The role of an inclusive innovation culture and innovation support strategies in university managerial and service innovations: Survey results for Australia and New Zealand

Anthony Arundel[1], Dominique Bowen-Butchart[2]
and Sarah Gatenby-Clark[2]

Abstract

We build on recent research on measuring innovation in the public sector to construct and test a questionnaire on administrative and managerial innovations in the university sector. The questionnaire uses a hybrid methodology that combines a 'subject' approach, with general questions on innovation activities, with an 'object' approach that asks a series of focused questions on a single 'most important' innovation. The questionnaire was sent between November 2015 and February 2016 to a sample of 1,732 senior managers at 39 universities in Australia and 6 universities in New Zealand. Responses were obtained from 573, for a response rate of 37.8%. The analyses in this paper focus on the support of the senior executive of universities for an inclusive innovation culture that includes all administrative staff and the use of several advanced methods for innovating. We find that there are large differences across universities in the share of respondents that perceive that their university's senior executive supports a positive and inclusive innovation culture. Econometric analyses show that support for an inclusive innovation culture increases the use of best-practice methods for innovating and decreases the likelihood of an abandoned or under-performing innovation. However, support for an inclusive innovation culture has no effect on the introduction of entirely new innovations.

[1] Corresponding author. Australian Innovation Research Centre, University of Tasmania, Australia and UNU-MERIT and UNU-MERIT, University of Maastricht, the Netherlands.
[2]Australian Innovation Research Centre, University of Tasmania, Australia

1. Introduction

The university sector in high-income countries faces a number of similar challenges, including a decline in government funding, increasing competition for students and potential competition from new methods of teaching based on online platforms. Addressing some of these challenges requires improvements to teaching or the research output of universities (these drive improvements on international rankings, which in turn attract foreign students), but others require organizational, managerial or service innovations to reduce costs, find new sources of funding and improve the student experience. These types of innovations are not part of the academic mission for teaching or research and consequently are developed and implemented by members of the university administration.

The ability of the administration and its professional staff to innovate requires internal innovative capabilities: both for adopting, modifying and implementing innovations that have been developed elsewhere and to develop unique innovations in-house. These innovative capabilities are similar to those used by private sector firms in the service sector or by public sector agencies to innovate. Consequently, the methods that have been developed for measuring innovation in the private and public sectors should be applicable for measuring innovation in the university sector, although these will need to be modified to capture the unique characteristics of the university sector and to collect data of relevance to university managers.

This study develops a questionnaire on managerial and administrative innovations in the university sector and uses it in a survey of senior managers in 39 out of 43 Australian universities[1] and in six of eight New Zealand universities. The questionnaire is inspired by the Oslo Manual guidelines for measuring innovation (OECD/Eurostat, 2005). Given the limited literature on administrative and managerial innovations in the university sector, the design of the questionnaire drew extensively on recent experience with developing questionnaires for measuring innovation in the public sector (Arundel et al, 2016) and on cognitive testing with university senior managers. The result is a survey instrument that is adapted to the university sector. As with other recent surveys of innovation in the public sector, it also uses a hybrid methodology that combines a 'subject' approach, with general questions on innovation activities, with an 'object' approach that asks a series of focused questions on a single 'most important' innovation.

The focus of this paper is on a supportive innovation culture that includes all professional (administrative) staff and the use of several advanced methods for innovating. An inclusive culture for innovation is an important condition for 'bottom up' innovation and stands in contrast to a top down innovation culture where innovation is driven by the senior management team. An important question is if an inclusive innovation culture results in better innovation outcomes.

The survey results show that there are large differences across universities in the share of respondents that perceive that their university's senior executive "supports a positive innovation culture that includes all professional staff". Furthermore, econometric analyse show that support for an inclusive innovation culture increases the use of best-practice methods for innovating and decreases the likelihood of an

[1] In total there are 43 universities in Australia, but we exclude two foreign universities with Australian campuses and two speciality universities. The two smallest New Zealand universities are also excluded.

abandoned or under-performing innovation. However, support for an inclusive innovation culture has no effect on the introduction of entirely new innovations. These results suggest that although an inclusive innovative culture is an asset, it is not always a necessary condition for successful innovation outcomes.

2. Innovation in Universities

Almost all universities in Australia and New Zealand, with the exception of a few non-profit universities, are publicly-funded and therefore part of the public sector. In the 1980s, New Public Management (NPM) was introduced into the public sector in many high income countries, including Australia and New Zealand, replacing a traditional Weberian governance structure. In comparison to traditional governance, NPM gave managers greater decision-making powers to develop and implement innovations to improve efficiency. Problems with the NPM model has led to experimentation with other governance models such as joined-up government and the networked model, both of which increase opportunities for bottom-up innovation that draws on the expertise of middle managers and front-line staff (Hartley et al, 2013; Sorensen and Torfing, 2012).

For universities in high income countries, the equivalent of NPM was a move to corporatization, with decision-making power shifting from committees run by academics to professional managers and administrators. This often required the creation of entirely new, permanent administrative positions (Bolden et al. 2012; Parker 2011; Parker 2002). One of the main drivers of corporatization was a decline in government funding, (Parker 2011; Parker 2002; Szekeres 2006), with professional managers responsible for developing and introducing managerial and administrative innovations to improve efficiencies and find alternative income sources (GAIHE 2016), for instance through improved services that attract fee-paying students. Iinnovations to reduce costs and raise new sources of revenue are viewed as essential in an increasingly competitive university sector (Hariri and Roberts, 2015).

The shift to the corporate university has not been entirely painless. Research has identified a possible link between corporatisation and an increase in stress, work intensification, reduced resources and increased expectations for academics, as shown by the increasing use of indicators to assess academic performance (Szekeres 2006; Parker, 2011; Hariri and Roberts, 2014). These or other perceived issues with corporatization could provoke resistance to change on the part of academics and other staff, or a concern on the part of professional managers that such resistance is possible. This concern could help justify a “top-down” organizational structure where decisions on innovations are made by senior management and then passed down the line to middle managers for comment or implementation (Parker 2002).

Surprisingly, there has been little comprehensive research into the processes that support or hinder administrative and managerial innovations within universities. Most of the available research focuses on the adoption of specific innovations in technology or teaching (see, for example Istance & Kools 2013; Kopcha, Rieber & Walker 2015; Tabata & Johnsrud 2008). Of greater interest here are a limited number of case studies, reviews, and one online survey of top level managers (such as the Vice Chancellor or Rector) that obtained responses from 25 educational institutions in Europe. These studies on the university sector cover a variety of relevant topics, including innovation drivers, the role of leadership and a supportive culture of innovation, and strategies to support innovation.

Based on this literature, the drivers of managerial and administrative innovations within universities are generally related to the challenges faced by the higher education sector. Brennan et al's (2014) case studies of seven universities in the United States, Germany and the United Kingdom identified three key challenges that lead to innovation: changes in higher education funding, pressures from globalisation, and changes in the supply of and demand for higher education.

Good leadership has been identified in several studies as an important factor in supporting innovation in universities. A literature review by Bryman (2007) identified several key aspects of effective leadership, including communicating with staff, encouraging open communication, creating a positive work atmosphere, and establishing a clear sense of direction and strategic vision. A strong link between these leadership actions and innovation has been found in the European online survey (GAIHE, 2016).

