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A Geographic and Analytic System for the Stock Assessment Program of National Fisheries Research and Development Institute

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Abstract. The fisheries sector, with its immense contribution to national welfare in terms of economic benefits and food security, is beset by various problems such as excessive and destructive forms of fishing that push the resources and the industry to a critical state. In response, the National Stock Assessment Program (NSAP) was created as a regular program of the Bureau of Fisheries and Aquatic Resources (BFAR) that intends to generate reliable data as a basis for the formulation of policies for the management and conservation of the country' capture fisheries resources in order to attain resource assessment and management. However, information on fish stocks recorded in NSAP is not publicly accessible. Thus, there is a need to develop a web-based system that can be openly explored by stakeholders, fisherfolk, and the populace for informative purposes and to raise awareness about the status of the Philippine fishery. A web-based Geographic Information System (GIS) with analytical and centralized system administration was developed to answer the limitation of the previous program. The research used the agile methodology as its development cycle and adopted ISO 25010 as its evaluation for software product quality standards. Based on the assessment of the end users, and IT experts, the system scored an excellent status with highly acceptable quality, which means that the study methodology was successfully implemented. Moreover, this research paper is important since it can be used as a reference for the continuation of development in relation to fishery management. The product result of the study is significant since the system can contribute to managing and monitoring the country's fish stocks.

Keywords: Analytical System; Fisheries; Geographic; Software Developmen; Web-Gis;

1. Introduction

The National Stock Assessment Program (NSAP) was implemented to give continuous information on fishery resources such as fish catch statistics and biological information, which are fundamental for fisheries management. It was

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conceptualized to provide standardized, specific, and time-series information on capture fisheries for the management of the country's marine resources.

The NSAP is the sole source of time-series fish stock assessment data in the Philippines which are primarily recorded in raw forms. Such data, which are in an electronic format, are maintained in all NSAP regional offices, therefore, access and analysis on the raw data provides a fisheries-independent measure of resource and status, and is used to generate historic baselines for restoration and management. (Garces LR, et. al, 2006)

The abovementioned database was developed to serve as a platform of all regional NSAP for the exchange and validation of information, hence enhancing fish stock monitoring. Also, it serves as an efficient and effective storing and management of time-series of raw collected data. The database also provides data for the status of the country's fishery resources in real-time for effective fishery management. However, information on fish stocks recorded in NSAP is not publicly accessible and it is not in a centralized structure since the databases are distributed and maintained by the respective regional offices all over the country. Thus, there is a need to develop a web-based system that can be openly explored by stakeholders, fisherfolk, and the populace for informative purposes. The key thrust of the project is to provide a centralized data management system with real-time analytical information and geographical mapping of catch and effort data of the marine species of the Philippines.

Additionally, the motivation that drives the researcher to conduct this study is to promote more advancement in terms of technology and give attention to the fisheries sector in the Philippines. The fisheries sector lacks recognition by the government itself, since limited investment or intense funding being provided in these agencies. Therefore, the researcher is eager to develop a system that is useful and hopefully this study can be a way to promote fisheries to attract more stakeholders in the future.

2. Methodology

The researcher used the developmental method of research and adopting the **agile development model** to develop an answer to the problem, prompted by the current version of the existing system. Developmental research is a system method in which it studies the designing, developing, and evaluating instructional programs, processes, and products that must meet criteria of

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internal consistency and effectiveness. Developmental research is particularly important in the field of instructional technology. Agile development is a process model in which it is used to develop software. Agile is a repetitive and incremental process in software development that helps the functionality of the software to release in smaller cycles. (Kumar, 2016). In figure 1 shows the research design of the study.

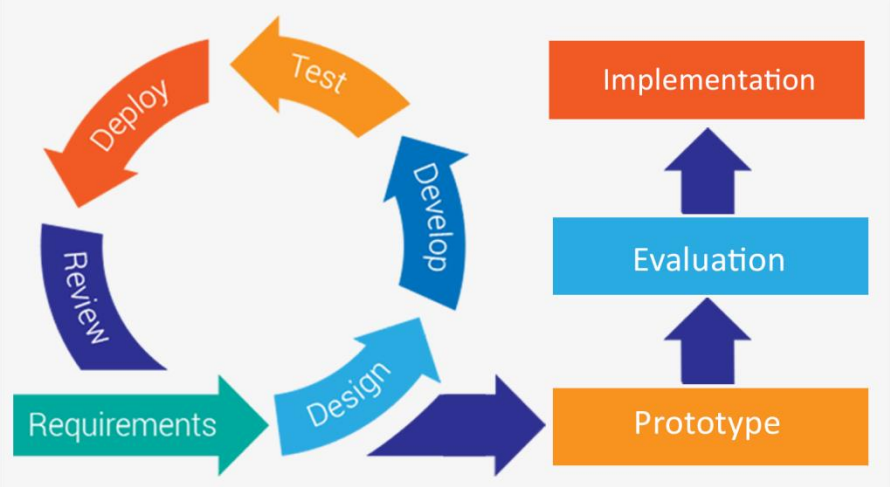

Figure 1. Research design using Agile development model.

