of information systems for middle management has been mentioned since 1980s. Despite the rapid improvement in technology and innovation, there are still lack of adoption of information systems for business process management in organisations, including universities. This study looks into the need of an information system for the management of research publication in a case university campus, which proposes an adoption of digital dashboard as part of reporting feature for the middle managers to better present at the higher level of management. This paper presents the prototype development of the Research Activity System (ReAct System), with results of the system interface and features usability evaluation. Significant finding shows a gap between the middle manager's view and the academicians' view in terms of the need for this system, which could be rectified with an emphasis of key performance indices (KPIs) in the system.

Keywords—management information system; digital dashboard; research publication management system; middle management

I. INTRODUCTION

The case organisation is one of the leading universities in Malaysia focusing on engineering technology. Governed by the Majlis Amanah Rakyat (MARA), an agency under the Ministry of Rural and Regional Development (KKLW), this university is given the mandate to upgrade the status of technical education in Malaysia. One of the key performance indices (KPIs) of the university is to be recognised in research and innovation, competing against other technical universities in Asia. With the strength of 13 campuses and hundreds of academicians per campus, it is a challenge to collect and consolidate the data and records of all research published by the academicians. The same challenge occurs every quarterly, when every campus Section Head of Research and Innovation (HoRI) is required to report the data to the central management committee, for the purpose of progressive monitoring on research KPI achievement.

Research publication is one of the four main activities monitored by the Centre for Research and Innovation (CoRI), which is based at the chancellery of the case university. Other research activities managed by this centre include: research funds and grants; research and innovation trainings; and research and innovation competitions. The data collection and monitoring of research activities are still performed manually at

campus level, with minimum one employee in charge under the leadership of campus HoRI. For one campus with approximately 130 academicians who are active researchers, it is a challenge for the person-in-charge to keep updated with the research activities. It is a custom to constantly request the academicians to report their research activities to the person-in-charge, which becomes cumbersome especially when there is hardly any response from them.

On top of manually collecting the research publications data every quarterly, the format or the details of the required data often vary from time to time. At one time, only a few fields of the record are needed for the academicians to fill in a spreadsheet format, whereas more fields are needed after half a year using a different format. Towards the later stage, the request is more lenient, in which it is up to the convenience of the academicians to report. Inconsistency of data retrieved due to these various versions of format causes difficulty in presenting accurate and complete data to the management. It is more challenging when the same data is required to be submitted as proof for the university recognition ranking.

At chancellery level, the case university has implemented a University Researcher Portal to gather updated research publications by the academicians, by merely allowing the academicians to key in their researcher identification numbers (i.e. researcher ID). The purpose is to reduce the work of keying data at the academicians' side because the researcher ID will automatically allow the system to extract the updated publications available in certain recognised research portals, such as SCOPUS and ORCID. At this stage, only the high impact journal and proceeding papers were imported into the university researcher portal, and even so it was not real-time due to the duration of the papers being indexed in the systems. The system is then extended to include links to the academicians' personal information in commercial research portals, such as Academia and ResearchGate. Regardless of the noble intention, the updates are still not as current as it supposed to be, because it highly depends on the academicians' commitment to update their information in the multiple portals. It also does not solve the issue of possible redundancy of data and information, nor the issue of reporting a research paper as one record when multiple authors belong to the same affiliation (which is a more accurate figure needed by the HoRI and CoRI).

In order to facilitate the Research and Innovation Unit in the said campus, it is proposed that a system should be developed to collect the data from the academicians, since they have the update research data at personal level. This is also to ease the constant reminder and announcement requesting them to report on their research activities. The proposed system presented in this paper is focused on the activities involving research publications only, with the objectives as follows:

- to analyse the user requirement for the research activity management system; and
- to evaluate the usability of the proposed system.

II. RELATED WORKS

This section summarises the literature related to this research. It starts off with the concept of management information system that links the traditional business management activities with the information system types, and digital dashboard that is the current trend in decision making at corporate management levels.

