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A case study on the development of requirements for the comprehensive credits management system project at H University

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Abstract. Nowadays, in order to adapt to informatization and enhance management efficiency, universities have an increasing demand for the development of management systems. This paper conducts an in-depth study on the case of requirements development for the comprehensive credit management system project at H University. Taking the problems existing in software project requirements development management as a starting point, this paper analyzes and researches the issues in requirements acquisition, requirements analysis, and requirements development management processes of the current project development team through the study of relevant theoretical content on requirements development. The paper proposes solutions to problems such as inaccurate identification of software project stakeholders, lack of scientific requirements analysis tools, and absence of prioritization in requirements. Through analysis, this paper, by drawing stakeholder maps and utilizing the KANO model for prioritizing project requirements, ultimately formulates an effective requirements development management solution tailored to the software project of the development team for this particular project.

Keywords: Requirement analysis, Requirement management, Stakeholder identification, KANO model, Case analysis.

1. Introduction

In recent years, with the rapid development of the information age, the informatization process of higher education management in China has further accelerated, entering a new stage of high-quality development. As a significant aspect of higher education management, student services have also encountered new opportunities and challenges. How to leverage informatization to empower the innovation and upgrade of student service models in universities has become an urgent and important issue.

As stated in the book "Research on Innovative Modes of University Student Management under the Internet Background," published by Leng Tianjiu and China Water Resources and Hydropower Press in September 2020, the management models for university students in the context of the Internet should fully absorb emerging advanced theories and practical content, seeking breakthroughs in theory, methods, and practices. Currently, most information management system solutions in universities are provided by professional software companies and students on campus. Typically, these companies excel

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in their original industries, but they often face certain weaknesses in newly explored business areas, such as narrow business channels, insufficient technical capabilities, and lack of business experience[1].

While students may develop solutions from their own perspectives, listing practical requirements, they often lack experience in specific development, leading to potential inefficiencies and challenges in the development process.

H University is located in Liaoning Province, China. The School of Information at H University is one of the most prominent colleges within the university. The school comprises 9 undergraduate teaching departments, 3 teaching and experimental centers, and 9 scientific and technological research institutes, showcasing robust teaching and research capabilities. Currently, the school has more than 180 faculty members, including 56 professors, 65 associate professors, and 3 provincial teaching masters. The undergraduate enrollment is 3,297, with 732 graduate students at the master's and doctoral levels.

The School of Information has achieved outstanding results in teaching and research. However, in terms of student management, the school has been using the university's academic affairs system without having its own system. This has resulted in inconvenience for the school in understanding the learning and living conditions of all students, especially in the statistical calculation of comprehensive points for award evaluations.

Presently, to obtain statistical data on student performance, the school relies on traditional reporting methods. This involves assigning the entire statistical task to one person, leading to low efficiency and a higher likelihood of errors in the process. Consequently, based on various feedback and suggestions, the school has decided to develop a comprehensive points management system to facilitate efficient management. The primary development responsibilities have been assigned to a group of students.

Taking the problems existing in software project requirements development management as a starting point, this paper analyzes and researches the issues in requirements acquisition, requirements analysis, and requirements development management processes of the current project development team through the study of relevant theoretical content on requirements development.

2. Current state and Challenges of Development Management of Project Requirements

2.1. Current State of Development Management of Project Requirements

The development team for this project primarily consists of undergraduate students, occasionally receiving guidance from professors in relevant courses. While most team members have learned the basic concepts of software development in previous courses, applying this knowledge to practical scenarios is challenging. During the requirements gathering phase, the team relies on a relatively traditional and inefficient method of verbal inquiries. This involves asking opinions from some students and teachers, and then compiling and analyzing the information together.

In the subsequent requirements analysis phase, there is internal disagreement within the development team regarding whether to implement certain functionalities. This disagreement arises because they have not meticulously organized and analyzed the information obtained in the previous phase. This difficulty results in a substantial challenge in implementing all related requirements. Additionally, there is inconsistency in opinions on whether to implement certain features, leading to conflicting viewpoints. This necessitates the team to spend a considerable amount of time on evaluation, causing slow progress in the project. The following outlines specific issues in requirements development management within the project.

