A Baseline Study and Paradigm Assessment on Innovation Support Programmes in Ghana

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Table of Content

1.0 Executive Summary

Globally, there has been an observable growth in innovation and technology in general. The building of technological capabilities and innovation are considered critical factors for economic growth. In Ghana, although the government, through Science and Technology Innovation (STI) and Research and Development (R&D), has shown commitment to enhancing total national development, little impact has been seen due to reasons such as weak policy and initiative coordination among stakeholders, and lack of capacity to implement initiatives. Support Innovation Programmes (SIP) have been developed, which arguably may impact participating institutions' innovation behaviour and performance differently.

The purpose of the baseline study is to take stock and inventory of research and innovation support programmes' access and utilization in the research ecosystem.

This study sought to, amongst others:

a. Help increase awareness and access to existing support programs such as;

- Tax and Finance Support Programmes to enable access to Manpower and Purchase Support Programmes
- Technology Development and Information Support Programmes
- Technology Transfer & Commercialisation Support Programmes
- Start-up Incubation Support Programmes
- IP rights through Intellectual Property Management Support Programmes Certification Support Programmes
- Industry-University-Research Institute (I-UR) Linkages Support Programme that will enable them to carry out research and development activities and boost innovation in Ghana.

b. Help develop a roadmap to address the challenges, gaps and deficiencies of the legal regime identified by the study to create awareness of same.

The target population were various institutions drawn from academia, government, the private sector and regulators which make use of innovation support programmes. A sample of 50 institutions was chosen, and this number was deemed adequate to infer the study population at a 1% margin of error. This sample also accounted for 10% non-responses.

Out of 50 surveyed companies,

- 19 (38%) belonged to Government Agency
- 16 (32%) were from Academia
- 13 (26%) belonged to the Private Sector
- Finally, 2 (4%) of the surveyed institutions belonged to other institution categories not captured in the survey instrument.

The survey results showed that across institutional category, all surveyed institutions had **engaged in innovation activities** in recent years **except for one institution** which was a **government agency**. Thus, at 5% significance level, no statistically significant relationship was found to have existed between the category that a surveyed institution belonged to, and whether they had engaged in innovation activities in recent years.

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Innovation Activities and Support

The survey findings showed that the most engaged-in innovation activities by surveyed institutions were:

- Training for innovative activities In-house or contracted-out training for personnel specifically for the development and/or introduction of new or significantly improved products or processes – 43 surveyed institutions
- Intramural (in-house) R&I: R&I activities are undertaken by institution to create new knowledge or to solve scientific or technical problem – 42 surveyed institutions
- Acquisition of machinery, equipment and buildings – 38 surveyed institutions

Institutions which undertook

- Intramural (in-house) R&I were mostly found in Academia,
- Extramural (contracted-out) were mostly found in Government agency, and
- Other activities: Other in-house or contracted-out activities to implement new or significantly improved products or processes such as feasibility studies, testing, tooling up, industrial engineering, etc, were mainly from the private sector.

Most surveyed institutions engaged in some innovative activities had mostly been in operation for above 30 years, followed by 10-20 years.

Similarly, for all innovation activities that surveyed institutions engaged in, the institution in partnership with other organisations was primarily responsible for developing the innovation, followed by instances where the institution alone was responsible for innovation development.

Clearly, innovation is more common amongst institutions which have been operating for a relatively longer period of time. This could be because it may not seem so necessary when an organisation has just started operating but may be prioritised as the organisation begins to see the need for new products/services and new ways of doing things (new processes), which typically happens after some years of operation.

Also, survey findings showed that partnering with other organisations is the primary strategy adopted in the development of innovations. Since partnerships are easier to foster when an organisation has had some years of service/operation, this could account for the reason why institutions which have been in existence for a relatively longer period of time tend to be more innovative.

The form of innovation support which was received by most (40 out of 50) surveyed organisations was Support for technology/knowledge transfer;

- 14 (35.0%) belonged to Government Agency, 13 (32.5%) were in Academia and 11 (27.5%) belonged to the Private Sector.

- Similarly, surveyed institutions who received this form of support were primarily those who had been in operation for above 30 years (40.0%) and 10-20 years (32.5%). In fact, for any form of innovation support received, majority of the institutions who received them had been in operation for 10-20 years or above 30 years.

- It is worthy to note, however, that out of 3 organisations who did not receive any support, 2 (66.7%) had been operating for above 30 years whereas 1 (33.3%), for less than 10 years.

Across board (form of innovation support received), surveyed institutions had their expectations largely met. In addition, for institutions who received "Support for awareness raising and information on support possibilities" and "Support for the creation of specific skills", their expectations were also perfectly met (29.7% and 30.0% respectively) as opposed to moderately met (22.2% and 23.4%) respectively.

Institutions who were from the Private Sector (27.1%) mostly had their expectations largely (10.4%) and perfectly (8.3%) met. Most of those from Government Agency (37.6%) stated that their expectations were largely (16.7%) and moderately (12.5%) met, whereas institutions from Academia (31.3%), aside having their expectations largely met (14.6%) also had theirs moderately and perfectly met (8.3% each).

Financial support for Innovation Activities

Institutions that belonged to Government Agency and Academia seemed to have obtained most of the financial support available.

- Out of 18 (37.5%) institutions surveyed which belonged to the Government agency, 11 (22.9%), obtained financial support.

- In Academia, out of the 15 (31.3%) institutions surveyed, 9 (18.8%) had financial support.

It is worthy to note that the financial support they received does not depend on the organisational category of an institution.

The findings of the survey revealed that, an institution ability to obtain financial support depends on its length of operation of the institution.

- Institutions which had been in operation for a longer duration seemed to have more funding than those who had been in operation for a relatively shorter period.

- Out of 22 (44.9%) surveyed institutions who had been in operation for over 30 years at the time of the survey, 13 (26.5%) obtained funding, however in the case of institutions who were less than 10 years in operation, no funding was obtained (for all 7 of them).

The main sources of funds for innovative activities for institutions in **Academia** and the **Private sector** were **Donor funds** (14.6% and 8.3% respectively) and **Internally Generated funds** (10.4% and 14.6% respectively).

Only institutions from the **Government Agency** received funding from the **Government of Ghana** (10.4%) in addition to **Donor funds** (14.6%) and **Internally Generated funds** (6.3%).

The survey findings showed that the **sources of funds** obtained by an institution **does not depend** on the **organisation category** of the institution.

- None of the institutions which were less than 10 years received any support from the Government of Ghana.

- However, Institutions with longer length of operations received some level of support from the Government of Ghana (2.1% each for 10-20 years and 21-30 years) in addition to donor funds and internally generated funds.

- Institutions that had been in existence over 30 years seemed to receive the highest levels of Donor funds (12.5%), Internally Generated funds (12.5%) and Government of Ghana funds (6.3%).

The study found that the **sources of funds** obtained for innovative activities **does not depend** on **length of operation** of the institution.

Financial support for innovation activities was mainly given in the form **Grants and Technical Assistance.**

- For institutions in Academia, 38.7% of funding was in the form of Grants whilst 30% was in the form of Technical Assistance.

- For the institutions in the Government Agency, 30% was in the form of Grants and 46.7% was in the form of Technical Assistance.

- All recipients of vouchers were funded by Donors, whereas all surveyed institutions that did not receive any financial support funded their innovation activities through Internally generated funds (IGF).

The findings of the survey also showed that financial support given by the Government of Ghana were mostly in the form of technical assistance, grants and tax breaks/exemptions.

Overall, the research revealed that innovative institutions have been in operation for a longer period. Additionally, the findings indicated that an institution's ability to obtain financial support from funding institutions/Government largely depends on its length of operation. Thus, institutions that had been in operation for a longer period received more financial support than those that had been operating for a relatively shorter time. It is worth mentioning that, in practice, funding institutions prefer to partner with credible institutions and institutions that have been in operation over a longer period may appear more credible (have a track record) compared to their counterparts who have been in operation for a relatively shorter time. **Based on the above findings, certification programmes are recommended for start-up institutions to strengthen their credibility and enable them to secure financial support to be innovative.**

Sources of Information and Cooperation for Innovation Activities

Amongst various information sources that provided new innovation projects or contributed to the completion of existing projects, information from within institution or institution group was deemed very important by 84.8% of respondents. No respondent saw this information source as unimportant. Information from universities or other higher education institutions, however, was deemed not important by 7.1% respondents. Nonetheless, 45.2% rated it as very important.

Information from Government or public research institutes was mostly very important (52.3%) or important (28.6%) whereas surveyed institutions who obtained information from private research institutes mostly found it very important (45.2%) or were neutral/indecisive about their rating (28.6%).

In relation to organisational category;

- When information came from within an institution or institution group, it was mostly considered as very important by institutions that belonged to Government Agency (32.6%).

- **Conversely, information which came from universities or other higher education institutions was mainly rated as very important by institutions in Academia (23.8%).**

- **The 7.1% of respondents who claimed that such information was unimportant came from Government Agency (4.8%) and Private Sector (2.4%).**

- Institutions that rated information from Government or public research institutes as important (28.6%) or very important (52.3%) mainly belonged in Academia and Government Agency.

- Finally, majority of institutions that rated information from private research institutes as very important (45.2%) were Private Sector institutions (21.4%) whereas those who were neutral/indecisive about their rating (28.6%) were predominantly institutions from Government Agency (16.7%) and Academia (9.5%).

Most surveyed institutions decided to introduce innovations due to the following reasons:

- Improving your institution's reputation (82.2%)
  Current or expected demand for innovations (66.7%)
- Government grants subsidies or other financial incentives for innovative development (48.8%)
- Existing innovation regulation (40.5%)

For these institutions, these factors were very important in influencing their decision to introduce innovation.

Findings showed that as compared to the 38.1% of respondents who were influenced by existing taxes, charges or fees, 16.7% found this factor unimportant in their decision to introduce innovation.

Although the association between organisational category and the ratings of factors which influenced the institution's decision to introduce innovation was not found to be statistically significant at 5% level of significance, the following findings were made:

- Surveyed institutions in Academia and Government Agency formed the majority (14.3% each) of institutions that rated **"Existing innovation regulation"** as very important in influencing their decision to innovate (40.5%).

- The same could be said for **"Improving your institution's reputation".** For surveyed institutions who stated that improving their institution's reputation was very important in their decision to innovate (82.2%), 24.4% and 33.3% were in Academia and Government Agency respectively.

- A similar pattern was observed for surveyed institutions who considered **"Government grants subsidies or other financial incentives for innovative development"** as very important in their decision to innovate.

- **Academic institutions were mostly (16.7%) neutral/indecisive about the influence of existing taxes, charges or fees.** However, surveyed Private sector institutions mostly found this factor very important (7.10%) or important (14.3%).

Finally, it was found that across all organisational categories except for "Other (Non-Governmental organisations/non-profit private organisations", most surveyed institutions had procedures to regularly identify and reduce the adverse effect of their innovations on the environment.

Innovation Protection

The findings indicated that copyright is the most common approach institutions in Academia use to protect their innovations. Additionally, 38.1% of the time, Academic institutions reported they patented their innovation to protect them. Mostly (37.0% of the time), institutions from the Private Sector conduct their innovations in secrecy to protect them. The Private Sector institutions, in addition, cited trademarking and Copyright as other methods they adopt to protect their innovations. In the case of government agencies, they primarily patent their innovations, followed by Patents and lead time advantage.

- Based on the innovation activities institutions engaged in, most institutions which patented their innovations engaged in Extramural (contracted-out): R&I, same as intramural activities but performed by other companies.

- Copyright is the main form of innovation protection method used by institutions which engage in the Acquisition of existing know-how, copyrighted works, patented and non- patented inventions and other types of knowledge from other institutions or organisations for the development of new or significantly improved products or processes (23.3%). These institutions also indicated that, next to the usage of Patent, they gained lead time advantage as a form of protection for their innovations.

- Surveyed institutions which engage in other activities (Other in-house or contracted- out activities to implement new or significantly improved products or processes such as feasibility studies, testing, tooling up, industrial engineering, etc.) reported they protect their innovation through secrecy.

Non-Innovators

Additionally, 2% (1) of the surveyed institutions did not engage in innovative activity. This government agency had over 30 staff and had been operating for less than 10 years. The institution reported it considered innovating, but the barriers to innovation were too large. The institution rated low demand for innovations in its research area and no need to innovate due to existing innovations as important reasons for its inability to innovate. Furthermore, the institution reported difficulties obtaining government grants or subsidies for innovation as an important barrier to innovation.

Inferring from this isolated finding, start-up incubation support programmes should be introduced to enable new firms or institutions have easy pathways to innovate.

In conclusion:

- Institutions from Academia accounted for 32% of the surveyed institutions, and all the surveyed Academic institutions had engaged in some form of innovation in recent years. Academic institutions mostly undertook Intramural (in-house) innovation activities, and they mainly protected their innovations through Copyright. Next to Copyright, they also obtain a lead time advantage and Patents as way of protecting their innovations. Furthermore, most of the Academic institutions received support for technology/knowledge transfer, and many of these institutions indicated the support they received largely met their expectations. The primary source of funds for innovative activities for Academic institutions was Donor funds, followed by Internally Generated Funds. The financial support received by the Academic

- institutions for innovation activities was mainly in the form of Grants and Technical Assistance. According to the study, no Academic institution received Government of Ghana finance projects.

- Institutions from Government Agencies constituted the majority (38%)of the sampled institutions. All but one of the surveyed institutions from the Government Agencies engaged in innovations in recent years. They primarily undertook Extramural (contracted-out) innovation activities, and their innovations were mainly trademarked as a form of protection, followed by patents and gaining lead time advantage. These institutions also reported receiving support for technology/knowledge transfer, which largely met their expectations. Institutions from Government Agencies were the only institutions in the sample that reported receiving Government of Ghana finance projects as a form of raising funds for innovation. They, however, indicated that most of their funds came from Donor partners.

- Institutions from the Private Sector made up 26% of the surveyed institutions. All these institutions reportedly engaged in innovations. The main form of innovation support received by these institutions was support for technology/knowledge transfer, and they indicated their expectations of this support were largely met. The institutions said they primarily engaged in other in-house or contracted-out activities to implement new or significantly improved products or processes, such as feasibility studies, testing, tooling up, industrial engineering, etc. They mainly funded their innovations through Internally Generated Funds, and most of their innovations were conducted in secrecy to protect them. The institutions also cited Patenting and gaining lead time advantage as other measures they adopt to protect their innovations.

1.1 Introduction

In recent times, innovation has grown, and technological change can be linked to changes in the innovation process. The innovation process combines skills, facilities and technologies to produce, support and deliver a product or service. The most promising thing about the innovation process is being able to actualise an idea into a successful concept. More so, innovation has now been joined by reindustrialisation and a corresponding emphasis on the manufacturing industry, embracing both high-tech and traditional industries (Radicic et. al., 2015).

Globally, there exist many Support Innovation Programmes (SIP). For instance, in Sweden, there exist Innovation Systems within the framework of the Swedish Research Cooperation (Hasche, Höglund, & Linton, 2020). Also, the United Kingdom Research and Innovation Programme supports global innovation in research activities. The Ecuadorian innovation support programmes are intended to strengthen institutions' technological and managerial capabilities; it is argued that these programmes may impact participating institutions' innovation behaviour and performance differently (Fernández-Sastre & Martín-Mayoral, 2015). Further, South Africa have designed a Support Programme for Industrial Innovation (SPII) that focuses specifically on the development phase, which begins after basic research and ends at the point when a pre-production prototype has been produced.

The building of technological capabilities and innovation are considered critical factors for economic growth. On them rely the competitiveness of a country, the creation of decent employment, the increase of its human capital and the capacity to use it efficiently to face the different challenges that arise in the process of productive development. The need for public support for innovation, particularly financial support, is based on the assumption that innovation is a non-rival good and, at least partially, not excludable. As a result, firms cannot fully internalise the return on their investments in innovation. This produces a gap between the social and private return to innovation, and therefore, firms tend to invest less than the social optimum (Aboal, Rojas, Servín, & Queraltó, 2019).

Further, Fernández-Sastre and Martín-Mayoral (2015) stated that developing countries face challenges such as firms' lack of sufficient capabilities, resources, complementary assets, knowledge and skills required to perform research and developing activities.

In Ghana, despite the slow pace of progress, the government is dedicated to enhancing total national development through Science and Technology Innovation (STI) and Research and Development (R&D). Government funding for STI is 56%, primarily from consolidated funds, and has increased to 83% since 2016. The Ministry of Science, Technology and Innovation (MESTI)

STI Policies, communicating and coordinating STI programmes and activities of all agencies, departments, R&D institutions and academia as well as other stakeholders (https://mesti.gov.gh/science-technology-innovation). Ghana's vision is to become a high-income country that fully applies and integrates science, technology, and innovation into national development strategies. This places the country in a position to leverage the nation's total science and technology capabilities to achieve national goals for poverty reduction, enterprise competitiveness, sustainable environmental management, and industrial growth.

Additionally, the Government of Ghana, through the MESTI, is collaborating with the Korean Government through the Science and Technology Policy Institute (STEPI), a research and development organisation, as part of Korea's K-Innovation ODA Partnership Programme. The collaboration aims to support Ghana in developing a robust and economically viable Technological Innovation System in the country. Also, the UNICEF programme (The Pathfinder) in Ghana seeks to promote large, country-level open-source platforms; built-on partnerships and relationships with government and academic stakeholders. While the latter brought several learnings and achievements, the former highlighted the Digital Public Good (DPG) potential.

While the government has shown significant interest in making science, technology and innovation focal enablers in Ghana's development agenda in the past ten years through initiatives such as the National Science Technology and Innovation (STI) Policy and the setting up of the GIRC Centre, the STIR ecosystem has seen little fruits from these endeavours. The lack of results has been due to several reasons, including:

- Weak policy and initiative coordination among stakeholders.
- Lack of capacity to implement initiatives.
- Gaps in support programme access and visibility.
- Challenges with STIR communication, advocacy and marketing.
- A collaboration wedge between the government and business community hindering private sector investment into innovation programmes.
- Exclusion of input and considerations of issues impacting minority groups such as women, youth and people with disability.
- Lack of a potent private sector-led commercialisation framework.

To this end, a baseline to take stock and inventory of research and innovation support programmes' access and utilisation in the research ecosystem in Ghana cannot be overemphasized.

1.2 Survey Objectives

The purpose of the baseline study is to take stock and inventory of research and innovation support programmes' access and utilization in the research ecosystem.

The study amongst others is expected to achieve the following outputs:

Produce a baseline study report on the state of research and innovation in Ghana and the level of coordination to support programmes including dissemination summary of the baseline study report on

- institutions,
- status,
- ecosystem sector,
- geographical location,
- material resources,
- financial resources and the status of their publications.

Generally, the study will help;

c. increase awareness and access to existing support programs such as;

- Tax and Finance Support Programmes to enable access to Manpower and Purchase Support Programmes
- Technology Development and Information Support Programmes
- Technology Transfer & Commercialisation Support Programmes
- Start-up Incubation Support Programmes
- IP rights through Intellectual Property Management Support Programmes
- Certification Support Programmes
- Industry-University-Research Institute (I-UR) Linkages Support Programme

that will enable them to carry out research and development activities and boost innovation in Ghana.

d. develop a roadmap to address the challenges, gaps and deficiencies of the legal regime identified by the study to create awareness of same.