A. Management Information System

The domain of information system today brings out the importance of knowledge being “essential for creating successful competitive firms, managing global corporations, adding business value and providing useful products and services to customers” [1]. Information system itself is defined as a set of coordinated network of components, which act together towards producing, distributing and or processing information, with precision as an important factor, which may not apply to other types of systems [2]. In addition to that, information system is a system that assembles, stores, processes and delivers information relevant to an organisation in such a way that the information is accessible and useful to those who wish to use it, including managers, employees, clients and citizens [3]. The management information system helps the top level management in goal setting, strategic planning and evolving the business plans and their implementation, which indirectly helps to pull the entire organisation in one direction towards the corporate goals and objectives by providing the relevant information to the organisation [4].

It is pointed that the role of management information system is to have the capability for decision making and it is increasingly used as a tool in organisations to facilitate the management to make decision. Managers should be cautious to consider the complexity of the system because of the integrated data that spans across units of functions. The components of an information system include: hardware for input, output and storage of data; software for data processing and instructing the hardware component; databases that are located in the system where all the data will be automated; and procedures, which is a set of documents that explain the structure of the information system [5]. The system is responsible for controlling and recovering data of the environmental world and business operations with the organisation in a way of organising and selecting data, in which necessary information would be used by the managers for making decision, planning and controlling [6].

The roles of managers coincides with the suggestion of having management information system for the middle management level of the organisation structure, proposed in the 1980s [7]. Figure 1 shows the four level pyramid model of different types of information systems based on the common hierarchical structure of an organisation. It is obvious that without the second level of management information systems for the middle managers, there will be a gap between the lower level and the upper level, causing lack of information for the upper level (i.e. senior managers and above) to make decisions that complements the organisation strategic goals.

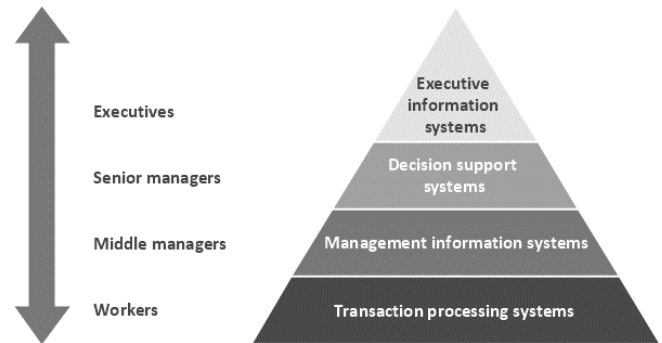


Fig. 1. The four level pyramid model – information systems types [7]

B. Digital Dashboard

In management information system, a dashboard is “an easy to read, often single page, real-time user interface, showing a graphical presentation of the current status and historical trends of an organisation’s or computer appliances key performance indicators to enable instantaneous and informed decisions to be made at a glance” [8]. According to Cheng et al. [9], a digital dashboard, also known as executive dashboard, is a computerised interactive tools typically used by managers to visually ascertain the status of their business via key performance indicators. This tool emerged from the concepts of decision support systems in the 1970s, and with the rapid growth of information technology through the 1990s, it is developed into standard tools in executive offices. The extract of information from data that is then used to predict trends and behavior patterns will help business to plan their resources better [10].

A dashboard is a concise, context-specific display of key metrics for quick evaluation of multiple subsystems, in which can integrate information from multiple components into a unified, interactive display, which is then presented as though it all came from one source [11]. With the trend of Internet technologies today, a web-based dashboard is possible to be developed, constructed to automate the extraction, processing and display of indicators (at near real-time) and thereby provide useful and current data for management [12]. In hospitals, dashboards are used in one study to control infections, with suggestions to improve capacity and workflow management in emergency departments, and provide the possibility of daily and real-time monitoring of productivity in organisations [12].

III. METHODOLOGY

This research went through the full cycle of system design and development. However, this paper presents only part of it, based on the objectives mentioned in the Introduction section. This paper covers the beginning stage (i.e. the user requirement stage) and the ending stage (i.e. the evaluation stage).