2.2. Challenges in Development Management of Project Requirements

2.2.1. Evolving System Requirements. The primary objective of this project is to construct an information management system for the statistical analysis of students' academic and comprehensive performance within the college. Initially, the responsible parties at the college envisioned a system that publicly displays the comprehensive points' statistical results. Each student should be able to view their own comprehensive points and ranking within the grade upon logging into the system. The system

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administrator could import scores from various modules, and the system would automatically calculate the final total and rank students accordingly.

However, approximately two weeks into the project, after the main framework of the system had been established, several students expressed the need to incorporate a dissent feedback feature. This would allow students to submit applications in the system when they disagreed with a particular module's score, for subsequent review by administrators. Following team discussions, the decision was made to modify the system requirements to include this functionality. After the first modification was completed, development continued. A few days later, a student responsible for aggregating and summarizing scores unexpectedly requested additional features for the dissent application module, such as the ability to manually enable or disable the module, specified time intervals for submitting dissent, and various other requirements. However, consensus between the score aggregator and other students regarding specific functionalities within this module could not be reached. Simultaneously, there were differing opinions within the team regarding the User Interface (UI) style of the system.

2.2.2. Overlooked Requirements and Unclear Requirement Identification. During the development process, the project team did not conduct in-depth requirement interviews with the intended users of the system. The logic and business flow of the entire system relied solely on sporadic inquiries during project reporting and official information from the school. Students and teachers responsible for using the system did not provide detailed explanations of the comprehensive points' statistical process. This lack of familiarity with the business scenarios led to a deviation between requirement understanding and expectations. Moreover, the main requirements were extracted from extensive texts during team meetings with college teachers, lacking clear itemization. As a result, when presenting the initial development progress to relevant teachers and students, minor requirements, such as font adjustments, were discovered to have been overlooked.

3. Project Analysis

For a development team with limited experience, such as the student development team, the effectiveness of the requirements phase has a significant impact on the overall project's time, cost, and progress since the software's functionalities are implemented based on the requirements provided by teachers and fellow students. In this project, the development team did not formulate a requirements research plan before conducting the research, leading to a chaotic and disordered requirements development process.

Firstly, the absence of an early requirements research plan resulted in confusion in the entire requirements development process. Secondly, the team lacked systematic thinking in the design of the software project system functionalities. They overly focused on business details and neglected the overall system development purpose and effects, prolonging the time required for requirements development. Furthermore, when faced with decision-making on issues such as UI styles and detailed design of the dissent application module, the team urgently needed a scientific tool or method to assist in decision-making. This tool or method should provide the client with a scientific and widely accepted solution, especially in situations where trade-offs between conflicting requirements are necessary.

4. Solutions

4.1. Stakeholder Identification

To address the first two issues, we can employ a stakeholder identification method to thoroughly communicate with the project's main stakeholders. Effective stakeholder identification during the requirements gathering process can significantly increase the project's success rate [2]. Organizing stakeholders and classifying them through a stakeholder map can help determine actions and measures corresponding to different types of stakeholders. This aids in identifying all stakeholders in the project, especially key stakeholders, which is crucial when developing a project requirements acquisition plan

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[3]. Stakeholder identification requires an understanding of the organizational structure and conducting a stakeholder analysis using scientific steps and methods [4].

The specific steps are as follows:

(1) If users belong to different departments, identify the head of each department as a key stakeholder.

(2) If these departments are branches, also identify the head of the branch as a key stakeholder.

(3) If there are senior deputy heads in the departments or branches, considering their influence within the organization, also list them as key stakeholders.