2.0 Review of Relevant Literature

Globally, everything around us is always changing. This is a result of the fast pace of technological advancement and disruptive global events; businesses must adapt and change over time to remain relevant and profitable. Innovation is critical for a company's competitive advantage.

Innovation, according to Kurdve, Bird, and Laage-Hellman (2020) is a method by which knowledge is produced, used, and expanded to reach pressing situations. Innovation support programmes bring onboard relevant activities to help an institution in its disruptive processes. Essegbey and Ofori-Gyamfi (2012) stated that innovation involves both tangible and intangible processes and results. Farmers, researchers, buyers, transporters, public authorities, customers, and policymakers are the crucial actors in the innovation system.

In this study, an innovation will be defined as the introduction of a new or significantly improved product (good or service) or process, a new knowledge, or a new organisational method.

Assessing the Impact of Innovation Support Programmes on Firms and Economies at large

Hassink (2002) examined trends in the types of support that innovation activities receive in certain countries. He contextually explains systems of innovation as being birthed by the cooperation of firms - either internally or externally - in an interactive way and broadly groups the systems into the production system and the institutional system. Emphasis was placed on the institutional system which talks about how innovations happen across different organizational levels and the types of support they receive. The research further emphasized the need to regionalize firms to be able to source the right support for them according to policies and technological advancements that are known to be disruptive. Referring to policy advancements, Hassink (2002) concludes that most innovations stem from similar policy implementations.

Todtlıng (2002) asserts that innovation is one of the most important strategies of competition, both for small and large firms. It is often argued that Small and Medium-sized Enterprises (SMEs) innovate in specific ways, different from the innovation process in large firms. The most important factors that influence innovative performance in firms are the technology level, the market relations (the more dependent a firm is on dominant customers, the more likely the increment character of their innovation), and the strategies of competition. The study revealed that direct support seems to be quite effective as far as the financial bottlenecks of innovation projects are concerned.

Tödtling and Trippl, (2005) argue that innovation should be seen as an evolutionary, non- linear and interactive process, requiring intensive communication and collaboration between different actors, both within companies as well as between firms and other organisations such as universities, innovation centres, educational institutions, financing institutions, standard setting bodies, industry associations and government agencies.

Robson, Haugh and Obeng (2009) used three variables namely, the traits of the entrepreneur, the internal competencies of the firm, and the location of the organization to analyze the seven different forms of innovative activity (firm size, location, business growth, involvement in exporting, organizational form, entrepreneur's educational background and entrepreneurial attitude). They found that incremental innovation was much more common than unique innovation. The entrepreneur's educational background had an impact on how innovative they were. Also, their study revealed that business growth was less systematically correlated with innovation than firm size and involvement in exporting. Export involvement is only marginally related to firm innovation and growth in Ghana. Compared to businesses in large and small towns, conurbations had more innovative businesses.

Radicic, Pugh, Hollanders and Wintjes (2014) investigated the impact of innovation support programs on SMEs in traditional manufacturing industries across seven European Union (EU) regions. They argued that recent literature identifying potential sources of government failure in innovation policy suggests that public support measures to increase private innovation may be underwhelming. Their findings supported this hypothesis. They proffered policy direction for overcoming government failure and, as a result, increasing the potential additionality of innovation support programs.

In the EU regions, innovation support programs typically use a "cream skimming" selection strategy, in which program managers systematically select firms based on observable characteristics conducive to innovation. Their study recommended some practical guidelines for random allocation of a recently launched innovation support programme for SMEs.

Galbraith, McAdam, Woods and McGowan (2017) performed a multi-level investigation into the connections between policy interpretation and assistance program design and the growth of innovation capabilities among participant SMEs in a peripheral region of the United Kingdom. The findings showed that, although connected to a clear Regional Innovation Strategy, the Innovplus program's design lacks consistency with regard to the policy and practical interpretation of knowledge and innovation. The program's actual design reflects this discrepancy,

discrepancy, which reduces the program's effectiveness. Prior to participating SMEs transitioning to realize absorptive capacity, it was discovered that recognition and development of emerging absorptive capacity drivers in potential form were crucial for the growth of innovative capability. The effectiveness of the Local Innovation Agents (LIA) programme was evaluated by de Carvalho, de Carvalho, Cardoso and Gon calves (2018) using a sample of more than 6000 Brazilian micro and small firms. Their results revealed some improvement in each area, although marketing and organizational-related improvements outperformed those pertaining to products and processes.

Becker (2019) examined the impact of firm innovation and performance on innovation policy. The study found that public R&D and innovation policy support could significantly improve firms' R&D investment and innovation. His study also revealed that, many small or micro-enterprises lack the capacity for an R&D department. He argued that to maximize the effectiveness of policy support, it is critical to target the types of firms and industries that add the most value and support both innovation input and output. However, issues such as the dynamics and composition of firms' R&D, the source of public R&D funding and other firm constraints have received little attention thus far.

According to Faure et al. (2019), networking, facilitation and brokerage functions are critical throughout all stages of the innovation process.

Odei, Stejskal and Prokop (2021) also studied innovation survey datasets in order to determine the variables that significantly affect innovative outputs from the viewpoints of small and medium-sized enterprises (SMEs), as well as large businesses, that are both radical and incremental. Their study findings highlight the importance of human capital intensity and imply that both incremental and radical creative enterprises are successful in absorbing new knowledge that enhances new product creation in these regions. However, unexpectedly, their findings debunk prior beliefs about the significance of innovation cooperation and show the lack of significance in many of the collaboration activities, indicating some degree of unavailability in R&D cooperation in both radical and incrementally innovating SMEs and large firms.

Kasmi et al. (2022) performed a theoretical review of the innovation space as a driver of eco-innovations for a circular economy. The outcome indicates that the contribution of innovation support in supporting territories and the region's transition towards a systematic development of new sustainable models, such as the circular economy, is not directly and sufficiently developed in literature. The study suggested a need for further empirical studies to assess the real impacts of innovation support on a circular economy.

Funding Innovation Support Programmes

Most of the available evidence in the literature measures the impact on R&D expenditures. Garcia and Mohnen (2010) evaluated whether public support for innovation from the central government or the European Union spurs innovation in Austrian firms. The effect is estimated separately on R&D expenditures and the output side of innovation, measured by the share of total sales due to new or substantially modified products.

Pergelova and Angulo-Ruiz (2014) examined government financial support's influence on new firms' performance. Extant empirical research on the topic has found mixed results, which warrants an exploration of the theoretical basis for the impact of support policies on new firms' performance. Their study contends that performance outcomes should not be the first outcomes of public policies to be examined. Instead, they suggested competitive advantage formation as a link between support policies and new firms' performance.

Further, they examined the impact of government financial support measures – government loans, guarantees and government equity – on firms' overall competitive advantage and more specific types of competitive advantage based on innovation, licensing- in, marketing and human capital. The result revealed that government guarantees and equity have a direct effect on new firms' competitive advantage and an indirect impact on performance.

Le and Jaffe (2017) investigated the impact of government subsidies through R&D grants on New Zealand firms' innovation output. Their study aimed to discover whether R&D grants significantly impact more novel innovation than incremental innovation and whether larger, project-based grants are more effective at promoting innovation than smaller, non-project-specific grants.

3.0 Survey Methodology

The analytic techniques to be used in this study are Descriptive statistics (tables, graphical and pictorial representations), Chi-square cross-tabulations and test of independence. The Chi-square test[1] of independence will be used to test for association or dependence between two variables under study. Pictorial representations of the established dependence will be represented using bar graph. The bar graphs will also aid in determining the direction of association.

The target population would be various institutions drawn from academia, government, the private sector and regulators which make use of innovation support programmes.
A representative sample of 50 institutions were surveyed. This can be used to make inference about the study population at 1% margin of error will be selected. This sample also account for 10% non-responses.

In sampling, we treated the institutions as strata. This is to account for homogeneity in the existing innovation support programmes within the institution. Allocations into stratum was done by proportional to size of the stratum. In each stratum, the simple random sampling technique was adopted to select the sample elements. Figure 1 shows the distribution categories of the surveyed institution.

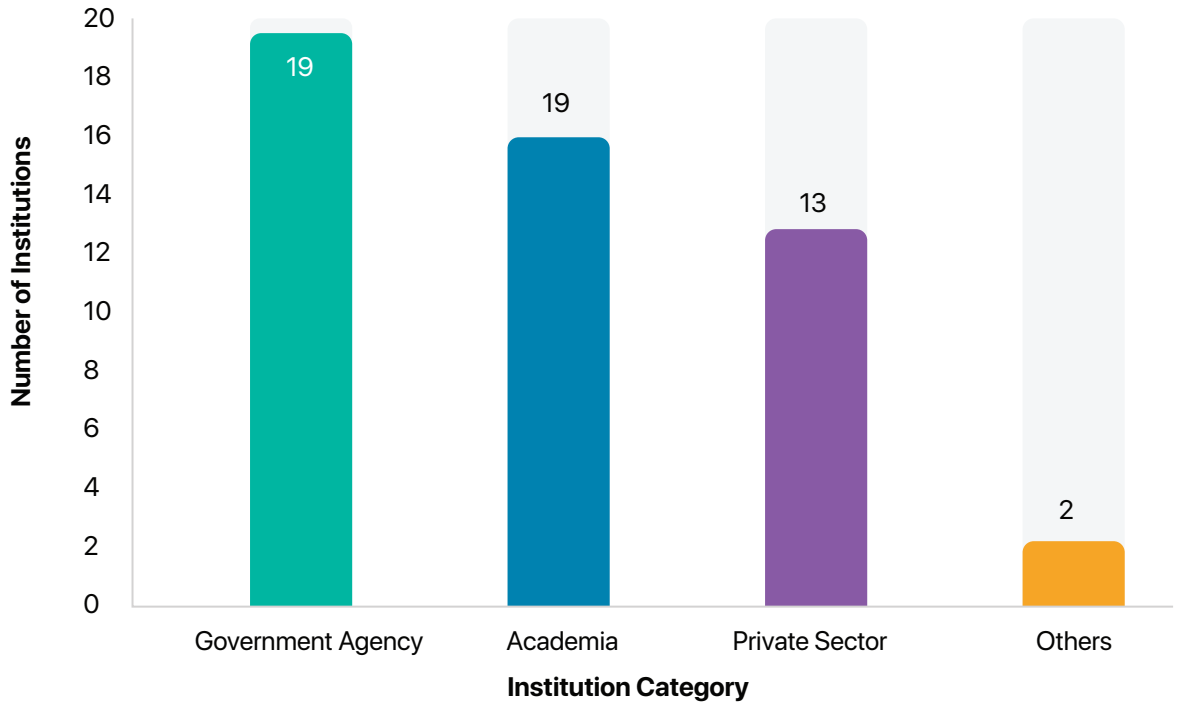

Figure 1: A bar plot showing the distribution of the categories of surveyed institution.

[1] *The Chi-Square analysis in statistics is used to test the degree of relationships between categories of the questions that presents variables.*

4.0 Analysis and Discussion of Results

The study was mainly expected to produce a baseline study report on the state of research and innovation in Ghana, and therefore the institutions in which research and innovation could take place were identified and relevant information obtained.

4.1 Bio-Information

Table 1: A cross-tabulation between Organisation category of surveyed institutions and whether surveyed organisations engaged in any innovation activities in recent years.

Variable		Yes	No	Total (N)	P-value
Organisational Category of institution	• Academia	16 (32.0%)	0 (0.0%)	16 (32.0%)	0.645
	• Private sector	13 (26.0%)	0 (0.0%)	13 (26.0%)	
	• Government Agency	18 (36.0%)	1 (2.0%)	19 (38.0%)	
	• Others[2]	2 (4.0%)	0 (0.0%)	2 (4.0%)	

Table 1 shows a total of 50 institutions sampled for the survey. Of these institutions, 16 (32%) were from Academia, and all 16 institutions had engaged in innovation activities in recent years. 13 (26%) were from the Private Sector and all these institutions had also engaged in innovation activities in recent years. The sampled institutions from the Government agency were 19 (38%); of these, 1 (2%) indicated that they had not engaged in any innovation activities. There were 2 (4.0%) institutions that did not belong to any of the above categories (Non- Government Organisation/Non-profit private organisations) and they had both engaged in innovative activities in recent years. The p-value ($p > 0.05$) suggests that at 5% level of significance there is no statistically significant association between the organisational category of the institution and their engagement in innovation activities in recent years.

[1] *The Chi-Square analysis in statistics is used to test the degree of relationships between categories of the questions that presents variables.*

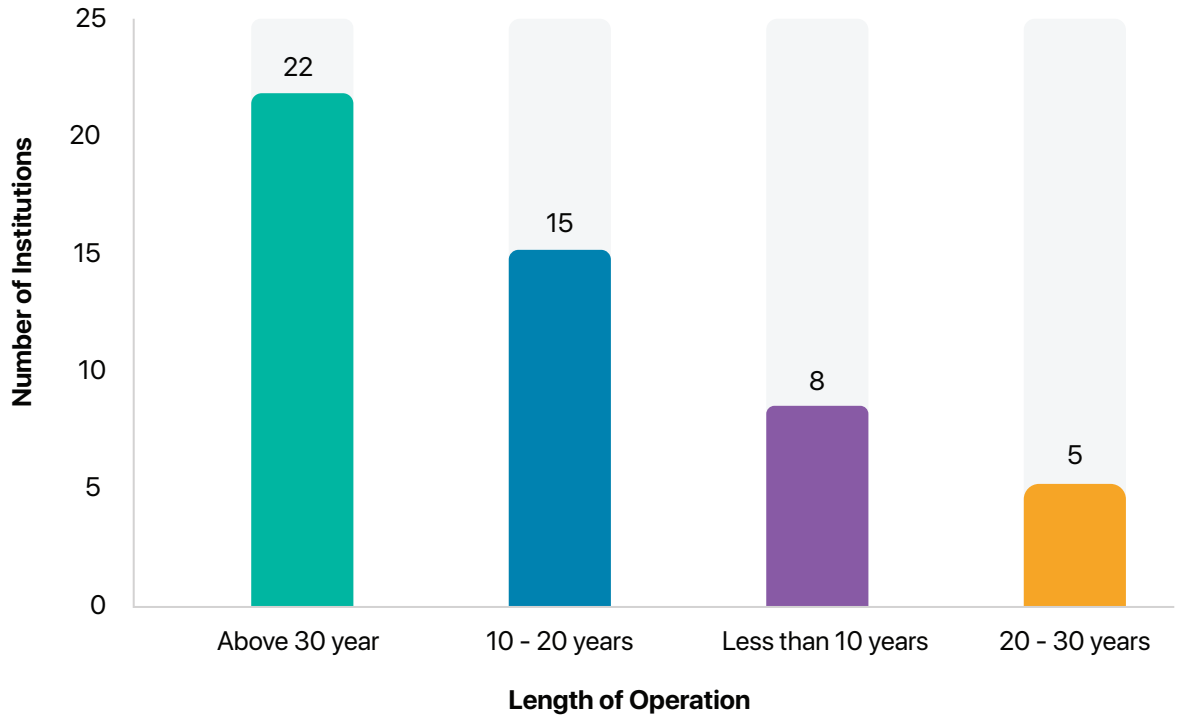

Figure 2: A bar plot showing the distributions of the number of years the surveyed institutions have been in operation

Figure 2 is a bar plot which shows the number of years the surveyed institutions had been in existence. Most of the surveyed institutions (22) had been in existence for over 30 years; however, only 5 of the surveyed institutions had been in existence for 20-30 years. The period of existence which had the second largest number of institutions was 10-20 years; there were 15 surveyed institutions. The surveyed institutions which had been in existence less than 10 years were 8.

[1] *The Chi-Square analysis in statistics is used to test the degree of relationships between categories of the questions that presents variables.*

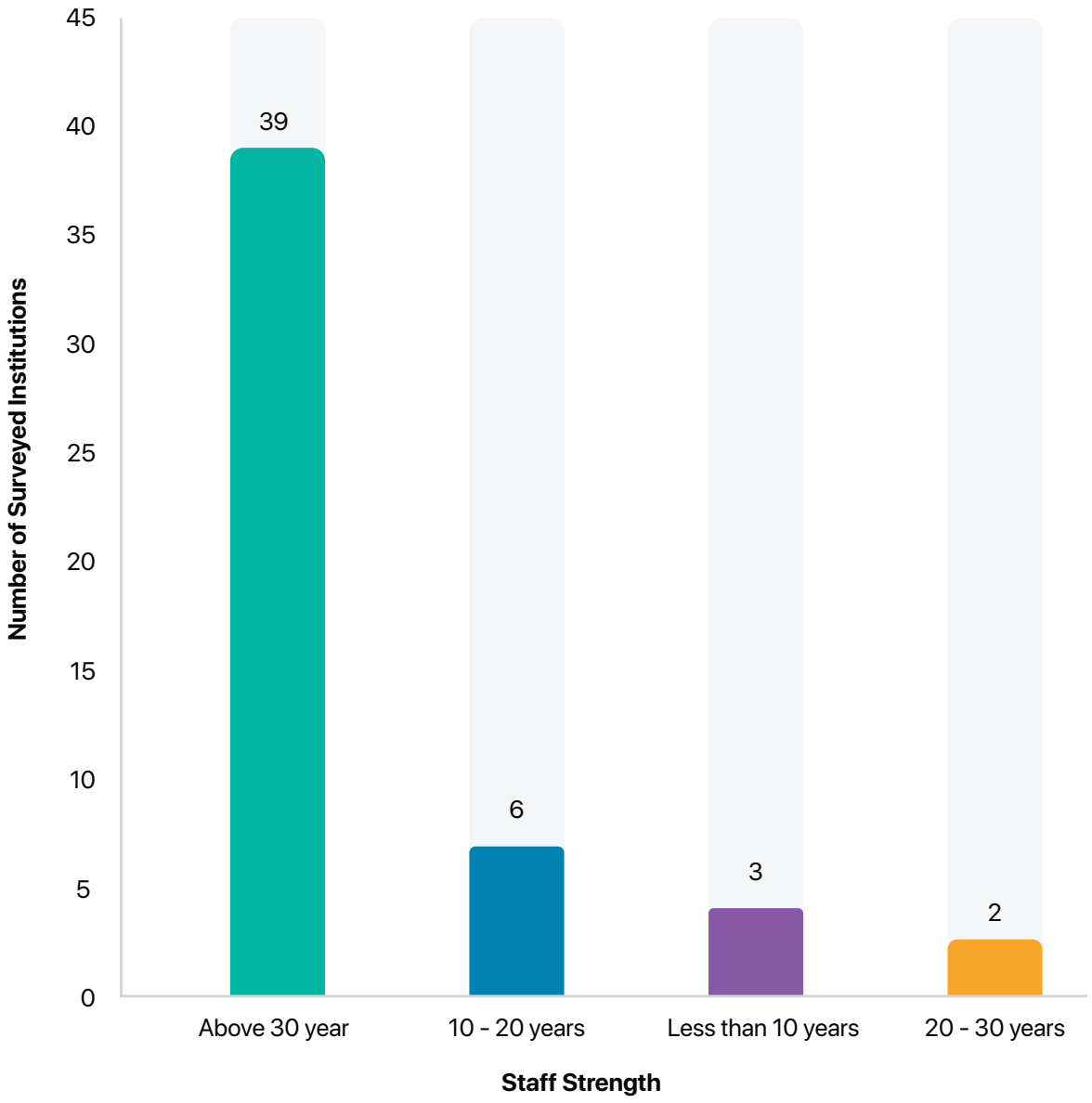

Figure 3: A bar chart presenting the estimated staff strength of the surveyed organisations

Figure 3 shows the staff strength of the surveyed institutions. Most of the institutions sampled (39) employed over 30 people. Staff strengths of 21-30 people were found in 3 institutions. Only 2 institutions reported having 10-20 employees. The lowest number of employees (less than 10) was found in 6 institutions.

