Innovations

Ecosystem Management Framework for Overcoming the Challenges of Public Sector Innovation

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Abstract : *This paper proposes a framework for overcoming the identified coordination and orchestration challenges in public sector innovation. Public sector driven innovation is essential for socio-techno-economic development on municipal and national level, as well as for the coordination of public and private sector interests in these paradigm changes. It is also essential for the implementation of national innovation and economic development strategies, empowerment of local business, and engagement of citizens. In our deductive review of earlier research we found that public sector innovation challenges are mainly related to organizational, interaction based, interest driven and context related challenges. Apparent research gap was identified in the holistic approach to overall management of these multi-stakeholder initiatives. We apply an ecosystem approach to public sector innovation, and propose a management framework for the implementation of public sector innovations as instruments to implement innovation policies. Building on earlier research and a representative case study, the paper presents a model for early user and broad stakeholder engagement in the strategy process, from the definition of shared national vision and innovation priorities, to the clear articulation of role division, collaboration models and initiatives in the implementation of the strategies. This ultimately involves the transformation of the ecosystem dynamics, and proposed best practices to manage this transformation. This paper contributes to contemporary research on public sector innovations and ecosystem innovation management literature.It further presents a representative case study for validation and further elaboration of literature based classifications of public sector innovations.The paper's key epistemic contribution is adding evidence to the body of research in public sector innovation. The practical contribution comes in form of managerial recommendations for public policy makers through more clarity on this transformation process with typologies of actors, motives and management practices for ecosystem based co-creation.The limitation of the paper is that it is based on a single case study. This limitation is overcome by rigorous methodological approach to data collection and strong benchmarking with the best in class public sector innovation hubs word wide.*

Keywords: 1.*Public Sector Innovation, 2.Ecosystem Orchestration, 3.Innovation Strategy and Policy*

1. Research Problem

This paper addresses the identified challenges in public sector innovation. Public sector innovation is characterized by multi-stakeholder engagement and complexity, as well as the strong focus on societal value creation. Our understanding of public actors' role in theco-creation of services and products of public interest has changed dramatically during the past decade (Cinar et al, 2019).In the past, public sector's role in innovation was considered as that of a procurer, acting in a passive role in service procurement and provision. The role of the innovator was reserved for private sector players (Voorberg, 2015).

This thinking has evolved significantly with public actors now taking the leading role in the co-creation with strong technical competences and specialized innovation and development agencies. Advanced technologies have further enabled new means for service creation and citizen engagement in the design process, and services are increasingly created in ecosystem based co-creation.Another major transition in the field is the strong involvement of citizens and academia in the co-innovation process(Sorensen & Torfing, 2017). Recent evidence of this include the raise of public innovation observatories, living labs, experimental zones and challenge driven procurement practices to boost innovation in public services.

Since this phenomena is relatively new, research and management practices on public sector innovation are lagging behind(Pucci et al., 2018). Furthermore, the understanding of the transformation from the traditional procurement based supply chains to innovation ecosystems have received little attention. In this paper we apply ecosystem approach to increase understanding of the dynamism between the various ecosystem actors in quadruple helix collaboration, as well as the ecosystem orchestration practices. The authors develop a framework for holistic understanding of the key elements of a successful innovation ecosystem, and validate it with a representative case study.

The authors began the investigation with a review of the latest innovation ecosystem literature from Scopus, Google Scholar and EBSCOhost bases from 2010-2021. In 2012 publications on innovation ecosystems took a significant increase(Autio & Thomas, 2013; Aarikka-Stenroos & Ritala, 2017). Research focuses on innovation ecosystems as platforms for co-creation of new products and services, or actor mapping and categorization (Kaiser & Landau, 2019). The review revealed that public sector as an ecosystem leader received little attention (Autio & Thomas, 2013), with apparent focus on university and private company lead ecosystems (Oh et al, 2016). Another research gap was identified in value appropriation and papers lacking elaboration of practitioner implications for strategic management (Benitez & Ayala 2020). Many of the studies were descriptive in nature, and focused on ecosystem internal dynamics, without focus on the ecosystem creation and transformation.
This motivated the authors to focus on ecosystem based public-sector innovation through managerial and ecosystem oriented lens. The investigation focused on contributing to the apparent research gap in public-actor driven co-creation processes, methodologies and management practices, and the practical implications and advantages of citizen engagement. The paper addresses the key innovation challenges of organizational, interaction specific, type related and contextual challenges (Cinar et al., 2019), as well as innovation actors, ecosystem maturity and openness of collaboration. Further identified challenges relate to policy alignment, citizen engagement and industry collaboration (Arundel et al., 2019). A good body of research has been devoted to public procurement processes and leadership aspects in innovation diffusion in intra-organizational context (Lewis et al., 2018), but less focus has been given for end-to-end management processes, research design and practical challenges for (McGann et al., 2018).
The presentedframework builds on the earlier reserach on ecosystem origins, initiation, evolution and growth dynamics (Dedehayir et al., 2018), (De Vasconcelos Gomes et al., 2018).The selected case focuses on a project for re-defining the institutional structures, roles and management practices in a regional level ecosystem for effective implementation of a national innovation strategy. The results include the validated ecosystem management framework, the reported case study of public sector innovation ecosystem management, and a reflection of the implications of the paper. The academic contribution is the new methodology for innovation ecosystem creation and management, and the managerial contribution comes in the form of practical recommendations and a benchmark case study.