An important component of leadership is the establishment of an organizational culture supportive of innovation (Brennan, 2014; Jackson, 2013; Kenney, 2002). The GAIHE (2014) survey found that 94% of respondents thought that the senior leadership team was responsible for leading innovation, followed by academics (81%) and the governing body (68%). In contrast, only 50% believed that administrative staff were responsible for innovation. Jackson (2013) identifies several aspects of an innovation culture that can support 'bottom up' innovation that includes the active involvement of staff throughout a university hierarchy: encouraging new relationships, collaboration, learning and the sharing of knowledge, supporting people to take risks, and celebrating achievements. A case study on the experiences of RMIT University in Australia concluded that innovation is supported by a culture of openness, risk taking, with learning, communication and feedback vital for innovation (Kenney, 2002)

Many of the identified strategies to support innovation derive from a supportive innovation culture, such as the use of collaboration and the sharing of knowledge. Other factors include incentives or rewards for staff to engage in innovative practices, collaboration with other institutions, skill development (Brennan, 2014), the provision of adequate resources and the use of project teams (Kenney, 2003).

The factors that have been found to support administrative and managerial innovations in universities are similar to those that have been identified in research on innovation in public sector administrative agencies. For example, collaboration is widely used for public sector innovations (Borins, 2010; EC, 2010) and staff training (Arundel et al, 2015) and good leadership have been identified as important contributors to innovation in the public sector (Parna and Tunzelmann, 2007; Bugge et al, 2011). The public sector innovation literature also identifies drivers, supportive strategies and barriers that have not been extensively considered in research on university innovation. These include the role of crises in driving innovation (Borins, 1998; Kay and Goldspink, 2012), risk aversion and staff resistance as barriers to innovation (Bugge et al, 2011; Arundel and Huber, 2013; Osborne and Brown, 2011; Torugsa and Arundel, 2015) and strategies to support innovation such as the use of diverse information sources (Torugsa and Arundel, 2016) and appropriate methods for developing innovation such as trial and error testing and the involvement of users in the design of services (Arundel et al, 2015).

The most important issues in many of the surveys of innovation in the public sector and of relevance to universities is how innovation occurs: where do the ideas come from, what methods are used by managers to support the development of the idea into an innovation, and what are the barriers to public sector innovation. These issues focus on the processes of developing and implementing an innovation and whether or not innovation is a 'top down' process driven by senior management or a 'bottom-up' process that can also involve middle management and front-line staff. The study by Arundel et al (2015), using survey data for 3,700 European public sector organisations, finds that public sector agencies characterized by a bottom-up approach to innovation have better innovation outcomes than agencies characterized by a top-down approach in which innovation is driven by government policy.

3. Methodology

The methodology for the survey consists of three components: the design of the questionnaire, the selection of respondents, and the implementation of the survey.

3.1 Questionnaire development

Preliminary versions of the survey questions were evaluated by tertiary education experts and by experts on measuring innovation in the public sector, with some of the initial questions adapted from public sector questionnaire surveys. Face-to-face cognitive testing interviews with 13 senior managers were conducted at seven Australian Universities located in Sydney, Melbourne and Hobart and resulted in a large number of changes to the questionnaire. The cognitive testing phase ensured the questions were understandable and relevant to the tertiary education sector, were interpreted as intended and that respondents could provide reasonably accurate answers.

Although drawing on previous innovation survey questionnaires in the public sector and reflecting several topics covered in the Oslo Manual (information sources, types of innovation), the questionnaire was targeted specifically to the university sector. For instance, it includes questions on restructuring in order to determine the effect of restructuring on innovation and the prevalence of innovation that is not part of a restructuring process. Other questions cover reasons for innovating (budget changes, reaction to a crisis, improve the university's brand, etc.), factors that form part of a supportive innovative environment (staff and student involvement in innovation, available resources, system for evaluating ideas, staff motivation), the innovation 'culture', including support from the Vice-Chancellor; inter-university competition, investment in innovation (training, use of working groups, hiring of new staff and redeployment of existing staff), and the use of good innovation practices (pilot testing, stakeholder surveys, testing for 'ease of use' etc.).

In order to obtain accurate responses on innovation activities, a series of questions focused on the respondent's most important innovation, defined in terms of its "expected impacts on your section, university, staff or students". This method avoids the problem of 'blended' responses where respondents must develop an average for different innovations.

Respondents were first asked to provide a short written description of this most important innovation. This information is used to determine the frequency of different

types of most important innovations and to get a measure of its novelty. Other questions on this innovation asked who was the initial source of the idea for this innovation, its purpose, target (academics, students, university's external community, etc.), the use of collaboration to develop this innovation, the number of staff involved in its development and implementation, and its negative and positive outcomes (increase in student numbers, effect on teaching and learning, effect on the student experience, etc.).

A similar approach is used to ask about a single 'abandoned' or 'under-performing innovation that did not meet initial expectations'. One question asked for the original purpose of this innovation and a second question asked about the importance of 10 factors in explaining the abandonment or under-performance. One of the reasons for focusing on a single abandoned or unsuccessful innovation was to avoid the "revealed barriers" problem whereby the more innovative the organization, the more respondents give a high importance to barriers to innovation (D'Este et al, 2012). Respondents that did not report an abandoned or unsuccessful innovation were asked to reply to a separate question on innovation obstacles.

Table 1 summarizes the main topics covered in the questionnaire.[2]

3.2 Respondent selection

Australian universities use a governance structure consisting of a University Council led by a Chancellor, but the Vice Chancellor (equivalent of a Rector or President in other countries) is responsible for the university administration. Senior management positions directly under the Vice Chancellor include a Chief Operating Officer (COO), several Deputy Vice Chancellors (DVCs) for international affairs, research and teaching and a Provost. Administrative units such as finance, human resources, information technology, legal affairs, marketing and communications, property/commercial services and library services are under the direction of the COO. Below the Provost are the faculty Deans while several managers can report directly to the DVCs, such as directors of research institutes.

Many Australian universities include a Senior Executive or Senior Management Team (SMT) as the principal decision- making body for all university operations. The SMT is generally made up of the Vice Chancellor, Provost, COO, Chief Financial Officer, DVCs, and faculty Deans. Some universities include Executive Directors, the heads of research institutes, and faculty managers.

For this study, the survey target population consists of all senior and departmental managers, with the exception of the senior management team (SMT). The SMT was intentionally excluded for three reasons. First, the goal was to obtain information on the processes used to innovate. The SMT is likely to make decisions on major innovations and to provide general oversight, but much of the work on developing innovations will be under the direction of the next level of senior managers. Second, we were interested in the degree to which all staff are involved in innovation and the level of support for bottom up innovation. The SMT could be too far removed from ongoing innovation activities to be fully aware of the involvement of middle managers or front-line staff.

[2] The full questionnaire is available in a preliminary report of the descriptive results, available at www.utas.edu.au/__data/assets/pdf_file/0005/849866/Management-and-service-innovations-in-Australian-and-New-Zealand-Universities.pdf.

Third, in order to assess the support of the SMT for an inclusive innovation culture, we needed to obtain the views of senior managers that were not part of the SMT. In addition, as the focus of the survey is on administrative and managerial innovations, faculty Deans were excluded to prevent any confusion between administrative innovations and innovations developed as part of the research function of the university.

