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Integration of the Quintuple Helix innovation Model into the Higher Education Sector: The case of Mohammed bin Rashid School of Government

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The Quintuple Helix's innovation model encourages collaboration between universities, policymakers, civil society, industry, and overall ecosystems. Collaboration is needed to tackle shared challenges and use them as a driving force to create innovative solutions through research and development. The Quintuple Helix's open innovation framework has been integrated into the Master of Innovation Management (MIM) Program, with five elements: 1) academia, 2) civil society, 3) government, 4) industry, and 5) natural environment. The MIM program is designed to provide students with theories and methods to help them learn to find solutions to their work-related problems. At the time of allocating recourses to the project, a number of factors must be taken into consideration, such as student's experience in the subject of the problem, knowledge from similar research areas, feedback from field stakeholder, and work simultaneously with the instructor to choose the appropriate research method for the study. In the United Arab Emirates, there is an increased expectation that public sector employees will participate in the adoption, promotion, and implementation of government innovation strategies and innovation projects. The Mohammed Bin Rashid School of Government (MBRSG), therefore, endorses students to work with faculty members and supports the publication of their work to enhance their research abilities, support the production of knowledge, create impact, and gain stakeholders trust.

Keywords: *Higher Education, Quintuple Helix, Students, Wicked Problems, Innovation.*

1 Introduction

The aim of this study is to explore how higher education institutions contribute to sustainable innovation in the public sector through a single case study analysis. The paper focuses on the role of higher education and, in particular, the role of Mohammed bin Rashid School of Government as a public sector higher education institution in promoting service innovation, which in turn offers students the opportunity to evaluate service provision in their entities and think about areas of service that need to be developed or improved through the lens of the Quintuple Helix innovation model. The case study also demonstrates how a public sector organization fulfills the government mandate of embedding innovation across the institution, while at the same time fulfilling the social responsibility of a higher education institution in stimulating economic development, innovation, and sustainability (Hayter and Cahoy, 2018). The findings are expected to be useful for other public higher education institutions looking to adopt innovation as well as for policymakers to address the larger role of higher education institutions in promoting the innovation capabilities of a nation.

On the increasing demand for smart transformation of government services, there is a fear for information security in many countries to prompt the design of control measures to introduce smart governance. However, in Dubai, this was not a fear holding back development, because the demand for maintaining the image of Dubai as a leading city for innovation was determined, and Dubai Government Departments took a leap to adapt to global innovation. An analysis of the Dubai smart-government indicates that the Government of Dubai has long been keen to put in place the required incentive schemes and major milestones for the successful implementation of the project (Badran, 2019). In the United Arab Emirates, there is an increased focus on public sector innovation by incorporating innovation into service design and service delivery across all sectors. Moreover, in the UAE there is an increased expectation that public servants will participate in the adoption, promotion, and implementation of innovation strategies and innovation projects. Mulgan and Albury (2003) define innovation as "The creation and implementation of new processes, products, services and methods of delivery which result in significant improvements in outcomes efficiency, effective-ness or quality." The Master of Innovation Management (MIM) program is designed to support the implantation of government plans and qualify managers and future leaders to be part of the innovation waves; to provide their organizations with new ideas and practical solutions to serve the UAE citizens. The MIM program was developed by incorporating the principles of the Quintuple Helix Model that call for a close linkage and interaction between academia, government, industry, civil society and natural environment to produce sustainable innovations. Innovation in the public sector can be defined as the 'the introduction of new elements into a public service—in the form of new knowledge, a new organization, and/or new management or procedural skills, which represents discontinuity with the past' (De Vries et al., 2015). Innovation for the public sector is no longer a choice but an imperative if the respective