Applying these methods in conjunction with the project's background, we can identify the main stakeholders of the project: relevant personnel from the School of Information representing supervisory departments, students responsible for comprehensive score statistics representing the system management department, and other students representing system users. Subsequently, based on relevance (direct correlation or responsibility size) and impact (influence on the project's direction and acceptance), create a 2x2 matrix using a stakeholder map as the analytical basis. The horizontal axis represents relevance, and the vertical axis represents impact. As the project has not yet differentiated stakeholders or created a stakeholder map, a possible stakeholder map is shown in Figure 1:

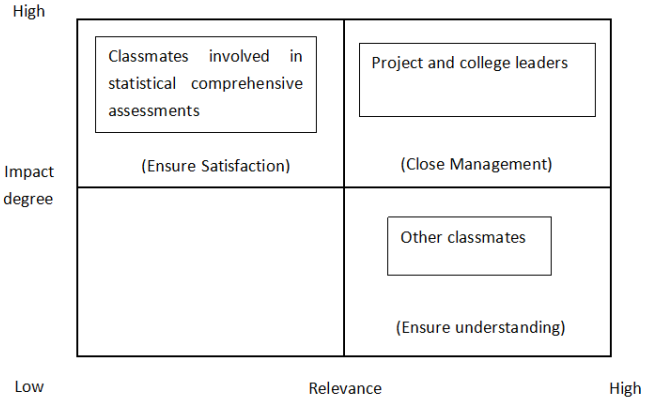

Figure 1. A possible project stakeholder map

Based on the different quadrants assigned to each stakeholder in the matrix, varying levels of attention should be given in the planning of requirements research:

Close Management: For project leaders and college leaders with high impact and high relevance, the project team should engage in thorough communication, closely monitor, and understand their planning and perspectives on the project. Each requirement should be carefully reviewed and confirmed.

Ensure Satisfaction: For classmates involved in statistical comprehensive assessments with high impact but low relevance, although not directly participating in the project, their influence on functional requirements is crucial. During the requirements research, when their needs align with the overall project goals, attention should be given to understanding and satisfying their requirements.

Ensure Understanding: For other classmates with low impact but high relevance, serving as users of the project, they are still a significant source of functional requirements. Understanding their needs is essential during requirements research.

Tailoring the approach based on the impact and relevance of each stakeholder helps ensure effective communication, understanding, and satisfaction throughout the requirements research process.

4.2. KANO Model

For the last issue regarding the trade-off of requirements in this project, we can prioritize and rank functionalities using the KANO model. By determining the priority order based on the KANO model, we can decide which features to implement, aiming to satisfy the main users quickly within a relatively short period. The KANO model is introduced as follows:

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The KANO model, proposed by Professor Noriaki Kano, categorizes user requirements and prioritizes them based on satisfaction [5]. The KANO model analyzes the nonlinear relationship between the degree of user requirement fulfillment and their satisfaction. It classifies user requirements into five categories: basic needs, performance needs, excitement needs, indifferent needs, and reverse needs. Specifically:

Excitement Needs: These are features that exceed user expectations. If these are not met, user satisfaction does not decrease, but satisfaction increases significantly if these are fulfilled. Performance Needs: These features have a positive correlation with user satisfaction. Satisfaction increases when these are fulfilled, and decreases when they are not.

Basic Needs: These are essential features that must be implemented. Satisfaction increases when these are fulfilled, but decreases significantly if these are not.

Indifferent Needs: Fulfillment or non-fulfillment of these features has no impact on user satisfaction.

Reverse Needs: These features are unwanted by users. If fulfilled, user satisfaction decreases [6].