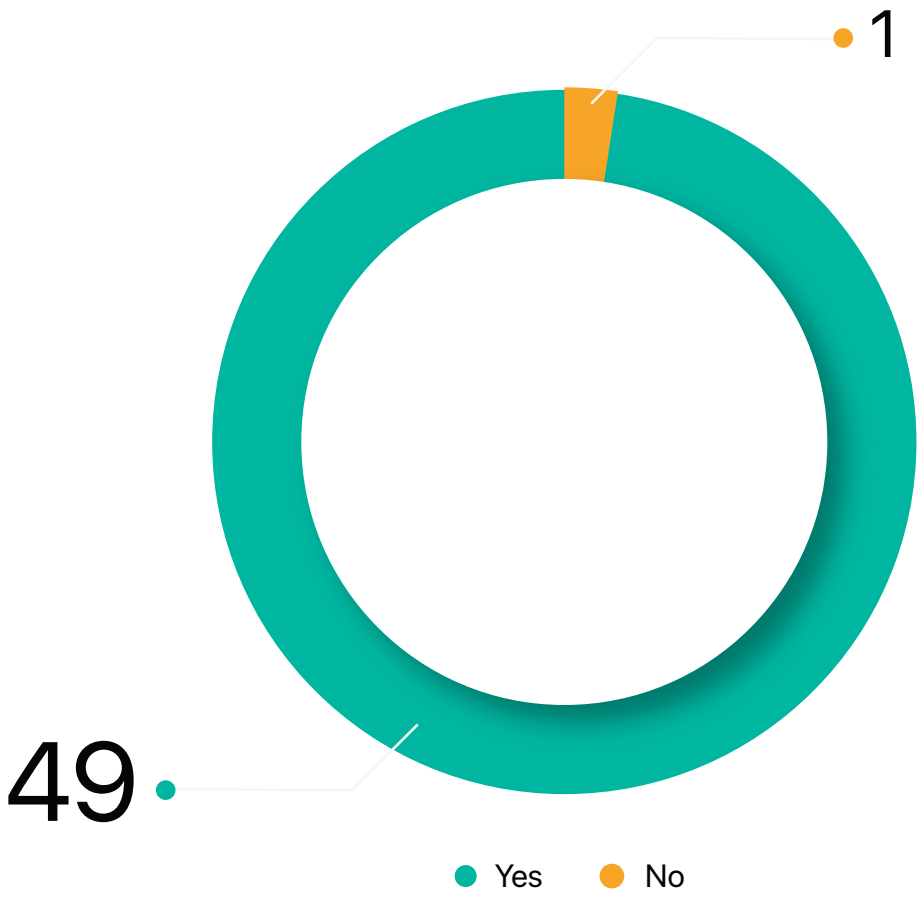

Figure 4: A pie graph presenting the distribution of whether surveyed organisations engaged in any innovation activities in recent years

Figure 4 shows the distribution of surveyed organisations involved/not involved in any innovation activities in recent years. It is clear that all but one of the surveyed institutions were involved in innovation activities in recent years.

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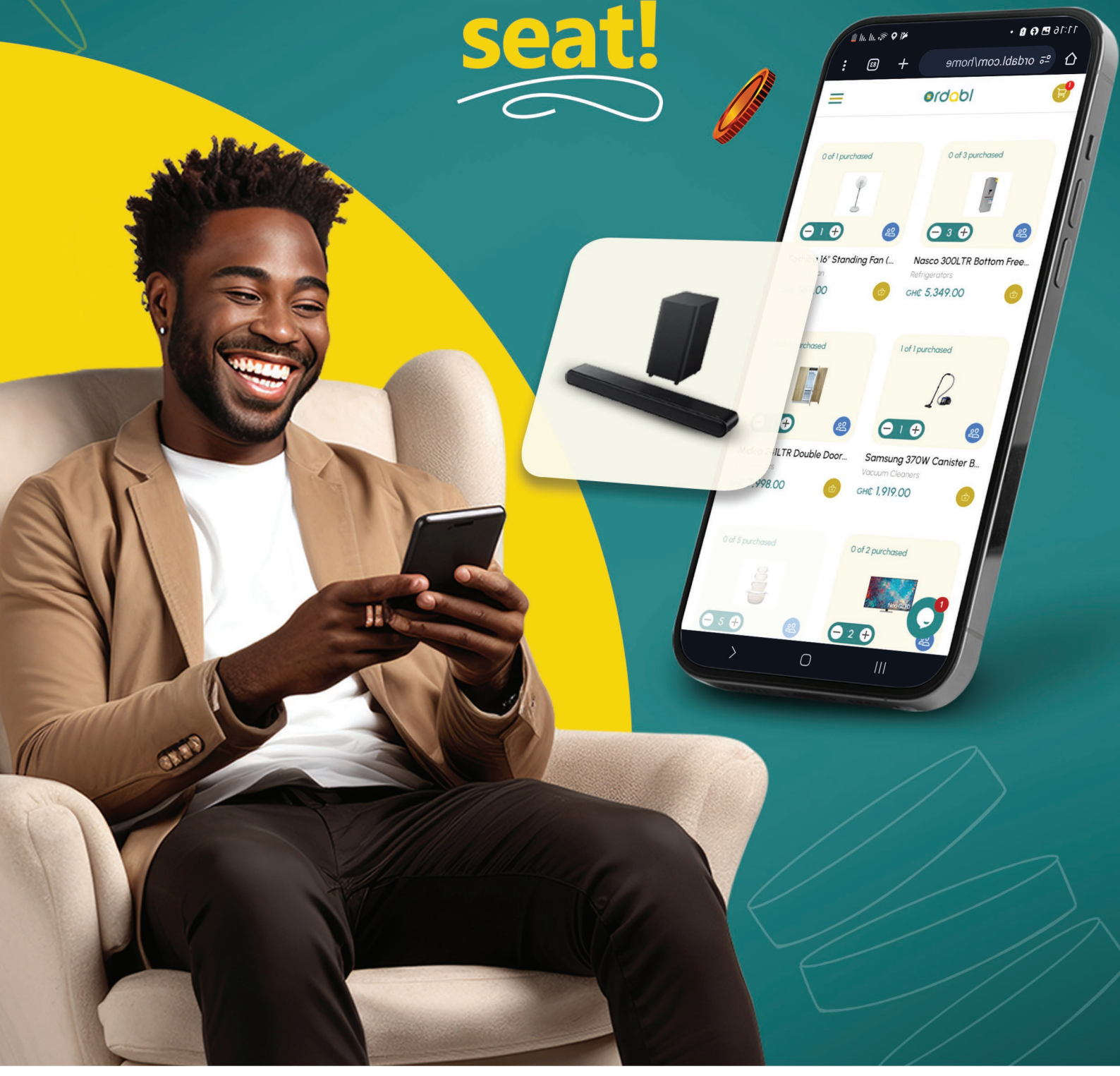

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4.2 Innovation Activities and Support

Table 2 presents a cross-tabulation between the innovation activities that surveyed institutions engaged in, and the organisational category of the surveyed institutions (academia, private sector, government agency, others). The predominant innovation activity among surveyed institutions were *Training for innovative activities In-house or contracted-out training for your personnel specifically for the development and/or introduction of new or significantly improved products or processes* - 43 institutions engaged in this activity. This was closely followed by *Intramural (in-house) R&I: R&I activities are undertaken by your institution to create new knowledge or to solve scientific or technical problem* which was undertaken by 42 surveyed institutions. The least engaged activity was *Other activities: Other in-house or contracted-out activities to implement new or significantly improved products or processes such as feasibility studies, testing, tooling up, industrial engineering, etc* - 19 surveyed institutions.

Institutions that engaged in the following activities were mostly found in Academia:

- Intramural (in-house) R&I: R&I activities are undertaken by your institution to create new knowledge or to solve scientific or technical problem (38.1%)

- Acquisition of existing know-how, copyrighted works, patented and non-patented inventions and other types of knowledge from other institutions or organisations for the development of new or significantly improved products or processes (44.8%)

However, institutions who undertook the following innovation activities were largely from a government agency:

- Extramural (contracted-out): R&I same as above but performed by other companies (41.9%)

- Acquisition of machinery, equipment, and buildings (42.1%)

- Acquisition of software for the development and/or introduction of new or significantly improved products or processes (39.4%)

- Training for innovative activities In-house or contracted-out training for your personnel specifically for the development and/or introduction of new or significantly improved products or processes (37.2%)

Surveyed institutions who practised Other activities (Other in-house or contracted-out activities to implement new or significantly improved products or processes such as feasibility studies, testing, tooling up, industrial engineering, etc.) were mainly from the private sector (36.8%).

These findings are graphically shown in Figure 5.

Table 2: A Cross-tabulation between Innovation activities surveyed institutions engaged in and the organisational category of the surveyed institutions

Variable		Academia	Private sector	Government Agency	Others	Total (N)
Innovation activities institution engaged in	• Intramural (in-house) R&I: R&I activities are undertaken by your institution to create new knowledge or to solve scientific or technical problem.	16 (38.1%)	11 (26.1%)	14 (33.3%)	1 (2.4%)	42 (100)
	• Extramural (contracted-out): R&I same as above but performed by other companies.	11 (35.5%)	7 (22.6%)	13 (41.9%)	0 (0.0%)	31 (100)
	• Acquisition of machinery, equipment and buildings	12 (31.6%)	9 (23.7%)	16 (42.1%)	1 (2.6%)	38 (100)
	• Acquisition of software for the development and/or introduction of new or significantly improved products or processes	9 (27.3%)	10 (30.3%)	13 (39.4%)	1 (3.0%)	33 (100)
	• Acquisition of existing know-how, copyrighted works, patented and non-patented inventions and other types of knowledge from other institutions or organisations for the development of new or significantly improved products or processes	13 (44.8%)	7 (24.1%)	9 (31.0%)	0 (0.0%)	29 (100)

	• Training for innovative activities In-house or contracted- out training for your personnel specifically for the development and/or introduction of new or significantly improved products or processes	15 (34.9%)	10 (23.3%)	16 (37.2%)	2 (4.7%)	43 (100)
	• Other activities: Other in-house or contracted-out activities to implement new or significantly improved products or processes such as feasibility studies, testing, tooling up, industrial engineering, etc.	6 (31.6%)	7 (36.8%)	5 (26.3%)	1 (5.3%)	19 (100)

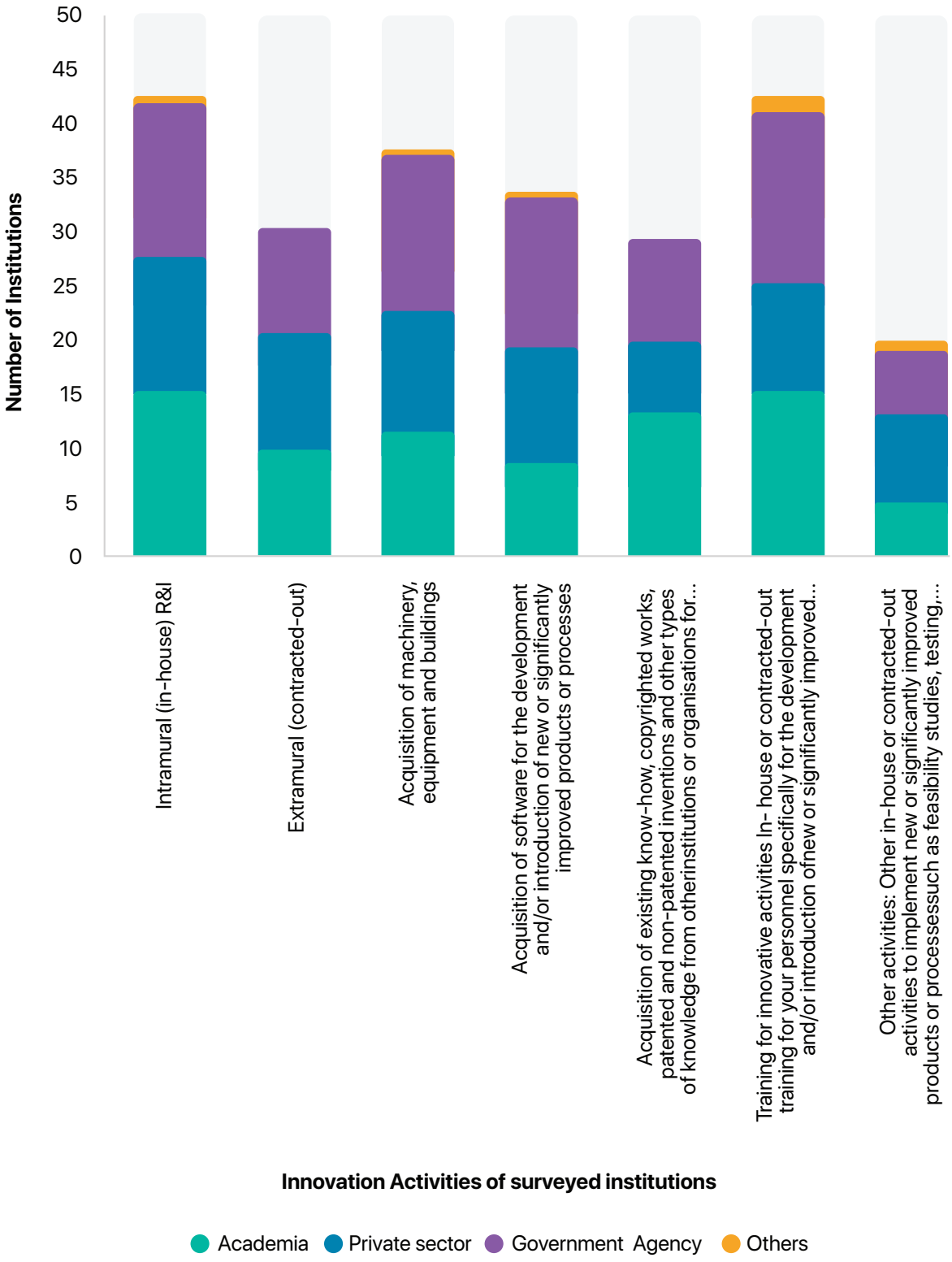

Figure 5: A bar graph of organisation categories across innovation activities of surveyed institutions

Table 3: A Cross-tabulation between Innovation activities surveyed institutions engaged in and the length of operation of the surveyed institutions

Variable		Less than 10 years	10 - 20 years	20 - 30 years	Above 30 years	Total (N)
Innovation activities institution engaged in	• Intramural (in-house) R&I: R&I activities are undertaken by your institution to create new knowledge or to solve scientific or technical problem.	6 (14.3%)	12 (28.6%)	5 (11.9%)	19 (45.2%)	42 (100)
	• Extramural (contracted-out): R&I same as above but performed by other companies.	4 (12.9%)	7 (22.6%)	3 (9.7%)	17 (54.8%)	31 (100)
	• Acquisition of machinery, equipment and buildings	4 (10.5%)	9 (23.7%)	4 (10.5%)	21 (55.3%)	38 (100)
	• Acquisition of software for the development and/or introduction of new or significantly improved products or processes	5 (15.2%)	7 (21.2%)	5 (15.2%)	16 (48.5%)	33 (100)
	• Acquisition of existing know-how, copyrighted works, patented and non-patented inventions and other types of knowledge from other institutions or organisations for the development of new or significantly improved products or processes	4 (13.8%)	9 (31.0%)	3 (10.3%)	13 (44.8%)	29 (100)
	• Training for innovative activities In-house or contracted- out training for your personnel specifically for the development and/or introduction of new or significantly improved products or processes	7 (16.3%)	12 (27.9%)	4 (9.3%)	20 (46.5%)	43 (100)

	• Other activities: Other in-house or contracted-out activities to implement new or significantly improved products or processes such as feasibility studies, testing, tooling up, industrial engineering, etc.[3]	4 (21.1%)	7 (36.8%)	1 (5.3%)	7 (36.8%)	19 (100)

Table 3 presents a cross-tabulation between the innovation activities that surveyed institutions engaged in, and their length of operation. For every surveyed innovation activity apart from "Other activities", surveyed institutions had mostly been in operation for above 30 years, followed by 10-20 years. For "Other activities", however, surveyed institutions had equally been in operation for 10-20 years and above 30 years (36.8% each). As previously mentioned, few (5 surveyed institutions) had been operating for 20-30 years at the time of the survey. Expectedly, this category for length of operation recorded the least figures (and percentages) under each innovation activity presented. This is shown in Figure 6.

