

SERVICE-BASED FRAMEWORK OF RESEARCH PROJECTS IN HIGHER EDUCATION INSTITUTIONS

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Abstract: This work presents and disseminates the services and infrastructure required to manage the quantity and quality of research projects in higher education institutions (HEIs). To achieve this objective, smart management of research offices, their processes, and collaborative projects are of paramount importance in order to understand the underlying activities for effective decision-making. This approach has been developed in-depth considering the lifecycle of grants in a research office. The processes of a research office, its automation, the importance of collaborative projects with academia and industry around the globe, and their impact on research output have been developed first and then applied to a public higher education institution. The developed framework with its implementation example can be adopted by various research-based organizations to efficiently manage and strengthen their research outlook.

1. Introduction

The higher education consists mainly of research in academia and then translating that into the service of society by the industrial sector. Researchers in higher education contribute with publications and multidisciplinary collaborations from academia and industry to innovate and invent various products and services beneficial to the community. This can only be achieved if a robust infrastructure is in place in educational organizations to manage and administer research grants. The crucial components of this infrastructure include the structure of the research offices and grants in higher education. This work focuses to provide a scientific basis for this infrastructure which will improve research quality in higher education. It disseminates the best practices adopted by the leading institutions to achieve higher-ranked status in research. In order to efficiently manage the research grants, it is required to build a smart mechanism in the research office that can streamline and automate processes throughout the lifecycle of the grants. Another important factor is to focus on collaborative grants and increase their quantity both in academia and industrial circles which boosts the research profile of an institution to the manifold. The work is organized by giving a general introduction on infrastructure to manage research grants. The framework is then discussed in depth with flowcharts for each phase of the grant with highlighting the importance of collaborative grants. Afterward, the impact of adopting this strategy in a public university is discussed and finally, the work is concluded.

2. Service-Based Project Management of Research Grants

A research grant goes through three main phases of pre-award, contractual compliance and post-award from its inception to close out under the supervision of the research office in the institution. The processes in each phase should be aligned and documented to address the management of grants more effectively. Once, this is done, it becomes easier for the research managers to understand the processes in detail and deploy automation where possible and required absolutely. Another step that should be carried out simultaneously with these reforms is to introduce new grants in collaboration with international educational and industrial partners. Such collaborations enhance multidisciplinary research which is required nowadays to tackle most of the problems requiring input from different fields. Moreover, this strengthens the networking profile also of an institution which gradually translates into higher publications of better quality.

STREAMLINE PROCESSES

The processes are streamlined with flowcharts depicting each step in the phases of research grants. In the pre-award phase, new grants are conceptualized in line with university policies as well as the initial processes of existing grants are conducted. This includes awareness sessions, calls for grant proposals, pre-screening, vetting, evaluation, validation, announcement and pre-funding of awards. All these activities are demonstrated in the flowchart of

Figure 1 for pre-award services provided in a higher education institution. The pre-award services can be categorized into awareness sessions, external funding, announcements, technical support and proposal submissions, pre-screening and vetting and finally evaluation and validation. Basically, in the pre-award phase, the research office initially conducts informative sessions on present grants prior to the start of each cycle and then the announcement to calls for various grants is made for the applicants. It also strives and supports to secure external funding. After the calls, it receives proposal submissions then and provides technical support for its systems to the candidates. After the submission deadline, the received proposals are scrutinized as per the requirements and successful applications are vetted. Finally, the vetted proposals are technically reviewed and prioritized to validate the successful applications according to the available financial budget. The candidates with the approved proposal are notified in the end. Once the projects are awarded to the lead principal investigators (LPIs) by the pre-award department, their legal contracts are developed to comply with all stakeholders' requirements. The contracts are drafted and the clauses are negotiated with all parties involved prior to signing off the agreements by the representatives of the projects. The contracts or agreements are mainly prepared for the grants where additional partners outside of the institution are involved such as the case in industrial and external grants. The workflow of this department is demonstrated in the flowchart of **Figure 2**.