As there was no prioritization of requirements in the actual development, let's analyze the main functionalities mentioned earlier hypothetically: Based on the requirements mentioned in the preceding text “Challenges in Project Requirements Development Management”, we can extract the main functionalities of the system: score import and statistics, dissent application, UI styles, and score viewing. For these functionalities, we can design a KANO questionnaire, setting two questions for each requirement: one positive and one negative. Customers' answers to whether they expect or do not expect each requirement should be classified into five levels: "Very Satisfied," "Should be that way," "Indifferent," "Barely Acceptable," and "Unacceptable," corresponding to scores of 1, 2, 3, 4, and 5, respectively. An example is shown in Table 1:

Table 1. Requirement Function KANO Questionnaire Item Form

Function name		Very Satisfied	Should be that way	Indifferent	Barely Acceptable	Unacceptable
UI Style Change	If this feature is provided	1	2	3	4	5
	If this feature is not available	1	2	3	4	5

By collecting and analyzing the responses to the KANO questionnaire, we can determine the priority and importance of each requirement and decide which functionalities to implement first to maximize user satisfaction.

According to this sample table, we can conduct document investigations with the student responsible for statistics, the teacher in charge of the project, and other users such as college leaders. Subsequently, we can use the KANO evaluation table (see Table 2) below as the basis for evaluating the results of the KANO questionnaire:

Table 2. KANO Model User Requirement Classification Comparison Table

Software requirements	Negative issue (if the product does not have this feature)					
Positive issue (if the product has this feature)	scale	Very Satisfied	Should be that way	Indifferent	Barely Acceptable	Unacceptable
	Very Satisfied	Q	A	A	A	O
	Should be that way	R	I	I	I	M
	Indifferent	R	I	I	I	M
	Barely Acceptable	R	I	I	I	M
	Unacceptable	R	R	R	R	Q

Among them, A represents Excitement Needs, O represents Performance Needs, M represents Basic Needs, I represents Indifferent Needs, R represents Reverse Needs, and Q represents problematic answers in the questionnaire. According to the evaluation criteria in the table above, the results of the

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KANO questionnaire for the requirement functionalities are summarized. The type corresponding to the maximum value in each category is taken as the basis for the attribution of the requirement item. That is, if a requirement item has the highest number of attributions to a certain KANO category, it is classified under that category. For example, for the UI style change requirement, a possible summary result could be as shown in Table 3:

Table 3. Requirement Item Classification Table

No	function name	Category Number						Total	Category	Type
		M	O	R	I	Q	A			
1	UI Style Change	0	7	0	0	0	10	17	A	Excitement Needs

Then, classify according to the type of requirement, and organize the corresponding functional names for each type of requirement. Among them, M-class basic requirements are the requirements that the customer believes must be met in the system. If these requirements are not met, it will cause customer dissatisfaction, so these basic requirements should be met first; For O-type craving needs, meeting these needs by the system will improve customer satisfaction. If these needs are not met, it will reduce customer satisfaction. Therefore, efforts should be made to meet the needs of this type as much as possible; For A-class charismatic needs, they can bring surprises to customers, and when these functions are not provided, it will not affect customer satisfaction; For Class I undifferentiated needs, whether these needs are met or not will not have an impact on customer satisfaction.

Finally, proceed with the implementation of the functionalities based on the categorized requirements. During the development process, ensure the prioritized implementation of M (Basic Needs) and O (Performance Needs). The implementation of the remaining requirements can be flexibly decided based on the actual situation and available resources.

5. Conclusion

This paper has primarily analyzed and discussed the challenges faced by H University in the development of a comprehensive credit management system, particularly dealing with the issues of evolving and prioritizing requirements. To address the issue of evolving requirements, the paper suggests employing stakeholder identification and stakeholder mapping methods to differentiate various users. It advocates a detailed analysis, giving priority to meeting the requirements of users with high impact and relevance to the project.

For the challenge of requirement prioritization, the paper recommends the use of the KANO model for prioritizing requirements. Emphasis is placed on implementing high-priority requirements. While the paper proposes solutions to the issues in the requirement analysis phase of the project, it acknowledges that practical implementation may encounter various challenges, necessitating the project team to adjust methods accordingly.

Furthermore, to ensure the smooth progress of the project, ongoing management research should be conducted in other phases of the project, aiming for comprehensive lifecycle management. This holistic approach is crucial for effectively achieving the project's objectives.

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