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Du Preez, M.; Arkesteijn, M.H.; den Heijer, A.C.; Rymarzak, M.

DOI
10.3390/su142316251

Publication date
2022

Document Version
Final published version

Published in
Sustainability

Citation (APA)
Du Preez, M., Arkesteijn, M. H., den Heijer, A. C., & Rymarzak, M. (2022). Campus Managers' Role in Innovation Implementation for Sustainability on Dutch University Campuses. *Sustainability*, *14*(23), Article 16251. https://doi.org/10.3390/su142316251

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Campus Managers' Role in Innovation Implementation for Sustainability on Dutch University Campuses

Mathilda du Preez [1,*], Monique H. Arkesteijn [1,*], Alexandra C. den Heijer [1] and Małgorzata Rymarzak [2]

[1] Department of Management in the Built Environment, Delft University of Technology, Julianalaan 134, 2628 Delft, The Netherlands
[2] Department of Investment and Real Estate, University of Gdansk, Armii Krajowej 101, 81-824 Sopot, Poland
* Correspondence: m.dupreez@tudelft.nl (M.d.P.); m.h.arkesteijn@tudelft.nl (M.H.A.)

Abstract: Internationally, the ambition to achieve a sustainable built environment is becoming urgent. On the university campus, this vision, combined with unparalleled access to innovative technologies for sustainable development enables/urges universities to implement more innovative solutions more often. As a prime test location, the university campus is uniquely able to serve as a context for living labs, implementing and testing innovative technologies in a real-world environment. However, implementation of innovation on campus requires a clear vision, intentional action and transdisciplinary collaboration, while innovations themselves pose several challenges to the business-as-usual way of work. To explore the role of campus real estate managers in innovation implementation decisions on the university campus, a literature review and a qualitative study among campus managers of 13 Dutch universities were conducted. The research explored the innovation project types, risks, drivers and barriers and the real estate management responsibilities and decision criteria in innovation implementation projects. As one of the outputs of this research, a comprehensive categorization framework was developed. It clarifies campus managers' decision-making dimensions for innovative sustainability project implementation on campus and highlights the sustainability objectives unique to universities. If implemented across universities, it could further strengthen the networked economy by identifying opportunities for cross-campus implementation of innovative projects for sustainability.

Keywords: innovation; campus; categorization framework; innovation implementation; decision support tool; sustainability; living labs

Citation: du Preez, M.; Arkesteijn, M.H.; den Heijer, A.C.; Rymarzak, M. Campus Managers' Role in Innovation Implementation for Sustainability on Dutch University Campuses. *Sustainability* **2022**, *14*, 16251. https://doi.org/10.3390/su142316251

Academic Editor: Bharat Dahiya

Received: 1 November 2022
Accepted: 2 December 2022
Published: 6 December 2022

1. Introduction

Universities are key stakeholders for sustainable development in their education and research tasks, but more recently also in addressing climate change and environmental issues through partnerships with society and external stakeholders. [1]. Their inter-disciplinary research on resource efficiency, carbon capture and mitigation measures are ambitious and innovative [2], wherein they strive to "become 'change-maker' universities; collaborating with each other in the knowledge economy; placing students at the center of the teaching and learning process; and fulfilling their 'third mission' to partner with external stakeholders and society" [1] (p. 1275). The physical university campus has therefore increasingly become part of an integrated ecosystem [3] for research and innovation for sustainable development, playing a central role in knowledge creation, sharing and valorization [4] by providing the setting within which experimentation and testing can take place and innovation for sustainable development can be implemented.

