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Research Management: Evolving Reporting and Scoring Capabilities in Research Tracking Systems for Higher Education Institutions

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Abstract

This paper presents advancements in Research Tracking Systems (RTS) of Higher Education Institutions, aimed at enhancing the efficiency and reliability of research management within higher education institutions. Building upon prior work, our focus lies on empowering the Post-Award teams with refined features tailored to streamline their processes. Leveraging a user-friendly interface design and integration of the CrossRef Application Protocol Interface (API), proposals' external reviewers benefit from enhanced usability and reliability in their evaluations. Furthermore, Lead Project Investigators (LPIs) and Administrators now have access to financial APIs, facilitating informed decision-making regarding project budgets. Additionally, the incorporation of automated reminders for LPIs serves to improve deadline adherence and overall efficiency. These enhancements alleviate burdens on stakeholders and significantly improve the effectiveness and reliability of research management within our institution. Through ongoing refinement and evolution of the RTS, we are committed to meeting the evolving demands of research management and supporting the diverse needs of our research community.

1 Introduction

Funding is indispensable for academia to conduct research effectively [1] and hence securing it stands as a paramount task. According to A. Siahaan et al. [2] stakeholders and funders should invest

in institutions capable of demonstrating enduring impacts rather than merely achieving short-term goals. Thus, the credibility of an institution is closely tied to its ability to translate funding into meaningful and impactful results, thereby fostering trust and confidence among stakeholders and funders.

E. Kabelele and H. Machumu [3] underscore the importance of effective communication, time management, and proper grant utilization by School Management Teams (SMTs). Effective communication within the team and with stakeholders ensures clarity of objectives and coordination of efforts. Proficient time management enables SMTs to prioritize tasks, meet deadlines, and optimize resource allocation, enhancing efficiency. Given these findings, our development of a tailored system at QU aims to address these crucial aspects, emphasizing the need for improved time management, communication effectiveness, and proper utilization of grants to enhance overall effectiveness in research project management.

O. Lagovska [4] suggests that the management of grant agreements plays a crucial role in ensuring financial transparency and efficiency within grant-receiving organizations. By adhering to international financial reporting standards, organizations can accurately track and report on the allocation and utilization of grant funds from various sources, including governmental organizations and international donors. This practice not only ensures compliance with grant terms and conditions but also facilitates the effective stewardship of financial resources, enabling organizations to assess project outcomes and impact. The management of grant agreements contributes to the financial stability, transparency, and accountability of grant-receiving organizations, enabling them to fulfill their commitments to donors and stakeholders.

Qatar University (QU) established the Office of Research Support (ORS) in 2006 to enhance research grant management and support for students and staff, later restructured and rebranded. ORS operates according to international standards and best practices, overseeing operations through its Pre-Award, Contracts & Compliance, and Post-Award departments.

The Post-Award department focuses on monitoring grant progress and gathering essential reports. Effective research management requires appropriate tools, divided into financial transaction and project management categories. While QU employs various platforms for financial transactions and proposal submissions, additional tools were needed for comprehensive grant tracking.

In today's rapidly evolving landscape of higher education, the efficient management of research projects is essential for fostering innovation and academic excellence. Building upon our previous work presented at EUNIS, where we introduced the RTS for Higher Education Institution (HEI) Research Grants [5], this paper delves into the substantial progress and enhancements made within the system over the past years. This study focuses on the evolution of reporting and grading functionalities within the RTS, reflecting our commitment to providing comprehensive support for research management and administration within HEIs. By exploring the new features and capabilities integrated into the RTS, we aim to demonstrate how these enhancements facilitate more efficient monitoring, evaluation, and decision-making processes throughout the lifecycle of research projects. Furthermore, we seek to highlight the significance of strategic reporting and robust grading mechanisms in empowering HEIs to navigate the complexities of research funding and resource allocation effectively.