[3] *Industry Needs assessments and valuation of laboratories; Project consultancy*

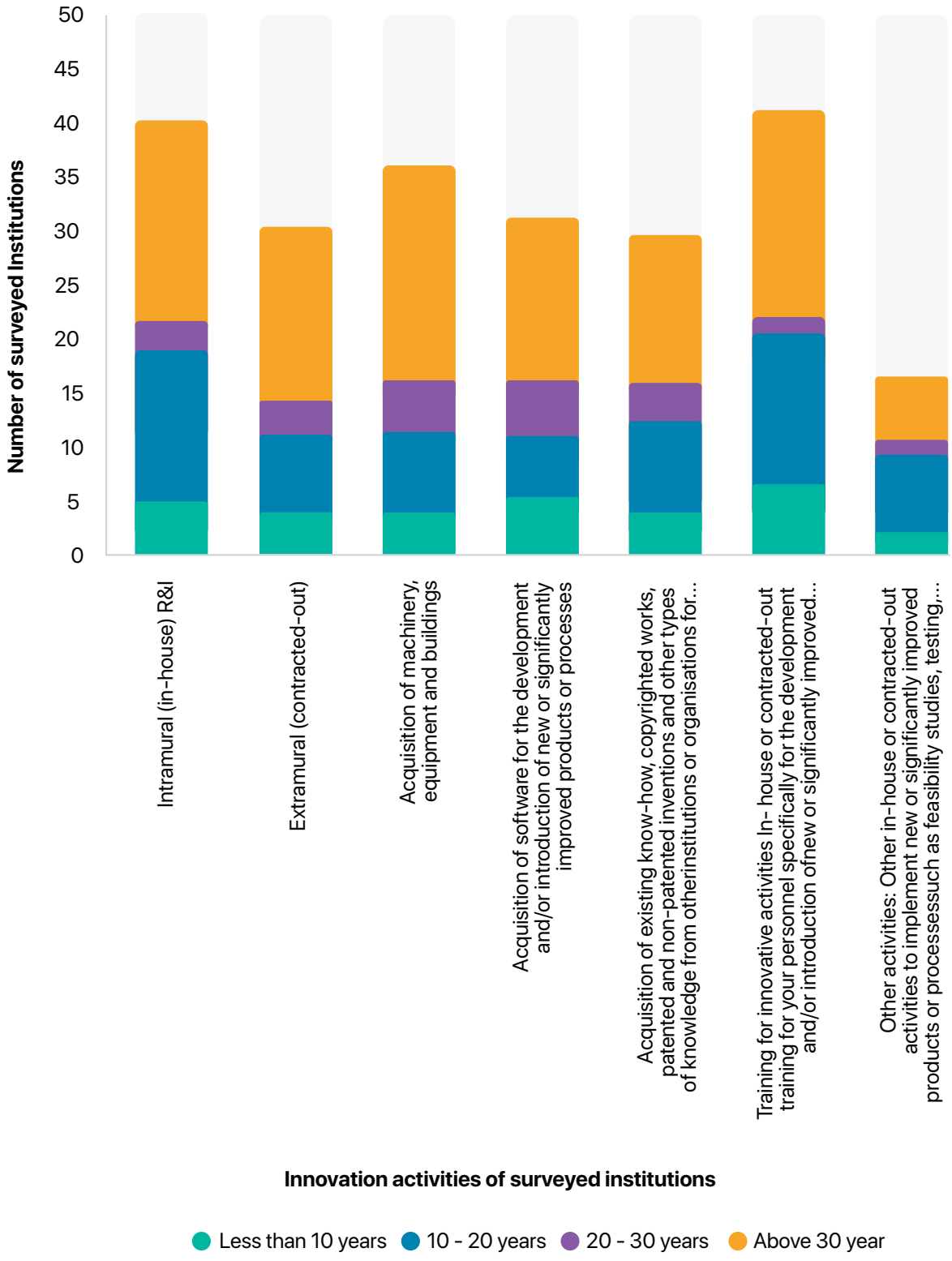

Figure 6: A bar graph of organisation categories of surveyed institutions across length of operations of the surveyed institutions.

In Table 4, a cross-tabulation between the innovation activities that surveyed institutions engaged in, and the people responsible for developing the innovations in the surveyed institutions is presented. For all innovation activities that surveyed institutions engaged in, the responsibility of developing the innovation mainly fell on the institution in partnership with other organisations. Specifically, for each innovation activity with the exception of "Intramural (in-house) R&I: R&I activities are undertaken by your institution to create new knowledge or to solve scientific or technical problem" (48.8%), more than half of surveyed institutions counted on their partnership with other organisations to develop their innovations. The percentage was highest for "Other activities: Other in-house or contracted-out activities to implement new or significantly improved products or processes such as feasibility studies, testing, tooling up, industrial engineering, etc." (72.2%) and "Extramural (contracted-out): R&I same as above, but performed by other companies" (66.7%).

Second to this, the institution itself mostly solely bore the responsibility of developing its innovations. For instance, about a third of surveyed institutions which engaged in

- Acquisition of software for the development and/or introduction of new or significantly improved products or processes,

- Intramural (in-house) R&I: R&I activities are undertaken by your institution to create new knowledge or to solve scientific or technical problem.

- Acquisition of existing know-how, copyrighted works, patented and non-patented inventions and other types of knowledge from other institutions or organisations for the development of new or significantly improved products or processes,

were responsible for developing their own innovations (34.4%, 34.1% and 32.1% respectively).

On few occasions, individual researchers in the unit were tasked to develop the innovations in the surveyed institutions. This was mostly recorded for the following activities:

- Acquisition of existing know-how, copyrighted works, patented and non-patented inventions and other types of knowledge from other institutions or organisations for the development of new or significantly improved products or processes (10.7%)

- Intramural (in-house) R&I: R&I activities are undertaken by your institution to create new knowledge or to solve scientific or technical problem (9.8%)

- Training for innovative activities In-house or contracted-out training for your personnel specifically for the development and/or introduction of new or significantly improved products or processes (9.5%)

Figure 7 pictorially displays these findings.

Table 4: A Cross-tabulation between Innovation activities surveyed institutions engaged in and the people responsible for developing the innovations in the surveyed institutions.

Variable		The institution	The institution in partnership with other organisations	Individual researchers in the unit	Others[4]	Total (N)
Innovation activities institution engaged in	• Intramural (in-house) R&I: R&I activities are undertaken by your institution to create new knowledge or to solve scientific or technical problem.	14 (34.1%)	20 (48.8%)	4 (9.8%)	3 (7.3%)	42 (100)
	• Extramural (contracted-out): R&I same as above but performed by other companies.	7 (23.3%)	20 (66.7%)	1 (3.3%)	2 (6.7%)	30 (100)
	• Acquisition of machinery, equipment and buildings	11 (29.7%)	21 (56.8%)	3 (8.1%)	2 (5.4%)	37 (100)
	• Acquisition of software for the development and/or introduction of new or significantly improved products or processes	11 (34.4%)	19 (59.4%)	1 (3.1%)	1 (3.1%)	32 (100)
	• Acquisition of existing know-how, copyrighted works, patented and non-patented inventions and other types of knowledge from other institutions or organisations for the development of new or significantly improved products or processes	9 (32.1%)	15 (53.6%)	3 (10.7%)	1 (3.6%)	28 (100)

	• Training for innovative activities In-house or contracted- out training for your personnel specifically for the development and/or introduction of new or significantly improved products or processes	12 (28.6%)	23 (54.8%)	4 (9.5%)	3 (7.1%)	42 (100)
	• Other activities: Other in-house or contracted-out activities to implement new or significantly improved products or processes such as feasibility studies, testing, tooling up, industrial engineering, etc.	4 (22.2%)	13 (72.2%)	1 (5.6%)	0 (0.0%)	18 (100)

[3]

Both institution and individual researchers.
Both the institution and the institution in partnership with other organizations

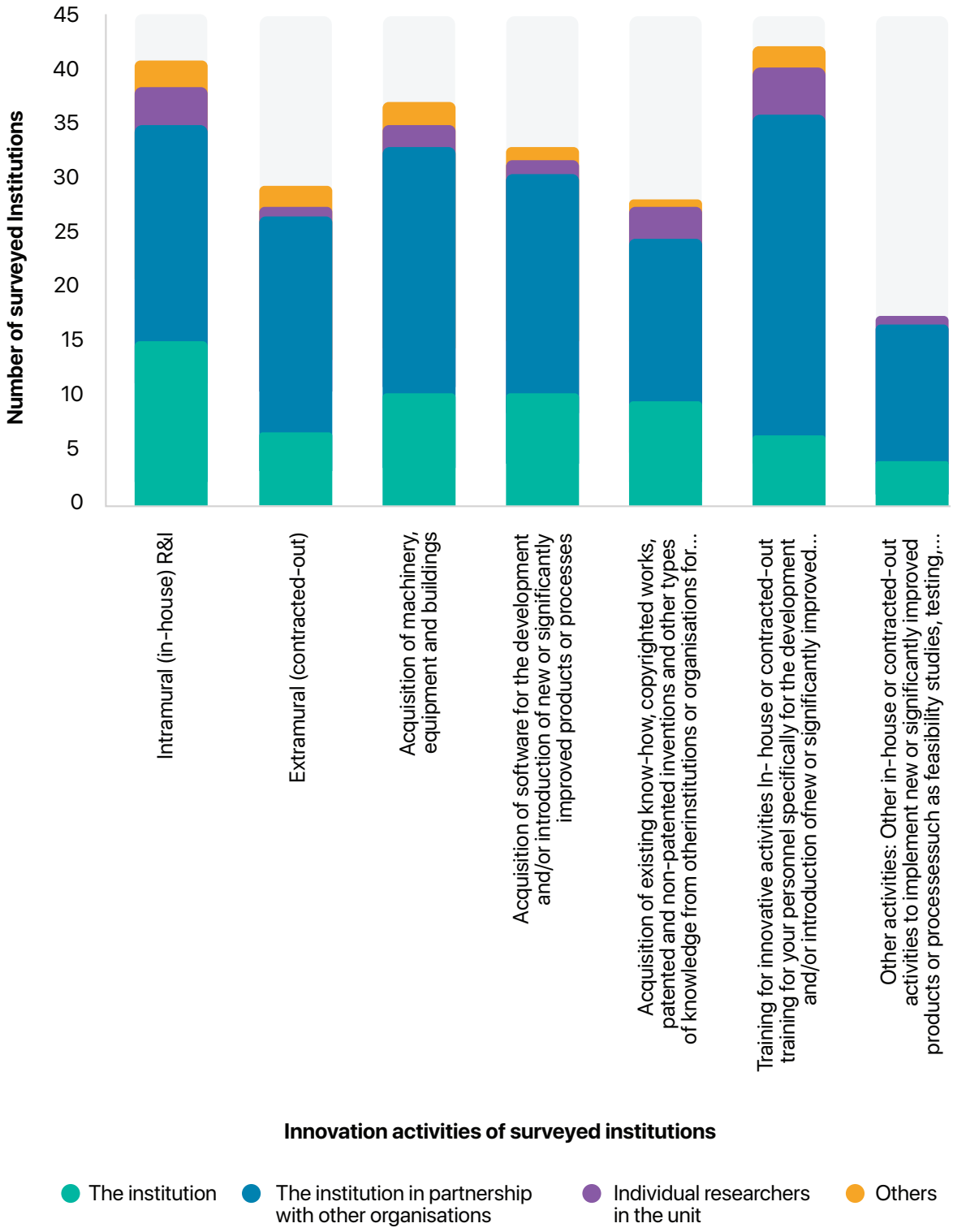

Figure 7: A bar graph of innovation activities surveyed institutions engaged in across those responsible for developing those innovations in the surveyed institutions.

Table 5: A Cross-tabulation between the form of Innovation support received by surveyed institutions and the organisational category of the surveyed institutions.

Variable		Academia	Private sector	Government Agency	Others	Total (N)
Form of innovation support received by institutions	• Support for financing innovation projects (including R&I)	11 (33.4%)	8 (24.2%)	13 (39.4%)	1 (3.0%)	33 (100)
	• Support for networking and cooperation between actors	9 (30.0%)	6 (20.0%)	14 (46.7%)	1 (3.3%)	30 (100)
	• Support for awareness raising and information on support possibilities	10 (37.0%)	7 (25.9%)	8 (29.6%)	2 (7.5%)	27 (100)
	• Support for technology/knowledge transfer	13 (32.5%)	11 (27.5%)	14 (35.0%)	2 (5.0%)	40 (100)
	• Support to identify innovation potential (information on market needs, market conditions, new regulations, new technology, etc.)	9 (30.0%)	9 (30.0%)	10 (33.3%)	2 (6.7%)	30 (100)
	• Support for innovation management (organisational management, IP management, design management)	8 (25.8%)	10 (32.3%)	11 (35.5%)	2 (6.4%)	31 (100)
	• Support for the creation of specific skills	10 (33.3%)	8 (26.7%)	11 (36.7%)	1 (3.3%)	30 (100)
	• No support received	1 (33.33%)	1 (33.33%)	1 (33.33%)	0 (0.0%)	3 (100)

From the cross-tabulation between the form of innovation support received by surveyed institutions and the organisational category of the surveyed institutions in Table 5,

- 40 surveyed institutions received support for technology/knowledge transfer and most of these fell within the organisational category of government agency (35.0%) and academia (32.5%).

- 33 surveyed institutions received support for financing innovation projects (including R&I) and most of these were from government agency (39.4%) and academia (33.4%).

- 31 surveyed institutions received support for innovation management (organisational management, IP management, design management), with the majority either belonging to a government agency (35.5%) or the private sector (32.3%).

- The following forms of innovation support were each received by 30 surveyed institutions:

  - Support for networking and cooperation between actors
  - Support to identify innovation potential (information on market needs, market conditions, new regulations, new technology, etc.)
  - Support for the creation of specific skills

  Most organisations who received the above forms of innovation support belonged to government agencies.

- Finally, 27 organisations were supported in awareness raising and information on support possibilities, out of which 10 (37.0%) were in academia, 8 (29.6%) were from government agency and 7 (25.9%) fell within the private sector.

3 surveyed institutions reported receiving no support with 1 (33.3%) each from academia, private sector and government agency.

Figure 8 is a bar graph of the form of innovation support surveyed institutions received across organisational category of the surveyed institutions.

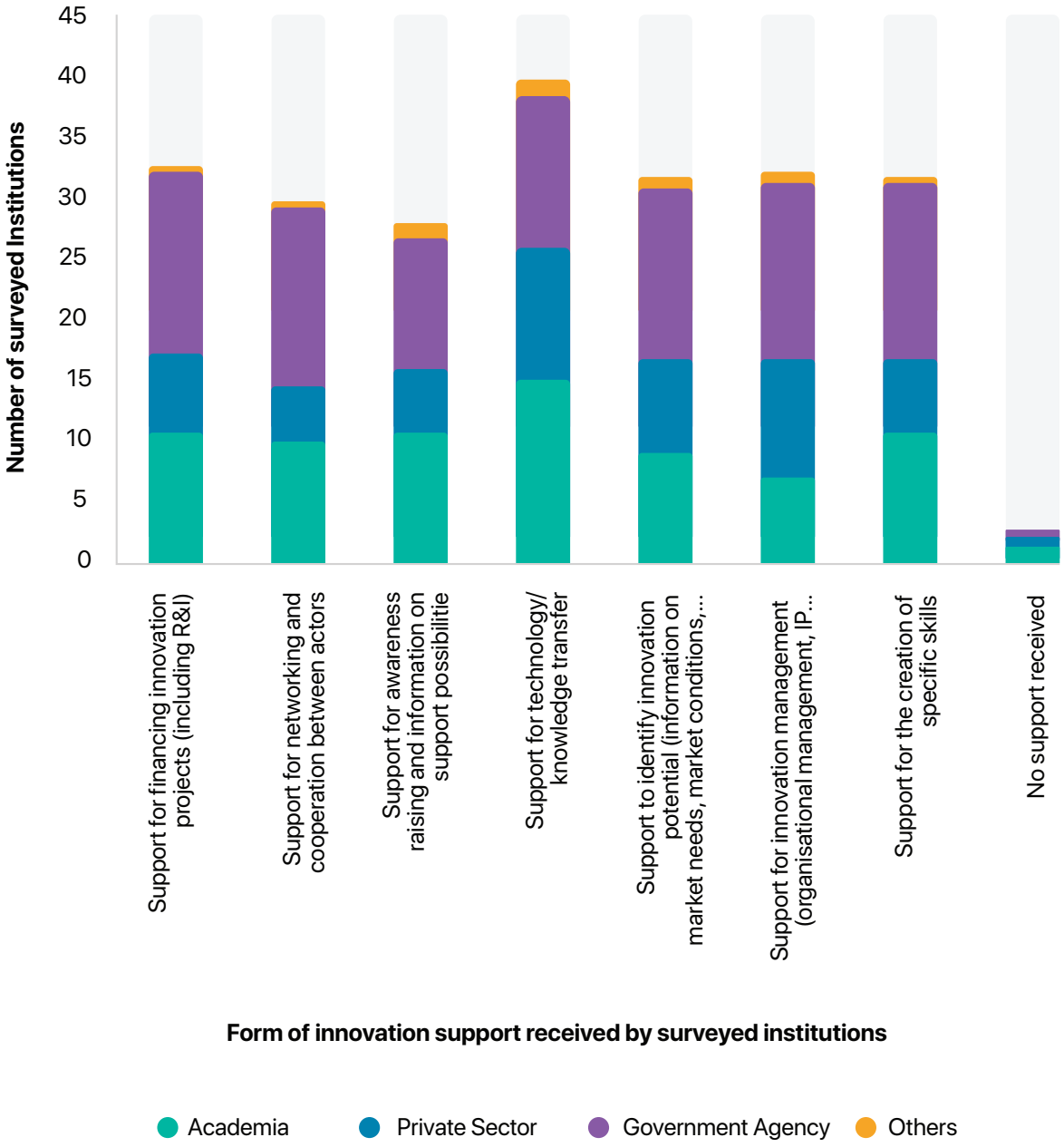

Figure 8: A bar graph of the form of innovation support surveyed institutions received across organisational category of the surveyed institutions

Table 6 shows a cross-tabulation between the form of innovation support received and the length of operation of the surveyed institutions.

As previously mentioned, the majority of surveyed institutions had been in operation for 10- 20 years or above 30 years. Thus, across the different forms of innovation support received, the institutions who attested to receiving support had mostly been in operation for 10-20 years or above 30 years.

Specifically, most institutions who received innovation support in the form of "Support for awareness raising and information on support possibilities" had been in operation for 10-20 years (37.0%).

For institutions who received innovation support of the following forms, however, the majority had been in operation for above 30 years:

- Support for networking and cooperation between actors (46.7%).
- Support for financing innovation projects (including R&I) (45.5%).
- Support for technology/knowledge transfer (40.0%).
- Support for innovation management (organisational management, IP management, design management) (38.8%).

For the following forms of innovation support, as many institutions as had been in operation for 10-20 years had also been in operation for above 30 years:

- Support to identify innovation potential (information on market needs, market conditions, new regulations, new technology, etc.) (36.7% each).
- Support for the creation of specific skills (36.7% each)

Out of the 3 institutions who reported receiving no innovation support, 2 (66.7%) had been operating for above 30 years and 1 (33.3%) had been operating for less than 10 years at the time of the survey.

This is graphically displayed in Figure 9.

Table 6: A Cross-tabulation between the forms of Innovation support received by surveyed institutions and the length of operation.

