Information and communication technology application improved higher education accreditation management

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Abstract. Higher education study program undergoes periodic feasibility assessment on nine accreditation standards compliance held by the National Higher Education Accreditation Board (BAN-PT). The process consists of three stages: evaluation of data and information, determination of accreditation status, and monitoring of accreditation status. However, presently data and information collection use manual methods that slow down the process and sometimes create inconsistencies. This study aims to take advantage of the information and communication technology (ICT) by developing a web-based undergraduate study program accreditation information system called Simaprosa. The developed system used two iterations of the prototyping method and utilized the Laravel 5.5 framework. Further, the developed system was tested using the black box method. The results of this study were that Simaprosa facilitated higher education study programs in managing and collecting data to satisfy nine accreditation standards: 1. Vision, Mission, Goals, and Strategies; 2. Governance and Cooperation; 3. Students Affairs; 4. Human Resources; 5. Finance, Facilities, Infrastructure, and Information Systems; 6. Learning Systems; 7. Research; 8. Community Services; and 9. Results and Latest Achievements. Users’ feedback results showed that all functions were satisfying according to users’ needs. Remind that users of Simaprosa followed the department and faculty organizational structures. On department level, the users comprised of Department Head, Department Secretary, Education Commission, Administration Head, and Treasurer. On the faculty level, the users comprise of Administration Head and Treasurer. In addition, the department and faculty level were granted personal Admin and Super Admin.

1. Introduction

Every five year each Indonesian private and state higher education institution (HEI) are compelled to measure their education quality achievement using HEI accreditation instruments. The measurement results are further submitted online to the HEI National Accreditation Body (BAN-PT). According to paragraph 1 Article 55 of the Law of the Republic of Indonesia number 12 the year 2012, accreditation is aiming to determine the feasibility of the study program and the HEI on the basis of its compliance to the standards determined by the National Standards of Higher Education (SN-Dikti). Every HEI submits its achievement six months prior to its accreditation expiration date [1]. The 2008 BAN-PT uses seven standards of measurement, while the 2017 BAN-PT uses nine standards of measurement. Previous BAN_PT assessment results are compiled into Study Program Accreditation Report (Document 3A) and...
Faculty Accreditation Report (Document 3B). Whereas, the latter BAN-PT does not employ the Faculty Accreditation Report. Instead, the latter BAN-PT uses Study Program Performance Report (LKPS) to further analyze and compose into Study Program Self-Evaluation Report (LED).

Both editions use preformatted instruments to measure their compliance with the accreditation standard. The accreditation instruments contain specified data and information that apply for a specific study program or HEI. In general, the accreditation process consists of three stages: evaluation of data and information, determination of accreditation status, and monitoring of accreditation status [2]. The 2008 BAN-PT accreditation assessment is now in the phasing out process, while the 2017 BAN-PT is in effect starting in mid-2019. This study uses the 2019 BAN-PT and applies to several of the nine study programs of the Faculty of Mathematics and Natural Sciences of IPB University (FMIPA) as a case study. Overall, the FMIPA study programs are Statistics, Applied Meteorology, Biology, Chemistry, Mathematics, Computer Science, Physics, Biochemistry, and Actuarial [3].

In general, the LKPS demands five-year determination and aggregation of data and information originating from nine BAN-PT standards, i.e. 1) Vision, Mission, Goals, and Strategies; 2) Governance and Cooperation; 3) Students Affair; 4) Human Resources; 5) Finance, Facilities; Infrastructure, and Information Systems; 6) Learning Systems; 7) Research; 8) Community Services; and 9) Results and Latest Achievements. Most study programs at FMIPA experiencing difficulties in processing and updating data and information. This is because the accreditation data and information was gathered and processed manually which causes the slow preparation of the LKPS and LED. Further, on the finance standard, general ledger compilation was carried out manually using MS Excel and MS Word. The finance data sometimes were incomplete, inconsistent, or out of date. Based on these cases, ICT application that integrates and links data and information within the study programs is in need. Therefore we developed a web-based undergraduate study program accreditation information system called Simaprosa.

In 2014 studies regarding several standards of the 2008 BAN-PT were developed. These studies were a human resource standard development [4], academic and infrastructure facilities standards development [5], and a financial accreditation standard development [6]. Further, in 2016 a web-based information system for academics standard for study program accreditation was developed [7]. Following that, in 2016 a dashboard system for the preparation of undergraduate study program accreditation based on 2008 BAN-PT Standards was developed [8]. All these studies were developed as separate applications; it did not utilize the whole seven standards of the 2008 BAN-PT in one application.