Laravel, a powerful PHP framework, serves as the backbone for the development of the RTS web application. Leveraging Laravel's MVC (Model-View-Controller) architecture, we have been able to create a scalable and maintainable solution for tracking research activities. Through robust authentication mechanisms and role-based access control (RBAC), we ensure that only authorized personnel can access specific data sets within the system. The RTS operates within a software environment comprising SQL Server, Laravel, PHP, JavaScript, and CSS. This robust technology stack provides the foundation for a scalable, secure, and high-performance research tracking solution. In this paper, we examine contemporary grant management tools currently in use. We provided a detailed account of the design and implementation specifications of our in-house solution, RTS, with features present in existing grant management tools and tailored to the specific needs of the QU research office. Lastly, we concluded the paper by discussing future avenues for research and development in RTS.

2 Features of Existing Software available in the market

Several grant management tools offer diverse features to support the lifecycle of research projects in academic institutions. In our previous paper [5] we discussed notable grant management software such as Submittable, PeopleSoft Enterprise Grants Management, and CyberGrants. Additionally, Sage Intacct, Fluxx.io, Versaic, Altum Grants Management, Grantium, OpenWater, and Grants Manager Plus were highlighted for their innovative features. However, new software solutions have emerged in this domain, offering novel functionalities to enhance grant management processes. These solutions are mentioned in financeonline.com.

Zengine by WizeHive revolutionizes grant management with its comprehensive suite of features. Seamlessly integrating grants management, online applications, and Customer Relationship Management (CRM) functionalities, it offers unparalleled customization, allowing organizations to tailor processes to their specific needs. With support for grants, scholarships, awards, and more, Zengine simplifies complex workflows while providing secure portals for users and administrators. Its extensive customization options, seamless integrations with over 1,000 popular applications, and automation capabilities ensure efficiency and accuracy throughout the entire lifecycle of grant management processes.

Another prominent software, Instrumentl is an intuitive online grant management platform catering to nonprofit organizations and researchers. It simplifies the search for funding opportunities by offering personalized matches from various sources, while its built-in project management tool ensures users stay organized with deadline reminders and progress tracking. By streamlining grant information and automating search processes, Instrumentl maximizes efficiency in grant management workflows. Alongside these solutions, a software named CC Grant Tracker by CC Technology Ltd simplifies grant management for organizations worldwide. With its comprehensive features and user-friendly interface, it streamlines the entire grant lifecycle from application to reporting, enabling efficient decision-making and improved business insights.

In the same domain, AIMS by Quest Computing Ltd emerges as a robust solution catering to diverse sectors like education, government, and international aid. With its end-to-end control over the grant lifecycle and features like flexibility and customizability, AIMS streamlines processes for efficient and effective grant management, ensuring organizations meet their objectives with precision and ease.

eAwards, developed by eVision, is a comprehensive grant management software developed for research institutions, universities, and funding organizations. It streamlines research funding administration processes, offers advanced planning capabilities, and eliminates the need for cumbersome Excel spreadsheets, ensuring efficient grant management and accountability to stakeholders.

3 New Features in RTS

In RTS, three main roles drive the project management process: LPIs, Administrators and Reviewers. Administrators, primarily represented by ORS (transformed currently to Research Grants and Contracts office), oversee project assignments, and manage the review process conducted by a team of expert Reviewers, who typically hold academic positions within the university. These Reviewers possess specialized knowledge in their respective fields, ensuring rigorous evaluation of project proposals.

Within the research management framework, the Post-Award phase plays a pivotal role in ensuring the effective oversight and execution of funded projects. This phase encompasses a structured series of steps aimed at facilitating seamless communication, assessment, and feedback between key stakeholders. It begins with the receipt of the progress report submitted LPI, providing an overview of

the project's advancements and challenges. Subsequently, a qualified reviewer, possessing expertise in the project's field, is assigned to evaluate the progress report meticulously. Their assessment aims to gauge the project's adherence to initial proposals and commitments, providing constructive feedback to steer it towards its intended objectives. Once the reviewer's feedback is provided, administrative personnel within the Post-Award Team publish it to the LPI, maintaining the anonymity of the reviewer to ensure impartiality. The LPI then submits the final project report, documenting outcomes and deliverables achieved throughout the project cycle. Upon receiving the final report, the reviewer undertakes a comprehensive analysis, referencing their initial feedback to assess the project's overall impact and effectiveness. Based on this assessment, the reviewer assigns an overarching grade, reflecting the project's performance against predetermined criteria. Finally, the project results, including the assigned grade, are disseminated to the LPI, facilitating informed decision-making and future planning. For better understanding the workflow is presented in Figure 1.