Table 1: Questions included in the survey

General question	Details	Response Options
General Information	Length of time in current position, number of professional staff reporting to respondent, change in the number of staff reporting to respondent from the previous year, restructure of university or respondent's section.	
Types of innovations	Definition of an innovation, implementation of 6 innovation types in the previous two years.	Yes/no
Reasons for innovating	Importance of 8 drivers of innovation.	Low, Medium, High, Not relevant
Sources of information for innovation	Importance of 8 sources of ideas or information for innovations: internal sources such as 'yourself or staff within your section', 'other sections of your university' and external sources such as 'other universities'.	Low, Medium, High, Not relevant
Supportive environment for innovation	Agreement with 7 statements on innovation activities within respondent's section, 3 impacts on innovation from inter-university competition, senior executive willingness to take risks to support innovation and senior executive support for a positive innovation culture.	Disagree, Neutral, Agree, Not relevant
Investments in innovation	Share of staff involved in 3 innovation support activities, number of staff hired and number redeployed to work on innovations, section's involvement in innovation activities or investment (receiving additional funds/resources, use of 5 design thinking methods).	Categories for staff share; Yes/No
Most important innovation	Written description of section's most important innovation in the last two years, source of the initial idea for the innovation (one out of 10 options), is the innovation fully or partially implemented, the original purpose of the innovation, the target of the innovation, was collaboration involved and if so who were the collaboration partners, how many section staff were involved in developing the innovation, effect of innovation on 9 outcomes.	For outcomes: Negative effect, Minor positive effect, Major positive effect, Too early to estimate, Not relevant
Abandoned or under-performing innovations	Was there an innovation in the last two years that was abandoned or under-performed, the original purpose of this innovation, and importance of 10 factors in contributing to abandonment/under-performance (lack of various resources, risks and resistance from staff).	Low, Medium, High, Not relevant
Obstacles to innovation	Importance of eight obstacles to innovation in the past two years (lack of resources, 'lack of a supportive culture for innovation', risks and resistance from academic and professional staff, etc.).	Low, Medium, High, Not relevant

Respondents were identified through the information provided on University websites. The goal was to obtain a representative sample of senior managers and directors from 10 core managerial and administrative functions in all universities of interest. For each of the 10 defined functions, two directors and two managers were sought for each University, for a total estimated sample of 1,800 managers (40 managers by 45 universities). Due to variations in the quality of university websites, the final sample was slightly smaller, at 1,732. Of these, 216 were identified in the survey as invalid, either because the email address was inactive, mailed correspondence was sent back as "return to sender", or correspondence from the University identified the contact as no longer employed. The removal of invalid cases resulted in a final valid population of 1,516. Responses were obtained from 573, for a response rate of 37.8%.

One concern is that senior managers involved in innovation were more interested in the survey and consequently more motivated to reply than managers that were not involved in innovation. If true, this would create an upward bias for basic results on the prevalence of innovation, although it would not affect many of the analyses that are limited to innovators only. To counteract this possibility, information letters, provided by email or mail, stressed that the questionnaire was relevant to both innovators and non-innovators. Furthermore, an analysis of 50 responses from managers that only completed a question on whether or not any innovations had been introduced in their section in the previous two years showed that the innovation rate for this group was slightly higher than the innovation rate for the survey respondents. This suggests that non-respondents are likely to innovate at the same rate as respondents.

Survey implementation

The survey was delivered primarily online, with a hardcopy version available on request. Respondents were initially invited to participate in the survey by an email containing a unique URL hyperlink to the questionnaire. The follow-up of non-respondents included two email reminders, each containing the unique URL. The initial contact was sent in mid to late November of 2015, with two follow-up reminders sent by mid December. In January of 2016 a postal invitation letter was sent to non-respondents, followed up a few days later by another email containing the unique URL. A final invitation to participate was delivered by post in early February and contained a printed copy of the survey questionnaire and an addressed reply-paid envelope. The survey was closed on the 30th of April, 2016.

Terms

In Australia and New Zealand administrative staff at all levels are defined as 'professional' staff to differentiate them from academic staff. Universities are not consistent in their definition of organizational units, with some using 'divisions', others 'departments', etc. For simplicity and to prevent confusion, the questionnaire used a neutral term, 'section', to define the respondent's area of responsibility. In this paper we use 'professional' to refer to administrators and 'section' to refer to the respondent's division or department.

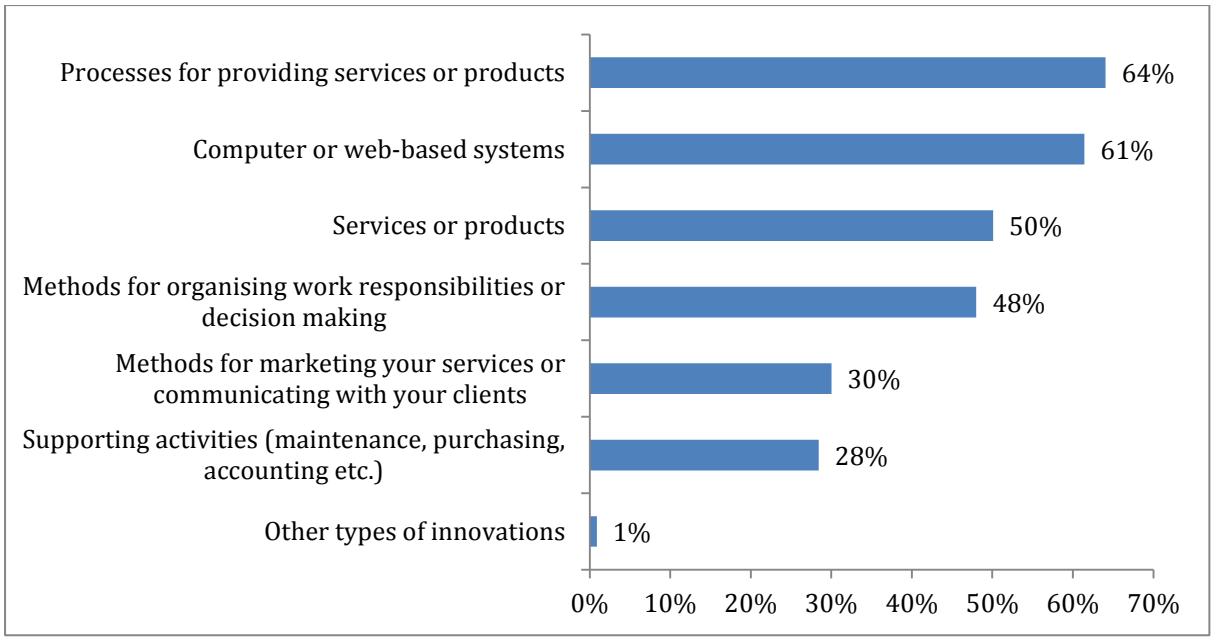
4. Descriptive results

Descriptive results are provided for the innovation rate, innovation culture for two aspects of the reported most important innovation: the source of the idea for this innovation and the types of collaboration partners involved in its development.

4.1 Innovation rate

All respondents were asked "in the past two years, did your section implement any new or substantially changed" services, processes (two questions), organisational methods and marketing methods. In addition, they were asked if they had introduced any new or substantially changed computer or web-based systems and if they had any other types of innovations. A very high percentage of respondents, 91%, reported at least one type of innovation. Of note, this high innovation rate is almost identical to the rate found in surveys of public administration agencies in Australia (91.3% innovation rate) and Europe (80% to 91.5%).[3] As shown in Figure 1, the most commonly reported innovation is processes for providing services or products, at 64%, with half of respondents reporting an innovative service or product. The total rate for process innovations is 70.5% (either a process for providing services or a supporting activity).