In this paper, the implementation of innovation for sustainability is defined as the "dynamic process of mutual adaptation between innovation and organization" [5] (p. 2). In this case, the dynamic process under consideration is the mutual adaptation between innovations that improve sustainability and the organization, the university campus real estate

management units. These units, hereafter called campus managers, have to plan and facilitate the implementation of these innovative solutions in campus real estate. Furthermore, the implementation of sustainable innovation available on campus could be instrumental in facilitating a networked economy, a "process of innovation [because of] changing social values and growing environmental pressures" [6] (p. 104) that would in time change organizations, institutions and communities. Universities can play a pivotal role in using this networked economy for improved sustainability on their own campuses [1]. Living labs are one of the primary ways in which this networked economy is put into action, where universities commit to support research and experimentation in real-life settings in response to environmental pressures. This is also the case at Dutch universities [7].

Thus, not only is the physical campus an ideal location for the implementation of innovations for sustainable development (in line with the trend to use the whole campus as a functional space [4]), but these innovations enable campus real estate managers "to wield technology as a strategic lever" [8] (p. 355), first on their own physical campus (the focus of this study) and then further afield. Innovation implementation on campus is, therefore, an important strategic challenge [9].

In the following sections, a brief overview of literature on the strategic challenges in innovation implementation is given (Section 1.1), the risks of innovation implementation are highlighted (Section 1.2) and how living labs are envisaged to facilitate the networked economy on campus is explored (Section 1.3).

1.1. Innovation Implementation on Campus—A Strategic Challenge

The strategic management of innovation implementation on campus presents campus managers with a difficult balancing act, finding the optimal solution between risks and benefits on campus. The efficient use of corporate real estate assets is where those assets reflect the overall corporate objectives and are in support of the corporate mission [10]. "Within this context, the CRE [corporate real estate] executive must then make the best decision possible" by applying prudent corporate financial discipline and making risk-averse decisions [10] (p. 32). The university, however, is not a corporation; the university balances the objectives of education, research and societal impact. This creates a natural and obvious conflict with regard to the objectives of campus managers of different departments—risk-averse real estate management on the one hand and testing innovative technologies within the same real estate assets on the other hand.

In the literature, five typical challenges in project implementation decisions have been identified [11]. These challenges are:

(a) multiple project objectives with conflicting goals (as in the case of campus real estate management),
(b) numerous project options have incomplete details (as in the case of diverse innovation projects),
(c) individually optimal solutions may not be the best portfolio options (as implementation of some innovations (for example using direct current) may disallow other innovations on campus (e.g., using hydrogen),
(d) expert judgements may be conflicting, causing problems during implementation from those who disagree with resource allocation (in many instances innovation implementation decisions are not clear or are one-sided);
(e) resulting in surreptitious work on non-approved projects (many innovation projects are seen as "hobby projects") [11].

These challenges are especially relevant for campus managers who are requested (expected) to implement sustainable innovation on campus. While some universities are already doing quite well addressing this challenge, others are struggling [12].

Implementation of innovation for sustainable development requires clear strategic intent and organizational support, enabling awareness, structure, resources and networks to match innovators and implementers frequently and effectively [13]. The research reported

in this paper specifically considers the identification and organization framework that can be used in strategic management of innovation for sustainability.

1.2. Risks: Innovation Characteristics That Make Them Suitable for Implementation on Campus

The changing corporate objectives of universities, focusing on innovation, sustainability and societal impact, require a strategic corporate real estate response from campus managers. However, managing innovation projects for implementation in campus real estate is complex, due to their financial challenges, potential compliance issues, divergent, unique character, "uncertain" application, unproven performance [14] and the potential for reputational damage of these risks combined. Innovations by nature require more time, money and attention to implement compared to the status quo.

"Novelty is central to innovation but this inevitably implies risk" [15] (p. 26). Risk is thus an integral part of innovation and risk assessment is central to innovation management. Technology Readiness Level (TRL) assessments are often used to gauge the maturity of an innovation, and are also used by the EU in their Horizon 2020 [16] resource allocation decisions. Understanding the "need for the technology", the "difficulty in developing the technology" and the "consequences of developing the technology or not" becomes a decision-making criterion for campus managers who have to safeguard the users and processes on campus. Implementation of innovation in a real-life context often deals with more mature innovations from TRL level 6 and up.

