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CRITICAL SUCCESS FACTORS FACILITATING THE PROPAGATION OF DEMONSTRATOR PROJECTS

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Abstract

The idea and practice of Demonstrator Projects have been used increasingly over the last 20 years; however, the process of demonstration and the unique characteristics of these projects do not feature prominently in the literature. This paper aims to define Demonstrator Projects, investigate their nature, and explore what factors exist to support or hinder them to demonstrate and propagate their findings. It enhances this knowledge in two main analytical stages, based on the questionnaire survey of Demonstrator Projects. Firstly, a Principal Component Analysis is performed to identify critical factors that impact the success in

demonstrating. Secondly, a cluster analysis is undertaken on the factors to classify Demonstrator Projects and to identify specific factors supporting or hindering their performance. The analysis emphasizes the importance of a clear communication plan that is sufficiently resourced and supported by the top management. The clusters developed generalities of behaviors to argue why some Demonstrator Projects are more successful than others. Implications for policymakers to shape opportunities for future Demonstrator Projects are then discussed in terms of managing the performance of Demonstrator Projects through tailored success evaluation strategies.

Keywords
Cluster Analysis, Critical Success Factors, Demonstrator Projects, Management

1. Introduction

The idea and practice of Demonstrator Projects (DPs) have been used increasingly over the last twenty years. DPs are often funded or otherwise supported by national bodies to facilitate innovation in areas of specific interest (Spanos et al., 2015). This specific role of 'demonstrating' has clouded the boundaries with 'normal' projects in that, all projects have the potential and often the purpose to 'demonstrate' something – a process, an outcome, compliance to policy, or better practice. This then raises the question about the specific characteristics or nature of DPs and the difficulties of defining them from other projects without becoming tautological. Demonstrator Projects are different by design, aim, and purpose from other projects, therefore the way the success of DPs is being measured should also be different (Collis & Vingerhoets, 1996). The success in demonstrating lies in the project's ability to affect change in a group of people or institutions (Gray & Bowman, 2003).

Having established a clear need to address what makes DPs successful, this paper defines Demonstrator Projects and aims to investigate empirically the distinctive characteristics they have, and the critical factors that assist or inhibit DPs from truly demonstrating and propagating their findings outwards. This study classifies Demonstrator Projects based on their perceptions and analyses the differences in profiles of demonstrator groups. Practical implications are given to stakeholders to shape opportunities for Demonstrator Projects by leveraging these differences in the profiles for tailoring their success evaluation and monitoring strategies.

1.1. Nature of Demonstrator Projects:

This research defined a Demonstrator Project as *'the process by which new thinking is tried and tested at scale and proactively communicated to target audiences, in order to improve processes, products, and services*. DPs are designed to widen knowledge about new

ideas discovered elsewhere and to inspire others to take on new ideas and innovative technologies following these projects (Smith, 2004).

The nature of Demonstrator Projects can be better understood by exploring the key characteristics that distinguish them from other projects. The main factors that can be said to play a vital role in differentiating a demonstrator from other research projects include the communication, application, and long-term impact of the tested solution (Durrant et al., 2015). While many Demonstrator Projects successfully test and apply new knowledge, the area that seems understudied is how they deliver a robust process of demonstration and what contributes to their relative success in raising awareness.

1.2. Success of Demonstrator Projects:

Demonstrating is slightly different, where success should be measured in terms of how the demonstrated activity has been recognized and perceived by others (Gupta & Zahiri, 2020). Two broad challenges were identified in defining what makes Demonstrator Projects successful. One is goal displacement, wherein the implementation of a project with essentially intangible aims, such as demonstrating, the operational and measurable objectives often become far more important than the overarching aims (Huizinga & de Bree, 2021). The other challenge is that it is not easy to define the future when the project's success depends on stakeholders outside the project– innovation dissemination relies on others to become interested, engage and make the best use of the innovations.