This contractual and compliance phase of the grant involves contract preparation, inter-departmental feedback, legal compliance and the finalization of the agreement. Initially, the agreement is drafted and reviewed as per the grant requirements. Then, the feedback of relevant departments such as Finance, Auditing, Post-award section and external legal department in case of external funding is incorporated. All the clauses as per institution's and sponsors' requirements are legally confirmed, negotiated and finally, the agreement is signed off by the involved parties in order to execute the contract. After the execution of the contract, the grant is the responsibility of the post-award section. This department provides services to the researchers throughout the duration of the running grants. The requests related to grants by the lead members are attended by this department. It is also responsible for monitoring the progress of the grants, gather annual and final technical reports and other important key performance indicators (KPIs) prior to close out of the awarded grants. The processes are shown in **Figure 3**. After the commencement of grants, the post-award section is the focal point for the lead researchers. It caters to their grant-associated requests such as hiring researchers, purchase equipment, travel for conferences, and other miscellaneous expenses. The received requests are managed normally by a combination of manual and automated systems. These requests are then forwarded to relevant departments for their approval and/or input. Throughout the execution of the grant, the post-award ensures legal compliance, track and support grants for productive results. It collects technical reports, assesses them and makes renewal decisions on an annual basis. In the end, complete audits are carried out by internal and external stakeholders prior to close out of the project.

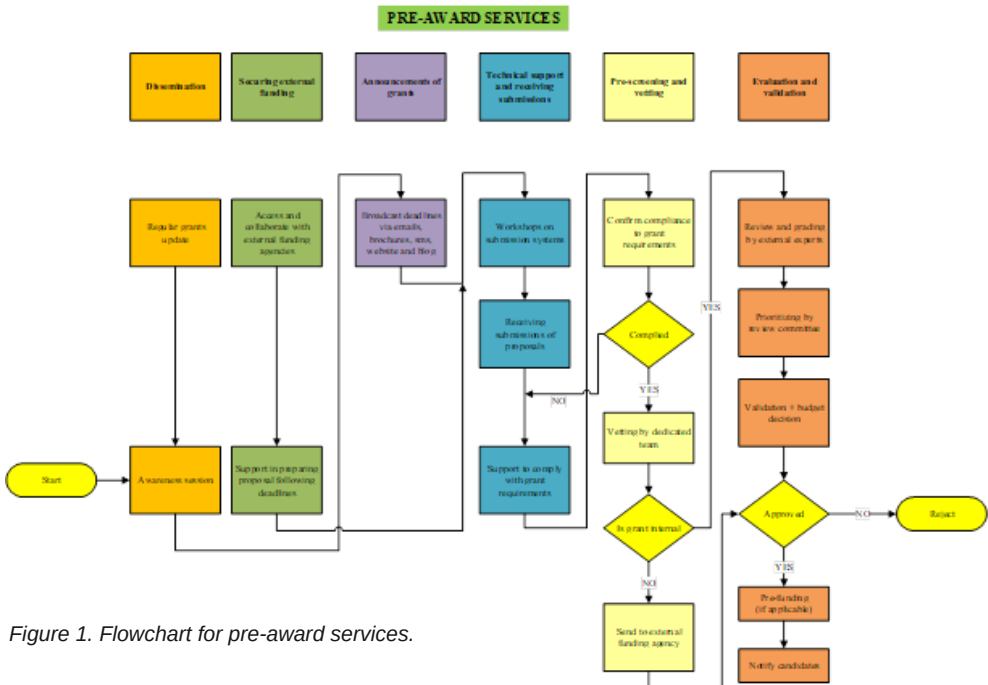


Figure 1. Flowchart for pre-award services.