The key components for strategic management of innovation are thus a clear indication of the potential benefits, and the innovation risks (financial, legal, technological and reputational). This classification of risk enables management to respond (accept, avoid, transfer or mitigate) to the risk posed by new technology [15]. The inevitable novelty of innovation combined with campus managers' risk-averse approach brings one more requirement to the fore—the physical space and management requirements of the innovation in a real-world setting—living labs.

1.3. Living Labs: A Broad and Narrow Definition

Living labs are not easily defined due to the diversity of projects that fall under the banner of "real-life experimentation". Compare, for example, the development and testing of user wear-and-tear impact on a new type of grass that requires less maintenance and water while attracting more pollinators [17], with the installation and data monitoring of user behavior for a plastic cycling lane made from recyclable materials [18], or occupancy tracking with smart meters [19]. Although they differ substantially, they may all be classified as living labs, because they consider user response with respect to innovation, and they require a campus implementation partner, maintenance and some commitment from campus managers for successful implementation [9]. Thus, in our research, the campus becomes the real-life testing community, with campus managers facilitating the implementation of the innovation in the campus setting.

Numerous definitions of living labs on campus describe the process for living lab implementation as a context in urban settings [20] or on campus [21], as a methodology [22,23] or as a tool, platform or conceptualization in an organization [24]. Therefore, in this paper, an important distinction is made between three streams of living lab definitions, wherein living labs are defined as (a) a context, (b) a method and (c) a conceptualization [25]. This distinction is emphasized because the physical context that campus managers are expected to provide should serve, support and even increase the real-life experimentation opportunities available to researchers on campus.

In other approaches, living lab projects are defined and identified by their combined array of attributes, dealing with the territory, location, duration, network, participation aspects, coordination aspects and innovation mechanisms and outcomes. The living lab project owner (or manager) may be the only person with information on all classifying attributes [26] which often does not include the campus real estate manager, who may face unique challenges in facilitating the physical space for living labs. The focus of this article is

thus to further develop our understanding of the campus manager's role in the facilitation of the university campus and living labs as a context.

The categorization of the campus manager's role is important because it not only enables strategic management, monitoring and evaluation of implemented living labs on campus but also eases the coordination and participation role of the living lab partners and participants [27]. However, this broad definition of a living lab, employing a description of the attributes, cannot effectively be used by campus managers to facilitate "a context" for living labs. This leads to the research question: Which roles do campus managers fulfil during the implementation of sustainable innovation on campus? Furthermore, taking a look at what campus managers are already doing—What enables some to be more successful than others?

In the following section, the methods employed to explore real-estate managers' experiences with sustainable innovation implementation are described (Section 2). Then, the enabling factors mentioned by campus managers to support their innovation implementation decisions are discussed in Section 3. In Section 4, the literature, identified enablers, physical features and management requirements are drawn together into a categorization framework. In conclusion, the potential benefit of the categorization framework in the advancement of sustainability objectives unique to the university is anticipated (Section 5).

2. Methods

A qualitative approach to ensure the in-depth exploration of campus real estate managers' experiences with innovation implementation [28] was employed in this research; semi-structured interviews were conducted with campus managers of 13 Dutch universities between October 2020 and February 2021. The focus of the interviews was twofold: (a) to develop a rich description of campus management's experiences (drivers, barriers and solutions) with innovation implementation projects on campus and (b) to develop a list of innovation projects campus managers have dealt with.

The interviewees were asked four open-ended questions requesting them to give examples of innovations developed on their campus, projects where they have had to implement these innovations on campus to test their viability, the drivers and barriers they came across in the process and the partnerships and collaborations in which they had to work.

These interviews and the resulting list enabled a rich description of the campus manager's role in facilitating the innovation implementation context and the problems they encounter, as well as developing a better understanding of the physical features of innovations that impact implementation decisions. All participants provided informed consent to participate in this study.