Figure 1. Percentage of respondents reporting each of seven types of innovations



Where possible, 'other' responses are reassigned to the most relevant option. Those that could not be reassigned remain as 'other'.

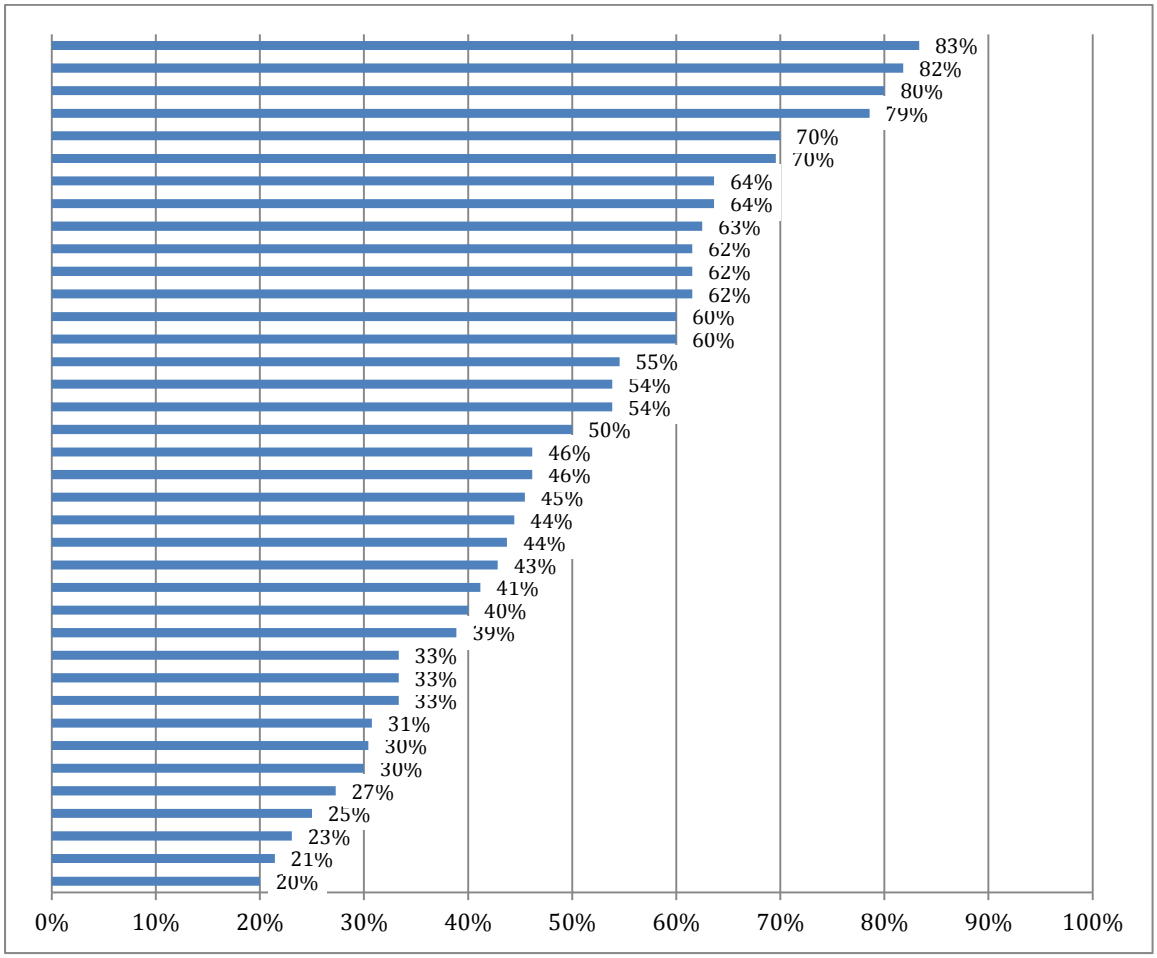
4.2 Inclusive innovation culture

The innovation culture of an organization is set by senior management. Respondents were asked to rate their level of agreement with the statement "The senior executive support a positive innovation culture that includes all professional staff". On average, 49% of respondents agree with this statement, but there are large differences in agreement by university as shown in Figure 2, with the rate of agreement varying from a low of 20% to a high of 83% in 38 universities for which there are 10 or more respondents.[4] This large difference in senior executive support for an inclusive innovation environment suggests that some universities follow a more top-down and less inclusive approach to innovation than other universities.

[3] See Arundel and Huber, 2013; Bugge and Bloch, 2016. Innovation rates in the public sector are consistently higher than in the private sector, partly because public sector organisations are larger, on average than private sector organisations and consequently have greater resources available for innovation (Earl, 2004).

[4] The results for all universities range from a low of 0% (based on 8 responses) to a high of 86%.

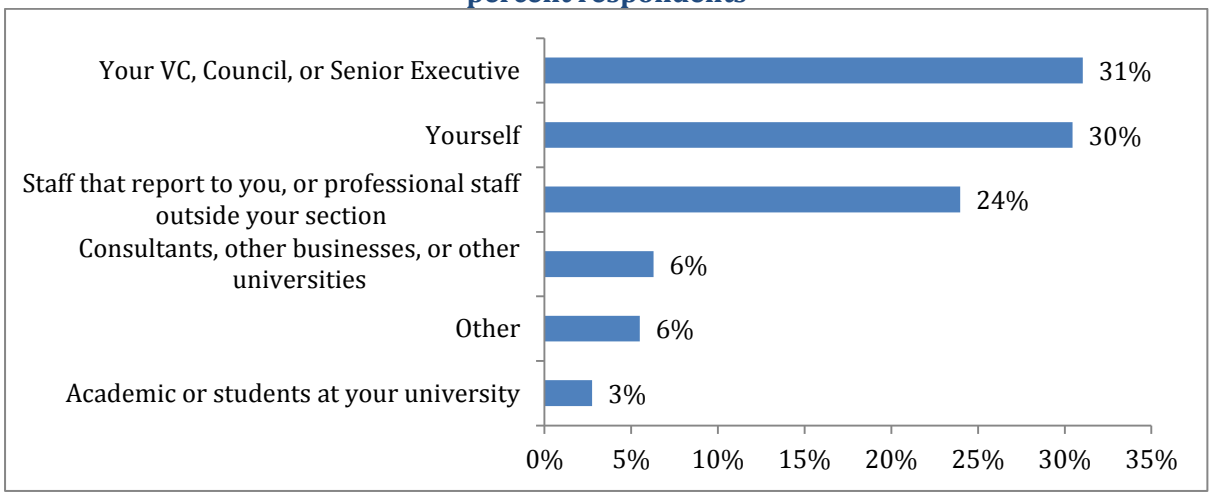
Figure 2. Percent respondents, by university, agreeing that the senior executive supports an inclusive innovation culture



Further information of relevance to an inclusive innovation culture is from a question that asked respondents about the source of the "initial idea for [their] most important innovation" introduced in the previous two years. Figure 3 shows that 31% reported that the idea came from 'your VC, council or senior executive', followed closely by 30% coming from 'yourself' and then 24% from "staff that report to you" or "professional staff outside your section". Academics or students at your university were the least common source of the idea (only 3%). These results can be compared to those from a survey of comparable senior managers in the Australian Public Service (APS).[5] Slightly less than 13% of APS managers reported that the idea for their 'most important innovation' came from the equivalent of the Senior Management Team in universities. This suggests that the innovation culture in Australian and New Zealand universities is less supportive of bottom up innovation than that of the Australian Federal government.