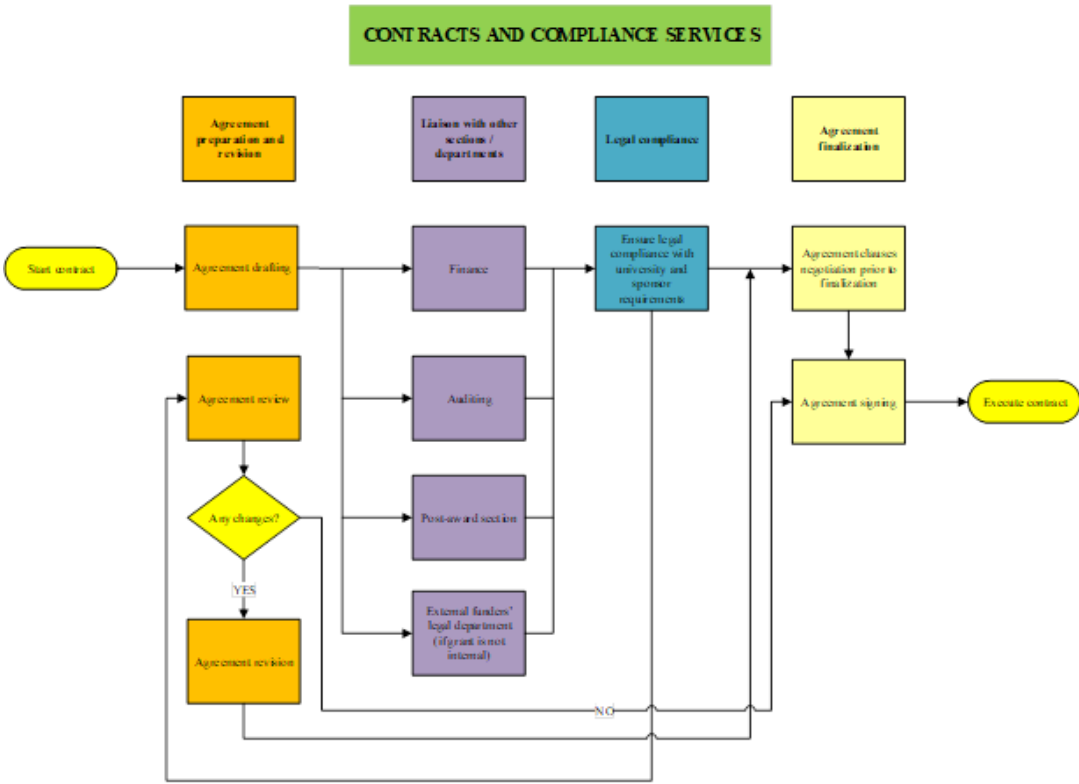


Figure 2. Flowchart of contracts and compliance services.

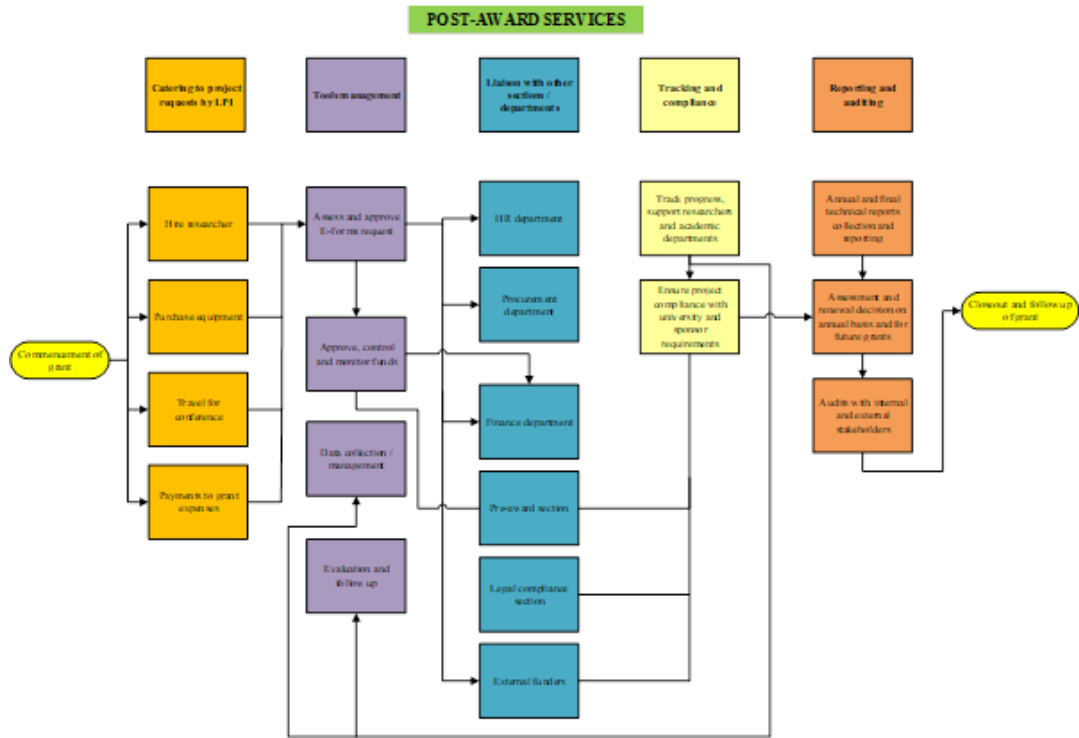


Figure 3. Flowchart of post-award services.