A. Analysis on Existing Systems

Most universities in Malaysia have their own management system to manage and monitor the research activities by their academicians, which are commonly not accessible to the public. Nevertheless, it is found that universities are not the only parties that the need to manage the records of research publications. Academicians, at their own personal level, also needs to manage their publication records, for personal and professional development. Hence, the emergence of some commercial research portals that are provided for free and/or premium prices.

This research gathers two examples of the commercial research portals, one university research management system, and one university researcher portal that is currently available at the case university, as shown in Table 1.

TABLE I. SAMPLE OF EXISTING RESEARCH PUBLICATION MANAGEMENT SYSTEM

Function Availability	Research Publication Management System			
	Academia	Research Gate	University Publication System ^a	University Researcher Portal ^b
Secured log in	Yes	Yes	Yes	Yes
Data key in	Yes	Yes	Yes	No
Statistical graphs	Yes	Yes	No	No
Graph for personal total publication	Yes	Yes	No	No
Graph for total publication by section	No	No	No	No
Suitable graph format for reporting to the management	No	No	No	No

^a. The name of the university that owns this system is kept confidential as research ethical purpose.

^b. The case university's current available portal.

Based on the comparison shown in Table 1, the commercial research portals (i.e. Academia and ResearchGate) do not provide a collective view of research publications for the university research management purposes. The last two functions listed in Table 1 are deem important for the purpose of KPI reporting by the section managers to the management of the university. Having said this, this research takes into account the digital dashboard function to present the progressive report on the number of research publications at campus level, section level, and also individual academician level.

In order to get specific requirements for the design and development of the proposed system, an interview was conducted on the Section Head of Research and Innovation (HoRI) of the case campus. The results of this interview are translated into diagrams that facilitate the development process of the system. These diagrams are presented in the next section.

B. Survey on System Evaluation

The system evaluation phased was conducted after the development of the prototype. The purpose is to test the usability of the system as well as retrieving feedbacks on the system usability.

The target respondents are separated into two categories: administrator (one respondent); and users or academicians (six respondents). The administrator tester holds the role and responsibility of a HoRI at the case campus, and a questionnaire on usability is distributed to him during the test.

On the other hand, six academicians are selected from the same case campus, based on their familiarity with research portal and information system, due to experience in using the commercial research portals and the university researcher portal. The respondents were given a briefing on the objectives of the proposed system and the scope, before they were given time to explore and answer the questionnaire. The questions given to them are on accuracy, reliability, feasibility and usability.

The survey results are presented in the next section, which comprise the four elements of system evaluation: accuracy, reliability, feasibility and usability.

IV. RESULTS AND FINDINGS

This section covers the two results from the activities mentioned in the previous section: system design and development; and evaluation results.

A. System Design and Development

The system interface is shown here for two different users: academician and administrator. Figure 2 shows the home page of once an academician logs in to the system. He or she can view the summary of personal research publications in total, based on the type of publications.

As compared to Figure 3, the administrator's home page shows the total publications by the campus that HoRI manages. It also gives the breakdown of total publications according to the publication types.

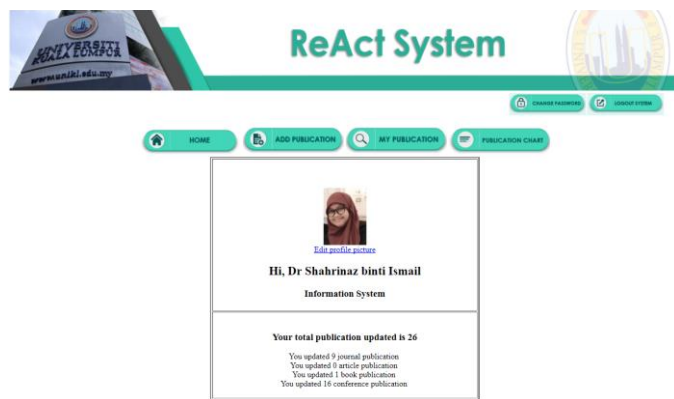


Fig. 2. Academician's home page with total research publications



Fig. 3. Administrator's home page with total publications (by campus)

Figure 4 shows the academician's view of his or her publications list. The academician can add new publication, and edit and delete the saved records of publication. He or she cannot view others' publications.