2.1. Sample

Recruitment of specific participants with specialized knowledge of the implementation of innovation was done by requesting an interview with directors and/or staff in campus real estate management of Dutch universities. Purposive sampling is often used in this manner to enable speaking to people who hold appropriate and useful information in line with the research question [28]. A total of 30 participants from 13 universities were interviewed via an online platform (the first interview was in person). This was an appropriate method of sampling—matching the qualitative nature of the study and the in-depth expert knowledge sought—to elicit expressive and vivid examples of innovation implementation projects and the presumed reasons behind their successes and failures.

2.2. Analysis

Interviews were recorded (with permission from participants) and comprehensive interview notes were compiled in English. This dataset was qualitatively analyzed using Atlas.ti 9.0. The analysis process started with immersive listening to the recorded interviews, reading the interview notes and subsequent coding, and the practice of content tagging

of recurrent topics. Topics were then grouped and arranged into themes [29]. The themes provide an in-depth view of the dimensions of the challenges and opportunities for campus managers responsible for the implementation of campus innovation, and are used in part to develop the categorization framework (see data availability statement for links to the Atlas.ti codebook).

Based on projects mentioned by campus managers during the qualitative interviews, a list of on-campus innovations and experiments was compiled and verified through internet searches of projects and publications. The list contains descriptions of one hundred projects in total. It is by no means an exhaustive list of innovations implemented on campuses but provides a good overview of the types of projects campus managers deal with, the project characteristics they attend to (from their point of view) and the consequent challenges they face during implementation and management of the innovation projects. The research question "How do campus managers effectively facilitate the implementation of sustainable innovation on campus?" can be answered by combining the outcomes from the literature review, the themes identified in the qualitative interview data, and the list of on-campus innovations and experiments. The theoretical contribution is therefore the improved understanding of campus managers' challenges in facilitating the context for experimentation in living labs on the university campus.

In the results section, the identified enabling factors for campus managers are discussed (Section 3.1) followed by a description of the project types found in the list of on-campus innovation and experiments (Section 3.2).

3. Results

From the interviews with campus managers across the Netherlands, four important themes that impact campus managers' ability to implement innovation on campus are highlighted. The "on-campus innovation and experimentation list" that was compiled and the consequent classifications of campus real estate management roles in innovation implementation challenges on campus are also presented.

3.1. Enabling Factors—Qualitative Themes

Four main enablers emerged from the interviews with campus managers. These are (a) campus managers have a partial role in and limited definition of living labs; (b) strategically aligned projects and academic schools of excellence enable the development of expertise (also within the campus management unit); (c) innovation implementation needs some "room" to maneuver (in terms of finances, project management, full-time equivalency (FTE) and risk management) and (d) a "go-between" is necessary between the two worlds of academic research and project implementation.

3.1.1. Enabler 1: Campus Managers' View on the Living Lab

From the interviews with campus managers, it became clear that no specific distinction between innovation implementation projects, demonstration projects and living labs is made. Two reasons for this lack of distinction become clear from the interviews (1) campus managers are not aware of the project's (scientific) attributes used to classify it as a living lab or not and (2) due to their project-specific focus on implementation within the allowed time and budget, only a few have the capacity to focus on the research aspect of the innovation implementation project.

One person commented that, "*We don't realize we are doing something already, so we don't display it either. This is the communication from campus development. We already are a living lab, but how can we know and see*?" 1:29.

From the campus managers' point of view, implementation of campus innovation facilitates the primary objectives of the university (education and research): "*This innovation support is part of our vision. We are supporting the primary process. It is important to show ourselves as a facility company but also help and support for research and education. It is the basis of who we are*." 6:20.