country's public sector wishes to survive in the unfolding era of privatization, liberalization, and globalization. Developed countries are using innovation in the public sector as a means to address growing budgetary pressures, and for meeting new societal demands. The United Arab Emirates (UAE) plans to reduce its dependence on oil and move towards being a knowledge-based economy and recognizes the role of innovation in driving economic development. Abu Dhabi's 'energy re-branding' since 2005 meant that it declared its intention to transform itself from an oil exporter to a total energy giant that also embraces alternative renewable and nuclear energy (Sim, 2012). The UAE launched several initiatives to promote innovation in the country such as the Year of innovation in 2015 (Month of Innovation, Mohammed bin Rashid Centre for Government Innovation, Government Innovation Labs, Sheikh Mohammed bin Rashid Al Maktoum Fund) to finance innovation and several other initiatives (United Arab Emirates Government Portal, 2019). The Global Innovation Index of 2019 identifies UAE as one of the global leaders in innovation and places UAE in third position in the Northern Africa and Western Asian region. The index ranked UAE 36th globally based on its capacity to innovate and 24th in the innovation input sub-index (Dutta et al., 2019). The UAE launched the National Strategy for Advanced Innovation in 2018. The strategy aims to shift the focus from the education sector to the purpose of enhancing future skills in students, in order to achieve the UAE Centennial 2071 objective of having the best talents and human capital in the world. This will be achieved by adopting experiments and tests that equip students with 22nd-century skills, and by embracing advanced teaching methods (UAE Innovates, 2018). The National Strategy for Advanced Innovation stresses the need for ideas in order to achieve tangible outcomes in the world. It entails raising questions and conducting experiments that enrich the discussion, contribute to identifying challenges, and inspire new ideas and unconventional solutions. The UAE Ministry of Education Standards for Institutional Licensure and Program Accreditation recognizes the role of universities and colleges in serving as a "core part of the nation's innovation system" (The commission for Academic Accreditation, 2019). The 2019 Commission for Academic Accreditation (CAA) clearly emphasizes in its Standards the role of education in developing graduates' innovation and entrepreneurship capabilities and requires academic institutions to include innovation in course learning outcomes.

2 Service Innovation in the Public Sector

Drawing on the taxonomy of innovation in public sector organizations proposed by Windrum (2008), there are six types of innovation: a) Service innovation b) Service delivery innovation c) Administrative and organizational innovation d) Conceptual innovation e) Policy innovation and f) Systemic innovation. The focus of this paper is service innovation which is defined as the introduction of a new service; (in this case curriculum) changes to improve an existing service while service delivery innovation is defined as new or altered ways of supplying public services (Windrum, 2008). The service innovation focuses on innovations in the public sector that would lead to new or improved services in order to create value for people in the UAE.

The current focus on public innovation is conditioned by three historically contingent factors. There is a growing cross-pressure between the rising demands and expectations to the public

sector and the limited public. Some demands will have to be curbed, while others must be met in new and creative ways that improve quality and provide customized solutions at the same or less costs. Specialized knowledge is needed in order to capture the complexity of the problem and efforts must be undertaken in order to reduce the risk of conflicts between the many different stake-holders. Globalization is discursively constructed as a competitive game that turns governments, regions, and localities into winners or losers depending on their innovative capacities. (Sørensen and Torfing, 2012).

3 Quintuple Helix Model

The quintuple helix model of innovation was proposed as an extension of the quadruple helix model by adding the fifth helix of 'natural environments of society' (Carayannis et al., 2012). The model focuses on the relationship between university, government, industry, public/society and natural environment. The model addresses the global need for being "ecologically sensitive" and considering the "biophysical structures of society" or the impact of culture and nature on the development of new products and services. The model advocates a knowledge-based society that is sensitive to the socio-ecological context, which produces and disseminates knowledge that promotes sustainable growth and development. The aim of the model is to incorporate sustainable development as an essential element in innovation and knowledge production (Caravannis et al., 2012).

4 Service Innovation in Higher Education Institutions

- A systematic review of innovation studies in public sector revealed that there is very limited literature available on innovation in the education sector let alone in the public institutions (De Vries et al., 2016).
- Limited evidence shows that innovation in HEIs is mostly in response to external pressures that forces institutions to bring about new and improved curricula, programs of study, institutional processes, practices and structures (Hasanefendic et al., 2017).
- Service innovation in the Higher Education sector often occurs in response to external pressures such as increased competition, student demands for new programs, or in response to employer requirements for a new suite of knowledge, skills, and competencies in graduates.