In this study, the developed Simaprosa is focusing on the latest BAN-PT nine accreditation standards released in 2018. The developed system was expected to facilitate FMIPA and its nine study programs in collecting and integrating accreditation data and its related information. It was hoped that the data and information in the LKPS and the LED Reports are in accordance with the latest standards and timely submit to be assessed by BAN-PT. Simaprosa system development uses a 2-iteration of paradigm prototyping methods and utilizing the Laravel 5.5 framework which applied the Model View Control (MVC) concept and PHP programming language. Laravel was developed specifically for PHP 5.3 [9]. Laravel helps the developers in the development process creation to be easier while supporting the functionality of the applications developed. MVC separates applications based on application components such as data manipulation, controller, and user interface. In applications that use the MVC pattern, the controller acts as a link between the model and the view [10]. Here, the prototyping method was chosen because our users were unable to identify detailed requirements. This method provides good communication between the developer and the user to achieve a more reliable developed system.

2. Methods
The materials used in this study were the BAN-PT instruments downloaded from https://banpt.or.id/download_instrumen. The instruments are used to record and measure each of the following nine accreditation standards: 1. Vision, Mission, Goals, and Strategies; 2. Governance and Cooperation; 3. Students Affair; 4. Human Resources; 5. Finance, Facilities, Infrastructure, and
Information Systems; 6. Learning Systems; 7. Research; 8. Community Services; and 9. Results and Achievements. As a sample, we used the Computer Science study program of data and information.

The study started with the communication stage aimed at determining software requirements to be developed. This was carried out by interviewing various users at the study program and faculty that were in charge of managing related data and information (Figure 1). Prior to conducting the interview, we prepared questions such as constraints experienced during the formulation of accreditation instruments, users of each standard, and coordinator of each study program. The results of the interview were user requirements to manage data and information to be entered into the related instruments. Further, we carried out a quick plan stage followed by modeling quick design. In the quick plan stage, the results were represented in use case diagrams, use case descriptions, and activity diagrams. The resulted quick plan was further discussed with users so that researchers and users were on the same system description.

In the modeling quick design, we focused on representation aspects of the developed application that would be accessible to end users at each study program and faculty. To do this we created a human interface layout mimicking the layout of the BAN-PT instruments while at the same time considering users comfort and convenience in entering data and information. In addition, we carried the database analysis by utilizing class diagrams and sequence diagrams.

Following that, we continued to the construction of the prototype. The prototype was made with the Laravel 5.5 framework which applied the Model View Control (MVC) concept. The prototype was then deployed, delivered, and evaluated using the black box method. During the evaluation, study program and faculty users provided feedbacks that were used to further refine requirements. Iteration occurs on the condition that the prototype was not in accordance with user requirements; hence the prototype must be revised and returned to the communication stage.

![Figure 1. SIMAPROSA followed prototyping paradigm [11] because end users were unable to identify detailed functions and features requirements.](image)

3. Results and Discussion
Since April 10, 2017, the submission of the 2008 BAN-PT accreditation, i.e. the 3A (study program level) and 3B (faculty level) documents have been carried out through Online HEI Accreditation System called SAPTO (Sistem Akreditasi Perguruan Tinggi Online). The process of accreditation with SAPTO begins with HEI uploading an accreditation proposal online through SAPTO. Then the BAN-PT examines the documents and assigns assessors. Further, assessors receive assignments and conduct an assessment on adequacy (AA) and followed with field assessment (FA). The assessor provides the results of AA and FA. BAN-PT validates the results of AA and FA as well as issues decisions on accreditation results into SAPTO. Lastly, HEI receives the accreditation results (Figure 2). The LKPS and the LED reports of the 2017 BAN-PT also utilize the SAPTO mechanism.
3.1. Communication

The results of the communication stage we performed to nine study programs and the faculty were summarized in Table 1. The table showed that general data and information update frequencies were varied mostly by its happenings at any time throughout the year. Users at the study program and faculty were differentiated between a user who can only view (read-only, denoted by ‘-’ symbol) and update (read and write, denoted by ‘+’ symbol). Each study program had different user assignment. In addition to end users, the study program also has an admin who acts as the coordinator of the whole accreditation preparation yielded in the LKPS and LED Accreditation Report. For this reason, each study program asked for super admin to manage the whole standards and admin to manage a specific standard. In this study, different appointed users were given different logins and access privileges depending on their respective roles. Remind that, super admin also gave the right to enroll new users and granted access privileges accordingly.