[5] See Figure 6, Arundel and Huber, 2013. For further information on the APS survey see http://innovation.govspace.gov.au/2013/08/02/wrapping-up-the-australian-public-sector-innovation-indicators-apsii-project/

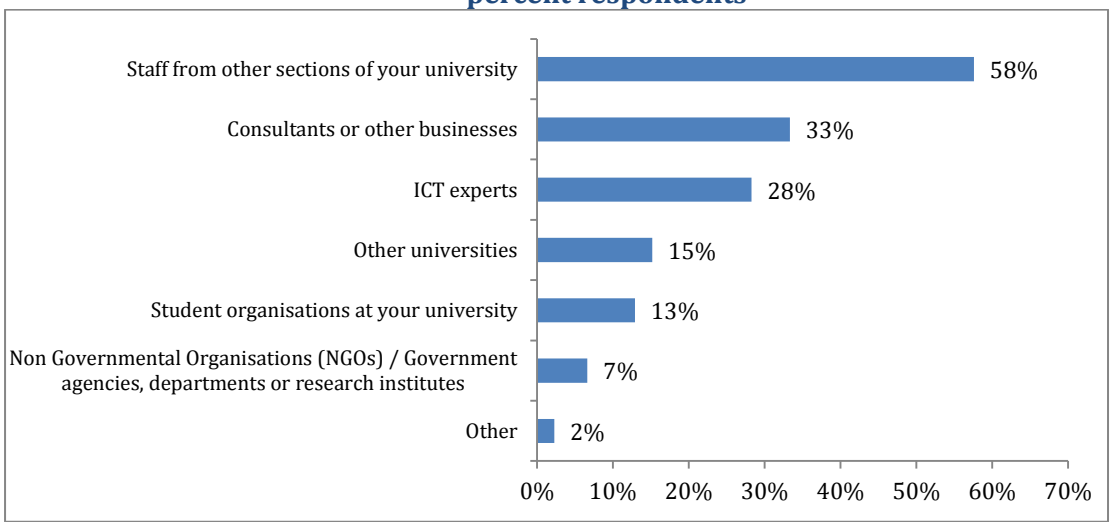
Figure 3. Source of the idea for the most important innovation, percent respondents



Results for 509 respondents reporting a most important innovation.

The use of collaboration is a characteristic of innovation in the public sector, with collaboration rates of approximately 80% in several studies (EC, 2010). This study provides similar results, with 72.9% of respondents reporting that their most important innovation was developed in "collaboration with individuals from other sections of your university or from outside your university". As shown in Figure 4, the most common form of collaboration is with 'staff from other sections of the university' (reported by 58% of collaborators), followed by 'consultants or other businesses' (33%) and 'ICT experts' (28%). Slightly more than half of respondents (54.4%) report collaborating with partners outside their university.

Figure 4. Collaboration partners for the most important innovation, percent respondents



Where possible, an 'other' response is reassigned to the most relevant option. Cases that could not be reassigned remain as 'other'. Answers from 370 respondents that reported collaboration.

5. Econometric analyses and variable definitions

The econometric analyses examine the effect of an inclusive innovation culture that includes all professional staff on the use of five design thinking methods for developing innovations. In addition, two analyses examine the effect of the innovation culture, use of design thinking methods and other factors on outcomes limited to a single innovation: 1) the introduction of a most important innovation that provided "an entirely new service, process or product (a measure of innovation novelty) and 2) the probability of reporting an abandoned or under-performing innovation (a measure of innovation failure). All analyses are largely exploratory, but they are guided by empirical research on the importance of a supportive innovation culture and innovation support strategies on innovation outcomes. We assume that the innovation culture, the reasons for innovating and the methods that are used to innovate apply to all innovations, including the most important innovation.

For independent variables, case conservation methods are used for matrix questions with two or more sub-questions to limit the number of cases that are excluded due to one or more missing values. For example, the question on the reasons for innovating uses eight sub-questions for specific reasons, each of which is measured on an importance scale (low, medium, high) plus a 'not relevant' option. Respondents that leave an individual sub-question unanswered are assumed to have found the question of either low importance or 'not relevant' if at least one other question in the matrix is answered. With a few exceptions, a 'not relevant' response is coded as of low or no importance.

5.1 Dependent variables

5.1.1 Design-thinking methods

Design thinking (also called 'co-creation' or user-led innovation) is a cluster of tested methods for innovation development and implementation that has been increasingly used in the European and American public sectors, as well as in the business sector. These methods, in combination with other activities to support innovation, should increase the innovative capabilities of an organisation and reduce the probability of poor innovation outcomes. Almost all of the cognitive testing interviewees were unaware of the concept of design thinking, but were aware of the different methods used in a design-thinking process. However, we suspect that most respondents that reported the use of one or more of these methods did not use them as part of a rigorous design-thinking process.

The questionnaire never uses the term 'design thinking', but includes questions on five design thinking methods within a question that asks "As part of developing innovation in the last two years, did your section" 1) "conduct project user or focus groups with potential users of an innovation", 2) "survey your stakeholders or potential users about an innovation", 3) 'test the 'ease of use' of a planned innovation on a sample of potential users", 4) "run a test pilot of the innovation" and 5) "run post-implementation studies to identify or solve problems with an innovation". Participants were given 'yes' or 'no' response options. A 'yes' answer is coded as 1 and a 'no' answer as 0.

5.1.2 Novelty of the most important innovation

Respondents that reported a most important innovation were asked if the "original purpose of this most important innovation" was to "provide an entirely new service, process or product" or to "replace or improve a previous service, process or product".

The former are defined as novel innovations and are coded as equal to 1, with improvements coded as 0. This variable is also used as an independent variable in the model for the outcomes of the most important innovation.

5.1.3 Abandoned/ Under-performing innovations

Innovators were asked if they had worked on an innovation in the last two years that was "abandoned or did not meet initial expectations". 'Yes' answers were coded as 1 and 0 otherwise. In total, 77.2% of innovative respondents reported an abandoned/under-performing innovation.

5.2 Independent variables

5.2.1 Innovation culture

The question "the senior executive support a positive innovation culture that includes all professional staff" provided four responses options: 'disagree', 'neutral', 'agree', 'and 'not relevant'. 'Disagree' is coded as 0, 'neutral' as 1, and 2 as 'agree'. In all analyses the reference category is set to 0 or 'disagree'. The never selected the 'not relevant' category for this question. This variable is included in all models.

5.2.1 Innovation support activities

Respondents that reported one or more innovations were asked about the use of several activities to support innovation, including the importance of seven different external sources of information for their innovations and the use of five design-thinking methods for developing innovations.

The seven external information sources cover two sources within the university but outside of the respondents section ("other sections of your university" and "students or student organisations at your university") and five external sources outside the university (other universities, professional associations, conferences, businesses and governmental organisations). The number of high-importance information sources are summed (each source is coded as 1 for high importance, zero otherwise), with values between 0 and 7.

The use of design thinking methods is included as an independent variable in the two models for novelty and abandoned/underperforming innovations. For these analyses, the number of reported design-thinking methods are summed, with values between 0 and 5.