5 The case study of Mohammed Bin Rashid School of Government (MBRSG)

MBRSG offers Masters programs in the field of Public Policy, Public Administration, and Innovation Management. The School delivers executive education programs in subjects such as public policy and administration, political science, economics, finance, and strategic management. The School offers consultancy services to public sector entities locally, regionally, and internationally through its advisory arm. MBRSG serves as an educational institution and public policy think tank that conducts multidisciplinary policy and government research. MBRSG's research production through policy councils and policy forums is aimed at fueling public sector dialogues for policy innovations. The MBRSG's Policy councils and Policy reviews are geared towards creating a better understanding and learning of public

policies, and appropriate solutions to problems that drive towards improving public sector policy instruments.

6 Service Innovation at MBRSG

MBRSG is a public sector organization that fulfills the United Arab Emirates government mandate to include innovation and promoting a culture of innovation across the organization by developing new and distinct programs from the current degree programs offered in the UAE. Service innovation at MBRSG takes the form of developing new degree programs or Executive training programs that address the need of the market. MBRSG is also keen to integrate UAE strategic priorities such as innovation, entrepreneurship, and sustainability while developing new programs. One example of service innovation by MBRSG is the development of the Master of Innovation Management (MIM) program which is designed for professionals working both in and with the public sector, who wish to pursue a career in innovation management. The program is designed to prepare graduates who are capable of promoting sustainable innovation in their field of work. This program is developed for current and future managers and leaders in national and international public and private sector organizations who wish to engage in innovation and believe in improving services through creativity and improvement. What distinguishes the Master of Innovation Management program is its focus on public sector innovation that is sustainable in terms of service development, public sector digitalization, service integration, and improvement of customers' happiness centers starting from ideation to implementation through applying the quintuple helix model. The values of the Mohammed Bin Rashid School of Government are reinforced throughout the MIM program. They are:

1 A strong emphasis on leadership dimensions and good governance policies. We believe in "Empowering Future Leaders". The School's operations are founded on global best practices developed in collaboration with the Kennedy School at Harvard University, and it is considered a unique model for academic institutions in that it focuses on the applied aspects of governance.
2 A commitment to the Sustainable Development Goals (SDG). MBRSG is a member of the UN's Principles of Responsible Management Education network and the SDG Network.
3 The overall design and implementation of training programs are built on the foundation of scientific thought and is inspired by the reality of Arab public administration and with a view to addressing; the issues and helping future leaders meet the challenges facing public administration in various parts of the Arab world.
4 The MIM program uses the reflective process of innovative thinking needed for experimentation. Several factors make the program a distinct service innovation:

a) Pedagogical Approach and Teaching Methods

The program uses active learning techniques such as project-based learning, design thinking labs, experiential learning, presentations, debates, and discussion to enhance classroom learning. The relevance of using active learning techniques in class is espoused by the constructivist theory which states that teaching is not a matter of transmitting knowledge but of engaging students in active learning, building their knowledge in terms of what they already understand (Biggs and Tang, 2011, pg.22). The constructivist paradigm views classroom as a "community of discourse engaged in activity, reflection, and conversation" (Fosnot, 1989), where learners are engaged in discussing their ideas to the classroom community.

b) Project-Based Learning – PBL

In delivering the MIM program, the MBRSG started using innovative teaching methods such as Project-based learning. The PBL promotes transdisciplinary thinking and encourages students to incorporate the principles of long-term sustainable development while developing innovative solutions. MIM is the first program in MBRSG to move to Project-Based Learning. The focus is to use human-centered design thinking to solve wicked problems. Four types of PBL are used in delivering the MIM courses (See Figure 1). Depending on the level of the student experience in the project, both reading and experience are used to increase knowledge. For example, in the Careem project, students downloaded the application and had to perform an individual analysis and then share experiences collectively. This allowed them to get a good understanding of the context for which they were creating innovative solutions. The university-company relationship is strengthened; students learn from real working environments and the companies benefit from a characterization of their logistics processes and are able to form a feasible improvement project which is validated technically and economically (Cano et al., 2019).