This may be effective in reaching their sustainability goals. "*There are a couple of important ingredients that need to be present for an experiment to be used. The real estate strategy wants to create value [for the university], and we want to make clear what the benefit is of this experiment for the real estate portfolio*." 2:25.

Thus, campus managers are not necessarily aware of whether a project is classified as a living lab or not, although they support the campus vision for sustainability which does require them to implement innovative projects on campus. The clarification of their role, delineation of performance criteria, required activities and desired outcomes is necessary to enable better facilitation of the living lab context on the university campus.

3.1.2. Enabler 2: A Vision for Sustainability, a Master Plan and Schools of Excellence

Campus managers emphasized the importance of an innovation vision for strategic management "*campus and facilities do what they do. The executive board of the university has to indicate that this [innovation] is a priority and has to be done*" 9:43. If there is no vision or mandate, innovation implementation on campus will not succeed. A clear vision would direct and guide innovation implementation projects and eventual strategic outcomes " . . . *if you want to manage [innovation] on a larger scale it becomes a bigger issue because it does not form part of the masterplan*." 9:27.

The extent to which sustainable innovation projects are aligned with the overall campus strategy was mentioned by six university campus management units. When innovations have an inadequate "fit" with academic schools of excellence, it requires extensive time and effort to ensure success, partly because of a lack of synergy (knowledge, effort, expertise, funding and research partners). However, when academic excellence centers and focus areas are clear, the synergy contributes to a reciprocal development of knowledge and expertise also in the campus real estate management unit. As one participant mentioned: "*The themes that we are good at as a university (green, sustainability, biodiversity, socially responsible) are very integrated; we [the CREM unit] want to get researchers and scientists involved in the beginning of the process, and make them experts.*" 6:10.

Thus, strategic management of innovation for sustainable development requires vision-aligned projects and knowledgeable experts. Ensuring innovation projects are linked to the vision also enables the allocation of resources, as we see in the next enabler.

3.1.3. Enabler 3: Sustainable Innovation Implementation Projects Need Some "Room" to Manage the Risks

Innovations are new and by definition embody aspects of uncertainty. Unclear governance structures in which decisions about implementation are made cause uncertainty: "*We do not have all the power to make these decisions. From both sides: do we even have room to fail? What are the costs for them? We are very practical as facility management and then he [the academic] is too abstract*" 8:28.

Thus, a vision for the implementation of innovation on campus will require managerial room to enable it. One participant said: "*Sometimes we have a bit of extra budget for these kinds of experiments because we do think it is important. You should be able to facilitate it.*" 2:20, but it may extend beyond traditional financial means. Additional human resource capacity in project teams, sanctioned risk mitigation measures, academic project management skills and clear agreements on result sharing (such as licenses and patents) and expected outcomes (such as KPIs) were all mentioned as necessary ingredients for the successful implementation of innovation on campus.

3.1.4. Enabler 4: Knowledge Brokers in the Innovation Ecosystem

A vision for innovation and room for implementation nevertheless still requires a personal commitment from campus managers. They explained that innovation projects still need them "*to put in the [extra] effort*" 6:10, to use their "*personal contacts*" 1:44, to identify synergies between "*people who want to do things on campus*" 2:23. In the view of campus managers, the same is true for scientists and academics who " . . . *have to promote their own*

projects to show what opportunities there are and how we [as campus managers] can cooperate" 10:35. Someone who facilitates the synergetic alignment of goals is therefore necessary.

Campus managers mention the need for (or in some cases where it is in place, the benefit of) a research coordinator with a mandate to establish connections, facilitate networks, and find synergy and projects of mutual benefit. As one participant explained: "*It is really about finding the match in the project planning and the funding and to combine this with the research ambitions*" 10:7. This would be an intermediary with a good grasp of both campus managers' requirements for projects and also the academic research process, funding applications and project proposals. One campus manager noted that "*[we need someone] who is assigned to the specific responsibility to keep an eye on the implementation of innovation*" 9:19.