5.2.3 Reasons for innovating

Innovators were asked about the importance of eight factors as drivers of their section's innovations. Four cover specific goals such as 'improve the student experience' or 'improve your university's brand or reputation that will not be relevant to many innovations and are therefore not used in the analyses. In contrast, three drivers could create problems for the development and implementation of all types of innovations. These are 'a decrease in your section's budget', 'need to do more with the same budget', and 'a problem or crisis requiring an urgent response'. The first two of these three drivers could create resource constraints, while the third could result in poor decisions made under stressful conditions. The importance scale of 'low', 'medium' and 'high' was recoded, with 1 equal to high importance and 0 otherwise. In addition, respondents were asked for their agreement on the statement that competition with other Australian or New Zealand universities "increased the need for your section to innovate" This

variable is coded as 1 if the respondent agrees and 0 otherwise and could also add to the stress of innovation activities.

5.3 Control variables

The models include variables to control for the effects of restructuring, the size of the respondent's area of responsibility (or section) measured by the number of employees, and the function of the respondent's section.

Organizational restructuring is very common in Australian universities, both throughout the university and within individual sections. In total, 77.2% of respondents reported either a major restructuring process across the university or within their section during the previous two years. The restructuring variable equals 1 if respondents reported either university or sectional restructuring and 0 otherwise.

The size of a section could affect the probability that design thinking methods are used or that the most important innovation is entirely new, on the basis that a large section could have more innovations. The size variable equals the number of professional staff (head count) that reported to the respondent in the month preceding the survey.

The function or purpose of a section influences the types of innovations that are introduced and the expected outcomes. Each respondent is assigned to one of 10 functions based on their position title: 'Library/information services', 'Governance, executive, central services', 'Research, academic and faculty services', 'Student services', 'Information technology services', 'Campus/property services', 'Financial services', 'Human resources', 'International services', 'Marketing and communications services'. Each function is coded as 1 when assigned to a case and 0 otherwise. The 'International services' function is used as the reference category.

5.4 Variables for analyses of the most important innovation

One control variable and two independent variables are only available for the most important innovation. The control variable concerns implementation, while the other variables are for the idea source and the use of collaboration.

Research consistently finds that public sector managers have a difficult time separating innovations that are fully implemented from those that are only partially implemented. Since more information is likely to be known about the outcomes of a fully implemented innovation and on the novelty of the innovation, the analyses of these two dependent variables include a control for implementation, which equals 1 when the innovation was "completely implemented" and 0 when the innovation was "partially implemented, with continuing improvements or extensions underway".

The results on the source of the initial idea for the most important innovation (see Figure 3) are combined to construct four dummy variables: 'VC, Council, Senior Executive', 'Yourself', 'Other staff or students at your university', and external sources (Consultants, businesses or other universities'). Each variable is coded as 1 or zero, with 'yourself' as the reference category.

Collaboration is expected to improve innovation outcomes. The collaboration variable equals 1 if the respondent reports any collaboration for their most important innovation and 0 otherwise.

6. Econometric results

The econometric analyses use logit regression models. The mean values of all independent variables are provided in Annex Table A1. Correlation analyses between the independent variables (see Annex Table A2) show that multicollinearity issues are unlikely, with all correlations below 0.263.

The model results provide odds ratios (expβ). An odds ratios over 1.0 indicates that the variable increases the probability of the outcome measured by the dependent variable, while an odds ratio under 1.0 indicates that the variable decreases the probability of the outcome.

6.1 Use of design-thinking methods

Table 2 provides results for the use of five design thinking methods. Each of these methods will incur costs in terms of employee time or the need for additional financial investments, but pilot tests and 'ease of use' studies likely to be the most costly. Their use therefore represents a high level of commitment to innovation.

Agreement with the statement that the senior executive support an inclusive innovation culture significantly increases the use of each of the five design-thinking methods, probably because a supportive culture gives senior managers greater freedom to use costly innovation support methods. The other innovation support activity of drawing ideas or information for innovation from a number of sources has no effect, except for post-implementation studies to identify or solve problems. This suggests that several sources of information are helpful for complementing problem-solving activities, whereas the number of information sources is not relevant to the three pre-implementation design thinking activities (focus groups, surveys, tests for ease of use) or for pilot testing.

The reasons for innovating are rarely associated with use of specific design-thinking methods, except for a positive effect of the 'need to do more with the same budget' on ease-of-use testing and a positive effect of competition with other universities on the use of pilot tests, possibly because competition is a large motivator for getting an innovation right.

The types of innovations reported by the respondent has a significant effect on the use of all five design thinking methods. As expected, services and computer or web based innovations increase the probability of using ease-of-use testing and pilot testing. Process innovations are correlated with post-implementation studies, possibly because of the difficulty in identifying all potential issues beforehand.

Table 2. Logit models for reported use of five design-thinking methods

	Conduct project user or focus groups with potential users of an innovation		Survey your stakeholders or potential users about an innovation		Test 'ease of use' of a planned innovation on a sample of potential users		Run a test pilot of the innovation		Run post-implementation studies to identify or solve problems with an innovation	
	Exp(β)	p	Exp(β)	p	Exp(β)	p	Exp(β)	p.	Exp(β)	p
Inclusive innovation culture		**.012****		**.014****		**.001*****		*.088**		**.029****
Neutral	.963	.900	1.619	*.088**	1.313	.362	1.328	.345	1.371	.282
Agree	1.925	**.029****	2.245	**.004*****	2.687	**.001*****	1.888	**.033****	2.072	**.012****
Type of reported innovations										
Service	1.395	.145	1.383	.130	1.789	**.012****	1.763	**.013****	1.278	.261
Process	1.993	**.010*****	1.739	**.029****	1.427	.189	1.157	.596	1.943	**.010****
Computer or web-based	1.988	**.003*****	1.174	.466	2.532	**.000*****	1.742	**.016****	1.101	.669
Reasons for innovating										
Decrease in section's budget	.889	.683	.911	.728	.910	.744	1.020	.945	.848	.544
Need to do more with the same budget	.829	.418	1.012	.956	1.626	**.035****	1.113	.638	1.081	.716
Problem or crisis	.821	.521	.786	.392	.768	.386	.839	.564	.954	.870
Competition with other universities	1.460	.112	1.107	.645	1.373	.183	2.419	**.000*****	1.284	.264
Other innovation support activity										
Sum of sources of ideas/information	1.244	.116	.974	.841	1.103	.478	1.009	.949	1.312	**.038***
Control variables										
Restructuring in university or section	.978	.934	.890	.641	.711	.214	.929	.786	1.720	**.032***
Number of staff in section	1.010	**.012****	1.005	.122	1.001	.732	1.003	.312	1.010	**.004*****
Function (includes dummies for 9 functions)										
Constant	.203	.009**	.354	.072*	.143	.002***	.183	.006***	.099*	.000***
Model Chi-square	75.26	.000	33.33	.043	83.93	.000	64.85	.000	62.64	.000
N	455		455		455		455		455	
Nagelkerke R^2	0.211		0.096		0.232		0.185		0.173	
Percent cases correctly classified	72.1		65.1		73.4		71.9		65.9	

*** = p < 0.01, ** = p < .05, * = p < .10

6.2 Novelty of the most important innovation

Table 3 gives logit results for the novelty of the most important innovation, defined as an entirely new service, process, or product, with the alternative being a service, process or product that has been improved or replaced. Neither the presence of an inclusive innovation culture nor the different reasons for innovating influence novelty. In contrast, two innovation support strategies, the sum of design thinking activities used by the respondent (though not necessarily for the most important innovation) and collaborative development of the most important innovation have a significant and positive effect. Of interest, the most important innovation is less likely to be novel if the initial idea for it came from the senior management team or from other sources within the university, versus from the respondent. This could be because the respondent has a better understanding of options for novel innovations in his or her section, compared to other university personnel.

