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# Research Support Services in Indonesian Academic Digital Libraries: A Proposed Business Model and Prototype Design

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**ABSTRACT**

Several studies have highlighted the critical role of academic digital libraries in providing research support services and improving research performance. Although several studies have discussed the value of realizing this role, a business model that can serve as a reference in carrying out this role is not yet available. This research aimed to propose a business model and a prototype design for Indonesia's academic digital library for research support services. A focus group discussion was conducted involving nine experts to identify the key factors. They were then mapped onto a Business Model Canvas. The key activities in the business model guided the requirements gathering for developing a prototype. The requirements were obtained from the literature reviews with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method. The requirements were validated by interviewing library managers, research unit managers, and information technology managers. This research resulted in the academic digital library Business Model Canvas and the proposed prototype design, which consisted of a mobile application for member users and a back-office application to manage services by librarians. Further research on prototype implementation testing and the development of a successful implementation model is needed to strengthen this research.

**Keywords:** Academic digital library; Business model; Research support services; Systematic literature review; PRISMA; Unified modeling language

## 1. INTRODUCTION

There is significant demand for improving the quality of research in higher education. Consequently, it challenges the role of libraries to meet the demand. Literature review in the recent studies discussed various activities and features related to research support services by academic digital libraries. These services demonstrate the role of academic digital libraries in the research life cycle[1]. The involvement of academic digital libraries in research support services contributes to advancing research performance in universities[2-3]. A study[4] identified the types of research support services that the academic digital libraries at adopted at the top 100 universities globally. The study demonstrated that these services have been adopted by academic digital libraries globally, especially in developed countries. They have given these services various names, such as research support and research services. Seven services were identified: research tool recommendations, research consultation, research guides, research impact measurement, scholarly publishing, open access, and data management research.

Unfortunately, the academic digital libraries in Indonesia have not adopted the services properly, and their implementation is still low. There is a need to paint a clearer picture of how academic libraries should re-think and re-design their services to support research, a process known as business process re-engineering. Although research support services have been carried out in many developed countries, no study has presented a business model that can guide the adoption of these services. The previous study only mentions issues and evidence of the existence of research support services in libraries, while in this study a business model and prototype were developed to implement the services with an academic library approach in Indonesia. The availability of the model will be helpful for library professionals in further development[5].

This study aimed to propose a business model and a prototype design as an initial recommendation on how the Indonesian academic digital libraries could carry out business process re-engineering to adopt research support services. A business model was designed, and a digital library prototype was proposed for the research support services of the academic digital libraries in Indonesia. Although academic libraries may have different service policies, the business model and prototype proposed herein can provide insights into how research support services can be carried out with the advantage of following the latest digital library development trends.

## 2. LITERATURE REVIEW

Various studies on the development of digital libraries have focused on improving service quality and user satisfaction. In

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several studies, digital service improvement was mapped onto Business Model Canvas. Some related studies provided lessons about how the Business Model Canvas is used to develop digital services.

### 2.1 The Development of Digital Libraries

Various features are developed in digital libraries by combining traditional and digital services called hybrid library[6]. Online ordering has been created to improve the physical collection lending services[7]. E-consultation with proactive chat features has complemented physical consultations[8]. Moreover, digital libraries have adopted mobile and Web applications to provide easy access to traditional library services. Some studies have revealed the benefits of adopting mobile applications in library services, foremost of which is that doing so can provide service improvement opportunities[9-10]. The National University of Tainan Library claims that the mobile applications it has adopted have increased the research convenience and have enabled it to offer more practical services[11]. Westerville Public Library improved its services by adopting mobile applications with e-commerce features and an online payment system. These applications use the shopping cart feature for ordering collections, which was adopted from the business-to-consumer (B2C) feature of the e-commerce platform[12]. Various trends in digital library development can be combined with research support services to produce an optimal business model.

### 2.2 Business Modeling

Business modeling is the inception phase of engineering workflows in information system development with an object-oriented approach. This phase is similar to the planning phase of the system development life cycle[13]. Another study suggested that business models be examined separately to gain deeper insights before adopting new business processes. The organisation may decide to adopt a new business because how to create, deliver, and capture value through such business has been defined[14]. Osterwalder[14] develops the Business Model Canvas as a tool for describing business models. The model comprises nine business building blocks: customer segments, value propositions, communication channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure. Although profit organisations have commonly used the Business Model Canvas, it has also been used by non-profit institutions such as government agencies or organisations.

The government has used the Business Model Canvas to design innovative digital services[15]. This article shows the effectiveness of the Business Model Canvas as a tool for creating digital services for the public sector. The results of this study can serve as a reference for the development of academic digital libraries that have a similar goal of providing non-profit services[15]. Other studies have shown that the Business Model Canvas can serve as an e-platform design recommendation to solve sailing tourism problems[16].

The business model adoption of a research support service will certainly change the business processes in academic digital libraries. Ching[17] stated that one of the success factors in implementing these changes is modeling business processes with Unified Modeling Language (UML), which is employed business process re-engineering. Therefore, for the analysis and design of the proposed prototype, an object-oriented approach with UML was employed. This method makes use of a use-case-driven, architecture-centric, iterative, and incremental approach[13].