Variable		Less than 10 years	10 - 20 years	20 - 30 years	Above 30 years	Total (N)
Form of innovation support received	• Support for financing innovation projects (including R&I)	4 (12.1%)	10 (30.3%)	4 (12.1%)	15 (45.5%)	33 (100)
	• Support for networking and cooperation between actors	4 (13.3%)	10 (33.3%)	2 (6.7%)	14 (46.7%)	30 (100)
	• Support for awareness raising and information on support possibilities	3 (11.1%)	10 (37.0%)	5 (18.5%)	9 (33.4%)	27 (100)
	• Support for technology/knowledge transfer	7 (17.5%)	13 (32.5%)	4 (10.0%)	16 (40.0%)	40 (100)
	• Support to identify innovation potential (information on market needs, market conditions, new regulations, new technology, etc.)	3 (10.0%)	9 (29.0%)	5 (16.1%)	12 (38.8%)	31 (100)
	• Support for innovation management (organisational management, IP management, design management)	5 (16.1%)	9 (29.0%)	5 (16.1%)	12 (38.8%)	31 (100)
	• Support for the creation of specific skills	5 (16.6%)	11 (36.7%)	3 (10.0%)	11 (36.7%)	30 (100)
	• No support received	1 (33.33%)	0 (0.0%)	0 (0.0%)	2 (66.7%)	3 (100)

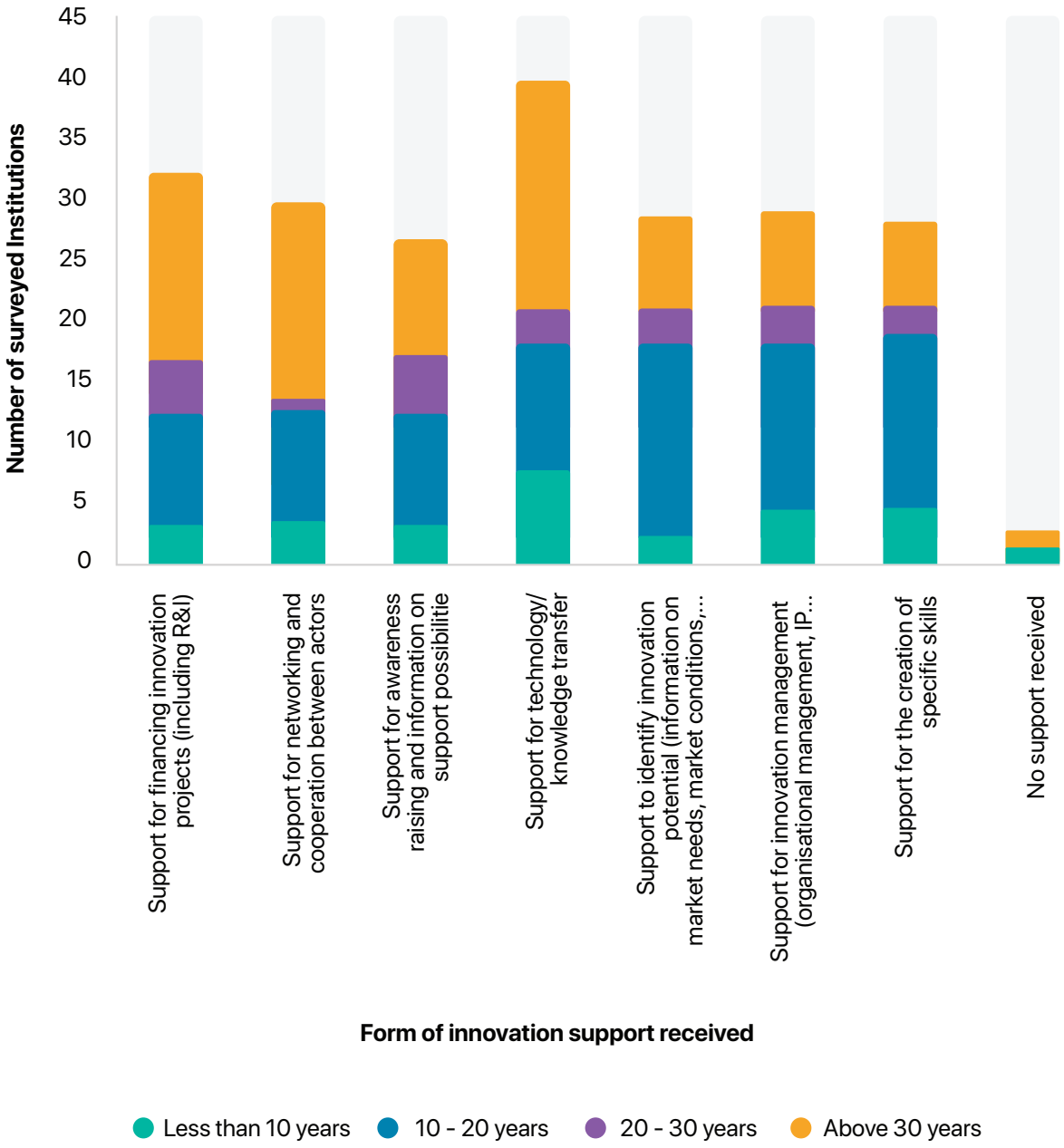

Figure 9: A bar graph of form of innovation support surveyed institutions received across length of operation

Table 7 shows the relationship between the form of innovation support received by surveyed institutions and the extent to which the support met their expectations.

Generally, it was discovered that the expectations of most surveyed institutions for the innovation support they received were largely met.

Institutions who received support in the following also said the support moderately met their expectations:

- Support for financing innovation projects (including R&I) (33.3%)
- Support for networking and cooperation between actors (33.3%)
- Support for innovation management (organisational management, IP management, design management) (29.1%)
- Support for technology/knowledge transfer (27.5%)

For the following forms of innovation support, however, a considerable number of surveyed institutions which received such support claimed the support perfectly met their expectations:

- Support for the creation of specific skills (30.0%)
- Support for awareness raising and information on support possibilities (29.7%)

It is worth noting that amongst institutions which received innovation support in the form of "Support for awareness raising and information on support possibilities" and "Support to identify innovation potential (information on market needs, market conditions, new regulations, new technology, etc.)", none said that these forms of support weakly met their expectations.

Figure 10 is a bar graph of these findings.

Table 7: A Cross-tabulation between the form of innovation support received by surveyed institutions and the extent to which the support met their expectations.

Variable		Weakly met your expectation	Moderately met your expectations	Largely met your expectations	Perfectly met your expectations	Not Applicable (For those who did not receive any support)	Total (N)
Form of innovation support received	• Support for financing innovation projects (including R&I)	1 (3.0%)	11 (33.3%)	12 (36.5%)	8 (24.2%)	1 (3.0%)	33 (100)
	• Support for networking and cooperation between actors	1 (3.3%)	10 (33.3%)	12 (40.0%)	7 (23.4%)	0 (0.0%)	30 (100)
	• Support for awareness raising and information on support possibilities	0 (0.0%)	6 (22.2%)	12 (44.4%)	8 (29.7%)	1 (3.7%)	27 (100)
	• Support for technology/knowledge transfer	1 (2.5%)	11 (27.5%)	17 (42.5%)	10 (25.0%)	1 (2.5%)	40 (100)
	• Support to identify innovation potential (information on market needs, market conditions, new regulations, new technology, etc.)	0 (0.0%)	8 (26.7%)	13 (43.3%)	8 (26.7%)	1 (3.3%)	30 (100)
	• Support for innovation management (organisational management, IP management, design management)	1 (3.2%)	9 (29.1%)	12 (38.7%)	8 (25.8%)	1 (3.2%)	31 (100)
	• Support for the creation of specific skills	1 (3.3%)	7 (23.4%)	12 (40.0%)	9 (30.0%)	1 (3.3%)	30 (100)
	• No support received	0 (0.0%)	1 (50.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	2 (100)

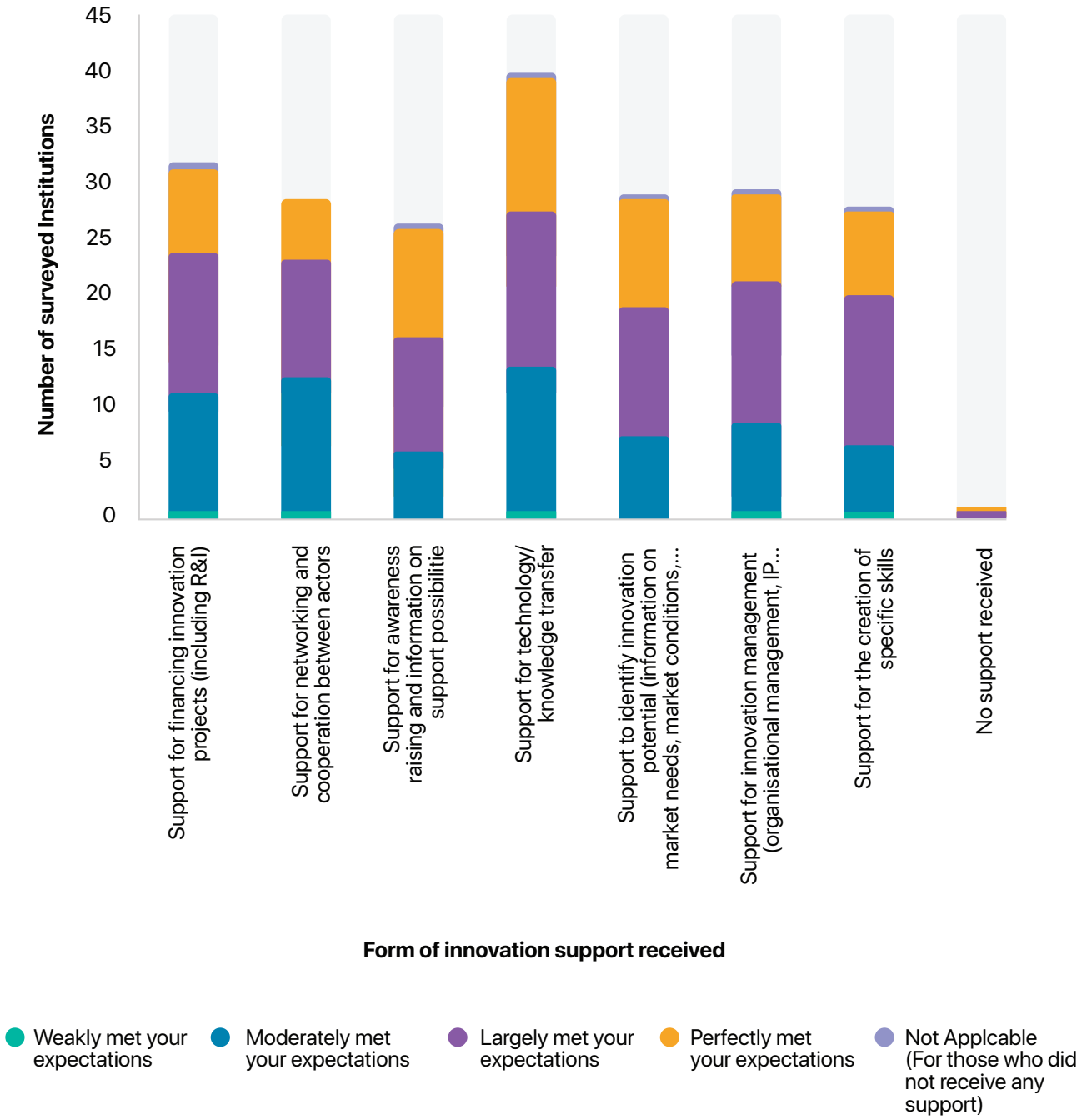

Figure 10: A bar graph of form of innovation support surveyed institutions received across the extent innovation support received met expectations of surveyed institutions.

Table 8: A Cross-tabulation between the organisational category of surveyed institutions and the extent to which the innovation support received met expectations of surveyed institutions

Variable		Weakly met your expectation	Moderately met your expectations	Largely met your expectations	Perfectly met your expectations	Not Applicable (For those who did not receive any support)	Total (N)	P-Values
Organisational Category	• Academia	0 (0.0%)	4 (8.3%)	7 (14.6%)	4 (8.3%)	0 (0.0%)	15 (31.3%)	0.900
	• Private sector	0 (0.0%)	3 (6.3%)	5 (10.4%)	4 (8.3%)	1 (2.1%)	13 (27.1%)	
	• Government Agency	1 (2.1%)	6 (12.5%)	8 (16.7%)	3 (6.3%)	0 (0.00%)	18 (37.6%)	
	• Others	0 (0.0%)	1 (2.0%)	1 (2.0%)	0 (0.0%)	0 (0.0%)	2 (4.0%)	

From the cross-tabulation in Table 8, surveyed institutions which belonged in academia (31.3%) had their expectations of the innovation support they received, largely met (14.6%). The remaining 8 were equally split between moderately met expectations and perfectly met expectations (8.3% each).

Surveyed institutions which belonged to the private sector (27.1%) also predominantly had their expectations largely met (10.4%) and perfectly met (8.3%).

For institutions in government agency (37.6%), their expectations were mostly largely met (16.7%) and moderately met (12.5%).

Institutions that found themselves in other sectors/categories (4.0%) either had their expectations moderately or largely met (2.0% each).

The results show that no statistically significant association exists between organisational category of surveyed institution and the extent to which the innovation support received met the expectations of the surveyed institution ($p>0.05$). That is, they are independent of each other. Figure 11 is a bar graph which displays these findings.

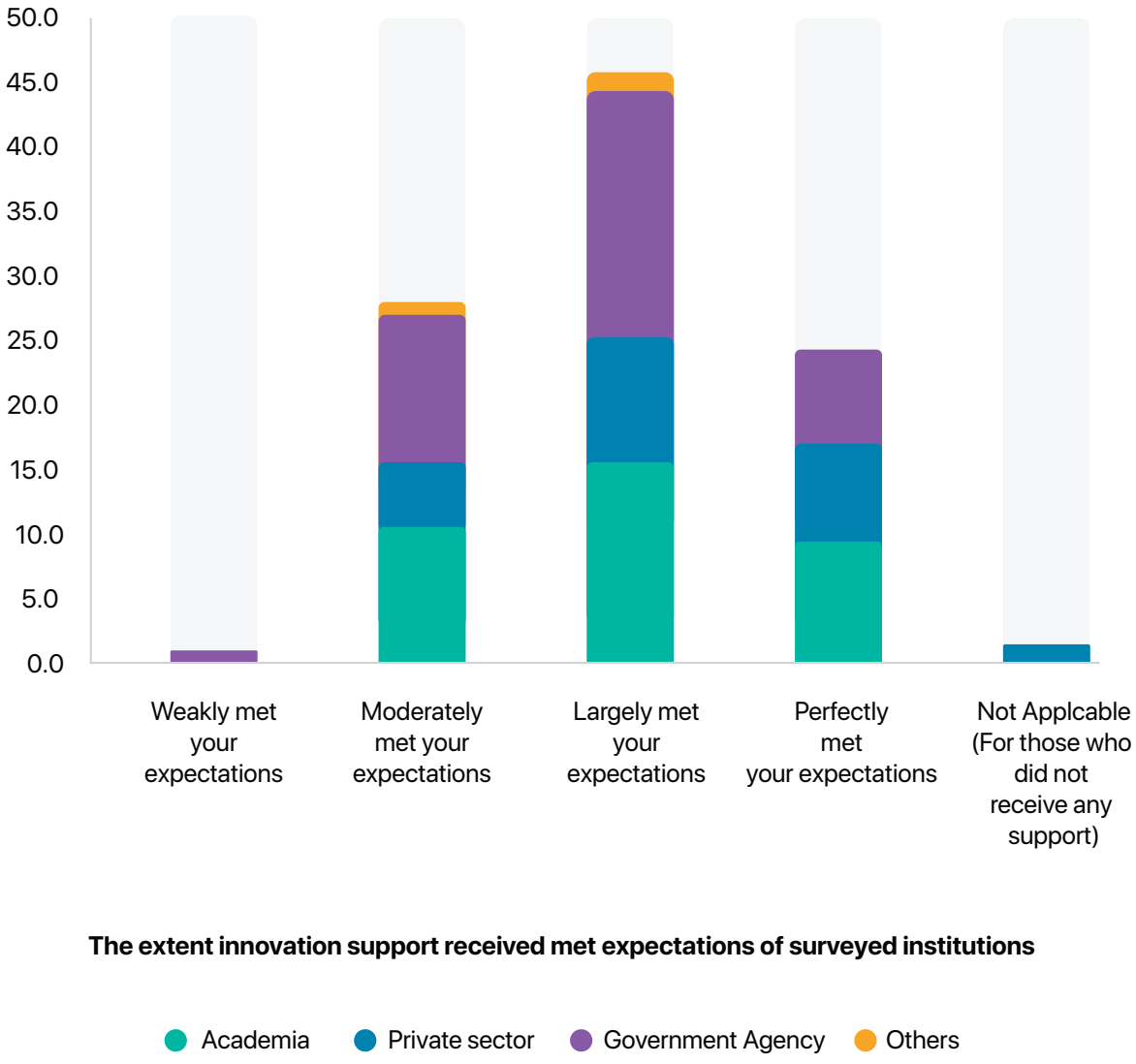

Figure 11: A bar graph of organisational category of surveyed institutions across extent to which innovation support received met expectations of surveyed institutions


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4.3 Financial Support for Innovation Activities

Table 9: A Cross-tabulation between whether surveyed institutions received any financial support for

Variable		Yes	No	Total (N)	P-value
Organisational Category	• Academia	9 (18.8%)	6 (12.5%)	15 (31.3%)	0.645
	• Private sector	3 (26.0%)	10 (20.8%)	13 (27.1%)	
	• Government Agency	11 (22.9%)	7 (14.6%)	18 (37.5%)	
	• Others	0 (0.00%)	2 (4.10%)	2 (4.10%)	
Length of Operation	• Less than 10 years	0 (0.00%)	7 (14.3%)	7 (14.3%)	0.049
	• 10-20 years	7 (14.3%)	8 (16.3%)	15 (30.6%)	
	• 21-30 years	3 (6.10%)	2 (4.10%)	5 (10.2%)	
	• Over 30 years	13 (26.5%)	9 (18.4%)	22 (44.9%)	

Table 9 shows a cross-tabulation between whether surveyed institutions (who had engaged in any innovative activities in recent years) received any financial support for innovation activities from the government, and some bio-information of the institutions. The bio- information considered was the organisational category and the number of years in which the institution had been in operation. Out of the 15 (31.3%) institutions in academia, 9 (18.8%) received financial support while 6 (12.5%) did not receive any support. For the institutions in the private sector (27.1%), only 3 (6.3%) received financial support while 10 (20.8%) did not. With the government agency, 11 (22.9%) institutions received financial support whereas 7 (14.6%) did not. The 2 institutions which did not belong to any of the categories listed did not receive any funding.

The p-value ($p > 0.05$) suggests that at 5% level of significance, there is no statistically significant relationship between whether surveyed institutions received any financial support for innovation activities from the government and the organisational category in which they belonged.

All 7 (14.3%) institutions with the shortest length in operation (less than 10 years) received no financial support from the government. For the institutions which had been in existence between 10-20 years (30.6%), 7 (14.3%) received financial support while 8 (16.3%) did not. For institutions

in existence from 21-30 years, 3 (6.1%) received financial support while 2 (4.1%) did not. Out of the 22 institutions which had been in existence for over 30 years, 13 (26.5%) received financial support and 9 (18.4%) did not.

The $p < 0.05$ suggests that at 5% level of significance, there is a statistically significant relationship between whether surveyed institutions received any financial support for innovation activities from the government and their length of operations, implying that the length of operation and whether a surveyed institution received any financial support, are dependent.

Table 10: A Cross-tabulation between why surveyed institutions did not receive public financial support for innovation activities and Organisational category

Variable		Application Rejected	Lack of Information	Process too complicated	Time Constraints	Not Applicable	Others	Total(N)	P-Values
Organisational Category	• Academia	1 (2.3%)	0 (0.0%)	2 (4.5%)	0 (0.0%)	6 (13.6%)	5 (11.4%)	14 (31.8%)	0.256
	• Private sector	0 (0.0%)	0 (0.0%)	3 (6.8%)	1 (2.3%)	6 (13.6%)	2 (4.5%)	12 (27.3%)	
	• Government Agency	2 (4.5%)	2 (4.5%)	0 (0.0%)	2 (4.5%)	7 (15.9%)	2 (4.5%)	15 (34.1%)	
	• Others	1 (2.4%)	1 (2.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.4%)	3 (6.8%)	

Table 10 presents a cross- tabulation between the reasons provided for which the surveyed institutions did not receive financial support and the organisational categories to which the surveyed institutions belonged. The "Not Applicable" option was selected by the institutions who had received financial support.