In this study, the development method was divided by the researcher into nine (9) phases, namely; requirements; designing; development; testing; deployment; review; prototyping; evaluation; and implementation. The **requirements phase** is the first phase in the system development life cycle. In this phase, the overall system requirements are defined, such as the information requirements, software, hardware requirements, and the evaluation tools. The **design phase** is the essential phase in the system development life cycle. The list of requirements that was defined in the requirements phase was used to make design choices. In this phase, outlines of the system were created such as the database design, modules functionalities, and relationship of modules. The **development phase** deals with the actual work of creating the system that was planned from the previous step. In **testing phase,** all functionalities were trialled and examined if it has accomplished the goal defined in the first step. In the **deployment phase,** the system was compiled for installation and undergoes review of functionalities and the overall system compilation. After the compilation the researcher together with the NFRDI-NSAP IT staff installed the current system on a computer. Afterwards, in the **review phase** the current system was assessed if it has finished the objectives defined

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in the requirement phase. If the system did not satisfy the respective objectives, the process shall repeat itself until the review results have passed. If in this phase the system failed in review, it will again be process in development phase, where correction or additional requirements shall develop. In contrast, if the system passed the review the prototyping phase was executed next. In **prototyping phase,** the finalized version of the system has been compiled, and the documentation of the development was added as a package. The product compiled has been submitted for evaluation. In the **evaluation phase** the system undergoes evaluation from the NFRDI-NSAP Operational Staff, NFRDI-NSAP IT staff, and IT experts. During the evaluation step, there are categories needed to be satisfied; these categories are (1) functional suitability, (2) performance efficiency, (3) compatibility, (4) usability, (5) reliability, (6) security, (7) maintainability and (8) portability of the developed system. These categories are the standard software product quality defined in the ISO/IEC 25010. In this phase the respondent examined, evaluated and made a decision whether to approve the product or to make remarks if the product needed more improvement. In the **implementation phase**, the prototype version has been submitted to the respective collaborated agency, namely the NFRDI. The version has been installed on a local computer by the researcher and has been overseen by the staff member of the said agency.

2.1 Sample and Sampling Procedure

The researcher adopted the stratified purposive sampling method. Using this sampling method, the researcher can select individuals based on the usefulness of the respondent in the study. Furthermore, in this sampling type, the researcher aims to gain qualitative results. The selected respondents evaluated the developed project based on the quality of standard defined by the ISO/IEC 25010. There are three (3) group categories on collecting data namely NFRDI-NSAP Operational staff, NFRDI-NSAP IT staff and external IT expert.

2.2 Respondents of the Study

The respondents of this research were defined into three (3) groups. The first group was the **NSAP-NFRDI Operational Staff**; the second group was the **NSAP-NFRDI IT staff;** and the external **IT expert** group. In the first group, these are individuals who are responsible in operating the developed system. The second group are individuals that have expertise on software programming, database management, and system administrator in NFRDI-NSAP project while

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the last group are group of expert people with a high degree of knowledge in terms of information technology specifically in system development. The respondents are selected based on the criteria of expertise, knowledge, and area of specialization in relation with the fisheries science or information technology. Furthermore, IT experts are included as participants since they provided evaluation on proper standard system development and reduced bias in the study.

Table 1. *Distribution of Respondents*

Respondents	Number of Respondents (n)	(%)
NFRDI-NSAP Operational Staff		
Project Leader	1	5%
Enumerators	5	25%
NFRDI-NSAP IT Staff		
Database Administrator	1	5%
Programmer	3	15%
IT Expert		
IT Expert	10	50%
Total	20	100%

Table 1 shows the total number of respondents, individual designation or role, and the total percentage per participants. The research gathered six (6) individuals as the respondents of NFRDI-NSAP Operational Staff, and maximum of four (4) individuals in NFRDI-NSAP IT Staff. The last group is consisting of IT expert outside the agency with ten (10) respondents. These respondents evaluated the overall system quality based on the ISO/IEC 25010 Software Product Quality Standards.