2. Methodology and Approach

The research process follows classical qualitative case study research, starting by establishing the research gap in the area through literature review, and contributing to the identified gap in an inductive manner based on a case study

findings (Yin, 1992). The key steps included: i.literature review, ii. definition of the management framework, iii. case study validation, iv. reporting of results, and v. analysis and discussion.

In an effort to define the research gap in innovation ecosystem literature, the author's completed an in-depth literature review on 18 EBSCOhost databases, the Scopus database and the Google Scholar in August 2021. The first stage completed an EBSCOhost search with the keyword "innovation ecosystem". This resulted in 531 academic papers. This was then narrowed with keyword "management", which yielded 86 results. Similar search was completed with Scopus database, and it resulted in 69 publications with combination of ecosystem and management. Google Scholar was studied with keywords "innovation ecosystem" with 1540 results, and narrowed down by keywords "Managing innovation ecosystems" (102 results), and innovation ecosystem management (82 results).

The publications were analyzed based on the key contents and the assumed research gap in the holistic ecosystem management, specifically in public sector domain was established. Building on the literature based best practices, a framework for ecosystem analysis was established. The focus was allocated to six ecosystem dimensions that had been identified as the key determinants of the ecosystem success. The dimensions include the five key enablers for ecosystem innovation, namely inclusion of all relevant actors, clear vision and objectives, human capacity, regulatory environment and instrumentation. The sixth dimension is ecosystem orchestration, systematic coordination of these factors.

Table 1. Public Ecosystem Management Framework

Ecosystem Dimension	**Description**	**Scholars**
Talent Pipeline	Capacity Building. Access to right mix of talent and continuous upscaling of skills of the current and the future workforce.	Akcigit, U., Pearce, J. G., & Prato, M. (2020). Tapping into talent: Coupling education and innovation policies for economic growth (No. w27862). National Bureau of Economic Research. Cross Walker, T. (2020). Inclusive talent management in the public sector: theory and practice. Transnational Corporations Review, 12(2), 140-148.
Quadruple Helix Presence	Inclusive Innovation. Balanced participation of all stakeholders in the public-co-creation process.	Mahmoud-Jouini, S. B. Charue-Duboc, F (2017): Experimentations in emerging innovation ecosystems: specificities and roles. The case of the hydrogen energy fuel cell. International Journal of Technology Management 75(1/2/3/4):28 Pucci, Tommaso; Runfola, Andrea; Guercini, Simone; Zanni, Lorenzo (2018): The role of actors in interactions between "innovation ecosystems": drivers and implications.
Smart Specialization	Sectorial Specialization. Definition of the focus industries and areas for public sector innovation.	Arundel, A., Bloch, C., & Ferguson, B. (2019). Advancing innovation in the public sector: Aligning innovation measurement with policy goals. *Research Policy*, *48*(3), 789-798. Lewis, J. M., McGann, M., & Blomkamp, E. (2020). When design meets power: Design thinking, public sector innovation and the politics of policymaking. *Policy & Politics*, *48*(1), 111-130.
Lifecycle	Funding Instruments.	Bason, C. (2018). *Leading public sector innovation: Co-creating for*