AUTOMATE PROCESSES

Once the processes of the research office are outlined considering different phases of the lifecycle of a grant, the research managers will have a clear and detailed picture of the processes and they can make effective decisions to increase the productivity and efficiency of their research offices. Accordingly, by observing the processes, automation can be deployed to document the activities in an efficient manner. The parts where automation can be time-saving rather compulsory and accurate are depicted in Figure 4.

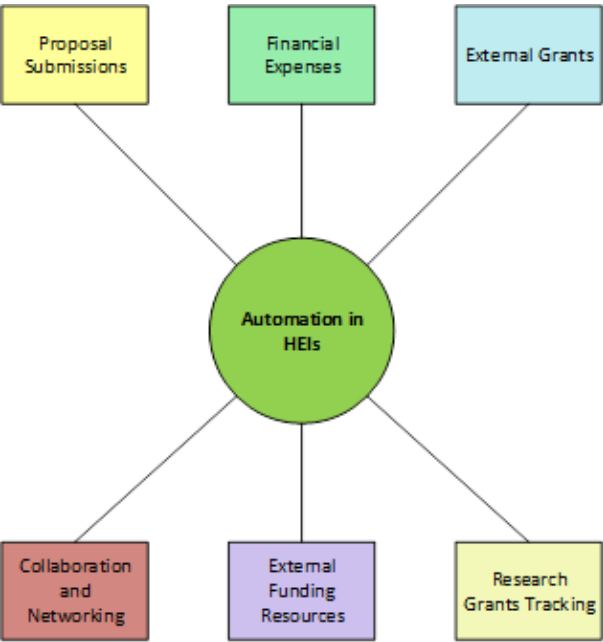


Figure 4. Automation areas for efficient management of research grants.

The broad categories of automation areas can be internal and external, corresponding to an institution. The tools required for this automation can be a blend of commercial ones and homegrown, rather we insist on adopting this combination to serve the tailored requirements of an institution. For internal grants, the home-developed tools will perform better and commercial tools can be utilized for external grants and funding resources. The automation of proposal submissions and finance management is crucial and mandatory, hence associated tools should be adopted as a first step by the institution. As soon as the grants tend to grow, the additional tools to enhance the research output can be deployed. For instance, the collaboration and networking between researchers and tracking the progress of running grants to grade them can be automated in later stages of the grants. For external grants management or securing external funding, commercially available tools serve well and are being employed by many institutions in higher education world-wide.

PROLIFERATE COLLABORATIVE GRANTS

Another angle, in addition, to streamline and automate processes in the research office, is to conceptualize, introduce and manage collaborative grants with academia and industry. We are living in an era of the industrial revolution which started from the invention of the steam engine, followed by electricity and information ages and presently, humanity has stepped into an era of cyber-physical systems (CPS) also regarded as Industry 4.0. In the present era, the role of HEIs has become of paramount importance by developing the skills of the students and researchers in accordance with the industrial demands. As industry 4.0 is the age of cyber-physical systems, hence interdisciplinary grants and techniques in teaching, research, innovation, and development are the key components to ensure the contribution of HEIs to Industry 4.0. HEIs are expected to interact and lead the society in Industry 4.0 era. The fourth industrial revolution is transforming the workplaces and a similar transformation is expected from the institutions. The mission of the HEI is to teach, conduct research, and provide services to the community. To prepare countries for the fourth Industrial Revolution, Country Readiness was suggested by World Economic Forum [1] which can help building strategies to leverage productions and assess future readiness. Among the weighting components for the readiness assessment are: Technology and Innovation and Human Capital. These components involve 40% of the assessment. HEIs are highly expected to participate in these two components. The collaborative grants between HEIs and industry can play a significant role in technology and innovation.