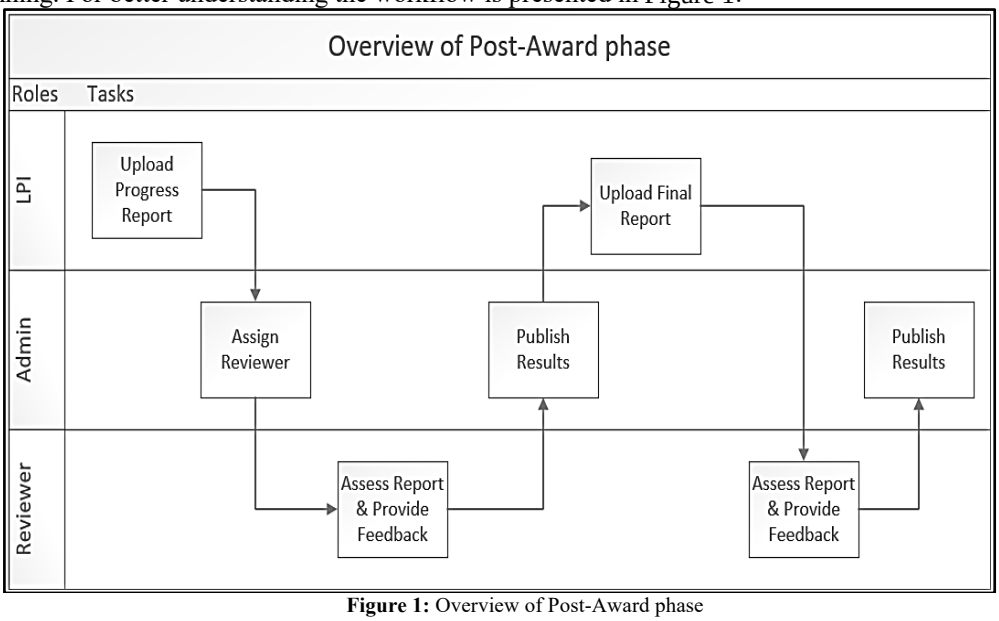

Figure 1: Overview of Post-Award phase

The RTS system is now live and accessible exclusively on campus to ensure robust security measures, including firewall protection. It operates within the private network designated for QU users, safeguarding sensitive research data, and maintaining confidentiality. This restricted access ensures that only authorized QU users can utilize the system, minimizing the risk of unauthorized access and data breaches. In the latest version of RTS, we have introduced several innovative features to enhance functionality and efficiency. These features are discussed next in the sub-sequent sections.

3.1 Integration of Single Sign-On

In this system, Single Sign-On (SSO) functionality, utilizing the Security Assertion Markup Language (SAML) protocol, has been implemented to enhance security, streamline access management, and improve user experience. Leveraging the same credentials users utilize to access other QU systems, SSO enables seamless authentication across our ecosystem of applications and services. With SSO, users can access multiple resources using a single set of credentials, eliminating the need to remember and manage multiple passwords. This not only simplifies the login process but also reduces the risk of security breaches associated with weak or reused passwords. Additionally, SSO allows us to enforce stronger authentication methods, such as multi-factor authentication (MFA), further enhancing

security across our system. Thus, the integration of SSO into our system enhances security, improves user experience, and ensures efficient access management for our organization.

SAML is an XML-based open standard for exchanging authentication and authorization data between parties, particularly in the context of web browser SSO implementations. It enables secure communication of authentication and authorization decisions across different domains, facilitating seamless access to multiple applications and services with a single set of credentials.

3.2 Automated Outcome Scoring and Comparison Against Commitments

In this system, the ORS has implemented a specific scoring mechanism for each research outcome. When an LPI enters an outcome into the system, it undergoes automatic scoring based on predefined criteria. This score is then compared against the commitments provided by the LPI at an earlier stage. By automating the grading process in this manner, we ensure consistency and accuracy in evaluating project outcomes against predetermined expectations.