Compared to the administrator's view, he or she can view the list of all publications recorded by the academicians within the campus that he/she manages (as shown in Figure 5). Filter buttons are also available if the administrator requires the list of publications according to section, name, year, or publication type, for reporting purposes.

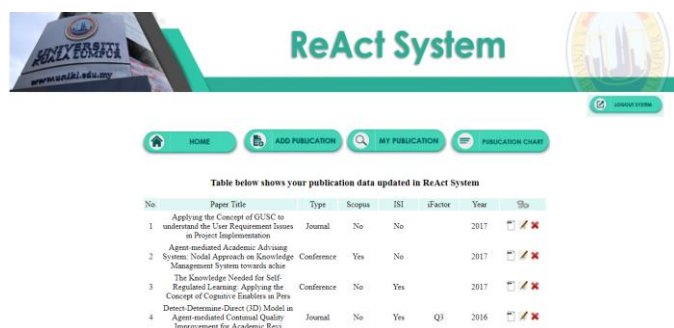


Fig. 4. Academician's research publications list

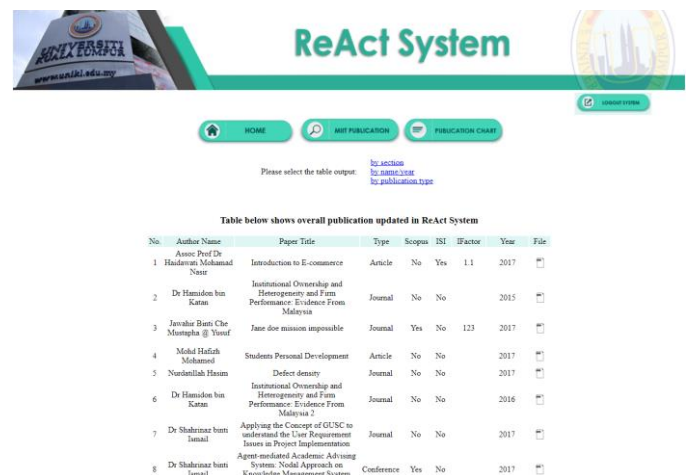


Fig. 5. Administrator's publications list (by campus)

Figure 6 shows the personal digital dashboard for academicians. The chart type is fixed to bar type for this prototype. Academician can filter the chart according to year, ample for reporting of the yearly KPI.

Compared to the administrator's view of the digital dashboard, he or she can filter the graph to present more options: overall by year; overall by section; by year and section; by publication type. These options of filter are as per the requirement by HoRI.



Fig. 6. Academician's publications chart (personal digital dashboard)



Fig. 7. Administrator's publications chart (with filters)

B. Evaluation Results

The questionnaire design distributed to HoRI, who plays the role as the administrator of the system, consist of statements on features usability from four aspects: features for users/academicians, administrator, HoRI, and overall. The measurement scale applied on these statements is the 5-Likert scale, with the following rates for the respondent to agree on: 1 for "strongly disagree"; 2 for "disagree"; 3 for "neutral"; 4 for "agree"; and 5 for "strongly agree". Figure 2 shows the results from this evaluation, with data value indicates the average result for each feature usability based on user profiles.