Another campus manager described the intermediary as a knowledge broker: "*In the future we would like to have knowledge brokers who can make connections between [innovation] ecosystems. Make synergies and co-creations. What are the skills necessary to facilitate the network management and coordinator role?*" 12:32.

Thus, an intermediary would fulfil a role in linking people with each other, but also facilitate discussions around campus innovation implementation, consider the innovation readiness level (TRL), understand and describe the risks involved and align project, finance, schedule and research goals between different parties.

The key enablers to facilitate living labs as a context, therefore, point to clarification of the campus manager's role (enabler 1) in implementation of vision-aligned innovations for sustainable development on campus (enabler 2), combined with enough room to facilitate these innovations (enabler 3) and supported by knowledge brokers to match opportunities and facilitate partnerships (enabler 4). In the next section, the roles campus managers fulfil in the living lab or innovation implementation projects on their campuses are explored.

3.2. List of On-Campus Innovations and Experiments to Identify Campus Manager Roles

Campus managers do not necessarily have access to project details that would enable the classification of a project as a living lab, nor are all features of living labs equally significant to campus managers' decisions about the implementation of innovation on campus. To further explore the role of campus managers in these projects, a list of on-campus innovations and experiments comprising 100 innovation projects was compiled, based on the discussions with campus managers. Out of these projects, 79 were distinct stand-alone innovation for sustainable development projects implemented by campus managers on their campus and 21 were projects in which campus managers participated as network or strategic partners to enable large-scale studies such as using alternative energy sources or using direct current on parts of the campus.

Projects that were identified during the interviews dealt with a diverse set of topics including improvement of biodiversity or urban farming practices (13%), energy efficiency, generation and balancing (9%), circularity (including tendering practices, development of calculators, and assessing waste management practices) (7%), building design (moss facades, green building practices) (7%) and smart tools for space use management and planning (7%). Medical projects, teaching projects and experiments in behavioral studies, robotics, mobility and infrastructure were also mentioned but less often. Finally, projects focused on experiments with food, business processes, AI and marine research were also only briefly mentioned and not discussed in detail.

In line with the expectations, 82% of projects mentioned by campus managers were already quite mature, generally from TRL level 6 and up. This is because there are ample laboratory and field labs available for experimental tests on campus, and only when the fundamental research has been proven do projects venture to look for real-world implementation opportunities. In terms of implementation time on campus: projects were most often intended to be on campus between one and five years (70%), with a further 25% intended to remain indefinitely (such as campus-wide thermal energy storage (TES) systems, BREEAM level A renovations of heritage campus buildings and geothermal well

research and development projects on campus); only 4% were intended to be removed within one year.

The analysis of the list contextualizes the diverse requirements campus managers are required to facilitate. These are relatively advanced (but not fully mature) innovations that need a physical context for implementation on campus for at least one year. In combination with the literature, the important features of innovation projects impacting implementation decisions were identified as:

- the inherent uncertainty of innovations and the availability of tools available to manage the perceived risks;
- the expected duration and location of the innovation on campus (in line with living lab attributes identified by [30];
- physical aspects of the innovation including size, number of possible repetitive implementation opportunities and level of building integration (associated with technology risks of system integration potential) [30];
- campus real estate managers' role (described below and in [31]).

Six distinct but not mutually exclusive campus real estate management roles were identified in our analysis of the list of on-campus innovation and experiments. These proportions are given and the roles are described using examples from the list showing how managers enable or facilitate living labs on campus:

- Data provider (5%): Campus managers are requested to supply existing data collected and managed by them (from occupation rates during the COVID-19 pandemic to researchers' studying space use management using smart tools);
- Participant (5%): Campus managers are requested to complete questionnaires or interviews about their workload and implementation decisions (as was done in this study);
- Facilitator (37%): Campus managers are requested to host/tolerate the installation of innovation on their campus without management responsibilities (health prompts on elevator doors to encourage stair use; use of smart tools in specific buildings);
- Implementer (21%): Campus managers are requested to build and maintain the innovation on campus (plastic cycling road; colored PV panels on buildings; moss-inducing rendering for buildings);
- Network partner (28%): Campus managers are requested to connect, liaise and link project partners, funders and academic researchers to innovation projects (PV chimneys on tall buildings);
- Strategic instigator (4%): Campus managers are expected to drive the innovation project in collaboration with strategic government and research partners, developing the technology and the policy (a geothermal well).