## 3. METHOLOGY

This study consisted in two parts: building a business model and developing a prototype design.

### 3.1 Building a Business Model

In this study, the business model was created using the Business Model Canvas. A focus group discussion (FGD) was conducted involving five experts from academic digital libraries. They were two academic digital library heads, the digital library laboratory manager of Universitas Indonesia, and two digital library expert lecturers. Besides, the FGD was participated by three experts from research libraries and one expert from the digital library business. The expert opinions and experiences were explored in delivering research support services. Two experts from research libraries, who were more advanced in providing research support services, provided insights related to their experiences in offering such services. The FGD results were recorded and transcribed for thematic analysis. The analysis results were mapped onto nine building blocks in the Canvas.

### 3.2 Developing a Prototype Design

The prototype design was completed in three phases: requirement gathering, analysis, and design. For the analysis and design phases, an object-oriented approach with UML was used[13].

#### *3.2.1 Requirement Gathering*

Rrequirements were gathered with the business model as a guide. The critical activities on Canvas were adopted as the main functional requirements, but they were enriched with insights from the literature review. The findings from the literature review were confirmed with the library managers in IPB University and Universitas Indonesia through interviews. There was an exploration of the obstacles in research support services. Interviews were also conducted with the library manager, the research manager, and the IT manager of the Faculty of Computer Science, Universitas Indonesia, to comply with the service policies in this library as a case study.

The literature review was conducted with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline[18]. According to the actor involvement, there was a synthesis of the literature and the roles of such actors in the business processes of research support service to construct functional requirements. Only the articles published in 2015–2019 were included in the study. The keywords *academic library* and *research library* were used to obtain broader coverage. There was a literature search from the reputable Scopus database obtaining 162 records without duplication. Paper screening resulted in 76 related articles. Ten manuscripts were excluded that were not related to digital

**Table 1. Identification of the key factors of a business model based on the thematic analysis of the focus group discussion results**

| Thematic analysis | Canvas mapping |
|---|---|
| Service objective: To increase the user satisfaction | Value proposition: Provision of access to research outputs, convenience, provision of information to support research |
| Research support services business processes | Key activities of the academic digital library |
| Problems encountered in delivering the services | Key partner, key resources, software cost |
| Digital library development plan | Customer relationship, communication channels, customer segments, revenue streams |

libraries, leaving 66 records. Search for full-text articles was conducted through ScienceDirect, SpringerLink, ProQuest, IEEE Xplore, ACM Digital Library, and open-access databases. Rigorous selection related to the practice of developing academic digital libraries yielded 25 full-text articles. Three were three articles excluded because they were not in English and were too short. It left 22 articles included for qualitative synthesis.

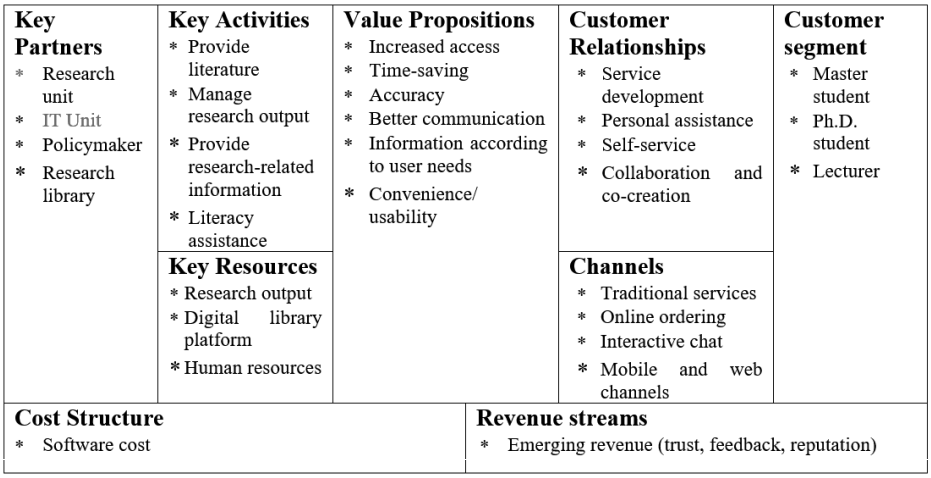


**Figure 1. Academic digital library Canvas model for research support services.**

### *3.2.2 Analysis Modeling*

At this stage, there was the analysis of the functional requirements for constructing a business process. The business processes were adjusted to comply with the service policies of the library of the Computer Science Faculty of Universitas Indonesia as a case study. Business processes and interactions with systems were modeled in the use case and activity diagrams.

### *3.2.3 Prototype Designing*

A prototype design was proposed for an academic digital library in the form of a mobile application. Mobile applications are the emerging technology that academic digital libraries can adopt. Several studies have shown that mobile applications support such libraries' research services[19-20]. Goria[5] has suggested that academic libraries develop mobile technology because it has a broader coverage and will increase the use of online resources. Madhusudhan[21] has studied the initiation of mobile information services in academic libraries, and the library application is one of the innovations that can be adopted. As of this writing, the Universitas Indonesia library does not yet have a mobile application, so the proposed prototype can also be used for testing the acceptability of the proposed mobile application in future studies.