3.3 Usability of User Interface design

A well-designed user interface (UI) enhances software usability by organizing information intuitively, simplifying navigation, and minimizing cognitive load [6]. Clear layouts, intuitive controls, and visual cues contribute to a seamless user experience, facilitating efficient task completion and reducing user errors [7].

In the RTS, the team has implemented a user-friendly interface where all reports, commitments, and outcomes provided by LPI are conveniently accessible in a single window, organized under distinct tabs, as shown in Figure 2 . This design ensures that Reviewers can easily navigate between tabs to view commitments, refer to their previous remarks and feedback on progress reports, and compare various aspects such as progress and outcomes. By presenting information in this manner, the RTS enhances usability, allowing Reviewers to efficiently assess project status and track adherence to commitments without the need for extensive navigation or searching through multiple documents or interfaces.

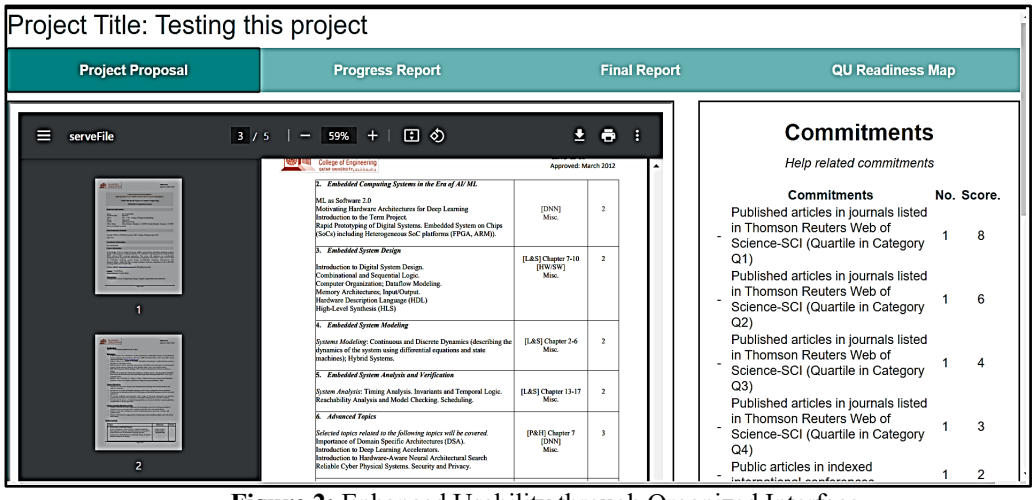

Figure 2: Enhanced Usability through Organized Interface

3.4 Integration of CrossRef API for Enhanced Information Retrieval and Review Efficiency

To facilitate the review process, RTS has incorporated the CrossRef API [8], enhancing the efficiency and accuracy of information retrieval. LPIs are required to furnish a list of DOIs corresponding to scholarly outcomes from their projects, which are then uploaded into RTS. Subsequently, basic information extracted from these DOIs is stored in the RTS database, accessible to Reviewers during evaluation. Should a Reviewer require additional details, they can effortlessly utilize the API to access comprehensive information by simply clicking on the DOI and a pop-up window with additional information is displayed as shown in Figure 3.