Table 3. Logit model for a novel most important innovation (entirely new service, process or product)

	Exp(β)	P
Senior executive support for inclusive innovation culture[1]		.504
Neutral	.702	.250
Agree	.763	.356
Reasons for innovating		
Decrease in section's budget	1.307	.334
Need to do more with the same budget	.740	.183
Problem or crisis requiring an urgent response	1.474	.191
Competition with other universities	1.061	.799
Innovation support strategies		
Sum of design-thinking activities	1.386	**.031****
Sum of sources of ideas or information for innovation	.934	.615
Collaboration	2.197	**.003*****
Source of the initial idea[2]		
Senior executive	.609	*.063**
Other sources within the university	.498	**.013****
Sources external to university	.893	.809
Control variables		
Restructuring	0.990	.969
Number of staff in section	0.999	.785
Fully implemented	1.076	.748
Function (includes dummies for 9 functions)[3]		
Constant	.300	.061
Model Chi-square	42.89	.010
N	449	
Nagelkerke R square	0.126	
Overall % correct	69.3	

*** = p < 0.01, ** = p < .05, * = p < .10

1: Reference category is 'disagree'.

2: Reference category is 'yourself' (respondent).

3: Reference category is international services.

5.3 Abandoned/underperforming innovations

Table 4 gives results for the occurrence of an abandoned or under-performing innovation, reported by 135 (26%) respondents. In addition to the control variables (none of which are statistically significant), the model includes variables for the respondent's perception of the senior executive's support for an inclusive innovation culture, four reasons for innovating that could increase the stress of innovation activities, and two types of innovation support activities.

The most significant independent variable is the senior executive's support of an inclusive innovation culture. Such support significantly reduces the probability of an abandoned or under-performing innovation. Two of the reasons for innovating, a decrease in the section's budget and competition with other universities increase the probability of an abandoned or under-performing innovation, suggesting that stressful conditions increase the probability of experiencing problems with activities to innovate.

Table 4. Logit model for occurrence of an abandoned or under-performing innovation

Variable	Exp (β)	p
Senior executive support for inclusive innovation culture[1]		**.026****
Neutral	.583	*.077**
Agree	.443	**.007*****
Reasons for innovating		
Decrease in section's budget	1.631	*.092**
Need to do more with the same budget	0.856	.513
Problem or crisis requiring an urgent response	1.626	.102
Competition with other universities	1.565	*.062**
Innovation support activities		
Sum of design-thinking activities	1.054	.736
Sum of sources of ideas or information for innovation	1.103	.494
Control variables		
Restructuring in university or section	.691	.172
Number of staff in section	1.002	.528
Function (includes dummies for 9 functions)[2]		
Constant	.603	.381
Model Chi-square	41.8	.002***
N	453	
Nagelkerke R^2	0.129	
Percent cases correctly classified	75.3%	

*** = p < 0.01, ** = p < .05, * = p < .10

1: Reference category is 'disagree'.

2: Reference category is international services.

7. Discussion and conclusions

This study shows that it is both possible to measure innovation in the university sector and to obtain useful results for informing university strategies to support innovation. It is also possible to use university websites to construct a sample of respondents and to collect data on the function of the respondent's section, which is similar to the sector of activity for businesses. Although we do not report results by function in this paper, the respondent's function can have a notable effect on some of the factors linked to innovation (see the report by Arundel et al, 2016b).

As for other public sector organizations, we find very high innovation rates in the university sector, with 91% of respondents reporting an innovation in their section (their area of responsibility). Restructuring is very common in this sector, reported by 77% of respondents, and could be partly responsible for the high innovation rate. However, restructuring has very little effect on the use of methods to support innovation, innovation novelty or the occurrence of abandoned or underperforming innovations.

The support of the senior executive (the Vice-Chancellor, Deputy Vice-Chancellors, Chief Operating Officer, etc.) for a "positive innovation culture that includes all administrative staff" has a significant effect on the use of design-thinking methods for the development of innovations and significantly reduces the probability of abandoned or under-performing innovations. In contrast, a supportive culture has no effect on valuable novel innovations (the reported most important innovation) that are an entirely new service, process or product. A possible explanation for this lack of effect is that the respondent is the source of the idea for many of these novel innovations and draws on his or her expertise on what is necessary.

These results suggest that creating an inclusive innovation culture, an important part of bottom up innovation, has important benefits in terms of supporting advanced methods for innovating and reducing innovation failure, such as abandoned and under-performing innovations. However, we would like to know more about the effect of an inclusive innovation culture on the benefits of innovation, for instance on outcomes.

The questionnaire collected data on several outcomes of the most important innovation, which could provide a test of the effect of an inclusive innovation culture on positive outcomes such as 'simpler or faster processes' or a better 'student experience'. Unfortunately, over half of the results are missing for many of the outcomes, with respondents either reporting that that it was 'too early to estimate' the effect of their most important innovation on an outcome or that the outcome was not relevant for their innovation. The only outcome with a sufficient number of responses is 'simpler or faster processes', possibly because this outcome is easy to detect and occurs quickly after the implementation of a process innovation. For this outcome, a logit regression found that an inclusive innovation culture had a significant and positive effect.

These limited results indicate that we have not yet found a suitable method for measuring outcomes. A major factor could be that the reference period is too short, particularly as 65% of the most important innovations had not yet been fully implemented. Another issue is that the outcomes are self-reported. It may be possible to match results at the university level with other types of outcome data from publicly available sources, such as data on changes in student enrolment or research output.

In addition to the focus in this paper on a supportive culture for innovation, the survey provides useful results for developing indices of innovation performance and data for further in-depth analyses. Due to space and time constraints, we have not been able in this paper to evaluate the effect of all innovation support strategies on innovation performance or how the use of these strategies could vary by the characteristics of individual universities. These issues will be addressed in future research.

8. References

Arundel, A., Huber, D., 2013. From too little to too much innovation? Issues in monitoring innovation in the public sector. *Structural Change and Economic Dynamics* 27, 146-149.

Arundel A, Casali L, Hollanders H., 2015. How European public sector agencies innovate: The use of bottom-up, policy-dependent and knowledge-scanning innovation methods. *Research Policy* 44:1271-1282.

Arundel A, Bloch C, Ferguson B., 2016a. Measuring innovation in the public sector. OECD Blue Sky 2016 conference paper.

Arundel A, Bowen-Butchart D, Gatenby-Clark S, Goedegebuure L. 2016b. *Management and Service Innovations in Australian and New Zealand Universities*, LH Martin Institute, University of Melbourne.

Bolden, R., J. Gosling, A. O'Brien, K. Peters, M. K. Ryan, S. A. Haslam, L. Longsworth, A. Davidovic & K. Winklemann 2012, *Academic leadership: changing conceptions, identities and experiences in UK higher education*, Leadership Foundation for Higher Education, London, England.

Borins S. 2010. *Innovation as Narrative*. Ash Center for Democratic Governance and Innovation, Harvard Kennedy School, Cambridge.