The proposed prototype was designed with a use case orientation feature. For the interface, a detailed design (high-fidelity design) was used. The system used a Java mobile source code to design and develop the mobile library application system. Non-functional requirements were used to design the physical architecture and technical specifications to clarify how to implement the proposed prototype.

## 4. RESULTS AND DISCUSSION

This study produced two outcomes: a business model and a prototype design for research support services by academic digital libraries. The business model was designed for the general academic libraries by involving experts from various fields (library practitioners, lecturers, and businessmen). On the other hand, the prototype was designed through the case study approach, using the Faculty of Computer Science, Universitas Indonesia library as the case. There may be different requirements for different circumstances, depending on the policies of each academic digital library. Still, the developed prototype is recommended for the research support services of academic digital libraries.

### 4.1 Business Model

The FGD results were classified into four thematic groups: service objectives, service activities, problems encountered in performing services, and digital library development plan. The improvement of each group was identified as a key factor that was mapped onto the Canvas map (Table 1).

Canvas mapping describes the value of academic digital libraries' proposed research support services and how to achieve such value. The key factors are mapped onto the Canvas map, as shown in Fig. 1. The details of each key factor are discussed in the next section.

### *4.1.1 Key Partnerships*

Collaboration with research units can optimise research support services. With this collaboration, the research output resources managed by the research unit, can be served by the library either directly or only the bibliography. The concept of co-creation is applied to enable the research unit to continue carrying out its functions. The library provides a digital library

platform that improves its research functions in terms of user accessibility. This collaboration will also reduce the threat of competition between the research units and the libraries[22].

Cooperation with the Information Technology (IT) unit also needs to be carried out to develop a digital library system for research support services. IT development for libraries in universities in Indonesia is generally carried out by an IT unit that is separate from the library. Therefore, this business can be successful if the IT unit supports it.

The partnership also needs to be done with research libraries for the provision and management of research data. In Indonesia, research data management (RDM) has only been developed in several research libraries, while not in academic libraries. Academic libraries can cooperate with research libraries for access and management of research data.

Support from policymakers plays a vital role in successful collaboration with various units. This support relates to the legality of cooperation between units and also support for costs and human resources.

#### *4.1.2 Key Activities*

The key activities in the business model were formulated based on the literature review enriched by an exploration of business processes from experts. The activities include providing the literature needed by researchers, managing research output, providing research-related information (funding, research data, publications), organizing training/ workshops to improve the research capabilities of researchers, and extending literacy assistance. All of these services are the key activities proposed in the business model.

#### *4.1.3 Key Resources*

Academic libraries can optimise their resources to support research. Research output is an important asset that can be a crucial resource in running a business model. As some of these resources have been managed by research units at universities, collaboration is needed to produce optimal services. It requires appropriate collaboration methods according to the conditions of each library and research unit. An agreement between the two needs to be made for optimal resource management. The digital library platform is also an essential physical key resource required to run the business model. This resource management is supported by professional library human resources trained in managing literature.

#### *4.1.4 Value Proposition*

Changing roles and involvement in research activities in the academic environment can increase the value of academic digital libraries. Singh[23] stated that academic libraries support research through their services will provide value for users. A rise in the value of such libraries can be obtained by delivering faster services, more users, and increasing access to the collection. The increase in qualitative value is advancing the type of service provided and user satisfaction.

The types of research support services proposed were based on the increasing need of the users to improve their research performance. Many of the research-related problems that arise in the universities in Indonesia can be resolved with these services[1,24]. Access to research outputs, information on research funding, and other supporting research information benefits users from the proposed changes in the academic digital libraries' business processes. Various information guides for publication can also help researchers carry out their duty of reporting and disseminating their research results. Value is also obtained by providing a digital library platform that is convenient and has good usability.

#### *4.1.5 Customer Relationships*

Academic digital libraries' business processes need to be improved to maintain the libraries' relationships with their users for (i) winning back people who no longer use the library for information search, (ii) keeping the current library users from leaving the library and switching to other sources of information, and (iii) increasing the users' utilisation of the valuable information sources in the library[14]. These relationships are required if the academic digital libraries want to continue to exist.

Effective communication or personal assistants can advance the relationship above by improving the communication channels as previously discussed. Librarians can become subject experts and teach information retrieval skills to improve the library users' research capabilities[25]. Online ordering can also increase the effectiveness of the services, with the library users empowered to perform self-service in collecting and returning resources[12]. In conducting research, researchers often also need space to build community. The pre-existing social media has a broad community. The provision of collaboration features in the proposed business model allows the users to use the features to co-create and share information with the other academic community members, thus building research collaborations.