The main way in which project proposers address these challenges is to provide multiple measures of success in terms of cost, quality, and time. This is inherent in demonstrator funding streams that come with a requirement to meet strict timeframe, budget, and reporting constraints. The project manager wants to see the project succeed to continuing with what is to be demonstrated and to successfully apply for other projects with the reputation of having delivered a project on cost, on time, and to the prescribed quality (Csiszárik-Kocsir & Varga 2019). Rooted on DP's complex design and long-term purpose, defining their success with a single indicator poses the danger that goal displacement proliferates, particularly if the indicator is an output indicator. This is inherent in project management where there is a difference between what a project can report and what stakeholders want to find out, and a difference in stakeholders' priorities (Netto & Raju 2017). In balancing project ambition and achievability, many Demonstrator Projects show success in attaining output objectives (number of workshops held, number of tweets or emails sent out) whilst not having achieved any of its material outcomes (additional revenue, number of new customers or partnerships).

Whilst the ultimate goal of Demonstrator Projects is to change stakeholders' minds and practices (Gray & Bowman, 2003), the danger is clear that in the effort to show measurable progress, the original intangible ambition has been replaced by a much more modest but measurable definition of success. Yet it is obvious from the continuation of government funding, that Demonstrator Projects have a highly valuable role in translating research and innovation into mainstream society so Demonstrator Projects' success is often falling in the gap between what can be measured and what others want to know about their relative success

1.3. Characteristics and Features:

There are a number of key characteristics that successful Demonstrator Projects tend to exhibit. Throughout the literature, most references refer to the importance of the quality of the internal governance and leadership structures, effective management of time and budget, the robustness of monitoring, and evidence of thorough dissemination (Durmic, 2020). To seek a greater understanding of the success of Demonstrator Projects, a growing body of literature emphasized the importance of these dimensions: clear aims (Jinasena et al., 2020), project management (Durmic, 2020), organizational benefits and drawbacks (Jonas, 2010), dissemination target stakeholders (Smith, 2004) and well-established dissemination channels (Schmidt et al., 1969).

This study aims to comprehend the factors which make Demonstrator Projects successful. To facilitate this objective, the study has established the background of the research methods used in this area. Montequin et al (2016) analyzed the success factors and failure causes in projects, based on a questionnaire to the project managers, and identified nine clearly differentiated clusters using cluster analysis. Ciric Lalic et al (2022) explored whether different project management approaches (traditional, agile, or hybrid) differentiate concerning their impact on project success. Exploratory factor analysis (EFA) was used to validate the factors constituting the project's success. Subsequent cluster analysis was used to distinguish respondents' profiles among agile, hybrid, and traditional project management approaches. While these techniques have been applied in the settings above, the success of Demonstrator Projects has not been investigated thoroughly using these methods in the papers to date, suggesting the need for further investigation.

2. Method

Based on the literature review, an online questionnaire was developed to collect data and insights from current Demonstrator Projects. The first part of the questionnaire constitutes

some questions for background information of the practitioners and the Demonstrator Projects they are working on or had recently finished, such as the respondent's role, project type, starting year, and grant funding. In the second part of the survey, the practitioners were asked to rate the impact of factors, based on their experiences in demonstrating. Using a cross-sectional survey design, questionnaires were distributed to 480 key contacts for different Demonstrator Projects. Sixty-six responses were returned, and fifty-five were used after screening.

2.1. Data Collection and Analysis:

Data was collected on the aims of DPs, their dissemination channels and dissemination targets, project management, and organizational benefits of demonstration, as well as possible drawbacks contributing to the success of DPS. Based on the existing literature, these six dimensions developed a research framework to assess the Demonstrator Project's success. This framework was then used initially to investigate the perceptions of practitioners of DPs on each success dimension, using the empirical data from a survey.

Using SPSS, data were analyzed in three steps: Firstly, Principal Component Analysis (PCA) was run on items of each dimension separately to identify key determinants within each dimension that can impact the project's success, termed critical success factors (CSFs) (Pandremmenou et al., 2013). Secondly, these factors served as input variables for cluster analysis. Thirdly, after attributing each project to one cluster, chi-squared tests were used to identify significant differences in the demographic characteristics of the clusters. The success of Demonstrator Projects has not been investigated thoroughly using these methods in the studies to date.

3. Results

The results are structured as follows: firstly, descriptive statistics outlined the combination of the key characteristics of Demonstrator Projects, secondly, PCA generated fifteen behavioral factors which affect the success of DPs, and thirdly, cluster analysis identified five groups of DPs with significantly different perceptions and demographic profiles.