Brennan, J., S. Broek, N. Durazzi, B. Kamphuis, M. Ranga & S. Ryan 2014, "*Study on innovation in higher education: final report*".

Bryman, A. 2007, "Effective leadership in higher education: A literature review", *Studies in higher education*, vol. 32, no. 6, pp. 693-710.

Bugge M, Mortensen PS and Bloch C (2011), *Measuring Public Innovation in Nordic Countries: Report on the Nordic Pilot Studies, Analyses of Methodology and Results*. MEPIN, NIFU, Oslo.

D'Este, PS, S. Iammarino, M. Savona and N. von Tunzelmann, 2012. What Hampers Innovation? Revealed Barriers versus Deterring Barriers. *Research Policy* 41:482- 488.

EC (European Commission) (2010). *Innobarometer 2010 Analytical Report*, European Commission, Brussels.

GAIHE 2016, *Governance and Adaptation to Innovative Modes of Higher Education Provision*. Erasmus project report, European Commission.

Hariri, A. & P. Roberts 2014, "Challenges and Issues Hindering Innovation in UK Universities", *International Journal of Management and Marketing Academy*, 2: 41-54.

Hariri, A. & P. Roberts 2015, "Adoption of innovation within universities: proposing and testing an initial model", *Creative Education*, 6:186.

Hartley, J., Sorensen, J., Torfing, J., 2013. Collaborative innovation: A viable alternative to market competition and organizational entrepreneurship. *Public Administration Review*, 73, 821-830.

Istance, D. & M. Kools 2013, "OECD Work on Technology and Education: innovative learning environments as an integrating framework", *European Journal of Education*, 48:43-57.

Jackson, N. 2013, "The Wicked Challenge of Changing a University. A Tale of Bottom-Up Innovation Supporting Strategic Change", viewed 18/07/2016, <http://www.normanjackson.co.uk/uploads/1/0/8/4/10842717/changing_a_university.pdf.

Kay, R., Goldspink, C., 2012. *What public sector leaders mean when they say they want to innovate*. Incept Labs, Sydney.

Kenny, J. 2002, "Managing innovation in educational institutions", *Australasian Journal of Educational Technology*, 18:359-376.

Kenny, J. 2003, "A research-based model for managing strategic educational change and innovation projects", in *HERDSA 2003 Conference*.

Kopcha, T. J., L. P. Rieber & B. B. Walker 2015, "Understanding university faculty perceptions about innovation in teaching and technology", *British Journal of Educational Technology*.

Osborne, S.P. and Brown, L., 2011. Innovation, public policy and public services delivery in the UK: The word that would be king? *Public Administration* 89:1335-1350.

OECD/Eurostat, 2005*. Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, OECD, Paris.

Parker, L. 2011, "University corporatisation: driving redefinition", *Critical Perspectives on Accounting*, 22:434-450.

Parker, L. D. 2002, "It's been a pleasure doing business with you: a strategic analysis and critique of university change management", *Critical Perspectives on Accounting*, 13: 603-619.

Parna O, von Tunzelman N. 2007. Innovation in the public sector: key features influencing the development and implementation of technologically innovative public sector services in the UK, Denmark, Finland and Estonia. *Information Polity* 12:109-125.

Sorensen, E., Torfing, T., 2012. Enhancing collaborative innovation in the public sector. *Administration and Society* 43, 842-868.

Szekeres, J. 2006, "General staff experiences in the corporate university", *Journal of Higher Education Policy and Management*, 28:133-145.

Tabata, L. N. & L. K. Johnsrud 2008, "The impact of faculty attitudes toward technology, distance education, and innovation", *Research in Higher Education*, 49:625-646.

Torugsa N, Arundel A., 2015. The nature and incidence of workgroup innovation in the Australian public sector: Evidence from the 2011 State of the Service survey, *Australian Journal of Public Administration*, 75:202-221.

Torugsa N, Arundel A., 2016. Complexity of Innovation in the public sector: A workgroup-level analysis of related factors and outcomes, *Public Management Review*, 18: 392-416.

Annex Table A1: Mean values of independent variables			
	Mean		Mean
Executive support a positive innovation culture - disagree	.19	Function: Student Services	.12
Executive support a positive innovation culture - neutral	.31	Function: Research, Academic and Faculty Services	.13
Executive support a positive innovation culture - agree	.49	Function: Human Resources	.09
Service innovator	.55	Function: Financial Services	.09
Process innovator	.77	Function: Campus/Property Services	.10
Computer or web-based innovator	.67	Function: Governance Executive, Central Services	.10
Driver - A decrease in your sections budget	.22	Function: Library/Information Services	.14
Driver - Need to do more with the same budget	.52	Function: Marketing and Communications Services	.06
Driver - Problem or crisis requiring an urgent response	.17	Function: Information Technology/Technology Services	.10
Driver – Competition with other universities	.41	Most important innovation (MII) completely implemented	.35
Number of design thinking methods	.97	MII idea source: VC, Council or Senior Executive	.31
Sum of 7 external idea sources of high importance	1.01	MII idea source: Other staff/students internal to university	.27
Restructuring in the section or university	.77	MII idea source: External to university	.06
Number of professional staff in section	27.9	Collaboration used for MII	.73
		MII an entirely new service, process or product	.34

Annex Table A2: correlations for the independent and control variables																		
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
1.Positive innovation culture	-																	
2.Service innovation	.039	-																
3.Process innovation	.140**	.137**	-															
4.Computer or web based innovation	.033	.193**	.035	-														
5.Driver - a decrease in your sections budget	-.087	.030	.077	.030	-													
6.Driver - need to do more with the same budget	-.023	-.060	.009	-.029	.230**	-												
7.Driver - problem or crisis requiring an urgent response	.017	-.003	.026	.062	.090*	-.017	-											
8.Competition	.061	.073	.026	.082	.009	.100*	.011	-										
9.Number of DT methods	.188**	.197**	.196**	.216**	.020	.025	-.001	.144**	-									
10.Sum of idea sources (b to h)	.036	.154**	.133**	.111*	.046	.024	.050	.215**	.127**	-								
11.Restructure status	-.042	.022	.088*	-.007	.133**	.067	.055	.029	-.010	.027	-							
12.Number of professional staff in section	.081	.113*	.058	.084	.009	.035	-.026	.126**	.179**	.119**	.000	-						
13.Most important innov. completely implemented	.037	-.045	-.017	-.031	-.009	-.060	-.021	-.106*	-.001	-.117**	-.029	-.049	-					
14.Idea source: VC, Council or Senior Executive	.110*	-.037	-.003	-.052	.022	-.099*	.029	-.053	-.029	.040	.064	-.074	-.030	-				
15.Idea source: Other staff/students internal to university	.007	-.011	-.045	.048	-.006	-.049	-.032	.070	.035	-.033	-.092*	.007	.059	-.405**	-			
16.Idea source: External to University	-.011	.025	-.015	-.011	-.012	.005	.004	.093*	-.064	.125**	.026	.020	-.038	-.174**	-.156**	-		
17.Collaboration	.116**	.135**	.175**	.069	.003	-.081	-.010	.120**	.263**	.195**	-.052	.047	-.101*	.055	.068	.030	-	
18.New Service, Process or Product	-.028	.159**	.030	.059	.054	-.041	.055	.046	.169**	.045	-.013	.058	-.009	-.014	-.058	.002	.165**	-