#### *4.1.6 Communication Channels*

The traditional library services are carried out physically and via web channels. Communication is conduct via the phone and e-mail channels. The experts in the FGD agreed on the need to improve how to communicate with digital library users. It can be done by adding a mobile channel and online ordering and chat features to advance the business processes. The mobile application was chosen to increase user convenience[19-20]. An online order can more accurately determine collection availability and enable the digital library users to save time while searching for collections[7,12]. Chat communication channels can be provided for more interactive communication[8].

#### *4.1.7 Customer Segments*

The target users of research support services in academic digital libraries are the masters and Ph.D. students and lecturers. These user groups have high literacy levels, which will affect the need for and value of the information services. The characteristics of these target users will also influence their relationships with the librarian[25]. Communication between the two should be done personally to meet the needs of the target users and for the efficient provision of research assistance.

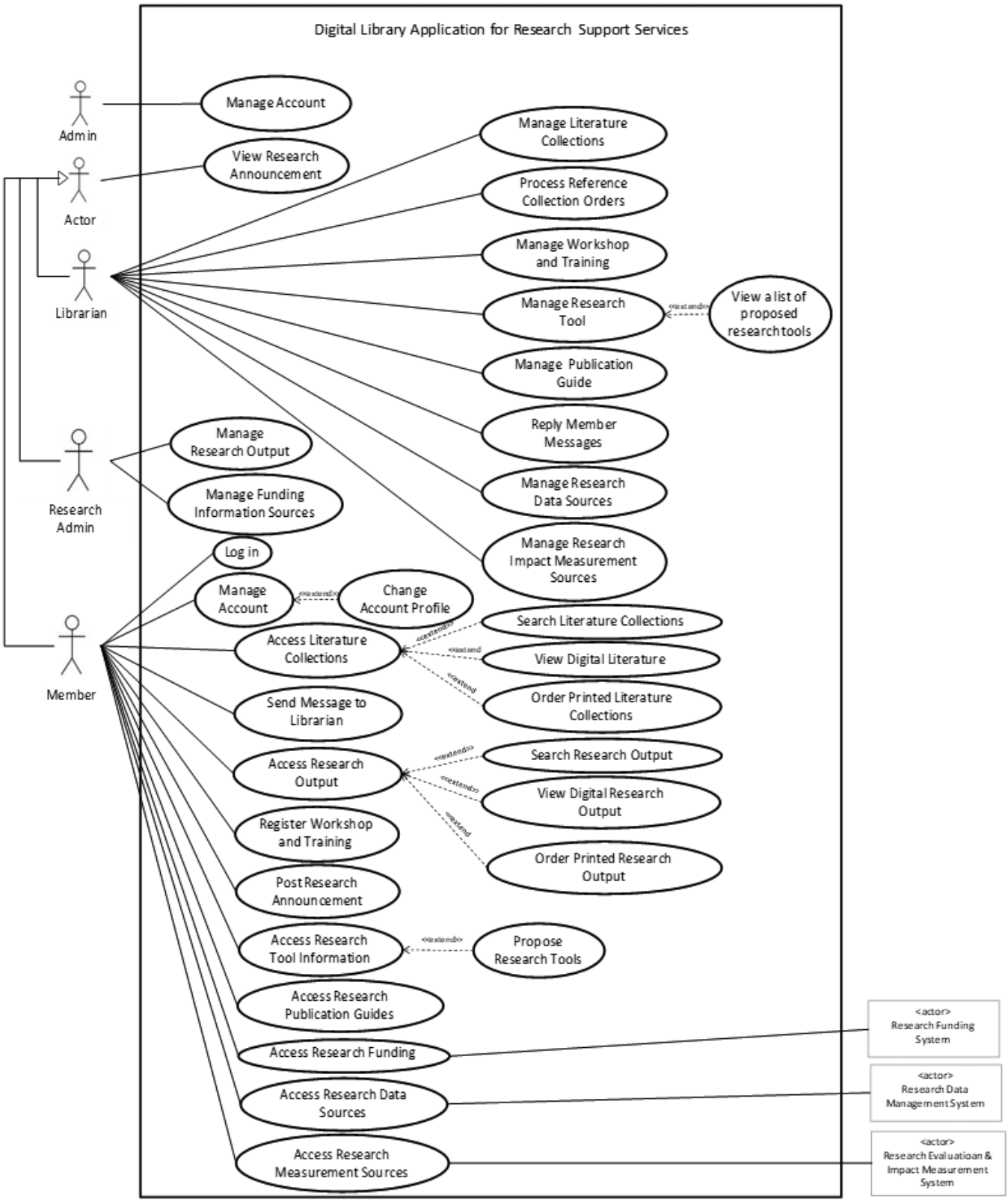


**Figure 2. Use case diagram of the digital library application for research support services.**

*4.1.8 Cost Structure*

The most considerable cost involved in providing research support services is developing a digital library information system. Academic libraries have a limited budget for system development. The highest cost allocated to subscribe to journals and other operations. Testing research support services with the available platform can generate value that can convince policymakers to give optimal budgets for the development of information systems of research support services.