Most MIM students are working professionals (a minimum of three years of work experience is a condition for admission) and therefore have a good idea of the contextual setting. In the MIM program, we use PBLs in II, III, and IV quadrants for teaching because they have work experience. The understanding is that the students will apply the learnings in their real-world context. Many of the projects they choose at the individual level revolve around their work environment. The students' projects are designed with industry - Careem (UAE's first Unicorn), civil service - International Humanitarian City, and Government (Agile Government and Competitive Clusters). The field trips, which would ideally fit in Quadrant 1, are not graded and field trips have been arranged so far to South Korea, China, and San Francisco. The students meet a variety of stakeholders - government, industry, academia, the civil sector, and get an appreciation of the national context. They are encouraged to look beyond disciplinary boundaries with a focus on innovation that is long-term, culturally relevant and which focuses on sustainable development. Thus, the program exposes students to the interaction and relationship between the five subsystems of Quintuple Helix Model – academia, industry, civil society, government and natural environment.

Figure 1: 4 types of PBL used in delivering the MIM courses

	Real World (Live)	Real World (Proxy)
Public / Industry context	**Quadrant I.** Internships, co-op, field trips	**Quadrant III.** Working on a live problem with key deliverables, within assessment guidelines (with field stakeholder), dissertation and Projects.
Case reports	**Quadrant II.** Working on a live problem with key deliverables, within the assessment guidelines (without field stakeholder), dissertation, projects	**Quadrant IV.** Simulations, Case studies

c) Progress of Design Thinking Lab

Design Thinking Labs help students identify challenges and opportunities when they begin to select a critical problem associated with their work; design-thinking (See Figure 2) has four steps: 1) problem identification, 2) ideas collection, 3) idea incubation and 4) reporting (Aisha et al., 2018). The students add knowledge to the problem, by collecting relevant references to the specific problem; each student performs an individual analysis, and then discusses the results in a group discussion with classmates to determine other solutions proposed by colleagues for the same problem. To ensure the academic achievement, the instructor provides students with emotional support and guidance to help them draft the concept and identify its factors. If students have ideas for implementation, the School provides the desired support in terms of resources and facilitates field visits to Dubai government institutions. Students are advised to document all stages of their work and discuss it with field stakeholders and seek instructors' support. The solutions are developed and linked to the work context and when the field stakeholder acknowledges the solutions the research team provides the technical support, the ethical applications are applied, after which time the research papers are drafted. Finally, when papers meet the requirements, they are published on MBRSG website and scientific journals.

Figure 2: Design thinking steps, (Aisha et al., 2018).

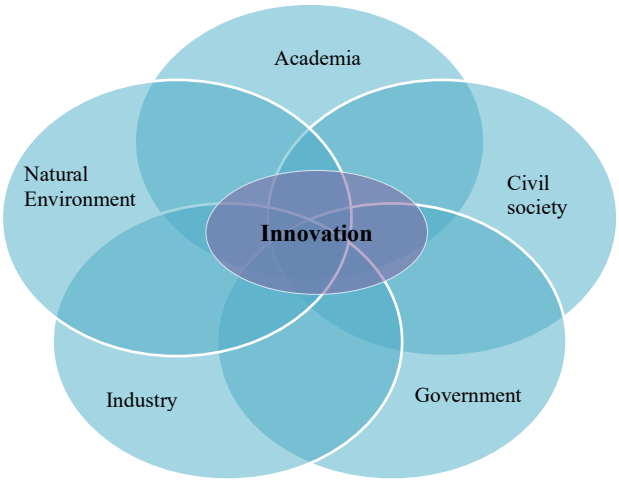
Problem Identification	→	Ideas collection	→	Idea incubation	→	Reporting
The instructor will provide the students with the problem statement and encourage discussion to help finding solutions to the problem.		The instructor will encourage the students to write down all ideas that come to mind, they can write or draw.		The instructor will ask the students to get all ideas into reality and to look into the problem whether it will close the gap or not.		The instructor will request the students to write report on the grouped ideas.