For institutions in academia, 14 indications made included: rejected Application: 1 (2.3%); complicated process: 2 (4.5%); and 5 (11.4%) indications were due to other reasons not listed. The 6 (13.6%) indications of "Not Applicable" were from institutions who had received funding. For institutions in the private sector, 3 (6.8%) indicated that the process was too complicated. There was 1 (2.3%) indication that time constraint was the issue, and 2 (4.5%) indications were due to other reasons not listed. Government agency institutions indicated the following reasons: rejected application: 2 (4.5%); lack of information: 2 (4.5%); and time constraints: 2 (4.5%). There were also 2 (4.5%) indications of other reasons not listed. It should be noted that the

institutions in the "Others" category indicated both rejected application and lack of information as reasons why the funding was not received.

The p-value ($p > 0.05$) suggests that at 5% level of significance, there is no statistically significant association between the reasons why the surveyed institutions did not receive financial support and the organisational categories to which they belonged.

Table 11: A Cross-tabulation between how surveyed institutions funded innovation activities and some bio-information of the surveyed institutions

Variable		Donor-funded project	Internally Generated Funds (IGF)	Government of Ghana Finance Project	Others	Total(N)	P-Values
Organisational Category	• Academia	7 (14.6%)	5 (10.4%)	0 (0.0%)	4 (8.3%)	16 (33.3%)	0.059
	• Private sector	4 (8.3%)	7 (14.6%)	0 (0.0%)	1 (2.1%)	12 (25.0%)	
	• Government Agency	7 (14.6%)	3 (6.3%)	5 (10.4%)	3 (6.3%)	18 (37.5%)	
	• Others	2 (4.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (4.2%)	
Length of Operation	• Less than 10 years	3 (6.3%)	3 (6.3%)	0 (0.0%)	1 (2.1%)	7 (14.6%)	0.927
	• 10-20 years	6 (12.5%)	5 (10.4%)	1 (2.1%)	3 (6.3%)	15 (31.3%)	
	• 21-30 years	3 (6.3%)	1 (2.1%)	1 (2.1%)	0 (0.0%)	5 (10.4%)	
	• Over 30 years	8 (16.7%)	6 (12.5%)	3 (6.3%)	4 (8.3%)	21 (43.8%)	

Table 11 shows a cross tabulation between how surveyed institutions funded innovation activities and some bio-information of the surveyed institutions. The bio information considered included the organisation category to which the surveyed institution belonged, and the length of operation of the institution.

For surveyed institutions in Academia, their innovative activities were mainly funded by donor support: 7 (14.6%), followed by Internally generated funds: 5 (10.4%). There were 4 (8.3%) instances where it was indicated that the funding was from other sources not listed. For the institutions from the Private Sector, there were 4 (8.3%) indications of donor support and 7 (14.6%) instances of internally generated funds. 1 (2.1%) institution funded their innovation activities through other sources not included in the list. Institutions from Government Agency indicated mainly instances of donor funding: 7 (14.6%), closely followed by instances of funding from the Government: 5 (10.4%). Instances from internally generated funds and other sources not included on the list both recorded 3 (6.3%) each. The institutions which belonged to the "Other" category indicated that their only source of funding was from donors. From the above, it is clear that the only organisations that received funding from the Government of Ghana (10.4%) belonged to the Government agency.

The p-value ($p > 0.05$) suggests that at 5% level of significance, there is no statistically significant relationship between the source of funding for the innovative activities that surveyed institutions embarked on, and the organisational categories to which they belonged, that is, the two variables are independent.

Institutions which had been in existence for less than 10 years indicated equal instances of donor funding and internally generated funding 3 (6.3%) for their innovation activities. They also indicated 1 (2.1%) instance of "other" source of fund. Institutions which had been in operation between 10-20 years mainly had donor funds: 6 (12.5%), closely followed by internally generated funds 5 (10.4%). There were also 3 (6.3%) instances of "other" source of funds and 1 (2.1%) instance of funding from the Government. Institutions that had been in existence for 21-30 years indicated instances of donor funds: 3 (6.3%) and equal instances of internally generated funding and government funding: 1 (2.1%) each. Institutions that had been operation for over 30 years indicated instances of all the various sources of funding as follows: Donor Funding – 8 (16.7%); Internally generated funds – 6 (12.5%); Government funds – 3 (6.3%): and "Other" source of funding – 4 (8.3%).

The p-value ($p > 0.05$) suggests that at 5% level of significance. there is no statistically significant association between the source of funding for the innovative activities and the length of operation of the institution.

Table 12: A Cross-tabulation between Nature of financial support institutions received and organisational category

Variable		Academia	Private sector	Government Agency	Others	Total (N)
Nature of Financial support institutions received	• Provision of funds in the form of grants	12 (38.7%)	3 (9.7%)	14 (45.2%)	2 (6.5%)	31 (100)
	• Provision of tax breaks/exemptions	1 (11.1%)	3 (33.3%)	5 (55.6%)	0 (0.0%)	9 (100)
	• Provision of vouchers	1 (50.0%)	0 (0.0%)	1 (50.0%)	0 (0.0%)	2 (100)
	• Provision of technical assistance	9 (30.0%)	6 (20.0%)	14 (46.7%)	1 (3.3%)	30 (100)
	• Others	0 (0.0%)	2 (50.0%)	2 (50.0%)	0 (0.0%)	4 (100)
	• Not Applicable (For those who did not receive any financial support)	3 (42.9%)	4 (57.1%)	0 (0.0%)	0 (0.0%)	7 (100)

Table 12 presents the nature of financial support the institutions received, in the various organisational categories. Funds in the form of grants were mainly received by surveyed institutions that were Government Agencies; 14 (45.2%), and Academia; 12 (38.7%). The Private sector and institutions for the "Other" category recorded 3 (9.7%) and 2 (6.5%) institutions respectively.

Funding in the form of tax breaks/exemptions was received mainly by institutions that were Government Agencies; 5 (55.6%), and the Private sector; 3 (33.3%). Institutions form Academia indicated only 1 (11.1%) instance of receiving tax breaks/exemptions as financial support and institutions for the "Other" category did not receive any tax breaks/exemptions.

Provision of vouchers as a mode of funding was not very popular and was only received by 1 (11.1%) institution each that belonged to both Academia and Government Agency.

Provision of technical assistance was another popular mode of funding for institutions that were Government Agencies; 14 (46.7%) and Academia; 9 (30.0%). 6 (20.0%) institutions and 1 (3.3%) institution belonging to the Private sector and "Other" category respectively attested to receiving financial support of this nature.

Institutions from the Private Sector and the Government Agency both obtained funding of "other" forms/nature equally; 2 (50%) institutions each.

From the above, it is clear that the provision of grants and technical assistance are the most popular forms of financial support received amongst surveyed institutions, regardless of their organisational categories.

Table 13: A Cross-tabulation between Nature of financial support institutions received and how surveyed institutions funded innovation activities.

Variable		Dono-funded project	Internally generated funds (IGF)	Government of Ghana financed project	Others	Total (N)
Nature of Financial support institutions received	• Provision of funds in the form of grants	17 (54.8%)	4 (12.9%)	2 (6.5%)	8 (25.8%)	31 (100)
	• Provision of tax breaks/exemptions	3 (33.3%)	3 (33.3%)	2 (22.2%)	1 (11.1%)	9 (100)
	• Provision of vouchers	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100)
	• Provision of technical assistance	14 (46.7%)	7 (23.3%)	3 (10.0%)	6 (20.0%)	30 (100)
	• Others	1 (25.0%)	1 (25.0%)	1 (25.0%)	1 (25.0%)	4 (100)
	• Not Applicable (For those who did not receive any financial support)	0 (0.0%)	7 (100.0%)	0 (0.0%)	0 (0.0%)	7 (100)

Table 13 presents the way in which sources of funding was received. For financial support received that were funds in the form of grants, 17 (54.8%) were from Donor-funded projects, 8 (25.8%) were from "Other" sources, 4 (12.9%) were Internally generated funds and 2 (6.5%) were Government of Ghana financed projects.

The provision of tax breaks/exemptions was found equally in Donor funded projects and Internally generated funded projects; 3 (33.3%) each. The survey results also showed that 2 (22.2%) institutions that received tax breaks/exemptions were funded by the Government of Ghana, and 1 (11.1%) by "Other" means.

Provision of vouchers as mode of funding could only be found in Donor-funded projects; 2 (100%).

Provision of technical assistance could be found in all the funding sources as follows: Donor funded projects – 14 (46.7%); Internally generated funded projects – 7 (23.3%), Government of Ghana funded projects – 3(10.0%) and "Other" funded projects – 6 (20.0%).

Other modes of funding not included in the list could be found equally in Donor-funded projects, Internally generated funds, Government of Ghana funded projects and "Other" funding sources; 1(25.0%) each.

Clearly, the provision of grants and technical assistance is mainly used in Donor funded projects.

4.4 Sources of Information and Cooperation for Innovation Activities

Table 14: Descriptive of the ratings of information sources that provided new innovation projects or contributed to the completion of existing projects

Variable		Very Important	Important	Neutral/ Indecisive	Not Important
	• Within your institution or institution's group	39 (84.8%)	6 (13.0%)	1(2.2%)	0 (0.0%)
	• Universities or other higher education institutions	19 (45.2%)	13 (31.0%)	7 (16.7%)	3 (7.1%)
	• Government or Public research institutes	22 (52.3%)	12 (28.6%)	6 (14.3%)	2 (4.8.%)
	• Private research institute	19 (45.2%)	9 (21.4%)	12 (28.6%)	2 (4.8%)

Table 14 describes how the surveyed institutions rated information sources that provided new innovation projects or contributed to the completion of existing projects. Regarding information sources from within the institution or institution's group, 39 (84.8%) surveyed institutions rated it as very important, 6 (13.0%) rated it important, and the remaining 1 (2.2%) was neutral/indecisive about this information source.

Additionally, a majority (45.2%) rated information sources from universities or other higher education institutions as very important, followed by 31.0% that rated it as important and then 16.7% that were neutral/indecisive about their rating. It should be noted that 3 (7.1%) surveyed institutions found this information source unimportant.

The rating of information sources from government or public research institutes were as follows: 22 (52.3%) rated it as very important, 12 (28.6%) rated it as important, and 6 (14.3%) were neutral/indecisive about it.

Finally, 19 (45.2%) rated private research institutes as very important information sources whereas 12 (28.6%) surveyed institutions were neutral/indecisive about this information source. 9 (21.4%) surveyed institutions reported that private research institutes are an important source of information on innovation projects or contributed to the completion of existing projects while 2 (4.8%) thought this information source was unimportant.

The results in Table 14 are presented pictorially in Figure 12.

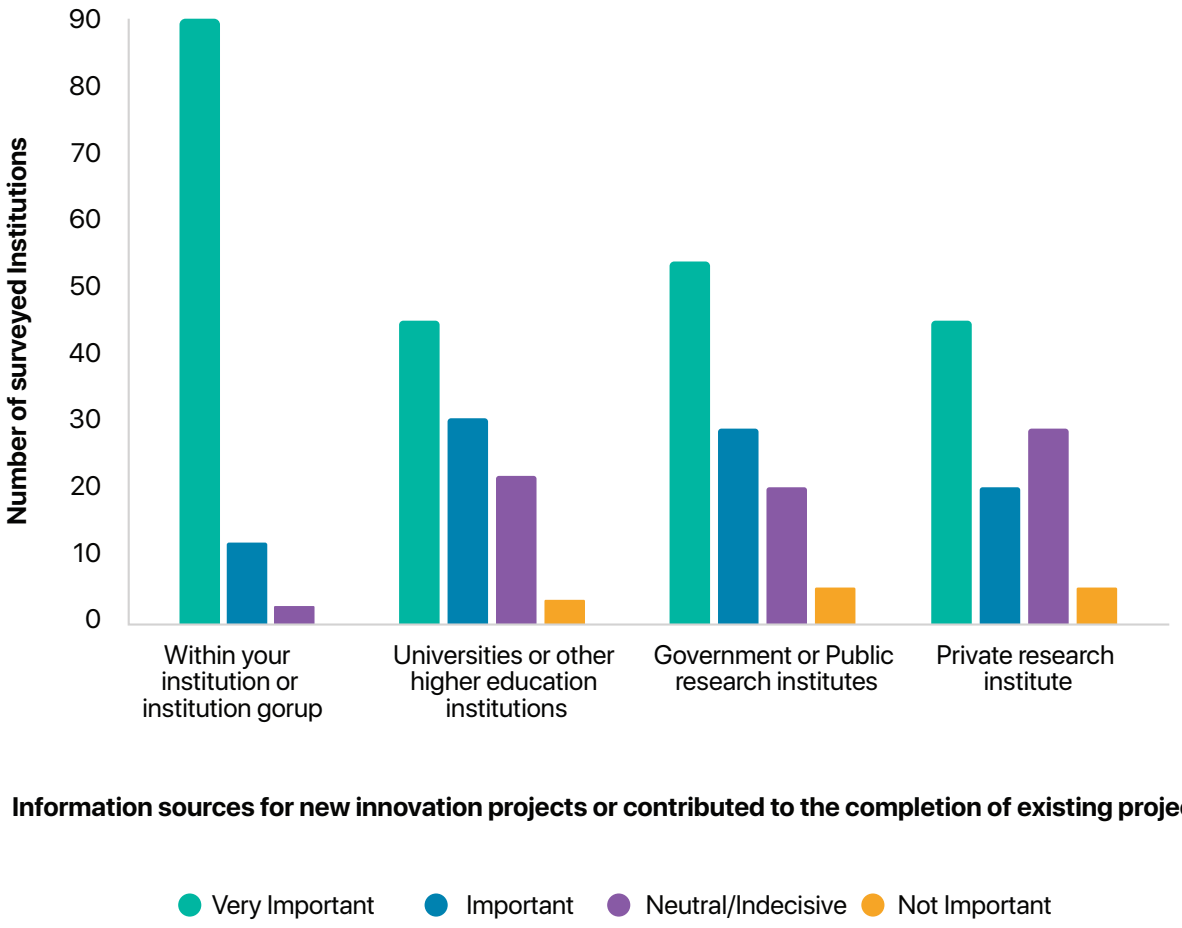

Figure 12: A bar chart of the ratings of information sources that provided new innovation projects or contributed to the completion of existing projects.

Table 15: A cross-tabulation between the ratings of information sources that provided new innovation projects or contributed to the completion of existing projects, and organisational category.

Variable		Academia	Private Sector	Government Agency	Others	Total (N)	P- value
Within your institution or institution's group	• Very Important	12 (26.1%)	11 (23.9%)	15 (32.6%)	1 (2.2%)	39 (84.8%)	0.358
	• Important	3 (6.5%)	0 (0.0%)	2 (4.3%)	1 (2.2%)	6 (13.0%)	
	• Neutral/Indecisive	1 (2.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.2%)	
Universities or other higher education institutions	• Very Important	10 (23.8%)	3 (7.1%)	6 (14.3)	0 (0.0%)	19 (45.2%)	0.615
	• Important	4 (9.5%)	4 (9.5%)	4 (9.5%)	1 (2.4%)	13 (31.0%)	
	• Neutral/Indecisive	2 (4.8%)	2 (4.8%)	2 (4.8%)	1 (2.4%)	7 (16.7%)	
	• Not Important	0 (0.0%)	1 (2.4%)	2 (4.8%)	0 (0.0%)	3 (7.1%)	
Government or Public research institutes	• Very Important	7 (16.7%)	6 (14.3%)	8 (19.0%)	1 (2.4%)	22 (52.3%)	0.158
	• Important	6 (14.3%)	2 (4.8%)	4 (9.5%)	0 (0.0%)	12 (28.6%)	
	• Neutral/Indecisive	2 (4.8%)	1 (2.4%)	3 (7.1%)	0 (0.0%)	6 (14.3%)	
	• Not Important	0 (0.0%)	1 (2.4%)	0 (0.0%)	1 (2.4%)	2 (4.8%)	
Private research institute	• Very Important	5 (11.9%)	9 (21.4%)	3 (7.1%)	2 (4.8%)	19 (45.2%)	0.147
	• Important	4 (9.5%)	1 (2.4%)	4 (9.5%)	0 (0.0%)	9 (21.4%)	
	• Neutral/Indecisive	4 (9.5%)	1 (2.4%)	7 (16.7%)	0 (0.0%)	12 (28.6%)	
	• Not Important	1 (2.4%)	0 (0.0%)	1 (2.4%)	0 (0.0%)	2 (4.8%)	

Table 15 shows the association between the ratings of information sources that provided information to surveyed institutions on innovation projects or contributed to the completion of existing projects, and the organisational category of the sampled institutions.

- Regarding the 84.8% of institutions which rated information sources from within the institution or institution's group as very important, 15 (32.6%) were government agencies, 12 (26.1%) were academic institutions, 11 (23.9%) were private sector institutions and 2.20% non-governmental organisations/non-profit private organisations (Others). The 1 (2.2%) surveyed institution who was neutral/indecisive about this information source was an academic institution.

- For the 45.2% sampled institutions that rated information sources from universities or other higher education institutions very important, the breakdown is as follows; 10 (23.8%) were academic institutions, 6 (14.3%) were government agencies and 3 (7.1%) institutions belonged to the private sector.

- Of the 3 (7.1%) institutions that rated this information source as not important, 2 (4.8%) were government agencies and 1 (2.4%) belonged to the private sector.

- The 52.3% of the surveyed institutions which rated information sources from government or public research institutes very important comprised 19.0% government agencies, 16.7% academic institutions, 14.3% institutions from the private sector and 2.40% non-governmental organisations/non-profit private organisations (Others).

- The composition of the 45.2% of surveyed institutions that rated information sources from private research institutes as very important is as follows: 21.4% from the private sector, 11.9% in academia, 7.1% government agencies and 4.8% non-governmental organisations /non-profit private organisations (Others).

A chi-square test of association was employed to test the association between the ratings of information sources that provided information to surveyed institutions on innovation projects or contributed to the completion of existing projects, and the organisational category of the sampled institutions. According to the p-values in Table 15, none of the information sources is significantly associated with the organisational category at 5% level of significance. That is, the sources of information and organisational category are independent.

Table 16: Descriptive of the ratings of factors which influenced the institution's decision to introduce innovation

Variable	Very Important	Important	Neutral/ Indecisive	Not Imortant
• Existing innovation regulation	17 (40.5%)	13 (40.5%)	15 (32.6%)	4 (9.5%)
• Existing taxes, charges or fees	17 (40.5%)	13 (40.5%)	15 (32.6%)	4 (9.5%)
• Government grants subsidies or other financial incentives for innovative development	21 (48.8%)	11 (25.6%)	6 (14.0%)	5 (11.6%)
• Current or expected demand for innovations	28 (66.7%)	11 (26.2%)	3 (7.1%)	0 (0.0%)
• Improving your institution's reputation	37 (82.2%)	7 (15.6%)	1 (2.2%)	0 (0.0%)
• Needs to meet requirement for public procurement	15 (34.9%)	10 (23.3%)	12 (27.9%)	6 (14.0%)

From Table 16, regarding the rating of factors that influenced the surveyed institutions' decision to introduce innovation:

- A majority (40.5%) rated existing innovation regulation as very important, 31.0% rated it important, 19.0% of the institutions were neutral/indecisive about it, and 9.5% rated it as not important.