Funding	Targeted instruments that reach up all the way to the commercialization phase of innovation.	*a better society*. Policy press. Rukanova, B., Post, S., Tan, Y. H., Migeotte, J., Slegt, M., Wong, S., & Hintsa, J. (2020, June). The role of public funding in the initiation and upscaling of collective innovation trajectories. In *The 21st Annual International Conference on Digital Government Research* (pp. 336-337).
Regulatory Enablers	Flexible Regulation. Conditions favorable for development and uptake of innovations with incentive programs	Kusumasari, B., Pramusinto, A., Santoso, A. D., & Fathin, C. A. (2019). What shapes public sector innovation?. *Public Policy and Administration*, *18*(4), 430-446. Hjelmar, U. (2021). The institutionalization of public sector innovation. *Public Management Review*, *23*(1), 53-69.
Ecosystem Orchestration	Professional Facilitation. Neutral party lead systematic management practices for collaboration.	Dedehayira, Ozgur; Mäkinen, Saku J. ; Ortt, J. Roland (2018): Roles during innovation ecosystem genesis: A literature review Yaghmaie P., Vanhaverbeke W. Identifying and describing constituents of innovation ecosystems: A systematic review of the literature, EuroMed Journal of Business, Vol.15(3), pp.283-314; 05/10/2020

The framework was validated in a participatory case study research in September 2021-June 2022 in Dubai, the United Arab Emirates. The case focused on re-defining the implementation framework for the national innovation strategy in the Emirate of Dubai. The vision and focus areas for innovation and societal transformation in the country were clear and thoroughly communicated to all affected parties, and the progress of the implementation rigorously followed by Global Innovation Index based key performance indicators. The authorities in charge of the implementation in Dubai considered it necessary to re-evaluate the implementation framework, and apply best practices from the leading innovative nations to the local context.

The project involved interviews with 20 local ecosystem key actors, review of 20 national innovation strategies, 15 expert interviews, and the articulation of the key focus areas for benchmarking. The interviews covered the identified innovation challenges, and focused on the local contextual factors. The benchmarking process involved an in-depth research of the processes and structures conducive to innovation in leading countries including Singapore, Ireland, China, the USA, Estonia, the Netherlands, Germany, Israel, UK, Switzerland and Finland. The findings of this project were analyzed using the proposed ecosystem management framework. The case study process is described separately in the next section, since it holds its' explicit value for research.

In the last step, the findings from the case analysis were reflected to the earlier knowledge in order to define specific areas for contribution. The contextual factors were filtered for improved validity of the framework and applicability a broader range of use contexts. The key managerial recommendations are presented in the six categories of the framework. Discussion on the limitation of the study and pathways for the future research are presented.

3. Case Study Findings

This case study presents the project for the evaluation and re-definition of the management practices for the Emirate of Dubai innovation ecosystem. It is a representative study of a journey of a regional ecosystem transforming into a modern, technology enabled, well instrumented and collaborative ecosystem. During this transformation, ecosystem challenges were discussed with the key stakeholders in open consultations, international best practices were followed, and the findings reported as implementation recommendations for the government. With this, the process can be used as a learning case and inspiration for other regions, taken into consideration the contextual factors. These limitations and constraints are detailed in the conclusion section.

Dubai is maturing into a world class innovation ecosystem with clear vision stemming from the national knowledge economy policy. The objective is to reimagine, inspire and design Dubai's future in collaboration with our public and private sector partners, and position Dubai as a world-class hub for Research, Development and Innovation (RDI). For this purpose, a major research project was initiated by Dubai Future Foundation in September 2021 with the following tasks:

- Defining what success is for RDI Ecosystems
- Benchmarking of the leading RDI ecosystems
- In-depth diagnostics of the Dubai's RDI ecosystem
- Development of a framework for future-readiness

The international benchmarking revealed certain patterns for the most successful ecosystems. These included private sector matching public sector investments in RDI, balanced participation of all stakeholder groups, and access to knowledge resources. An interesting finding was that the demands for an ecosystemvaried significantly among multinational companies and SMEs. Since Dubai's objective was to attract corporations as anchor firms for locally grown start-ups and SMEs, the focus in the analysis was placed for the MNC focus areas. These included pipeline of talented people, regulatory enablers and collaboration opportunities for commercialization. The key take-away from the benchmarking was the requirements for an effective innovation ecosystem and a practice based list of key success factors for innovation ecosystems.