Key physical aspects impacting the implementation of innovation on campus were therefore the expected role of the campus manager combined with the physical features on campus such as location, duration on campus, size, building integration and number of potential iterations of the innovation. Beyond the physical features, the benefits of the implementation action for campus real estate and the risks are also considered.

4. Discussion

Finally, the key components identified in the literature review (Section 1), the enablers from the interviews (Section 3.1) and the list of on-campus innovation and experiments (Section 3.2) were combined into the innovation project categorization framework. Following the strategic management approach described earlier in the paper [11], this framework enables the start of an innovation funnel (identification), classification of a broad spectrum of innovation projects (categorization) and prioritization of potential innovation projects which are aligned with the vision, with clear benefits, risks and requirements for implementation (resource allocation) [11].

The categorization framework is based on four main classification themes:

1. Benefits: Aligned with the sustainability, education and teaching vision of the University. This means that the potential benefits to education, research and society are made clear;
2. Risks: Financial, legal, maintenance, technological and reputational risks are highlighted and mitigation measures are proposed;
3. Physical space requirements: Clearly defined physical space;
4. Management requirements: Expected management roles and agreements to facilitate implementation.

The key components identified in each section, with the main topics and their assessment dimensions are presented as the categorization framework in Table 1.

Table 1. Categorization framework for innovations to be implemented on campus.

Key Component	Main Topics	Assessment Dimensions
Benefits: Vision aligned and potential benefits are highlighted	Vision alignment [2]	Statement on how this project supports the vision of the university in a broad sense. Linked to campus schools of excellence/unique opportunities on campus
	Define the intended topical improvement from the status quo	Reduce energy/Generate energy/Energy balance improvement/Circular design/Cost reduction/Improved maintenance efficiency CO_2 reduction/Capturing carbon/Biodiversity improvements/Mitigate the effects of climate change
	Benefit to society	Specify sustainability topics (energy, mobility, construction etc.) Number of commercial partners involved Number of government units involved
	Benefit to education	Number of student groups for education Number of Master's theses or courses Number of internal departments involved Number of (other) educational institutes involved
	Benefit to research	Number of student groups in research Number of PhD researchers Number of (other) research institutes involved
Risks	Financial & HR	TCO calculations/In-kind contributions/FTE allocation/Business case available
	Legal compliance	Ease of compliance with current legislation
	Technological [30]	Technology Readiness Levels (TRL)/System alignment/Current technologies/R&D difficulty/Need for technology/Probability of failure/Consequence of success
	Maintenance	Installation and maintenance guidelines
	Reputational impact	Combination of financial & HR, legal, technological risk and vision alignment
Physical space requirements	Location [30]	Traditional laboratory/Field laboratory or regulation free zone/Building(s) (internal)/Buildings(s) (external)/Outdoor/Virtual/Cloud or business system
	Size	Physical size in square meters
	Building integration	Stand-alone/Partly integrated/Building component
	Duration on campus [30]	Less than 12 months/12 months to 5 years/More than 5 years
Management requirements	Iterations	Unique project/possible repeated implementation/ prolific implementation
	Implementation role [31]	Data provider/Participant/Facilitator/Implementer/ Network partner/Strategic instigator

The outcome of this preliminary categorization framework clarifies the living lab characteristics important to campus managers, who have the difficult task of providing real-life settings for innovation implementation projects on campus [25]. This categorization framework contributes to the implementation decision in several ways:

(a) It clarifies the physical and management requirements necessary for campus managers to decide about hosting living labs on campus;
(b) It creates a transparent categorization of the important attributes of innovation implementation projects on campus;
(c) It allows for the development of an innovation inventory;
(d) It facilitates the acquisition of a "more complete" set of "good enough" information from potential innovation projects [11];
(e) It provides key information for tactical decision-making about vision-aligned innovations to be implemented on campus.