The **NFRDI-NSAP Operational staff** provided questionnaire that has evaluation based on the ISO/IEC 25010 Characteristics Quality Standard such as; functional suitability, performance efficiency, usability, and level of acceptability of the system. The **NFRDI-NSAP IT staff** provided with evaluation based also in the ISO/IEC 25010 Characteristics Quality Standard but have more categories to evaluate and these are the functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability as well as the level of acceptability of the system. Lastly, the external **IT experts** were also given with the evaluation form. The evaluation form for

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this group consists of characteristics similar to that of NFRDI-NSAP IT staff. The evaluation characteristics are functional suitability, performance efficiency, compatibility, usability, security, and maintainability. The data gathered in this sampling procedure are used as the general assessment of the developed system.

2.2.1 Research Site

This study was conducted with the help of the NFRDI, located at the Mother Ignacia Ave., Quezon City, Metro Manila. The respective office was created under Section 82 of Republic Act (RA) 8550, or also known as the Philippine Fisheries Code of 1998 as amended by RA 10654. One of the objectives of the organization is to promote technological advancement and provide scientific equipment to facilitate, monitor, and implement various research needs of the fisheries sector. Thus, this study fits perfectly with their goal. The researcher has chosen this site as its study since the area houses the national fisheries information. Therefore, the researcher had easy access of information provided by the agency.

3. Results and Discussion

The system was successfully completed based on the agile software development life cycle. In the said method, the development went on a series of methodological phases in order to deliver the software in systematic approach. The phases involved in the development are Definition of Requirements, Software Development, Reviews, and Implementation. The following figures show the completed software.

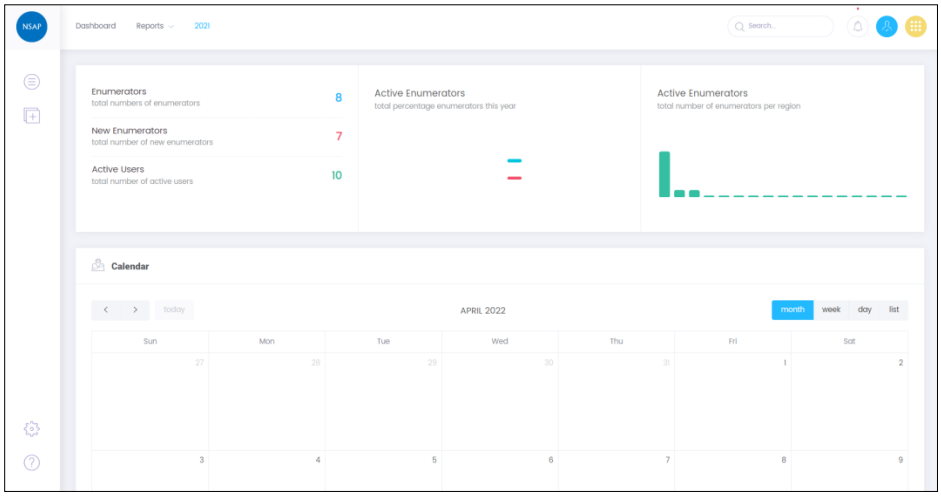

Figure 2. Dashboard interface.

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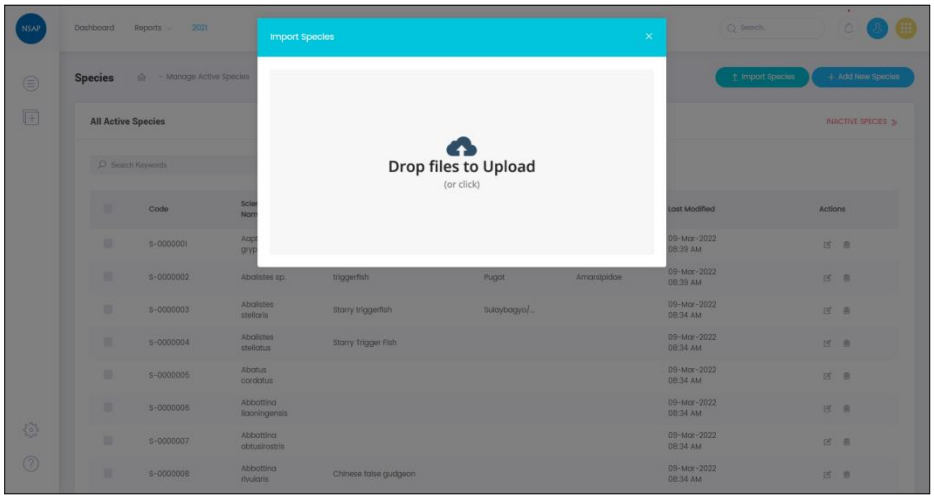

Figure 3. Batch Import function.