3. Case Study

The public university considered for investigating the application of the framework is a leading research and educational university in Qatar. Qatar University (QU) started a new division for the Research sector in 2006 to effectively manage research grants and to support students and staff. The new departments performed based on international standards and accepted best practices in work to qualify audits on organizational and international levels [2]. Presently, the following six offices are working under the Office of Vice President for Research and Graduate Studies (VPRGS) to streamline research and related tasks in QU [3]:

- 1. Office of Research Planning & Development
- 2. Office of Research Support
- 3. Office of Graduate Studies
- 4. Office of Central Business Services
- 5. Office of Engagement and Communication
- 6. Office of Quality and Certification

Office of Research Support (ORS) provides the services necessary to carry out research activities in an organization. This involves introducing new research projects, accepting and evaluating proposals, support in hiring people and equipment for the awarded grants and provide aiding services until the closeout of the projects. The management offices overlook the administration and make policies and decisions to make the administration services more robust and efficient. In order to administer and manage the research activities, adopting appropriate tools, software and even in-house solutions look tedious on the one hand but they simplify the complex tasks manifold on the other hand if used with clarity in their scopes.

RESEARCH PROCESSES

ORS handles all the processes from planning to the closeout cycle of all grants inside QU. The grant cycle can be divided into pre-award, legal compliance and post-award stages. Accordingly, the office team is divided into these departments to perform tasks due in these stages of grants. The tasks, duties or services provided by each department of ORS are shown in Figure 5 and then explained further in detail.

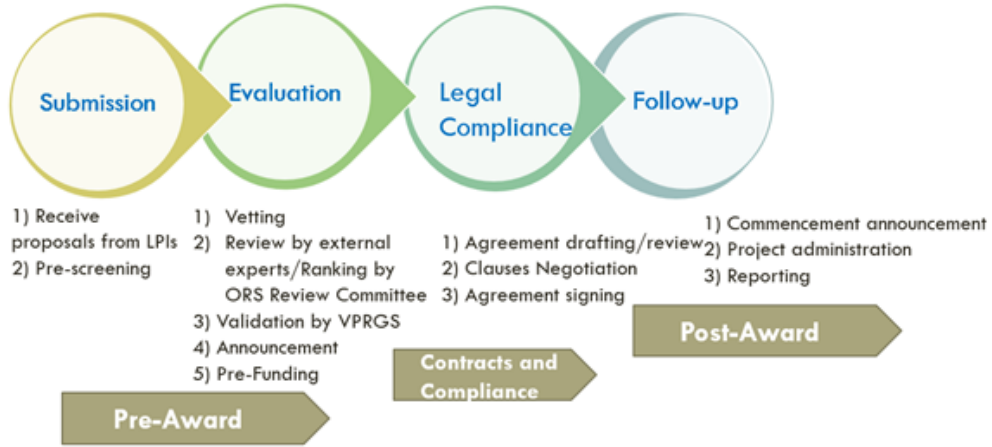


Figure 5. Overall workflow diagram of ORS in QU.



Figure 6. Lifecycle of submitted proposal for grant in QU.

The call for proposals for all QU grants are opened on an annual basis for the QU researchers. Once the proposals are submitted and deadlines are closed, ORS pre-award team sends all of these proposals to external reviewers for their technical evaluation and grading. Based on this evaluation, the prioritization of the evaluated proposals is done by the pre-award task force. These prioritized proposals are validated for shortlisting with the Office of Vice President of Research and Graduate Studies (VPRGS). The validated proposals are then announced as per the budget approved by the Office of VPRGS in a formal session conducted by ORS. The proposal's lifecycle from submission to announcement is shown in Figure 6.