The in-depth current state analysis of Dubai's innovation ecosystem identified strengths in the areas of global connectedness, access to markets, safety and stability, quality or life, technology driven economy, excellent infrastructure, fast economic growth and agile government. These findings supported the Global Innovation Index (GII) 2021 analysis of the UAE, which is used as a means to measure the developments on local level. The current state analysis revealed that Dubai has room for improvement in all areas of ecosystem development, but most notably in the culture of collaborative development and effective monitoring frameworks on ecosystem level.

In the following chapters the findings of the case study project are described reflecting the proposed framework dimensions for ecosystem success.

3.1 Quadruple Helix Presence

It was clear from the start, that the ecosystem vision could only be achieved by collaboration among all the regional stakeholders, along with linkages to international partners and knowledge inputs to specified areas. Government identified a set of strategic initiatives that offered opportunities for universities and SMEs to collaborate with government on a project level. The initial analysis revealed that Dubai does not capitalize on the potential of collaboration across its different RDI entities. There is no culture or incentives to encourage cross-sector collaborations. Knowledge sharing and visibility to RDI activities across institutions was also considered as a weakness. Further challenges for collaboration was set by the limitations of the existing funding models. Overall the ecosystem involved the key actors, but the collaboration was limited due to the lack of structures and earlier culture of collaborative development.

The recommendation was to mobilize the actors through different government lead initiatives. This included setting up a network of experimental zones, living labs and test beds for experimentation. Collaboration is organized under challenge driven collaborative RDI projects featuring shared funding models of government funds co-financed by own funding and in-kind contributions. Also regulatory sandboxes were set up to support real-life experimentation with easy access and sustainable cost models.

3.2 Smart Specialization

The priorities involved reaching the frontiers of productivity in all operations through four inter-related objectives: i. attract global RDI-centric corporations to localize RDI activities in Dubai, ii. outline initiatives and programs that will position Dubai as a leading hub for RDI, iii. increase value added to the economy and support economic diversification, and iv. contribute to the knowledge economy and support the development of human capital across sectors of RDI. The set objectives deviate some from the literary based best practice cases, which propose the objectives of solving local problems, attracting high tech innovations, and development of unicorns (Pucci et al.,

2018). This can be accounted for the specific features of Dubai economy in terms of low level of current technology research and innovation, and heightened need for fast-paced economic diversification.
The national innovation strategy for the UAE defines priority sectors for stimulating innovation as: renewable energy, transport, education, health, technology, water and space. Dubai selected four sectors under the umbrella of the national priorities as i. Health and Wellbeing, ii. Environmental Technology, iii. Smart Built Infrastructure, iv. Space and Augmented Human-Machine Intelligence. RDI in these areas is instrumented and regulatory barriers addressed. Recommendations were also given to address the long lead time for materials for scientific discovery and research, legal frameworks for intellectual property protection and data management and protection practices.

3.3 Talent Pipeline

In terms of RDI capability challenges, the main challenge was the limited access and high cost of top researchers. There were plans for Arab Scientist Visa and funding instruments to attract regional talent. Talent platform was built for showcasing profiles and matching talent to opportunities. The pipeline for home-grown RDI talent was considered as sub-optimal. This was accounted for the lack of existing track record of academic outputs to attract global RDI talent. It was noted that only 3 percentage of regional job advertisements are related to research and innovation. Solutions were searched from private sector hiring of young talent and funding talent programs for local students. University- corporate knowledge transfer was considered as an area to improve at all levels. Government intervention in this was funding for stimulating companies to establish innovation and scientific research centers, adopt new technologies and develop innovative products and services.
Government established programs like Dubai future academy and One million coders. A specific outreach office was established to reach the hidden talent from regions.A major initiative that was started was a regional technology transfer office for increasing visibility and awareness of regional research and talent. The objective to attract pioneering international firms in key innovation sectors to conduct their research and innovation activities in Dubai will further support talent acquisition Special incentive packages and visa categories to support transition and movement of people between university and private sector will be established.

3.4 Regulatory Enablers

The UAE innovation strategy seeks to develop an environment that promotes and enables innovation by developing the right regulatory framework, providing comprehensive enabling services, enhancing the technology infrastructure and ensuring the availability of investments and incentives. The analysis of the status of implementation in Dubai revealed suboptimal IP frameworks in some cases, public procurement laws were not suitable for pre-commercial development, there was absence of RDI specific regulatory incentives, and infrastructure access to policies. Further challenges were still faced on business set up requirements, even this area has developed significantly over the recent years.
The plan was to establish RDI centric regulatory sandboxes for the free zones in Dubai. Also a revised science, technology and innovation policy was published in 2022 with related strategic large scale initiatives. The objective was to focus on each step of the innovation process with IP protection, data management policies and commercialization support through venture platforms.Special targets are set for open innovation and citizen engagement. New types of performance based funding instruments were launched, and governance was allocated under one single entity for efficient coordination and access to test infrastructure, experimental zones and government data.