#### *4.1.9 Revenue Streams*

Libraries, as non-profit organisations, do not aim to get revenue directly from their users. However, revenue can flow with the increase in funding provided by agencies for library operations[26]. The experts argue that this increase can be obtained from the emergence of trust, good feedback, and an improved library reputation due to improved services. Re-designing services in such a way as to support research is the appropriate step in enhancing the academic library services.

Academic digital libraries can use the business model above to answer the following "what" and "who" questions: What activities are required? What are the library's resources? What are the value and revenue that will be obtained? Who are the stakeholders who will carry out the business process? Meanwhile, the prototype design can serve as a recommendation on how to implement the business processes of the model.

### 4.2 Prototype Design

The research stage generated the proposed prototype design. The following explains the results obtained at requirement gathering, analysis modeling, and prototype designing.

#### *4.2.1 Requirement Gathering*

The literature review produced information synthesised from 22 full-text articles. The results were encoded based on the type of service, the actor, and the practice of organizing the digital library. The literature review provided evidence of research support services that have been developed in digital libraries, which are divided into six groups: scholarly publishing access, research result dissemination, research data management, research consultation, and capacity building, repository, and research tool and research guide[3,22,27-44]. Research funding and collaboration services have not been developed in digital libraries. The data obtained from the interviews with library managers align with the findings obtained from the literature review. The research support services that are widely implemented are scholarly publishing access (digital and physical), research consultation and capacity building, and the use of research tools and guides. These services are accessed online but on separate platforms. For example, consulting services are carried out through e-mail media. The interviews with the library and research managers stated that it is difficult for the library to obtain research funding data. Besides, there were separate units that manage research data and research impact. It indicates that the actors involved in the developed system are human actors (end-users and librarians) and other system actors. These are research data management, research impact measurement, and research funding management.

No research evidence of integrating all the research support services in a digital platform has been found. As proposed in this study, integrating all the research support services will make it easy for the users to avail themselves of such services. The results of the literature review and interviews enrich the insight in gathering requirements that are taken based on critical factors in the business model.

#### *4.2.2 Analysis Modeling*

Based on the requirements analysis in this study, a business process model was proposed for research support services presented in use case and activity diagrams. There are three primary actors in the proposed prototype: the members, librarians, and research administrators. An "admin" actor, not directly related to the service, is added to manage all accounts on the system. The actor interaction with the system can be seen in the use case diagram (Fig. 2).

Nine use cases were analysed by member actors, eight use cases by librarians, and two use cases by research administrators. Member has use cases manage account, access literature collections, send message to the librarian, access research output, register workshop and training, post research announcement, access tool information, and access research publication guides. Some use cases are related to other systems, namely access research funding, access research data

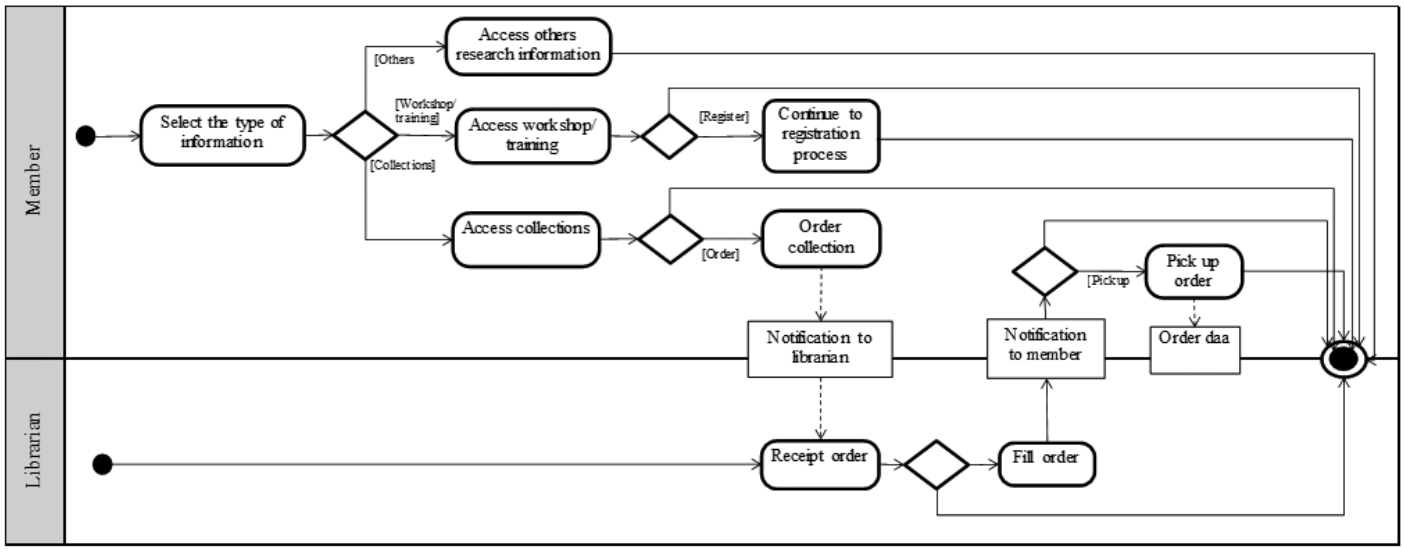


**Figure 3. Activity diagram of the information access business process in academic digital libraries as part of the research support services.**