3.1. Descriptive Statistics:

52% of the responses came from project leaders. 40% of DPs are led by private sector organizations. 42% of DPs are involved in the science and technology sector. 78% of the projects have worked with five or more partner organizations. 80% of the projects are funded by Innovate UK. 73% of projects started in 2018 and 67% were finished by 2021 suggesting DPs do not usually have a long project duration. 44% of projects have received grant funding

above £1M. The data indicates that organizations with economic muscles pursue DPs, benefiting primarily from demonstrating the viability of the technology. 67% said they have a communication or dissemination plan as a key feature. The respondents emphasized that their communication activities are mostly targeted at key stakeholders to generate their interest, and they also added that communicating with potential customers is the most important of all target audiences. Social media is most often used for communication activities bDPSPs. Demonstrator Projects believe that success in demonstrating lies in having a clear communication plan that is sufficiently resourced and supported by the top management.

3.2. Principal Component Analysis:

PCA was run on items of six success dimensions separately to identify critical success factors (CSFs) within each dimension. Rotated PCA was carried out using the maximum likelihood method combined with the Varimax rotation and Kaiser normalization (Fajarwati & Suyanto, 2019). Table 1 shows the framework of DP success used for our study comprising the success dimensions, reflective items of each dimension observed as questions on the survey, CSFs identified from PCA, factor loadings for each item, and Cronbach's alpha of each CSF. The item with the highest factor loading has the strongest relationship with the factor (Montequin et al., 2016).

PCA on the Aims dimension identified three primary aims of DPs, thereby reducing the complexity of this dimension (see table 1). *Sector transformation* represents respondents' perceptions of the importance of the Demonstrator Project's aim to transform the wider sector. *The business expansion* represents the perceived importance of the aim to expand the business. *Engaging funders* represent respondents' perceived importance of aiming to attract new funders.

PCA on the Project Management dimension results in three CSFs that drive the project management success of the Demonstrator Projects. *Transparency and reporting* represent practitioners' perception of independent auditing and project control at each stage of project implementation and its impact on the success of the Demonstrator Project. *Clear leadership* measures how important committed leadership and clear demonstration aims are to drive the success of the Demonstrator Projects. *Project efficiency* represents respondents' perception of the importance of a sufficiently resourced dissemination plan and the efficiency with which the time and budget constraints are met to facilitate the success of Demonstrator Projects.

PCA on Organisational benefits dimension maps two CSFs measuring the benefits of Demonstrator Projects to the organizations. *Raising a profile* represents perceived benefits, including building a strong profile, securing funding, and building an organization's innovation capability. *Technology demonstration* represents perceived benefits to the organization from demonstrating the viability of the technology.

The organizational drawbacks dimension examines the drawbacks to the organization from involvement in the project. *Monitoring burden* represents the drawbacks of tight timescales and excessive funders' requirements. *Project delays* represent respondents' perceived drawback of delays from involvement in the Demonstrator Projects.

The dissemination target dimension addresses the target audience for the dissemination activities for DPs. PCA results in three target groups (table 1). *Third Sector Communication* represents respondents' impression of how important communication with non-governmental organizations and local authorities is. *Business Partners Communication* represents respondents' impression of how important communication with business partners and other stakeholders is. *Customer communication* is a measure of respondents' perceived importance of communication with the customers.

The dissemination channels dimension addresses the typical route for dissemination activities aimed at translating research and innovation into external audiences and mainstream society. *Academic dissemination* represents respondents' perceptions of how often they use academic dissemination activities like conferences, websites, seminars, etc. *Social media and showroom dissemination* is a measure of how often respondents disseminate the project insights via showroom or social media.

High scores for these factors indicate the high perceived importance of the factor for the success of Demonstrator Projects. The fifteen CSFs generated by PCA have Cronbach's α of 0.6 or above showing the internal consistency of the factors, hence all the factors are suitable for subsequent cluster analysis.