- As pertaining to the influence of existing taxes, charges or fees, most (38.1%) organisations rated it important, 28.6% of institutions reported that they were neutral/indecisive about it, 16.7% rated it as very important and the remaining proportion rated it as not important.

- The rating of government grants subsidies or other financial incentive for innovative development is as follows: 48.8% rated it very important, 25.6% rated it important, 14.0% were neutral/indecisive and 11.6% rated it as not important.

- A more significant proportion (66.7%) of the surveyed institutions rated current or expected demand for innovations as a very important factor influencing the institution's decision to innovate. In comparison, 26.2% of them rated it as an important factor and 3 (7.1%) said they were neutral/indecisive about their rating.

- 82.2% of the sampled institutions rated improving the institution's reputation as a very important factor influencing the organisation's decision to innovate, and 15.6% said it was an important factor.

- 34.9% rated the need to meet requirement for public procurement as a very important reason that influenced their decision to innovate, and 27.9% were indifferent. 6 (14.0%) stated that this factor was unimportant in their decision to innovate.

Figure 13 is a pictorial representation of Table 16.

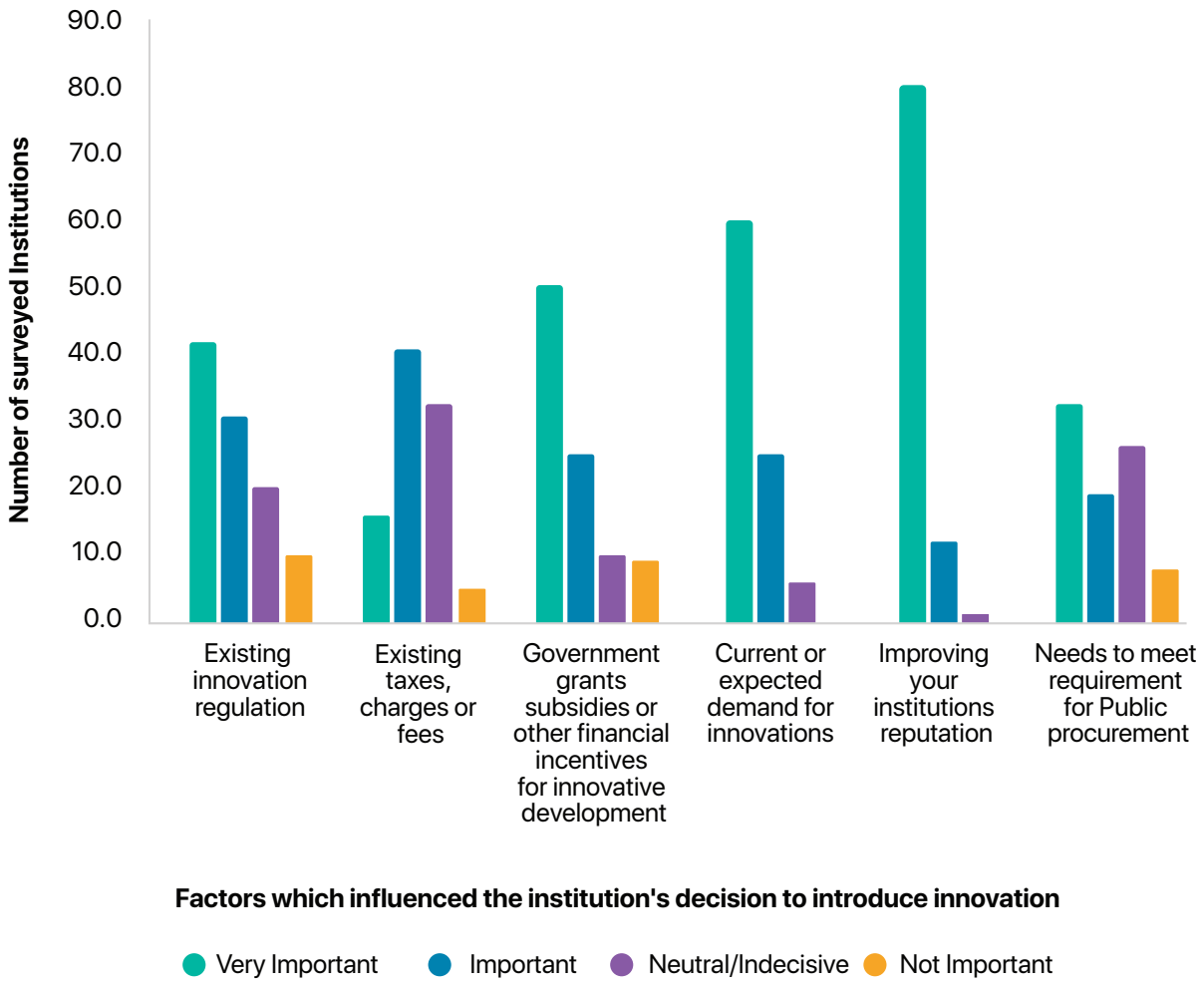

Figure 13: A bar chart of the ratings of factors which influenced the institution's decision to introduce innovation

Table 17: A cross-tabulation between the ratings of factors which influenced the institution's decision to introduce innovation and organisational category.

Variable		Academia	Private Sector	Government Agency	Others	Total (N)	P- value
Existing innovation regulation	• Very Important	6 (14.3%)	4 (9.5%)	6 (14.3)	1 (2.4%)	17 (40.5%)	0.962
	• Important	4 (9.5%)	4 (9.5%)	4 (9.5%)	0 (0.0%)	13 (31.0%)	
	• Neutral/Indecisive	3 (7.1%)	1 (2.4%)	2 (4.8%)	1 (2.4%)	8 (19.0%)	
	• Not Important	2 (4.8%)	1 (2.4%)	2 (4.8%)	0 (0.0%)	4 (9.5%)	
Existing taxes, charges or fees	• Very Important	1 (2.4%)	3 (7.1%)	3 (7.1%)	0 (0.0%)	7 (16.7%)	0.302
	• Important	4 (9.5%)	6 (14.3%)	5 (11.9%)	1 (2.4%)	16 (38.1%)	
	• Neutral/Indecisive	7 (16.7%)	1 (2.4%)	3 (7.1%)	1 (2.4%)	12 (28.6%	
	• Not Important	4 (9.5%)	0 (0.0%)	3 (7.1%)	0 (0.0%)	7 (16.6%)	
Government grants subsidies or other financial incentives for innovative development	• Very Important	8 (18.6%)	3 (7.0%)	9 (20.9%)	1 (2.3%)	21 (48.8%)	0.349
	• Important	4 (9.3%)	4 (9.3%)	3 (7.0%)	0 (0.0%)	11 (25.6%)	
	• Neutral/Indecisive	4 (9.3%)	1 (2.3%)	1 (2.3%)	0 (0.0%)	6 (14.0%)	
	• Not Important	0 (0.0%)	2 (4.7%)	2 (4.7%)	1 (2.3%)	5 (11.6%)	
Current or expected demand for innovations	• Very Important	9 (21.4%)	9 (21.4%)	9 (21.4%)	1 (2.4%)	28 (66.6%)	0.579
	• Important	4 (9.5%)	1 (2.40%)	5 (11.9%)	1 (2.4%)	11 (26.2%)	
	• Neutral/Indecisive	2 (4.8%)	1 (2.4%)	0 (0.0%)	0 (0.0%)	3 (7.2%)	
Improving your institutions reputation	• Very Important	11 (24.4%)	9 (20.0%)	15 (33.3%)	2 (4.4%)	37 (82.2%)	0.871
	• Important	3 (6.7%)	1 (2.2%)	3 (6.7%)	0 (0.0%)	7 (15.6%)	
	• Neutral/Indecisive	1 (2.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.2%)	
Needs to meet requirement for public procurement	• Very Important	3 (7.0%)	5 (11.6%)	7 (16.3%)	0 (0.0%)	15 (34.9%)	0.163
	• Important	3 (7.0%)	4 (9.3%)	3 (7.0%)	0 (0.0%)	10 (23.3%)	
	• Neutral/Indecisive	6 (14.0%)	0 (0.0%)	4 (9.3%)	2 (4.7%)	12 (27.9%)	
		3 (7.0%)	2 (4.6%)	1 (2.3%)	0 (0.0%)	6 (13.9%)	

Regarding rating the factors which influenced the institution's decision to innovate, we found from Table 17 that:

- 6 (14.3%) of the academic institutions rated existing innovation regulations as a very important factor. Similarly, 6 (14.3%) government agencies rated it very important, and 4 (9.5%) institutions from the private sector rated it as a very important factor. On the other hand, 2 (4.8%) academic institutions, 1 (2.4%) government agencies, and 1 (2.4%) private sector institutions rated existing innovation regulation an unimportant factor in their decision to innovate.

- A majority (7) of academic institutions were neutral/indecisive about existing taxes, charges or fees being a factor that influenced their decision to innovate. However, most private sector institutions and government agencies (6 and 5, respectively) considered existing taxes, charges or fees to be an important factor influencing their decision. A higher proportion of the institutions which rated existing taxes, charges or fees as not important were academic institutions (9.5%); the remaining 3 (7.1%) were government agencies. No private sector institution rated it as an unimportant factor.

- For government grant subsidies or other financial incentives for innovative development, this factor was mostly rated very important by government agencies (20.9%) and academic institutions (18.6%). No academic institution rated this factor as not important; however, 2 (4.7%) government agencies and private sector organisations each found this factor unimportant.

- Regarding current or expected demand for innovations, the same proportion of academic institutions, government agencies and institutions from the private sector rated it as a very important factor that influenced their decision (21.4% for each). On the other hand, 2 (4.8%) surveyed academic institutions were neutral/indecisive about it.

- Considering the factor "improving the institution's reputation" as a reason for surveyed institutions to introduce innovations, government agencies predominantly rated it as very important (33.3%), followed by academic institutions (24.4%). No institution from any surveyed organisations rated this factor as unimportant.

- 7 (16.3%) government agencies reported that the need to meet requirements for public procurement was a very important factor that influenced their decision to innovate, followed by private sector institutions (11.6%). Academic institutions were, however, mostly neutral/indecisive about this factor.

Table 18: A cross-tabulation between organisational category and whether surveyed institutions have procedures to regularly identify and reduce the adverse effect of their innovations on the environment

Variable	Yes	No	Not Applicable	Total (N)	P-value
• Academia	10 (20.8%)	4 (8.3%)	2 (4.2%)	16 (33.3%)	0.56
• Private sector	10 (20.8%)	0 (0.0%)	2 (4.2%)	12 (25.0%)	
• Government Agency	11 (22.9%)	4 (8.3%)	3 (6.3%)	18 (37.5%)	
• Others	1 (2.1%)	1 (2.1%)	0 (0.0%)	2 (4.2%)	

From Table 18, a total of 32 (which constitute 10 academic institutions, 10 institutions from the private sector, 11 government agencies and 1 non-governmental organisation /non-profit private organisations (others)) reported they have procedures to regularly identify and reduce the adverse effect of their innovations on the environment. On the contrary, 4 academic institutions, 4 government agencies and 1 non-governmental organisation /non-profit private organisations indicated no such measures exist within their organisation.

A chi-square test of association was employed to assess whether a significant association exists between the two variables: organisational category and whether surveyed institutions have procedures to regularly identify and reduce the adverse effect of their innovations on the environment. The test indicated that the two variables are independent (> 0.05), at 5% level of significance

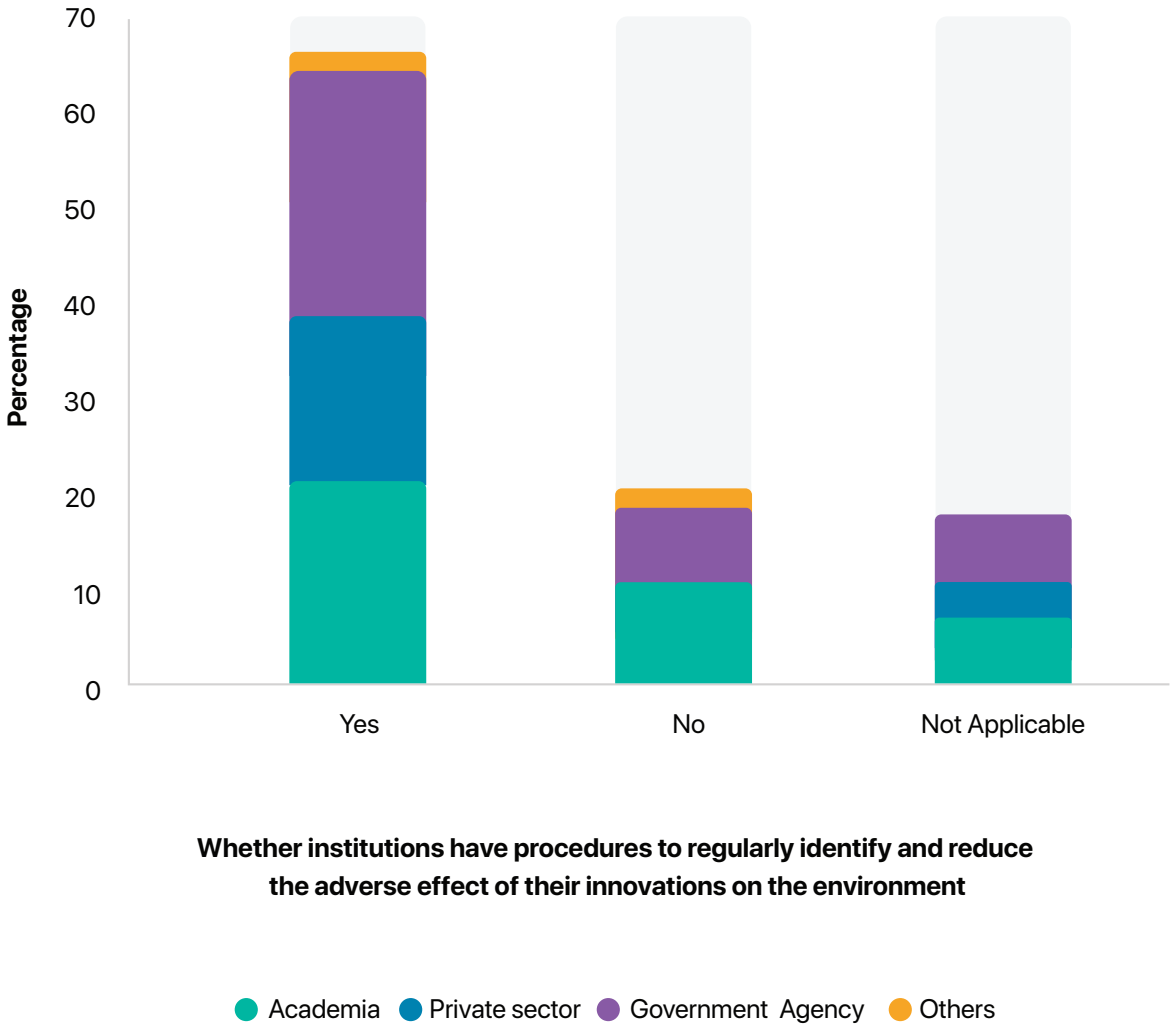

Figure 14: A bar graph of whether surveyed institutions have procedures to regularly identify and reduce the adverse effect of their innovations on the environment across organisational category.

4.5 Innovation Protection

Table 19: A Cross-tabulation between methods surveyed institutions adopted to protect innovations

Variable		Academia	Private Sector	Government Agency	Others	Total (N)
Methods surveyed institutions adopted to protect innovations	• Patents	8 (38.1%)	5 (23.8%)	8 (38.1%)	0 (0.0%)	21 (100)
	• Copyright	12 (41.4%)	9 (31.0%)	7 (24.1%)	1 (3.4%)	29 (100)
	• Trademarks	6 (23.1%)	9 (34.6%)	9 (34.6%)	2 (7.7%)	26 (100)
	• Lead time advantages	9 (36.0%)	8 (32.0%)	6 (24.0%)	2 (8.0%)	25 (100)
	• Secrecy	10 (37.0%)	6 (14.3%)	8 (29.6%)	2 (7.4%)	27 (100)

Table 19 shows a cross-tabulation between the methods surveyed institutions adopted to protect their innovations and the organisational category they belong. According to the table:
The same proportion (38.1%) of academic and government institutions patented their innovations. 23.8% of the surveyed institutions from the private sector patented their innovations.

29 surveyed institutions copyrighted their innovations and out of these, 41.4% were academic institutions, 31.0% were from the private sector and 24.1% were government agencies.
Regarding institutions which trademarked their innovations, there were a total of 26: 9 (34.6%) each from private sector institutions and government agencies, 6 (23.1%) from academia and 2 (7.7%) from "others".

Majority (36.0%) of the sampled institutions that had lead time advantage belonged to the academia, 32.0% belonged to the private sector, and 24.0% were government agencies.
Finally, a relatively more significant proportion (37.0%) of the surveyed institutions that reported their innovations were conducted in secrecy as a means of protection were from the private sector; 29.6% were government agencies, and 25.9% were academic institutions. The above results are supported by Figure 14.