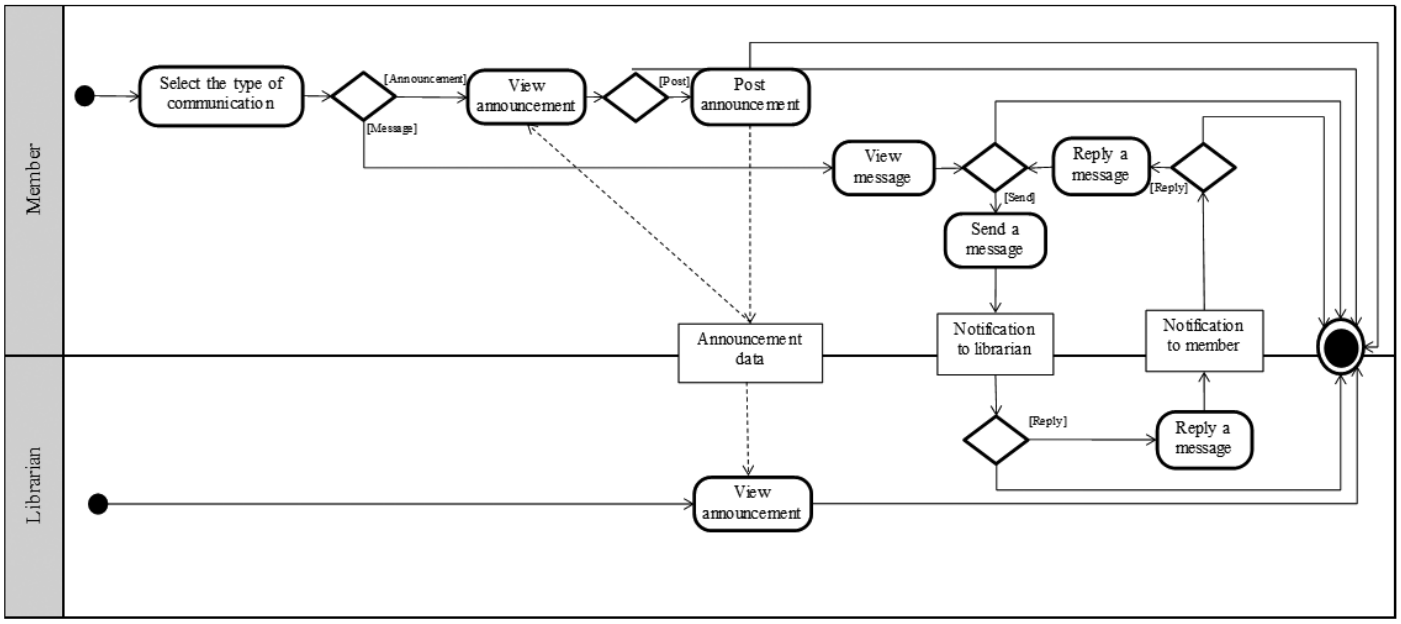


**Figure 4. Activity diagram of the research communication business process in academic digital libraries as part of the research support services.**

sources, and access research measurement sources. Librarians and research admin have use cases that aim to provide services related to member use cases. (Fig. 2).

As the proposed business process model involves a unified, use-case-driven process, each use case is a significant feature in the interface design, which will be explained in greater detail in the design section of this paper.

This article presents an activity diagram to illustrate the leading business process workflow (high level). There are two primary business processes: information access and research communication. The information access process consists of collections (publications and research results), workshops/ training, and other specific information related to research support (Fig. 3). Collection access involves interaction between the members and librarians for ordering collections. The collection ordering process starts when a member finds a physical collection search result. There is an "order" button that will notify the librarian when clicked. The librarian responds by preparing the ordered collection and providing notification of the collection's availability. Members pick up the collection at the place specified by the librarian. This activity is not available in the traditional system. This feature is proposed to improve the convenience and accuracy of the collection access service and the users' satisfaction with it. As for workshops/ training, they can be held not only by the library but also by the research unit. The primary process, registration, often uses widely available online forms. Thus, in the proposed system, the registration process is outside the scope of activities.

The second activity diagram illustrates the communication research business process. There are two types of communication: announcement and chat (Fig. 4). Announcements are activities conducted by the members to communicate with the other members (forging research collaborations, putting together a research team, or obtaining research feedback). Chat, on the other hand, is a communication activity between the members and the librarians. It is a cyclical process, where the members and librarians can send messages to each other and reply to their received messages.

### *4.2.3 Designing the Prototype*

The application was designed to have two parts: a mobile application for the member users and a back-office application for the librarians' management of the services. The mobile application has 11 main functional features. The common feature of the digital library is the general library information (operating hours, location, contact details) and account function. This unique function consists of providing library information through improved research support services incorporating the current technology. The interface designs of the mobile application and back-office application are shown in Fig. 5 and Fig. 6, respectively.