Users at the study program and faculty both stated that there are information systems available at the university level that might be related for accreditation. The university organizes at least six information systems related to data and information to be used for BAN-PT instruments as depicted in Table 2. Most of the systems were developed and deployed by relevant directorates (read and write, denoted by ‘+’ symbol). However, the owner of the data and information send their data and information to the systems over preformatted worksheets. Neither study program, department, nor faculty granted direct access or web services to input or get raw data contained within the systems (denoted by ‘-’ symbol). In this study, we were unable to export data from existing systems into the developed Simaprosa. Hence, we provided create, read, update, and delete (CRUD) features on each BAN-PT instrument that demanded data and information.

Table 1 Data and information update frequency and various users at study program and faculty level of each BAN-PT Standards.

| Standard Number | Number of Instruments | Update Frequency | Study Program Users | Faculty Users |
|-----------------|-----------------------|------------------|---------------------|--------------|
|                 |                       | By Occurrence | By Study Program | By Faculty |
| 1               | 4                     | Monthly        | Head Dept.         | Treasurer   |
| 2               | 3                     | Annually       | Head Secretary     |            |
| 3               | 3                     | Biannually     | Head of Study Program |            |
| 4               | 7                     | Annually       | Education Commission |            |
| 5               | 7                     | Biannually     | Commission         |            |
| 6               | 12                    | By Occurrence  | Lecturer           |            |
| 7               | 1                     | Annually       | Administration Staff |            |
| 8               | 1                     | Biannually     | Academic Staff     |            |
| 9               | 3                     | Annually       | HR Staff            |            |

Remarks: Standard No.
1 - Vision, Mission, Goals, and Strategies
2 - Governance and Cooperation
3 - Students Affairs
4 - Human Resources
5 - Finance, Facilities, Infrastructure, and Information Systems
6 - Learning Systems
7 - Research
8 - Community Services
9 - Results and Achievements

Table 2 Related information systems and its owner that might be a source of data for BAN-PT Accreditation Instruments.

| Standard Number | SIMAK | SIMAKER | SIPAKARIL | SIMPEG | SIMKEU | SPMI | Related Existing Institutional Information Systems | Data Owner |
|-----------------|-------|---------|-----------|--------|--------|------|---------------------------------------------------|------------|
| 1               | +     | +       | +         | +      | -      | +    | Lecturer                                          | +          |
| 2               | +     |          |           |        | +      | +    | Study Program                                     | +          |
| 3               |        | +       |           |        | -      | -    | Department                                        | -          |
| 4               |        |          |           |        | -      | -    | Faculty                                           | -          |
| 5               |        |          |           |        | -      | -    | Directorate                                       | +          |
| 6               |        |          |           |        | -      | -    | Institution                                       | -          |
| 7               |        |          |           |        | +      | +    | Study Program                                     | +          |
| 8               |        |          |           |        | +      | -    | Study Program                                     | -          |
| 9               |        |          |           |        | +      | -    | Study Program                                     | -          |

Remarks: Standard Number 1 to 9 – the same as in Table 1
SIMAK - Academic Information System
SIMAKER - Performance Management Information System
SIPAKARIL - Information System for Assessing Credit Numbers and Scientific Works
SIMPEG - Personnel Information System
SIMKEU - Financial Information System
SPMI - Internal Quality Assurance System

3.2. Quick Plan
Following update frequencies and various users as denoted in Table 1, we developed use case diagram consisted of Manage Standard 1 to Manage Standard 9 use cases with extend CRUD and include Login use cases accordingly. The use case diagram is depicted in Figure 2. Each use case was accompanied by a use case description and relevant activity diagrams. The data and information required for each accreditation instrument were summary data at the study program level. In addition, for each use case, we provided features such as search data, download template, download data, upload data, upload attachments, download attachments, view reports, and download reports. Also, in addition to study programs and faculty actors, we added admin for each study program and super admin for the faculty to manage various users. During this stage, we decided that the development process was carried within two iterations at the most.
3.3. Modeling Quick Design

During modeling quick design we focused on the software user interface that will improve end users understanding regarding Simaprosa. Prior to that, we developed a class diagram and sequence diagram. We used class diagrams to explain the relationships between classes and their attributes in Simaprosa and ways that they collaborate with each other to achieve its objectives. Further, sequence diagrams were used to show how objects interact with each other along with the sequence of occurrence of these interactions and focus on message interchange between lifelines (objects). Figure 3 showed a sequence diagram scenario to input research data. When a user logged in, the user then selected the standard for data to be inputted. Users added data and saved the data into the database. Before that, the system checked for the validation of the data entered, if the data was valid, then the data was stored in the database and the system displayed a message that the data was saved successfully.