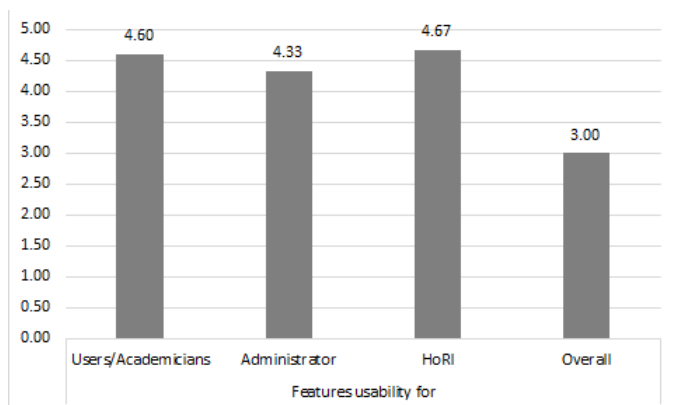


Fig. 8. Usability evaluation on features based on user profiles

The result in Figure 2 shows that the features in the proposed system is highly useful for HoRI (average = 4.67) and academicians (average = 4.60). The administrator stated in this result is meant for the employee in charge (administrative position), or HoRI's subordinate. The usability of the features for this administrative employee is considerably high as well (average = 4.33). However, the overall usability of the system is at doubt, with rating given as neutral (average = 3).

The same 5-Likert scale is used as measurement for the statements in the questionnaire designed for the academicians. The statements are divided into four elements of system evaluation: accuracy, reliability, feasibility and usability. Figure 3 shows the result from this survey, with value data stated in average.

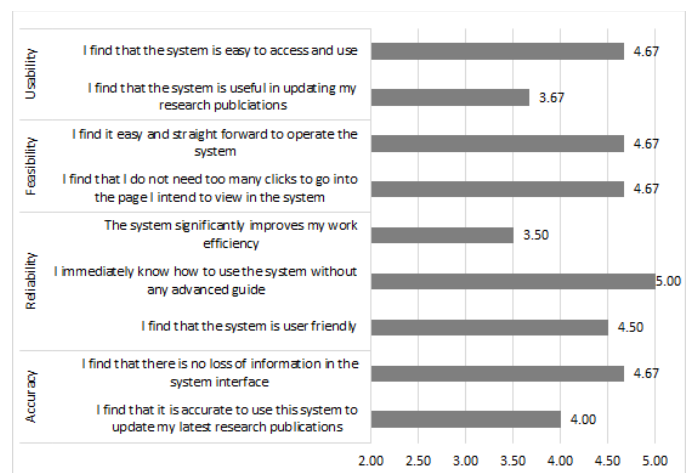


Fig. 9. System evaluation by academicians (n = 6)

In general, the proposed system is considered accurate and feasible, with high ratings given to these elements in system evaluation. Even though the highest average is on the statement "I immediately know how to use the system without any advanced guide" (average = 5.00) under the reliability test, the lowest average is also on the reliability test for the statement "The system significantly improves my work efficiency" (average = 3.5). This shows that the ease of use without advanced guidance does not mean that it can improve the user's work efficiency. In other words, there could be other factors to determine whether a system could improve a user's work efficiency, and this may be proven if the respondents are given longer duration of time to use it.

V. DISCUSSIONS

The average mark shown for one of the usability statements in Figure 3 is quite low (average = 3.67). Comparing this value with the value given for features usability for academicians in Figure 2, the difference is quite obvious. This shows the different perspectives on the system from two different employee categories. For HoRI, the system features provided for the academicians are usable, but the academicians themselves do not feel so. This may be due to the fact that there is an existing system available in the case campus (which was being upgraded during the time of this prototype development) that does not require the academicians to key in every research

publication they have. For them, the existing system may be ample or just nice. They do not see the benefit of the system features to the management of the institution.

The low average mark given for one of the reliability statements (average = 3.50) also proves that the users could not see the value of the system or how the system could give an impact on their work. If the system somehow reflects the benefit to the users, by showing an indicator or a remark that provides a feedback to the users on their progress in achieving their yearly KPI for research publication, this system may be seen as more reliable than it is. The gap between the management and the users is often on the understanding and alert on the KPI achievement. A good alignment for both parties through a projection of KPI progression in the system is recommended.

VI. CONCLUSION

This research takes into account the needs of the academic institution management, by proposing a research publication management system. Yet, it somehow comes with a lack of consideration on the perspective of data entry at the academicians' side. Nevertheless, by conducting the system evaluation on the prototype, this research has gained a new insight on how the gap between the management and the academician could be looked into by highlighting the KPI in the system interface.

Future work on this research will include improvements on the features, as well as an extension of the system by introducing the monitoring and management of the other three research activities under CoRI.

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