AUTOMATION TOOLS

Matrix structures in the management of quality scientific work are a best practice in research [4]. In order to accomplish effective research management and administration, there are two tools being employed in QU by ORS for financial transactions and collection of research proposals namely Oracle Grants Accounting (OGA) and iGrants respectively. The former is to handle the financial transactions once the grants are awarded where later provides a platform to eligible applicants to submit proposals for internal grants and International Research Collaboration Co-Funds (IRCC) once they are announced. For Qatar National Research Fund (QNRF) grants, they have deployed their own system known as QGrants for the submission of proposals. The university has also presently secured a subscription of Pivot (<https://pivot.proquest.com/>) [5] through Qatar National Library, which helps QU researchers to find funding opportunities across the globe. The two software viz. iGrants and OGA support ORS staff to streamline their proposals and budget respectively, however the scrutiny of the grants applications, tracking the progress of grants both during and after the project life cycle for productive decision-making call for additional tools to be deployed. Moreover, for better visibility of research outputs and networking of researchers worldwide for effective collaborations also require a robust system. In this perspective, QU is working on an in-house solution for effective tracking of grants throughout the projects' lifecycle named Research Tracking System (RTS). For visibility of research outcomes and networking of researchers, the solution provided by Elsevier by the name Pure is under official discussion with their representatives to explore the options tailoring it to the specific requirements of Qatar University. All these mentioned tools and software are summarized in **Figure 7**.

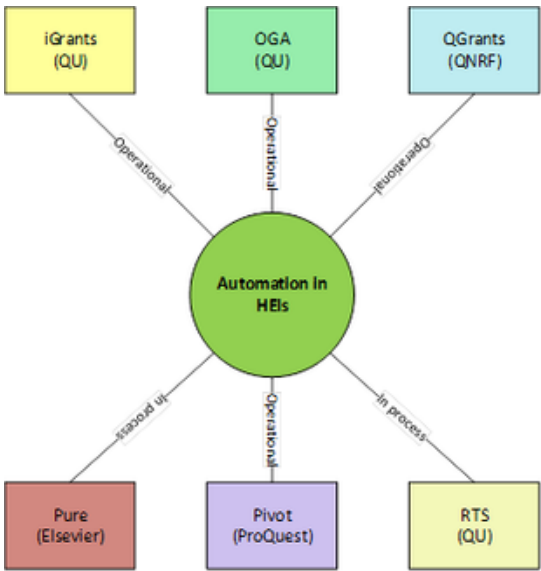


Figure 7. Tools and software in QU for management of research grants.

COLLABORATIVE GRANTS

The collaborative grants can be divided into two broad categories based on the collaboration partner viz. educational institutes and industry.

Collaboration with institutions

The collaboration efforts include the grants launched and funded by QU such as International Research Collaboration Co-Funds (IRCC) and by Qatar National Research Fund (QNRF) as an independent category working under Qatar Foundation to boost research culture in Qatar. IRCC is a flagship program of QU mutually funded by both parties, bringing during the last three years international collaborations with more than 50 countries around the world, to achieve scientific excellence through shared efforts [6]. As a result, the IRCC program has been developed and gone through two tracks. Track 1 is researcher-specific, in which the QU applicant collaborates with some international partners to work on particular co-funded topics agreed between two parties. Track 2 is university-specific, in which a QU college or research center works with a strategic partner to mutually collaborative on mid or long-term co-funded research. In both tracks the proposals are jointly submitted, evaluated by external reviewers and then selected by a joint committee.

QNRF played also an important role in developing quality research in the country in initiating several research grants, including its flagship grant program called National Priorities Research Program (NPRP) since 2007. This grant has been very successful in the past years producing quality results and publications boosting the country's image in the research world as one of the fastest-growing knowledge-based economies. Universities such as QU largely benefitted from QNRF funding, to successfully achieve their capacity building and perform high-level research outcomes. QNRF continues to work and launch various grants dedicated to fulfilling Qatar National Vision (QNV) 2030 in the light of four country's research pillars mentioned in the Qatar National Research Strategy (QNRS).

Collaboration with industry

We witness deliberate efforts nowadays from universities in the world to collaborate with industrial and business partners, following several university-industry cooperative models [7]. Leading and multinational industries are also making policies to invest more in innovation and entrepreneur ventures to stay in business for the long run [8]. In the country's local context, QU is interacting with local and international industries for research and development through various developed grants, research centers, and faculty as industrial chairs.

1. Industry Grants

These grants are funded by local industries in collaboration with QU colleges. The initiative is taken from the researchers to bring onboard industries to meet the mutual research objectives. The industrial partners are generally local, but there are also collaborations with international industry stakeholders such as the recent collaboration with Marubeni Group Japan. The group built specific grants with the university to increase the Technology Readiness Level (TRL) of some research outcomes in different industry fields through a grant called Concept to Prototype (CTP), leading to the university's contribution to industrial innovation and technology.