![Sequence diagram](image)

**Figure 3.** Simaprosa use case diagram developed for 9 BAN-PT standards’ instruments.

Following class diagrams and sequence diagrams creation, we employed mockups to provide the most interactive aspects of the human interface layout or display output format (Figure 4). A mockup is a static high-profile visual design draft of a design, used to represent the structure of information, visualize the content, and demonstrate the basic functionalities in a static way. Remind that SAPTO in total has 41 accreditation instruments that must be fulfilled by each study program/faculty (see Table 1). Hence, we need assurance that all end users approved the mockups we created.

![Mockup diagram](image)

**Figure 4.** Sequence diagram adds Simaprosa research data.
3.4. Construction of Prototype

The prototype was constructed using the Laravel 5.5 framework with a design pattern model, view, and controller (MVC) and the PHP programming language. The model is used as a database and controller link. The controller connects the model to the view. The next process is making a view. In this system, the view uses the interface of Admin LTE. Figure 5 showed an example of a research controller that displayed and took a request, initialized, called a research model and then took the response, then sent it to the view. The result was shown in Figure 6 (left side). At this point, upon selection of Standard 7 menu, users can add, upload, change, and delete data by selecting the 'Add', 'Upload', 'Change' and 'Delete' buttons. We also provided the 'Resume' button to ascertain the number of research titles, number of proposals, and the results of research that have been added into the system. We also provided 'Editor' to add the editor as a complement to the Standard 7 requirement. The right side of Figure 6 showed three submenus of Standard 5, i.e. Permanent Lecturer Workspace (Ruang Kerja Dosen Tetap), Infrastructure Data (Data Prasarana), and Supporting Infrastructure Data (Prasarana Pemunjang). On this page, users can add, change, or delete data as required. In addition, users can download the reports in pdf or spreadsheet format.

```php
$penelitian = DB::table('penelitian')->where('tahun_penelitian', ['=', $tahun])->get();
$totaldana = DB::table('penelitian')->where('tahun_penelitian', ['=', $tahun])->sum('dana_dana');
$totaljudul = DB::table('penelitian')->where('tahun_penelitian', ['=', $tahun])->count('judul_penelitian');
$sktli_penelitian = DB::table('sktli_penelitian')->where('id_departemen', $id_departemen)->get();
$proposal = DB::table('proposal')->where('id_departemen', $id_departemen)->get();
```

![Figure 5. Mockup medium-fidelity of Standard 5 on Sistem Informasi submenu and Perangkat Keras sub-sub-menu (left) and prototype results for each navigation menus and submenus for Standard 1 to 9 (right).](image)

![Figure 6. Sample of controller processed research data to be linked to the view component.](image)
Figure 7. Display of dummy Standard 7 research data (left) and Standard 5 infrastructure (right) that utilized the link among model, view, and controller within the MVC model.

Remind that in general, the MVC process begins when the user uses the controller to run a function, process the function or command from the user and then determine how the application is run. Model is the role that connects the controller to the database, this model manipulates data in the databases such as create, read, update, and delete (CRUD). Data obtained from the model will be processed by the controller and then the view is displayed to the user [12]. Here, the MVC process on Laravel was starting when the user's submitted a request. The request was then routed to the appropriate controller. Further, the controller interacted with the model and the database. After that, the controller assembled the view result and displayed it on the browser.

3.5. Deployment, Delivery, and Feedback

The prototype created was delivered and deployed to study programs and the faculty. Prior to the deployment and delivery stage, we applied the black box testing method focusing on system functionality. The test results were that all functions run successfully as intended to be. However, as their feedback, the users asked for additional attributes or enhancement on Standards 1, 2, 5, and 7. Those users were Statistics Head of Administration and Infrastructure Commission, Chemistry Head of Administration and Treasurer, Computer Science Head of Administration, and Biology Secretary.

Following the above users' feedback, we performed cycle 2 of the prototyping stages. In Standard 1, the user requested additional attributes for attachment code and attachment cabinet/shelf. In Standard 5, users requested for additional length and width attributes in the infrastructure table, including asked for the addition of procurement dates and prices in the Main Tools table in the Lab. Users also asked for the addition of publisher attributes in the Journal/Proceedings table. In Standard 7, users asked for additional attributes on the number of students involved. The construction results were depicted in Figures 7, 8, and 9.