Table 1: *PCA Results for Demonstrator Projects*

Dimension	**Critical success factors (CSFs)**	**Questions in survey**	**Factor loadings**	**Cronbach's alpha**
Aims	Sector transformation	To encourage organizations to adopt this technology	0.796	0.793
		To help transform the wider sector	0.789	
		To share results	0.763	

		To generate interest among key stakeholders	0.624	
		To develop new partnerships	0.594	
	Business expansion	To develop new markets	0.791	0.792
		To attract potential customers	0.702	
		To trial a process for deployment	0.665	
		To receive customer feedback	0.623	
		To develop the business case	0.589	
		To test new technology or function	0.572	
	Engaging funders	To generate interest among potential funders	0.89	0.776
		To attract new funders	0.8	
		To develop new products or services	0.51	
Project management	Transparency and reporting	DPs should have independent auditing of outcomes and impacts	0.765	0.738
		Regular reporting to funders helps keep the project on track	0.746	
		It is vital to have dedicated demonstrating resources	0.704	
		It is essential to be trained on demonstrating	0.6	
	Clear Leadership	It is critical to have clear demonstration aims	0.852	0.864
		It is important to have a high level of commitment to demonstrating	0.794	
		It is vital to have a capable team with a wide range of skills	0.671	
	Project efficiency	You need enough time to deliver everything you have planned	0.667	0.736
		Project sponsors must make it clear that dissemination is a key part of the Demonstrator Project	0.608	
		You need a strong budget to do all the planned demonstrating	0.577	
	Raising profile	Made subsequent project bids stronger	0.826	0.834
		Built internal expertise	0.761	
		Helped to secure funding or investment	0.72	

Organizational benefits		Communication with others made the overall project better	0.677	
		Raised the profile of our organization	0.631	
		Raised the profile of the project	0.621	
	Technology demonstration	Demonstrated the viability of the technology	0.809	0.63
		Helped to develop or grow new markets	0.779	
		Generated new partnerships	0.58	
Drawbacks	Monitoring burden	Demonstrating ideas became more important than generating good ideas	0.752	0.622
		Working with partners proved time-consuming	0.73	
		The funder's monitoring and reporting were a burden	0.577	
	Project delays	There were project delays	0.828	0.601
		Demonstrating is more difficult than it seemed	0.712	
		The demonstrator was a distraction from our primary activity	0.379	
Dissemination target	Third Sector communication	Non-governmental organizations	0.861	0.794
		Local authorities	0.764	
		wider sector or competitors	0.753	
		Policymakers	0.653	
		The public	0.459	
	Business Partners communication	Funders	0.859	0.679
		Business partners	0.755	
		Researchers or academics	0.586	
	Customer communication	Potential customers	0.936	0.669
		Existing customers	0.639	
Dissemination channels	Academic dissemination	Conferences	0.854	0.792
		Website	0.773	
		Seminars and workshops	0.741	
		Newsletters and articles	0.641	
	Social media and showroom dissemination	Showroom	0.853	0.756
		Videos	0.796	
		Social media	0.654	

(Source: Authors' Own Illustration)

3.3. Cluster Analysis:

The respondents are now grouped by the characteristics that relate to the management of Demonstrator Projects: aims, project management, organizational benefits, and drawbacks. Cluster analysis of the factors identified five groups that represent a broad spectrum of archetypical Demonstrator Projects based on their perceptions. Factor centre values > ± .25 were qualitatively classified as being substantial characteristics of individuals belonging to that cluster (Ciric Lalic et al., 2022). Table 2 shows the results of cluster analysis and labels for each cluster according to the mean score differences in the management characteristics of demonstrators. Furthermore, a chi-squared test was run to establish the distinguished demographic profiles of the five clusters. The relationships between demographic categories and the cluster membership variable are statistically significant for project size, project life cycle, sector, and success for demonstration (Belassi & Tukel, 1996). The respondents rated their success in demonstrating as not successful, partially successful, or successful.

Showcase growth (33%) is the largest cluster representing 33% of the survey DPs. These are projects characterized by showcasing a particular innovation or technology to expand the business and to make a notable impact on society, but they lack interest in raising more funds externally. It seems these projects are beyond proof of concept and have received sufficient dissemination funds already. Demonstrator Projects in the *showcase growth* cluster tend to be large-scale projects, Innovate UK projects, projects in growing stages, construction sector projects, and partially successful projects

Milestone delivery (22%) DPs excel in the project management dimension - they are very strong in meeting timescales and funding requirements, they tend to have nearly no project delays, monitoring has never been a burden and their success lies in the management skills of individuals. Strangely, they appear to be less focused on expanding the current business and more concerned with attracting new funders. They seem to be agnostic whether they seek new technology to demonstrate or other innovations. Membership in *milestone delivery* increases for finished projects, science & tech projects, and successful projects.