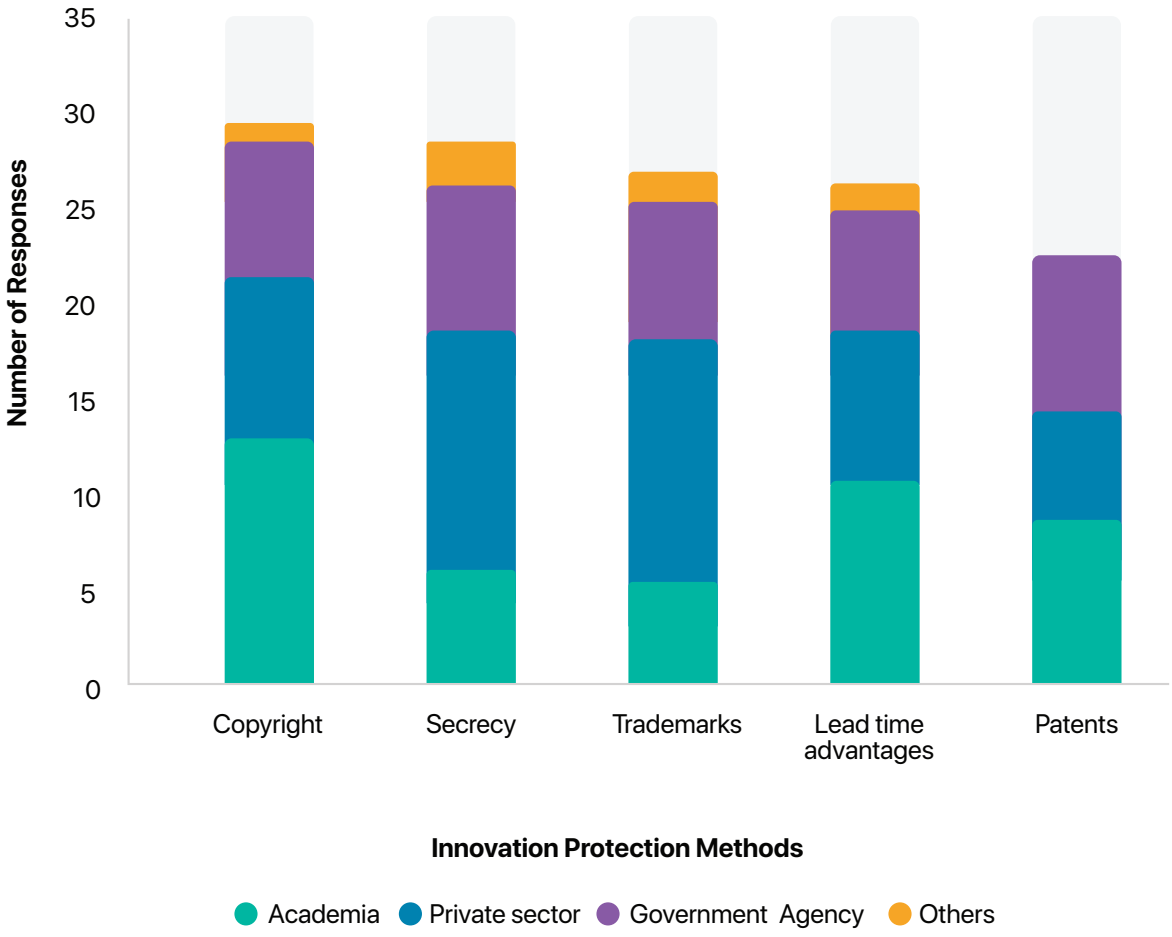

Figure 15: A pie chart of methods surveyed institutions adopted to protect innovations

Table 20: A Cross-tabulation between Innovation activities surveyed institutions engaged in and methods surveyed institutions adopted to protect innovations

Variable		Patents	Copyright	Trademarks	Lead time advantages	Secrecy	Total (N)
Innovation activities institution engaged in	• Intramural (in-house) R&I: R&I activities are undertaken by your institution to create new knowledge or to solve scientific or technical problem.	20 (17.5%)	26 (22.8%)	23 (20.2%)	23 (20.2%)	22 (19.3%)	114
	• Extramural (contracted-out): R&I same as above but performed by other companies.	17 (20.5%)	18 (21.7%)	16 (19.3%)	15 (18.1%)	17 (20.5%)	83
	• Acquisition of machinery, equipment, and buildings	18 (17.0%)	24 (22.6%)	21 (19.8%)	20 (18.9%)	23 (21.7%)	106
	• Acquisition of software for the development and/or introduction of new or significantly improved products or processes	16 (18.0%)	19 (21.3%)	20 (22.5%)	16 (18.0%)	18 (20.2%)	89
	• Acquisition of software for the development and/or Acquisition of existing know-how, copyrighted works, patented and non-patented inventions and other types of knowledge from other institutions or organisations for the development of new or significantly improved products or processes	15 (17.4%)	20 (23.3%)	16 (18.6%)	18 (20.9%)	17 (19.8%)	86
	• Training for innovative activities In-house or contracted-out training for your personnel specifically for the development and/or introduction of new or significantly improved products or processes	19 (16.7%)	26 (22.8%)	25 (21.9%)	21 (18.4%)	23 (20.2%)	114

	• Other activities: Other in-house or contracted-out activities to implement new or significantly improved products or processes such as feasibility studies, testing, tooling up, industrial engineering, etc.	10 (16.1%)	13 (21.0%)	12 (19.4%)	13 (21.0%)	14 (22.6%)	62

The cross-tabulation between innovation activities surveyed institutions engaged in and measures surveyed institutions adopted to protect innovations is presented in Table 20.

The surveyed institutions which engaged in intramural (in-house) innovation activities protected their innovations as follows:

- 22.8% reported their innovations were copyrighted
- 20.2% said their innovations were trademarked
- 20.2% indicated they received a lead time advantage for their innovations
- 19.3% indicated they conducted their innovations in secrecy
- 17.5% were patented.

Regarding organisations which engaged in extramural (contracted) innovation activities, 21.7% reported their innovations were copyrighted, 20.5% said their innovations were patented, another 20.5% said they conducted their innovations in secrecy, 19.3% of the institutions reported their innovations were trademarked to protect them, and the remaining 18.1% reported that they received a lead time advantage as a protection for their innovations.

106 institutions engaged in "acquisition of machinery, equipment and buildings". Out of this, 22.6% copyrighted their innovations, 21.7% innovated in secrecy and 19.8% trademarked their innovations as a means of protection.

Concerning institutions which engaged in "acquisition of existing know-how, copyrighted works, patented and non-patented inventions and other types of knowledge from other institutions or organisations for the development of new or significantly improved products or processes", most (23.3%) of the innovations from these institutions were copyrighted. 20.9% had lead time advantage and 19.8% of these institutions conducted their innovations in secrecy.

The majority (22.8%) of innovations from institutions which engaged in "training for innovative activities in-house or contracted-out training for the personnel for the development and/or introduction of new or significantly improved products or processes" claimed they protected their innovation through copyright. 21.9% of the sampled institutions also reported that their innovations were trademarked as a form of protection.

For institutions which engaged in innovation activities involving "acquisition of software for the development and/or introduction of new or significantly improved products or processes", most (22.5%) of them trademarked their innovations as a form of protection, while 21.3% of the institutions indicated they protected their innovations using copyright.

4.6 Non-Innovators

- Out of the 50 surveyed institutions, only one indicated it did not engage in any innovation activities in the past five years.

- The institution is a government agency and has been in operation for less than 10 years with over 30 staff.

- The organisation indicated that it considered innovating, but the barriers to innovation were too large. It rated "low demand for innovations in its research area" and "no need to innovate due to existing innovations" as important reasons for its inability to conduct innovative activities. It was, however, neutral/indecisive about "no need to innovate due to very little competition in its area of research" and rated the "lack of good ideas for innovation" as an unimportant reason for its failure to innovate in the past five years. The "lack of good ideas for innovations" was also rated as not unimportant reason contributing to the failure to innovate.

- Furthermore, the institution indicated that "difficulties in obtaining government grants or subsidies for innovation" was an important barrier to innovation. It further rated "lack of collaboration partners" as a very important barrier to innovation. It was, however, neutral/indecisive about the "lack of internal finance for innovation", "lack of information on access to financing possibilities", and "new regulations" as a barrier to innovation. The "lack of information on new technologies" was rated as an unimportant barrier to innovation.

5.0 Conclusion

This survey is a baseline study to take stock and inventory of the research and innovation support programme's access and utilisation in the research ecosystem in Ghana. In this study, an innovation is defined as the introduction of a new or significantly improved product (goods or services) or process.

A sample of 50 institutions was deemed adequate to generalise the study findings within a margin of error of 0.01. The sample also accounted for 10% nonresponse. The sample comprised 19 government agencies, 16 academic institutions, 13 institutions from the private sector, and the remaining 2 institutions belonged to other organisational categories not captured in the survey instrument.

The survey findings indicated that 98% of the surveyed institutions had engaged in innovation activities in recent years. However, the test of association between a surveyed institution's category and whether they had engaged in innovation activities in recent years at a 5% significant level was not statistically significant. Most (44%) of the sampled institutions had been operating for over 30 years. The surveyed institutions predominantly had an estimated staff strength of more than 30 people.

The study findings showed that **training for innovative activities** (In-house or contracted- out training for personnel specifically for the development and/or introduction of new or significantly improved products or processes) was the most innovative activity surveyed institutions engaged-in in recent years. Next to that was **intramural (in-house) R&I** (R&I activities are undertaken by an institution to create new knowledge or to solve a scientific or technical problem). According to the findings, the **institution, in partnership with other organisations, was primarily responsible for developing the innovation**, followed by instances where the institution alone was responsible for innovation development.

40 out of the 49 surveyed institutions which engaged in innovation activities in recent years received support for **technology/knowledge transfer**. These institutions comprised of 14 (35.0%) Government Agencies, 13 (32.5%) Academic institutions and 11 (27.5%) institutions that belonged to the Private Sector. Additionally, the institutions which received this kind of support had been in operation for over 30 years (40.0%) and 10-20 years (32.5%). It is also worth mentioning that 2 (66.7%) out of the 3 institutions which did not receive any form of support had also been operating for more than 30 years, and the remaining 33.3% had been in operation for less than 10 years.

Based on the form of innovation support received, surveyed institutions reported that the support largely met their expectations. Furthermore, institutions which received support such as

"Support for awareness raising and information on support possibilities" and **"Support for the creation of specific skills",** respectively indicated the support perfectly met (29.7% and 30.0%) their expectations. Considering the institutional category of the sampled institutions:

- 10.4% of institutions from the Private Sector which received some form of innovation support had their expectations largely met and 8.3% had it perfectly met.
- 14.6% of the Academic institutions which received support had their expectations largely met, whereas 8.3% had perfectly met.
- In the case of the Government Agencies, 16.7% largely had their expectations largely met and 12.5% had theirs moderately met.

In general, Government Agencies seemed to have received more support (37.6%), followed by institutions from the Academia (31.3%). A chi-square of association revealed that there is no statistically significant association between the organisational category of surveyed institutions and extent innovation support received met expectations of surveyed institutions at a 5% significant level.

The study found that Government Agencies and Academic institutions mostly received some form of financial support. 22.9% of surveyed Government Agencies and 18.8% of Academic institutions reported they received financial support. However, no statistically significant relationship was found between the organisational category and receiving financial support. Considering the years surveyed institutions have been in operation, 26.5% of the institutions which have been operating for over 30 years received financial support for innovation activities and 14.3% of those which have operated for 10-20 years also received some form of financial support. However, none of the surveyed institutions which have operated for less than 10 years reported they received financial support for innovation activities.

The association between the variables, receiving financial support and length of operations, was statistically significant at a 5% significance level. That is, the tendency for an institution to receive any form of financial support for innovation activity largely depends on the number of years the institution has been in operation.

Donor funds and Internally Generated Funds were the primary sources of funds for funding innovative activities in Academia (14.6% and 10.4%, respectively) and the Private sector (8.3% and 14.6%, respectively). On the other hand, government agencies received funding from the Government of Ghana (10.4%) and Donor funds (14.6%). No statistically significant relationship was found between the organisation category of the institution and the sources of funds obtained; that is, source of funds does not depend on the category of the institution. The study

also revealed that a higher proportion of institutions that had existed for **over 30 years** received **Donor funds** (12.5%) and **Government of Ghana funds** (6.3%) for innovative activities. These institutions also funded their innovative activities using Internally Generated funds (12.5%). It was found that there was no statistically significant relationship between the length of operation of the institution and the sources of funds for funding innovative activities.

The surveyed institutions reported that **financial support for innovation activities** was mainly given in the form of **Grants and Technical Assistance.** Funding that came in the form of grants was received by academic institutions 38.7% of the time and by Government agencies 45.2% of the time. Financial support in the form of Technical Assistance was received by academic institutions 30.0% of the time and by Government agencies 46.7% of the time. Financial support from grants and technical assistance were mainly Donor funds (54.8% and 46.7% respectively). The survey findings also showed that financial support from the Government of Ghana was mainly in terms of technical assistance, grants and tax breaks/exemptions.

According to the study findings, information within the institution or institution's group was considered a very important (84.8%) information source that provided new innovative projects or contributed to the completion of existing ones.

- 45.2% of the surveyed institutions considered information from universities or other higher education institutions very important.

- Information received from Government or public research institutes were mainly rated as very important (52.3%) or important (28.6%) by the surveyed institutions, and 45.2% of information from private research institutes were considered as very as important sources of information for innovation projects or that contributed to the completion of existing ones.

- Information from within an institution or institution's group was mainly considered very important by the Government Agencies (32.6%).

- Institutions in Academia rated information from universities or other higher education institutions as very important (23.8%).

- Information sources from Government or public research institutes were rated as important (28.6%) or very important (52.3%), mainly by Academic institutions and Government Agencies.

- Furthermore, most institutions that rated information from private research institutes as very important (45.2%) were Private Sector institutions (21.4%). In contrast, those who were neutral/indecisive about their rating (28.6%) were predominantly institutions from Government Agencies (16.7%) and Academia (9.5%).

The following are the main reasons behind the surveyed institution's decision to innovative:

- Improving your institution's reputation (82.2%).
- Current or expected demand for innovations (66.7%).
- Government grants subsidies or other financial incentives for innovative development (48.8%).
- Existing innovation regulation (40.5%).

The results indicated that most of the Academic institutions rated; **"existing innovation regulation", "government grants subsidies or other financial incentives for innovative development", "current or expected demand for innovations"** and **"improving your institution's reputation"** as very important factors which influenced their decision to innovate.

Similar observations can be made about institutions from government agencies. Institutions from the Private Sector also rated all factors given as very important in deciding to innovate, with the exception of "government grants subsidies or other financial incentives for innovative development".

The survey results indicate most institutions in the **Academia** protect their innovations through **copyright, followed by having lead time advantage, and next to that is patenting them**. The **Government Agencies** reported they mainly protect their innovations by trademarking them, followed by Patents and Secrecy. Institutions in the **Private Sector** mainly protected their innovations by **conducting them in secret, followed by Copyright and trademarks.**

- Copyrighting innovations as a form of protection was common among institutions engaged in Intramural (in-house) R&I (your institution undertakes R&I activities to create new knowledge or solve a scientific or technical problem).

- A similar observation was also made about institutions which engaged in Extramural (contracted-out): R&I, the same as Intramural R&I but performed by other companies and training for innovative activities in-house or contracted-out training for your personnel specifically for the development and/or introduction of new or significantly improved products or processes.

It is worthy to note that one Government agency which had been in operation for less than 10 years, reported they had not engaged in any innovative activity in recent years. The institution indicated that they considered innovating, but the barrier was too great. They rated difficulties obtaining government grants or subsidies for innovation as an important barrier to innovation. Inferring from this isolated finding, start-up incubation support programmes should be introduced to enable new firms or institutions have easy pathways to innovate.

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About Heritors Labs

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Our Projects - The Journey so Far

BASELINE STUDY ON RESEARCH AND INNOVATION SOCIALISATION, COMMUNICATION, ADVOCACY AND MARKETING INFRASTRUCTURE: This report assesses the challenges and opportunities in promoting research and innovation (R&I) in Ghana, focusing on gaps in communication, advocacy, and marketing efforts necessary for effective industry engagement and commercialisation.

BASELINE STUDY ON INNOVATION SUPPORT PROGRAMMES: This report by the University of Ghana's SACU department assesses innovation support programmes in Ghana, aiming to enhance access, utilisation, and awareness of these programmes to boost national innovation and address policy gaps.

GESI WORKSHOP: The RISA programme's workshop, held on November 29, 2022, aimed to address gender equality and social inclusion (GESI) in Ghana's research and innovation ecosystem. The session highlighted barriers such as underrepresentation, gender pay gaps, and systemic biases, and gathered insights to develop inclusive policies and practices.

R-BENCH: This project aimed to enhance research and innovation commercialization in Ghana by expanding access to support programmes and improving the communication and advocacy of STIR. It involved mobilising resources, facilitating collaborations, and accelerating impactful initiatives to strengthen the R&I ecosystem.

INNOVATION SUPPORT PROGRAMMES: Heritors Labs, in partnership with various stakeholders including the Ghana Research & Innovation Support Programmes Coordinating Office (GRISPCO), focused on enhancing research and innovation commercialisation in Ghana. The initiative aimed to expand access to support programmes, improve communication and advocacy for STIR, and foster collaboration within the R&I ecosystem.

A 2-DAY GESI LEVELLING UP TRAINING WORKSHOP ON ENTREPRENEURSHIP AND ACCESSING INNOVATION SUPPORT PROGRAMMES: The GESI Levelling Up Training Workshop, held from February 21-22, 2023, at AITI-KACE, empowered women, young people, and those with disabilities in Ghana to enhance their entrepreneurial skills and access innovation support. The workshop focused on entrepreneurship fundamentals, financial management, innovation synergies, and practical skills for business growth.

STIRHUB: STIRHub is a comprehensive online platform that connects stakeholders in the ecosystem with essential resources, including access to investors, tools, and mentorship from experienced industry professionals.

THE 2023 GHANA STIRS COMMERCIALISATION PARTNERSHIP ROUNDTABLE: The 2023 Ghana STIRS Commercialisation Partnership Roundtable, held on March 15 in Accra, united development partners, academia, and industry to foster collaboration and advance research and innovation in Ghana. The event focused on aligning research efforts, overcoming barriers, and mobilising resources for the GIRC-Centre and broader R&DI ecosystem.

2-DAY CAPACITY BUILDING TRAINING WORKSHOP FOR JOURNALISTS AND RESEARCHERS IN THE EFFECTIVE COMMUNICATION OF SCIENCE TECHNOLOGY RESEARCH AND INNOVATION OUTPUTS: Heritors Labs and partners focused on enhancing research and innovation commercialisation in Ghana. The initiative aimed to expand access to support programmes, improve communication and advocacy for STIR, and foster collaboration within the R&I ecosystem.

GHANA INDUSTRY-UNIVERSITY-RESEARCH INSTITUTIONS COLLABORATIVE: The Ghana Industry-University-Research Institutions Collaborative Discovery Roundtable, held on April 14, 2023, aimed to enhance collaboration and create synergies between industry, research institutions, and universities to drive innovation and address Ghana's challenges. The event fostered discussions on joint research projects, commercialisation opportunities, and strategies to bridge the industry-academia gap, with a focus on developing actionable solutions for national development.

PWD WORKSHOP: The Stakeholders' Engagement for the Validation of the PWD Framework Workshop, led by Dr. Augustina Naami, aimed to validate and implement a comprehensive blueprint to enhance support and accessibility for Persons with Disabilities (PWDs) within Ghana’s research and innovation ecosystem. The event promoted collaboration, gathered feedback, and outlined actionable steps for integrating the framework into existing programmes.

WOMEN IN INNOVATION AND RESEARCH CONCLAVE: The Women in Innovation and Research Conclave celebrated women's achievements, encouraged collaboration, and addressed challenges in these fields, promoting gender equality and inclusivity. It provided a platform for networking, knowledge sharing, and mentorship to inspire and support women pursuing careers in innovation and research.

STANDARDISATION WORKSHOP: The workshop, led by Heritors Labs and CSIR with support from RISA-Fund and FCDO, focused on advancing standardisation, certification, and conformity assessment. It aimed to promote collaboration among service providers, researchers, and innovators to enhance product quality and market readiness.

PATENT TRAINING WORKSHOP: The Patent Training Workshop, organised by Heritors Labs, MESTI, and CSIR, aimed to equip innovators with essential skills for effective patent filing and management. It covered patent drafting, application processes, and intellectual property laws to support and protect technological advancements.

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