Lastly, on cycle 2 deployment and delivery stage, the users gave no further feedback, and hence the development of Simaprosa was accomplished. The web-based Simaprosa and sample of the LED produced were depicted in Figure 10. Upon final deployment and delivery, we inquired persons in charge of each study program and faculty to update every occurrence related to accreditation instruments in their sites. This way, anytime the LKPS along with LED reports is uploading into SAPTO then the data and information contained within will be up-to-date. This is aiming to enforce the uses of ICT application efficiently in managing accreditation data and information.
Figure 8. Attachments code and cabinet/shelf attributes were added to Attachment of Standard 1.

Figure 9. Infrastructure Data menu after addition of length and width attributes.

Figure 10. Main Equipment in LAB (peralatan umum di lab) after addition of unit price, amount of price, and date of procurement attributes.
4. Conclusion

In conclusion, the web-based Undergraduate Accreditation Management Information System, called Simaprosa, was successfully developed using two cycles of prototype paradigm approach. The construction of the Simaprosa employed model, view, and control (MVC) approach and the PHP 5.3 programming language. The study accommodated 41 accreditation instruments contained within the latest nine accreditation standards determined by SN-Dikti and assessed by appointed BAN-PT assessors. Web-based Simaprosa was deployed and delivered to nine study programs and the faculty and is accessed accordingly. The existence of Simaprosa helps study programs in preparing the LKPS and the LED assessment reports. The HEI accreditation period is every 5-year assessment period. Each study program has a different assessment schedule, therefore it is necessary that data and information belong to each study program are updated continuously so that the aggregated data are current. Simaprosa has allowed this to happen. Further research may be able to integrate Simaprosa with available information systems at IPB that have relevant links with accreditation data. These IPB information systems are SIMAK - Academic Information System, SIMAKER - Performance Management Information System, SIPAKARIL - Information System for Assessing Credit Numbers and Scientific Works, SIMPEG - Personnel Information System, SIMKEU - Financial Information System, and SPMI - Internal Quality Assurance System.

References

[1] [BAN-PT] Badan Akreditasi Nasional Perguruan Tinggi. 2018. Akreditasi program studi. Jakarta. [Internet]. [Accessed September 15, 2018]; Available at http://banpt.or.id/download_instrumen

[2] Sukamto ST, Nugroho LE and Winarno WW 2016 Desain sistem informasi akreditasi program studi berbasis website di Indonesia [Proceeding]. ISSN: 1907-5022

[3] [FMIPA] Fakultas Matematika dan Ilmu Pengetahuan Alam. 2017. Program Studi Sarjana. [Internet]. [Accessed May 11, 2018]. Available at http://fmipa.ipb.ac.id/akademik/program-studi/sarjana

[4] Darmawan FK 2014 Pengembangan modul sumber daya manusia pada sistem informasi akreditasi program studi menggunakan agile unified process. Bogor (ID): Institut Pertanian Bogor

[5] Bhayuaji AR 2014 Modul akademik dan modul sarana dan prasarana dalam sistem informasi akreditasi program studi (SIAPS) untuk Departemen Ilmu Komputer. Bogor (ID): Institut Pertanian Bogor.

[6] Maulana RR 2014 Pengembangan modul keuangan pada sistem informasi akreditasi program studi (SIAPS) menggunakan Agile Unified Process. Bogor (ID): Institut Pertanian Bogor.
[7] Nurmiati S and Munandar H 2016 *Sistem informasi kegiatan akademik untuk akreditasi program studi berbasis web studi kasus Program Studi Manajemen Sumberdaya Perairan – IPB. Bogor (ID) [Internet] [Accessed May 16, 2018]; Available at https://is.its.ac.id/pubs/oajis/index.php/file/download_file/1614

[8] Raditya AA, Kartono and Raharjana IK 2016 *Sistem dashboard untuk persiapan akreditasi program studi sarjana berdasarkan Standar BAN-PT: Palembang (ID) [Internet] [Accessed May 16, 2018]; Available at https://ejournal.unsri.ac.id/index.php/jsi/article/view/2956

[9] Otwell T 2015 *Architecture of Laravel Applications*. [Internet]. [Accessed May 17, 2018]. Available at http://laravelbook.com/laravel-architecture

[10] Simanjuntak P and Kasnady A 2016 *Analisis model view controller (MVC) pada bahasa PHP*. Batam (ID) [Internet] [Accessed May 16, 2018]; Available at https://ejournal.medan.uph.edu/index.php/isd/article/download/80/10

[11] Pressman RS, Maxim BR 2015 *Software engineering a practitioner’s approach*. 8th Edition. New York (US): McGraw-Hill.

[12] Susanto MI, Darwiyanto E and Wisudawan GAA 2015 *e-Proceeding of Engineering* 2(3) 7731.