This gives direct impetus to the recommendations for future research to develop a weighted scoring system for the innovation projects in the inventory and develop a decision support tool for the selection of innovation projects. If embedded and managed proactively, this framework could allow for the monitoring and evaluation of innovation projects (some of which are living labs) on campuses, a practice still largely underdeveloped. The categorization framework could also contribute to the eventual ability to monitor and evaluate the successes of innovation projects, enabling knowledge sharing and perhaps in future, the management of innovation projects on campus as a portfolio, which warrants further investigation.

5. Conclusions

Enabling circumstances are thus created when the vision for achieving sustainability on the university campus is clear, and the expected role of the campus manager in innovation implementation for sustainable development is supported with "some financial room" and a knowledge broker for innovation and opportunity matching.

One example of campus managers in a facilitation role was to ensure facility management liaised with the coffee vendor operator to supply coffee grounds for mushroom growing and urban farming experiments on campus. In another example, campus managers were able to implement solar bicycle charging stations supplied by external partners and provide data on the use, while students assessed user experience. In both cases, the categorization framework helps highlight the potential benefit of the innovation (for the environment, but also research, education and societal value), highlighting the risks and describes the management requirements for implementation on campus, enabling campus managers to make better decisions and select the best projects to "wield technology as a strategic lever" [8] (p. 355).

If this categorization framework is consistently implemented to enlist and select innovative projects that support sustainable development, it could also serve to support much-needed monitoring and evaluation of these projects implemented on campus. If implemented across universities it could further strengthen the networked economy [1], creating opportunities for cross-campus implementation of innovative projects that support sustainable development, and becoming the "change-maker" universities of the future.

Limitations to this research include the non-generalizable view of the challenges experienced by a particular respondent group (Dutch university campus managers) in a limited setting (the university campus). It may therefore not apply to innovation implementation managers in other sectors, or universities in other countries. Nonetheless, the researchers consider this categorization framework to be a productive contribution for campus managers in the practical management and support of societal aspirations to demonstrate a sustainable campus and innovative designs, using the Dutch university campus to its full potential. Further research on the usability of the framework and determining the relative importance of the decision criteria considered during sustainable innovation implemen-

tation decisions by campus managers is recommended, and taken up in our future work research plans.

Author Contributions: Conceptualization, A.C.d.H., M.H.A. and M.R.; Methodology, A.C.d.H.; Software, M.d.P.; Validation, M.R.; Formal Analysis, M.d.P.; Investigation, A.C.d.H., M.H.A. and M.R.; Data Curation, M.d.P.; Writing—Original Draft Preparation, M.d.P.; Writing—Review & Editing, A.C.d.H., M.H.A. and M.R.; Visualization, M.d.P.; Supervision, A.C.d.H. and M.H.A.; Project Administration, M.d.P.; Funding Acquisition, A.C.d.H. and M.H.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research contract was supported by the campus real estate and facility management (CRE & FM) department TU Delft and the APC was funded by the TU Delft Library.

Informed Consent Statement: Verbal (recorded) informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data represented in this study are openly available in 4TU Research Data Repository at https://doi.org/10.4121/21220784.

Acknowledgments: The authors would like to thank all the participants in this study who provided their time and insights during the interviews to assist us in improving our understanding and strategic decision-making about sustainable innovation generation, adoption and integration on Dutch university campuses.

Conflicts of Interest: The authors declare no conflict of interest.

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