3.5 Lifecycle Funding

The existing funding instruments were considered sub-optimal and focusing more on technological discovery than applied research and commercialization. It was recognized that a bridge funding to link together these two types of RDI activity. Funding envelope for RDI is below par at 0,3 percent of the GDP. The majority of funding goes to universities basic tasks of student research. Also absence of performance-based funding model was considered as a weakness. Private sector contribution towards RDI was also not at the level of the benchmarked nations.

The proposal was to set a sustained and sizeable public funding envelope of performance and challenge driven funding. The new RDI council will open collaboration opportunities and partnerships in all stages of development. The funding instruments are made for shorter time spans with options for renewal in forms of grants, loans, equity investments and partnerships. A significant part of the funds is allocated for technology offtake, effective exploitation of future technologies across government entities, as well as for researcher lifecycle funding for each stage of the research career.

3.6 Ecosystem Orchestration

The key finding in the analysis of the strategic, ecosystem level orchestration highlighted the absence of one single empowered and accountable entity onthe Emirate level for priority setting, coordination and allocation of funds. Several entities worked in collaboration on execution layer, but ecosystem collaboration was sub-optimized due to the lack of coordination on higher level. This lead to un-clarity of the RDI Northstar that would act as an internationally recognized flagship initiative. RDI development strategies were decentralized, which lead to duplication of efforts and funds. Performance measures were sub-optimal and regulatory framework now supporting cross-sectoral collaboration. On execution level there were abundance of free zones, public research institutes, experimental zones and incubation centers, some of which under-utilized.

The newly launched RDI strategy includes the establishment of a special RDI council for Dubai. The committee collects representatives from all government agencies responsible for talent development. Special mandated task forces were set up to investigate specific challenge areas for faster impact creation in a portfolio of roadmap initiatives. The RDI council will make decisions on the priority programs and funding allocations. Budget is decided on annual level reflecting the target to allocate 3 percent of the GDP to RDI activities. An RDI platform will act as an engine for knowledge sharing and investigation of long term regulatory and policy needs.

1. Conclusion

The case study was a testimony of the earlier identified challenges in public sector innovation management. The investigation revealed interdependencies between the various innovation management challenges. The interaction specific challenges together with the contextual factors marked the major area for improvement. Traditionally, the city has sourced products and services from overseas, so local innovation ecosystem development is in very early stages. The lack of co-creation culture and consortium based development resulted in low levels of trust and interaction. Openness, risk sharing and role confusion were further typical signs of the immaturity of the innovation ecosystem.

The lack of management practices contributed to the second major category of challenges. Development was strongly driven by strong vision and shared agenda, along with clearly articulated innovation strategy and good instrumentation. The challenges laid in interaction between the ecosystem stakeholders and the lack of earlier reference cases and research architecture. The responsible government agency needed to define the concept for city wide experimentation for digitalization, the terms of engagement for co-creation, and even contractual templates to be used for collaboration agreements.

The paper contributes to the less published area of practical case studies in public sector innovation. The results further verified the challenges in public sector driven innovation, as identified in the earlier research. The six dimensional framework of innovation ecosystem success factors was used to structure the analysis. The framework was considered to suit well for the reporting of ecosystem evaluation and transformation initiatives. The dimensions are interlinked and combined at the ecosystem orchestration layer. The proposed framework and its' application to a real life case are the key academic contributions of the paper.

In practical terms, the paper proposes clear terms of engagement for ecosystem based innovation management. It singles out the dimensions that an ecosystem manager needs to optimize for a functioning and sustainable ecosystem set up and management. As for the limitations, further research on contextual factors in innovation management will

be needed by replicating the study in another context. Dubai is a young ecosystem whereby even radical changes are relatively easy to make with limited legacy structures and burdens. Another distinct factor is the strong role of the public sector with strong financial position and one party political system. This allows for long term strategic plans and priorities without regard to political cycles.

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