2. Industry Projects

Many research centers have been established in QU which are dealing directly with the industry and working in collaboration to build prototypes and solutions to industrial challenges as part of Industry 4.0. This is reflected by the numerous projects currently funded by the industry to QU centers and colleges.

3. Industry Chairs

QU is also collaborating with the local industry and the governmental institutions around Chair Professors positions. They act as focal experts from university to industry and government, contributing to the research and development of mutual topics of interest. The faculty chairs enhance the relationship with the industry by boosting research productivity, gathering data from the industry, carrying out simulations, delivering lectures on significant topics and producing technical reports for the stakeholders.

As per the Annual Research Forum and Exhibition 2019 of QU [9], the multiple deployed efforts increased the reputation of the university among its stakeholders, and enhanced its research output (such as multiplying the proportion of publishing in world Top 10 scientific journals by 3 from 2010 to 2018). Such efforts contributed to enhancing also the ranking of the university in the different international ranking lists.

4. Conclusion

Service-based project management of research grants in HEIs is critical to effectively achieve the intended results in terms of productivity. To this end, we have streamlined the processes of a research office in this work from the perspective of the lifecycle of a grant. The resulted flowcharts depict the activities or services provided by a research office throughout the grant in its different phases. This could be helpful for research managers to effectively address the underlying issues. For instance, several areas can be easily segregated from these

process flows where automation can be deployed to improve efficiency. Another factor discussed is the importance and nurturing of collaborative grants between academia and industry for the development of technology and innovation. The developed framework is investigated in a research office of a public university which achieved quality results in terms of research after adopting this framework. The processes and infrastructure could always be enhanced and implemented differently by other higher education institutions to improve their research profile. The framework depends on the context and the strategy of such higher education institutions.

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6. About Authors



Prof. Mariam Al Ali Al-Maadeed, is the Vice President for Research and Graduate Studies and Professor of Physics and Materials Science at Qatar University. She has been leading the research and graduate studies strategies, programs and developments since 2016. She played a major role in developing the research and graduate programs, as well as fostering and strengthening national and international relations within this field. Prof. Mariam also holds national and international awards in many fields such as in Physics, Women in Science and others. She published many peer-reviewed papers, book chapters in Materials Science, Nanotechnology and Higher Education. She is currently chairing the Academic Network for Development Dialogue, a new UN initiative related to implementing the SDGs within universities of the region and leading the initiative of the university transformation.



Shahbaz Hussain received his B.Sc. (Hons) and M.Sc. in Electrical Engineering from the University of Engineering and Technology (UET) Lahore, Pakistan. He has industrial experience of more than three years in various mega projects of Qatar. He is currently pursuing his Ph.D. in Electrical Engineering (Power) from Qatar University and is involved in research work related to his field in the same department. His research interests are renewable energy resources, power system protection, cybersecurity and optimization of the power systems in the fields of generation, transmission, and distribution using modern programming techniques. He is also working as a Graduate Assistant (GA) in the Office of Research Support (ORS), Qatar University where he supports to development framework and services required to automate the processes of research grants.



Prof. Mohammed Al-Salem, is the Director of Research Support and a Professor in the College of Engineering at Qatar University. In the Office of Research Support, he initiated several research and innovation programs, such as the High Impact, the Collaborative Grants, and the IRCC International Research Collaboration Co-fund programs. These programs had a great impact on the transformation of Qatar University into an international university. Prior to that, he held the position of Head of Department of Mechanical & Industrial Engineering for several years. During his term, Prof. Mohammed introduced innovative pedagogical tools and platforms contributing to the digital transformation of his department.



Prof. Abdelaziz Bouras is a member of the Computer Science and Engineering Department of the College of Engineering at Qatar University. He is currently managing the Pre-Award Department at the Office of Research Support of Qatar University. He managed several international projects (EU FP7, Qatar Foundation, French ANR, etc) and coordinated several Erasmus-Mundus programs between the EU and East Asia. He published many research papers in refereed journals/conferences and edited several books. He also founded two international journals (IJPd, IJPLM) and published several books, one of them related to university-industry collaboration within the Industry 4.0 context. He is currently chairing the IFIP International Federation of Information Processing WG5.1, which publishes a yearly edited book with Springer.

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