d) Mode of Program Delivery

The program delivery mode has been designed to meet the needs of adult learners' majority of who are working professionals. The program is delivered using the block mode of delivery where the instructional time consists of large blocks of several hours extending up to a full day (Burton and Nesbit, 2008) with the entire contact hours timetabled to be covered typically in a block of a few days or a week. Experiential learning focuses on a set of interactive seminars/workshops. The program uses a quintuple helix approach with a strong theoretical foundation on the core concepts of innovation management, in the context of creating public value (See Figure 3).The model is adapted from a series of publications by professor Elias G. Carayannis on the quintuple helix framework. The academic element focuses on knowledge creation and dissemination, subject matter expertise, research process, induced self-logical learning, and skills development. The civil society element focuses on agenda-setting, sense-making, and pubic private partnership. The government element focuses on public policy, instruments, and strategies, stakeholders, and transformation to the agile government. The industry element focuses on partnerships, entrepreneurship, knowledge spillovers and diffusion, and commercialization agility. The natural environment element focuses on future foresight, crisis management, scenario planning, sustainability, and commitment to sustainable development goals and wellbeing.

The program uses experiential learning through workshops, interactive discussions, and practice-based assessments to develop personal competencies to lead, design, manage, and implement innovation. The focus is on understanding and solving wicked problems using de-sign thinking and a customer-centric approach to contribute to and measure the impact of public value. Students are taught to use foresight and brainstorming to future-proof policies. Students also get some basic management grounding to be able to explain the cost-benefit proposition for their projects. The acquired skills are complexity thinking, creativity, crisis management, presentation and pitching skills.

Figure 3: MIM Quintuple Helix Open Innovation Model



e) Curriculum Content

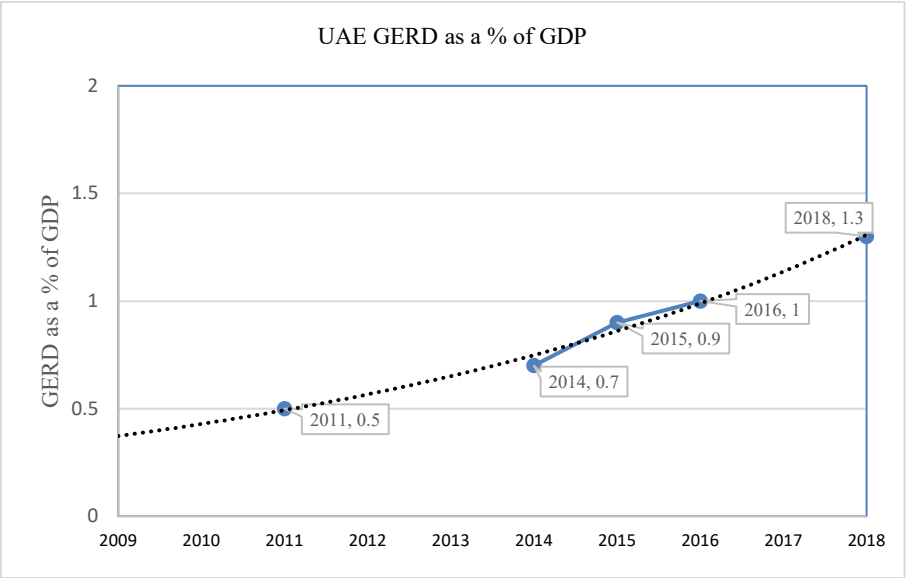
The MIM program focuses on innovative policymaking and innovation in general. The program curriculum includes the following dimensions: (1) Complex problem analysis; (2) foresight; (3) setting a strategic agenda; (4) understanding competitiveness; and (5) leadership and crisis management. These topics are embedded in the contextual understanding of evidence-based policymaking through the honing of research skills. The program has a strong focus on developing an understanding national and international "biophysical structures of society" and how these influence the development, and acceptance of innovation. For instance, the course Public Sector Innovation in the program makes students cognizant of the interaction between the five helixes of the Quintuple Helix model by covering topics such as government reforms, citizens' expectations for effective and efficient public services and higher value service innovations, the impact of demographic changes and climate changes, etc. The program promotes trans-disciplinary and interdisciplinary thinking (Caravannis and Campbell, 2010) and innovation through providing courses in a range of disciplines such as Economics, Strategy, Finance, and Business.