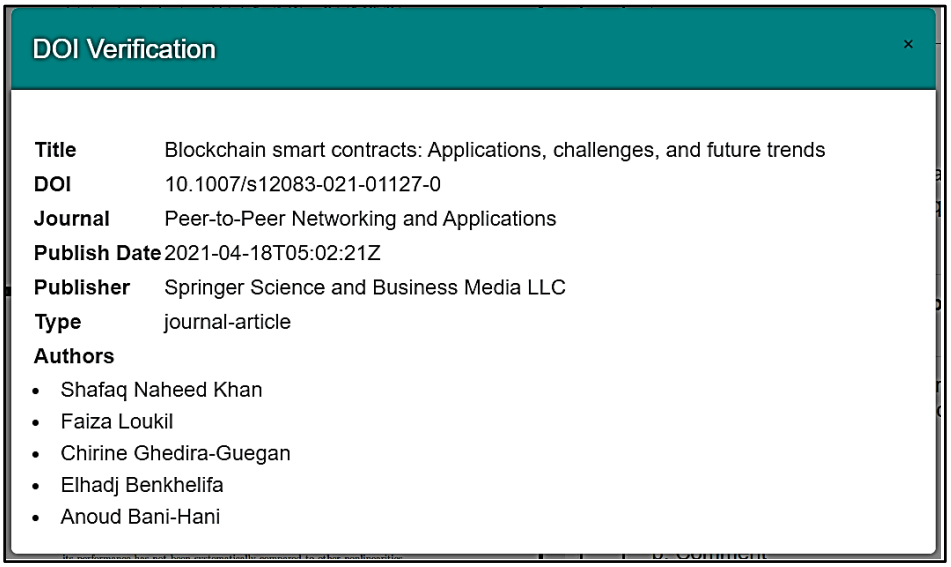

Figure 3: Enhanced Information Retrieval through CrossRef API

This approach offers several advantages:

1. Standardized Evaluation: By leveraging the CrossRef API, RTS standardizes the evaluation process, ensuring that assessments are based on objective criteria rather than subjective judgment.

2. Enhanced Accountability: Reviewers are empowered to selectively accept or reject publications linked to project outcomes, influencing the overall project grade. This mechanism fosters accountability and transparency in the evaluation process.

3. Streamlined Workflow: By automating data retrieval and verification through trusted third-party sources, RTS alleviates the administrative burden on both LPIs and Reviewers. This not only expedites the review process but also minimizes the risk of errors associated with manual data entry.

Overall, the integration of the CrossRef API in RTS represents a significant advancement in research project management, promoting fairness, efficiency, and reliability in the evaluation of scholarly outcomes.

3.5 Integration of Financial API for Enhanced Budget Monitoring and Decision-making

Furthermore, RTS integrates a financial API to empower both LPIs and Admins in monitoring project budgets effectively. This API enables real-time tracking of allocated funds, expenditure, and remaining budget, providing comprehensive financial insights. Admins gain access to a centralized dashboard showcasing financial details of all projects, facilitating assessment and oversight. Simultaneously, LPIs benefit from informed decision-making regarding project expenditures, enabling strategic allocation of resources such as services and equipment within budget constraints. This feature enhances financial transparency and aids in optimizing resource utilization across projects. The screenshot of the financial data from the API is shown in Figure 4.

Moreover, to improve security measures, the financial API employed by RTS operates on a dynamic key-ID system, periodically updated to avoid unauthorized access attempts. Additionally, to safeguard project-specific data, a mapping mechanism is implemented wherein public Project_IDs are translated into internal IDs before being passed to the API for data retrieval. This ensures that even if an external user gains knowledge of the public Project_ID, they would be unable to decipher the corresponding internal ID, thereby ensuring data confidentiality. The retrieval process operates in two discrete steps: initially, a request is made to obtain the mapped internal ID; a step concealed from the system's address bar for added security. Subsequently, a second request is issued to fetch data related to the specific project, with the internal ID securely embedded within the URL. This thorough approach to data retrieval not only enhances security but also underscores our commitment to safeguarding sensitive financial information while ensuring seamless access for authorized users.

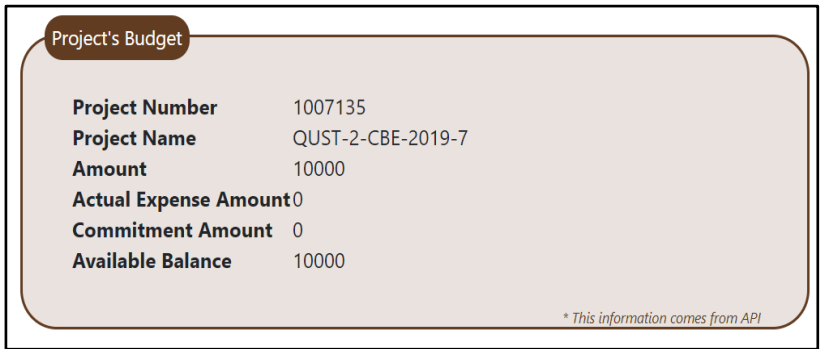

Figure 4: Financial record related to a specific project

This budget includes personnel support, software packages, materials and equipment, textbooks/publications, travel expenses, and miscellaneous costs. The committed amount indicates funds reserved for future expenses, such as travel to conferences, with these funds being temporarily unavailable for other purposes until utilized. The actual expense amount represents the remaining budget after deducting both the committed amount and expenses already incurred, providing a clear picture of available funds for ongoing and upcoming project needs