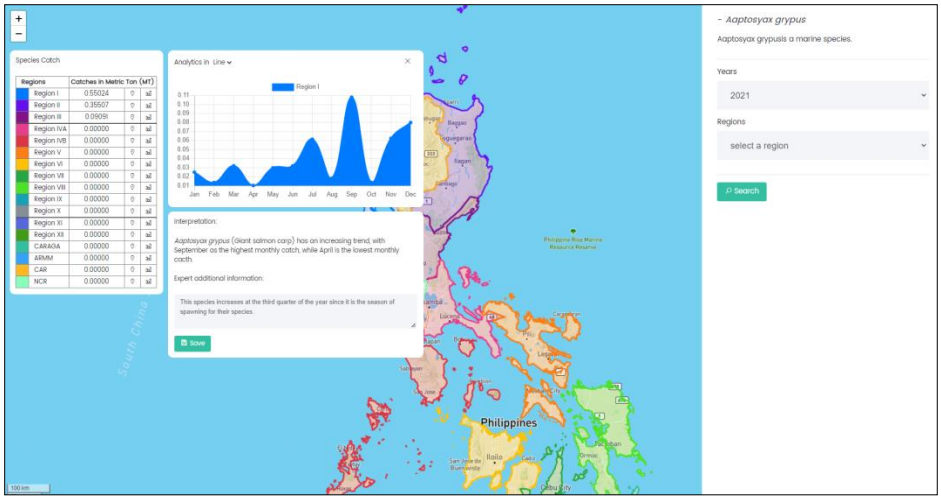

Figure 4. NSAP Interactive Map with Analytical presentation and summarization.

After the prototype has been released, the system has undergone a series of evaluations using the ISO 25010 Software Quality Standard. The new system has been evaluated by various participants with different levels of expertise. The participants are divided into 3 groups namely; NFRDI-NSAP Operational staff, NFRDI-NSAP IT staff, and IT experts. The NFRDI-NSAP Operational staff has been provided with a questionnaire based on the ISO/IEC 25010 Characteristics Quality Standard namely; functional suitability, performance efficiency, and usability. The NFRDI-NSAP IT staff has been provided with an evaluation questionnaire based also on the ISO/IEC 25010 Characteristics Quality Standard but has a greater list of categories to evaluate and these are the functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. The external IT experts have

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been provided with the evaluation form from ISO 25010. The categories that have been evaluated have characteristics namely; functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability.

During the time of evaluation, the researcher used an online survey method due to the pandemic. The researcher adopted some software solutions to handle the situation of evaluation, such as the use of a remote computer access application, an online questionnaire, and a video conference application. Using the said application the evaluation has been successful.

The following table shows the result of the evaluation per participant group. The weighted mean and the average weighted mean have been computed also the equivalent descriptions of the scores are shown in the tables.

Table 2. Summary of Evaluation NSAP-NFRDI Operational Staff.

ISO 25010 Characteristics	Weighted Mean	Verbal Description
Functional suitability	3.77	Highly Functional
Performance efficiency	3.83	Highly Efficient
Usability	3.70	Highly Usable
Avg. Weighted Mean	3.77	Excellent

The summary of evaluation for NSAP-NFRDI Operational Staff shows that the total average weighted mean has **3.77** score with an equivalent description of Excellent.

Table 3. Summary of Evaluation NSAP-NFRDI IT staff.

ISO 25010 Characteristics	Weighted Mean	Verbal Description
Functional suitability	3.58	Highly Functional
Performance efficiency	3.58	Highly Efficient
Compatibility	3.5	Highly Compatible
Usability	3.5	Highly Usable
Reliability	3.5	Highly Reliable
Security	3.83	Highly Secured
Maintainability	3.69	Highly Maintainable
Portability	3.58	Highly Portable
Avg. Weighted Mean	3.5964	Excellent

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The summary of evaluation for NSAP-NFRDI IT staff shows that the total average weighted mean has **3.5964** score with an equivalent description of excellent.

Table 4. Summary of Evaluation IT Experts.

ISO 25010 Characteristics	Weighted Mean	Verbal Description
Functional suitability	3.73	Highly Functional
Performance efficiency	3.53	Highly Efficient
Compatibility	3.7	Highly Compatible
Usability	3.5	Highly Usable
Security	3.7	Highly Secured
Maintainability	3.55	Highly Maintainable
Avg. Weighted Mean	3.61944	Excellent

The summary of evaluation for IT Experts shows that the total average weighted mean has **3.61944** score with an equivalent description of excellent.

Conclusions

Based on the findings, the researcher has concluded that the development of the "*A Geographic and Analytic System for the Stock Assessment Program of National Fisheries Research and Development Institute*" was successfully developed using the Agile Methodology model. The system evaluation was successfully implemented using ISO 25010 Standard Software Product Quality with a score of excellent by the NSAP operation staff, NSAP IT staff, and IT experts. This study and the product produced is a relevant contribution in terms of assessment and monitoring in fishery sector of the country.

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