The culmination of the program is the individual dissertation where the student chooses a problem to work on and uses research best practices to answer the research question. In their dissertation, the students are engaged in the research development of original work. Through this method, students get a first-hand understanding of data limitations, data design and the collection process, which are critical skills for evidenced based policy making. The published dissertations are part of MBRSG's contribution to the UAE's Gross domestic expenditure on Research and Development and our investment to the knowledge economy in the UAE. All dissertation projects which are successfully defended are uploaded into the MBRSG website; and some are further developed into publications as policy white papers, book chapters, or journal papers.

7 Innovation Outcomes

The Quintuple Helix's innovation system is principally a sound construct and it can be seen as a framework for interdisciplinary analysis and transdisciplinary problem-solving in relation to sustainable development, as it is built on the understanding of the production of knowledge (Maruccia et al., 2019). This diversity of thinking is required, as the same study encourages spending on education: government funding generally means that some students will graduate in scientific and technological subjects and increase the number of researchers, who, in turn, contribute to the knowledge creation, impact, and diffusion (Maruccia et al., 2019). UAE's Gross domestic expenditure on research and development (GERD) has improved over time. According to the UNESCO database, the GERD was 0.5 in 2011, before jumping to 1.3 in 2018 (See Figure 4). Between 2016 and 2018 the figure improved by 23% to 1.3.

Figure 4: Gross domestic expenditure on R&D (GERD) – Source UNESCO 2018



MBRSG research spending in 2018, according to the Ministry of Education Higher Education Classification Framework for 2019, was 0.97%, and is comparable to the UAE national GERD spend of 1%. Enhancing students' research abilities is important to help them choose research topics and write their dissertations, and to increase school research production. The students' dissertation projects are designed and supervised around the topics of innovation addressed by the Government of Dubai, the Federal Government, and the local governments. The research topics are influenced by best practices and the course instructors direct the students to design their research projects with a combination of practice and theory by referring to theories of creativity and innovation. The dissertation projects of students have been geared towards stimulating innovation in the public sector. Examples of dissertation projects completed by students demonstrate the program's roles in fostering innovation in the UAE public sector:

- Autonomous Vehicles Regulation through Multi-Agent Decision Making and Good Governance.
- The Perception of Healthcare Practitioners and Citizens in Dubai Regarding the Perceived Benefits of Patient Portals Used in Hospitals in the City.
- Enhancing the Intellectual Property Rights (IPR) system of UAE to achieve the national innovation strategy
- The Impact of Public-Private Partnership with Roads and Transport Authority on the Economic Development of Dubai.
- Innovation and Creativity in the Public Sector: Case of Umm Al Quwain government.
- Skills Required for Public Sector Employees to Transition into Industry 4.0, in the fourth industrial revolution.
- Availability of Big Data and Contributions in Innovation at Public Sector: Case Study Entity (Federal of Competitiveness and Statistics Authority).

8 Conclusion

Quintuple Helix innovation is a model that is able to be integrated into academic programs for the benefit of higher education institutions. The quintuple helix is a renewed quadruple helix model that focuses on problem-solving in multi-sectoral collaboration. Higher education is a strong partner when it comes to innovation management, enabling students to learn how to solve wicked problems through research and development. Students also learn about research skills and analytical thinking skills of work-related issues and identify service areas that need to be developed or improved by understanding the Quintuple Helix open innovation model. The joint efforts between various institutions are important to support innovation and create a positive environment for research and development. Moreover, opportunities should be available to students when it comes to problem selection, research funds and resource allocation.

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