3.6 Optimizing Student Verification with the Student Database API Integration

Another API in the pipeline for integration into RTS is the Student Database API. This addition addresses a critical need within the system: verifying the involvement of QU students in research

projects. Previously, verifying student participation was a laborious manual process, involving extensive cross-referencing of project details with student records.

With the incorporation of the Student Database API, this process becomes streamlined and efficient. Reviewers gain access to a centralized database containing information on enrolled students, including their academic status, enrollment duration, and graduation status. This allows reviewers to validate the involvement of students claimed by LPIs in their projects quickly and accurately.

By leveraging this API, reviewers can assess the extent of a student's contribution to a project and make informed evaluations based on their level of involvement. This not only enhances the credibility of project assessments but also provides valuable insights into the collaborative nature of research endeavors involving students from QU.

3.7 Automated Reminders for Timely Project Report Submissions

Our system incorporates automated reminders to ensure timely submissions of project reports. One month prior to the deadline, a reminder is sent to the LPI, followed by a second reminder a week before the submission date. This feature helps streamline project management and promotes adherence to deadlines, enhancing overall efficiency in research management processes.

This feature is facilitated through the utilization of the Windows Task Scheduler. The setup involves configuring scheduled tasks within the Task Scheduler interface. It triggers a scheduled task daily at 4:00 in the morning. Within the Laravel framework, this task dynamically checks the project deadlines. When one month is left before the submission deadline, the task initiates an email reminder to the LPIs. Similarly, when one week remains until the deadline, another reminder is dispatched. By integrating this functionality within Laravel and managing it through the Windows Task Scheduler, we ensure that timely reminders are sent to stakeholders without manual intervention, effectively promoting adherence to project deadlines and optimizing research management processes.

Acknowledgement

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4 Conclusion

In conclusion, the evolution of the RTS marks a significant advancement in research management at our institution. Building upon its foundation, we have introduced a range of new features designed to enhance usability and utility. Notably, improvements to the user interface facilitate seamless navigation between reports, streamlining the user experience. The integration of the CrossRef API enhances the reliability and ease of evaluation, providing researchers with a trusted source for assessing project outcomes. Additionally, the incorporation of the financial API empowers administrators and LPIs to make informed decisions regarding project budgets and expenditures. Furthermore, it's important to note that data retrieved from external sources, such as the CrossRef API, Financial API, and Student API, is strictly read-only within the RTS. This means that RTS users are unable to make any modifications to the original data sources. Rather, the RTS functions solely as a consumer of this data, enabling users to access and analyze information without altering its integrity. This read-only access

ensures that the original sources remain unaffected, preserving data accuracy and reliability across all integrated systems.

Moreover, the integration of SSO has significantly enhanced security and user experience across our system. By providing seamless authentication and reducing the burden of managing multiple passwords, SSO reinforces our commitment to robust access management practices, ensuring a secure and streamlined research environment for all users.

Another prominent enhancement is the implementation of automated reminders, which serve to improve deadline adherence and overall efficiency. By proactively notifying stakeholders of impending deadlines, this feature fosters a culture of accountability and ensures timely project submissions. Collectively, these new features have significantly bolstered the effectiveness and efficiency of research management within our institution.

Moving forward, we strive to continually optimize research processes and meet the diverse needs of our research community in QU. In the future, we aim to incorporate a feature within the RTS that will not only streamline research management but also extend the current ISO standards deployed by the office, to all the procedures of RTS. Through ongoing collaboration and feedback from users, we are dedicated to refining and evolving the RTS to align with the evolving demands of research management in QU.

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