Strugglers (18%) DPs find demonstrating difficult: they neither raise the profile of the project, seek business expansion nor are making other project bids stronger, they do suffer from project delays, their time, and budget overrun. They often have moderately weak leadership and, therefore, are highly unlikely to transform the wider sector as a result of the demonstration. Members of the *strugglers'* cluster tend to be smaller past projects carried out in collaboration with a few partners.

DPs in the *Future growth* (15%) cluster show that an emphasis on monitoring, reporting, and strong leadership leads to project success. The main drive of projects here is the securing of further funding to grow the business and future economic growth, often, but not necessarily, through the showcasing of new technology. These DPs demonstrate for future showcasing.

Visible success (13%) DPs are characterized by a raised public profile aimed to transform the whole sector and attract more funds. The focus of these types of DP is not necessarily the promulgation of technology. Internally, funder demands and monitoring can be a burden, although project monitoring is a key aspect of success. This looks like an archetypical national flagship project with no particular low scores for the success factors. Different demographic groups were evenly represented among the members of *visible success* and *future growth* clusters.

The clusters developed generalities of behaviors as a way of identifying why some Demonstrator Projects are more successful at demonstrating than others. This study has developed the demographic profile of the demonstrator groups to enable organizations to tailor the monitoring and evaluation strategies for different groups. These implications will assist policymakers to facilitate the propagation of Demonstrator Projects in the future.

Table 2: *Cluster Descriptions and Centre Values*

	Strugglers	**Future Growth**	**Milestone delivery**	**Visible Success**	**Showcase Growth**
Raising profile	-0.83	-0.15	-0.19	1.52	0.06
Technology demonstration	-0.95	0.23	0.05	-0.72	0.67
Project delays	0.39	0.37	-0.65	-0.45	0.23
Monitoring burden	0.01	-0.59	-0.53	1.65	-0.03
Sector transformation	-1.49	0.39	0.28	0.62	0.23
Business expansion	-0.25	0.48	-0.53	-0.32	0.40
Engaging funders	-0.32	1.04	0.59	0.53	-0.88
Transparency and reporting	-0.01	0.83	-0.49	0.48	-0.23
Leadership and capabilities	-0.09	0.84	-0.46	-0.10	0.02
Project efficiency	-1.17	-0.03	0.81	-0.25	0.23
N	10	8	12	7	18
% Of sample(n=55)	18	15	22	13	33

(Source: Authors' Own Illustration)

4. Conclusion

This study aims to identify distinguishing characteristics of Demonstrator Projects and investigate the factors affecting their success at demonstrating and up-scaling. This study defined Demonstrator Projects and identified two main challenges in measuring the success of DPs. One is goal displacement, the attainment of obfuscation of output vs outcome deliverables, and the other challenge is that success depends on stakeholders outside the project to change behavior. Using empirical data from the survey, this paper has outlined the combination of the key characteristics of Demonstrator Projects: DPs usually have short timeframes, multiple partner organizations, high funding, and a requirement to disseminate. Large enterprises often pursue DPs to validate new technology at an increasing scale. Demonstrator Projects believe that success in demonstrating lies in having a clear communication plan that is sufficiently resourced and supported by the top management through the project lifecycle.

The current study developed a better understanding of the factors facilitating and hindering the propagation of Demonstrator Projects by identifying fifteen behavioral factors which affect the success of DPs. In addition, a classification framework is proposed with five groups of Demonstrator Projects with significantly different behaviors and perceptions about successful DPs: *showcase growth*, *visible success*, *milestone delivery*, *future growth*, and *strugglers*, with clear practical and behavioral implications for Demonstrator Projects.

This study has developed the demographic profile of the demonstrator groups to enable organizations to tailor the monitoring and evaluation strategies for different groups. Organizations should also take account of the diversity of behaviors across the demonstrators in designing strategies. The misalignment between dissemination expectations of funders and grant recipients can be avoided by considering the varying needs of members of clusters. These implications will assist stakeholders in developing a business strategy pertaining to the impact and wider roll-out of the Demonstration Projects.

This research may have some limitations. This study is quantitative in nature, and future work could explore deeper with case studies. Given that these findings are based on a limited number of responses, future research should validate the results with a larger sample size and a broader set of sectors and countries. Nevertheless, this study adds to a growing body of literature by providing insights that can shape opportunities for improving the success of Demonstrator Projects in the future.

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