Access to literature collections in all libraries is divided into two types: digital and physical collection access. Access to digital collections varies depending on the policies of each library. At the Computer Science Faculty of Universitas Indonesia library, digital collections can be ordered at the library location by filling out a printed form. Then the librarian sends the digital collection via e-mail. As for the printed collections, they can be ordered only by coming directly to the location. The proposed prototype provides a facility for ordering digital and physical collections online. When a user requests a digital collection online, the librarian gets a notification of the collection order and sends the collection via e-mail. The online ordering of physical collections guarantees that the physical collections to be borrowed are available in the library[12]. The application can expedite the library's delivery of the physical collections ordered by the users with further development. This combination of services adopts the B2C e-commerce concept, where a digital platform accommodates the online ordering of physical products and services.

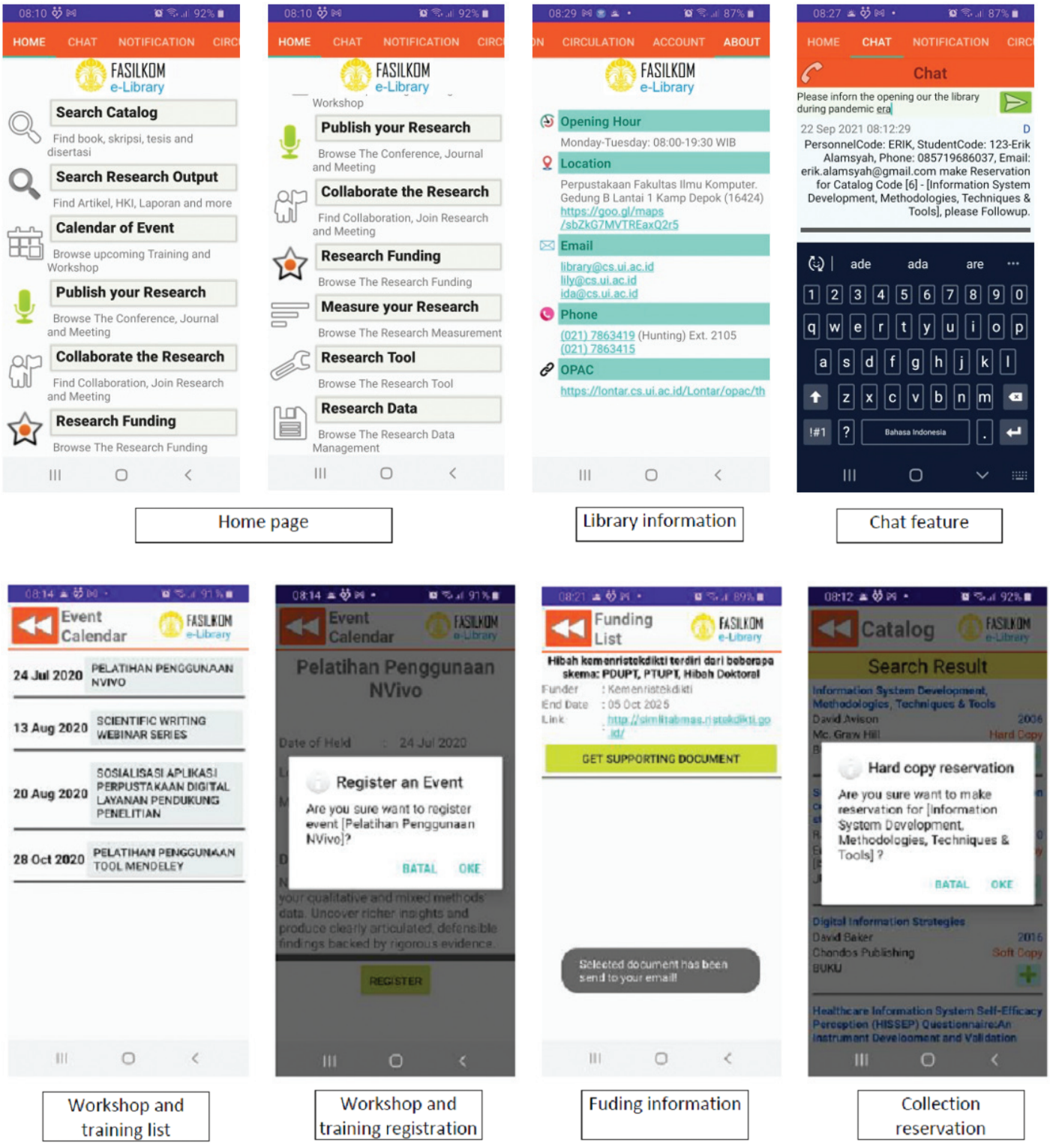


**Figure 5. Interface designs of the mobile library application for research support services in the academic digital libraries in Indonesia.**

The management of research outputs in an academic environment is different from that of a research institution. The research outputs at the universities in Indonesia are managed by a unit separate from the library. The research outputs at research institutions are governed by libraries, which are often called repositories. Therefore, the academic libraries in Indonesia need to collaborate with research units in providing access to research outputs. The proposed prototype accommodates the role of the research units in managing the research outputs.

Training/workshops have been organised separately by the libraries and research units in Indonesia to improve the research capabilities of researchers. Such training/workshops, however, have not been adequately managed. The proposed prototype provides opportunities for collaboration between

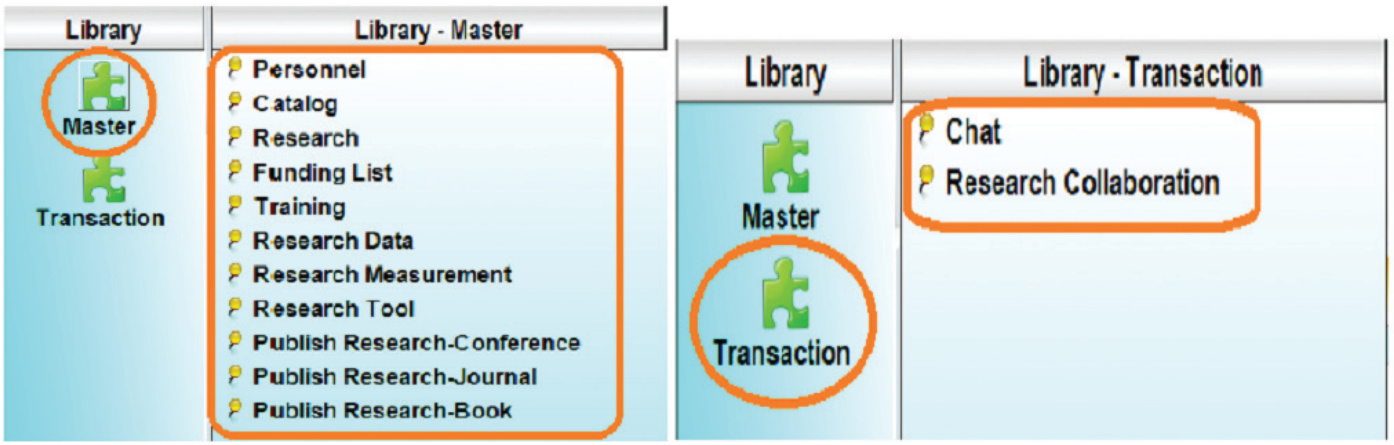


**Figure 6. Interface design of the back-office application for research support services in the academic digital libraries in Indonesia.**

**Table 3. Minimum specifications/standards of the proposed academic digital library mobile application for research support services**

| Specification | Standard client | Standard server | Standard mobile application | Standard database server |
|---|---|---|---|---|
| Operating system | Windows 10 | Windows 10 | Android OS Ver. 8.0 | Windows 10 |
| Special software | Acrobat reader | | Acrobat reader | Microsoft SQL Server |
| Hardware | Intel Core i3<br>8 GB Memory<br>80 GB Disk Drive | Intel Core i5<br>8 GB Memory<br>80 GB Disk Drive | 2 GB Memory | Intel Core i5<br>8 GB Memory<br>80 GB Disk Drive |
| Network | 100 Mbps ethernet | 100 Mbps ethernet | 100 Mbps ethernet | IP Public-Static / DNS |

libraries and research units in organizing training/workshops with better management. Users can register for workshops through the application, and the event manager can monitor the number of participants.

The "publish your research" feature is used by researchers to provide the information needed to publish their research outputs (related to guides, conferences, publishers, etc.). The provision of this information is expected to improve the quality and quantity of research publications at universities so that libraries can play a better role in enhancing the university's research performance.

A successful study often requires collaboration. This can be in the form of data collection assistance, search for respondents for trials, etc. Moreover, researchers often harness social media to seek potential collaboration. Therefore, the proposed application helps researchers collaborate with others in a university environment via a research collaboration feature.

The physical architecture of the proposed application was built based on non-functional requirements. In this architecture, the client computer processes the back-office applications used by the librarian and research administrator to carry out the collection and information management process. The server has the function of providing data access and storage. The e-library application can run on a version 8 or higher Android system. The digital library system can be installed on Android smartphones, tablets, and other mobile devices. The recommended minimum specifications/standards for running this prototype can be seen in Table 3.

This study had limitations, foremost of which was that the developed prototype was only a mobile application. This initial design, however, can be further developed to come up with a Web version. Further research on prototype implementation trials and the development of a successful business process re-engineering model in academic libraries is needed to strengthen this research.

## 5. CONCLUSION

The business model developed in this study has nine key factors recommended for use by academic libraries that will create digital libraries for research support services. The value and revenue obtained from using the model can encourage academic libraries to adopt it. Key activities and communication channels can provide insights for comparison with the existing services. An essential resource and cost structure are potential references for preparing the required resources.

In this study, a prototype design of an academic digital library was generated to implement the developed business model. The proposed design integrates all research support services with UML. Further research evaluating the prototype will enhance its effectiveness. A development implementation model is needed to support this research.

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