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MARKET NEEDS ASSESSMENT IN S&T SYSTEMS AND R&D INSTITUTIONS FOR A MASTER OF R&D MANAGEMENT PROGRAM

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ABSTRACT – Professional development through formal and non-formal education has to adapt to a continually changing environment of the industry and technological trends in learning management systems. One of the pioneering post-graduate programs of the University of the Philippines Open University (UPOU) is the Diploma in Research and Development Management (DR&DM) program, which aims to professionalize incumbent and potential R&D managers through formal education in an open and distance e-learning (ODeL) mode. With financial support from the Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD) of the Department of Science and Technology (DOST), the DR&DM will be upgraded to a Master of Research and Development Management (MR&DM) in ODeL. Before the curriculum designing, an assessment is conducted through surveys (pen and paper and online), key informant interview (KII), and focus group discussion (FGD) in the national science and technology (S&T) system to determine the market demand for the MR&DM program, as well as the professional development needs of researchers, scientists, and managers in higher education institutions (HEIs), government, and private agencies. A total of 208 respondents from DR&DM students and alumni, members of the Philippine Association of Research Managers, Inc. (PHILARM), personnel of various DOST agencies, and attendees of the R&D Symposium and Colloquium participated in the survey, KII, and FGD. Results showed a high (71%) market demand for an online MR&DM program, but 80% were not aware of any MR&DM program offerings elsewhere in the Philippines and abroad. Respondents expressed that they can support their studies by themselves or through scholarship, and that they preferred part-time study that they can finish in 2-3 years. They preferred special problem/project or thesis as their program output. The proposed topics/ titles for the MR&DM consisting of courses offered in the DR&DM program and those from related academic programs were ranked based on which are the closest to their learning needs in their workplaces. These topics served as the basis for the MR&DM curricular proposal. Educational service providers should be attuned not only in knowledge contribution to the state of the art in R&D management, but also to the needs of the market (organization and industry) and the learners' professional growth.

Keywords: R&D Management, Curriculum Development, Open and Distance e-Learning

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INTRODUCTION

Background and Rationale

Education is vital in shaping the future of the individual and the society. It is also largely influenced by the current and future economic, social, demographic, political, and technological forces in the environment of the learners and education providers.

Educational programs change since social forces are continually changing (Parkay et. al., 2006). Hence, education providers should be able to determine the changing needs to keep abreast of the advancement and dynamism of the society including science and technology (S&T). Needs assessment is used in determining and validating the true needs of the curriculum (Salvadurai & Krashinski, 1989). The information about the actual needs that are required for the procedural development of the program is acquired through needs analysis. Information gathered may also help the curriculum designers in the instructional design of the curriculum (Grier, 2005). Needs assessment occurs at the beginning of the curriculum development process, and its output will be used in the curriculum-writing phase.

Research and development (R&D), a component of S&T, refers to the method of developing innovative activities in producing new products and services, or improving existing services or products. It is often seen in global competitiveness ranking that S&T is the fuel that boosts society's economic development. At present, the Philippines' allocation on R&D and the number of researchers is among the lowest among its Southeast Asian neighbors.

The Philippines allocates 0.14% of its GDP to R&D, and there are currently 187 researchers per million inhabitants, while countries like Thailand and Vietnam invest 2% of their GDP in R&D, and with 964 and 674 researchers per million inhabitants, respectively ("How much does your country invest in R&D", UNESCO Institute for Statistics, 2018).

The National Economic Development Authority (NEDA) states that investments in S&T, which includes R&D, should increase to 2% of the annual GDP for the Philippines to develop to First-World Status ("More investments in R&D needed", Business Mirror Editorial). In the 2017 Investment Priority Plan by the Department of Trade and Industry, R&D activities will be incentivized to encourage more companies to invest more in R&D. Hence, with these statistics as a challenge, the need for R&D Management surfaces.

The Diploma in Research and Development Management (DR&DM) is one of the pioneer programs offered under the Faculty of Management and Development Studies (FMDS) of the University of the Philippines Open University (UPOU). It was first conceptualized as a Master in Professional Studies in R&D Management program, which aimed to cater to research and support personnel of R&D/S&T organizations, and was also intended to be offered to practitioners, incumbent, and potential managers. With no needs assessment data to back up its offering, the UPOU removed the thesis requirement of the master's program and offered it as a diploma program in 1996. Over the years, the enrollment of the program has been sustained, and in the succeeding years, the question of the graduates was the same, when will the Diploma be elevated to Master's?

The Department of Science and Technology (DOST) Philippine Council for Industry, Energy, and Emerging Technology Research and Development's (PCIEERD) support to professionalize S&T personnel gave UPOU the opportunity to back up with hard facts the demand for the Master of Research and Development Management (MR&DM) program. UPOU, through the FMDS, proposed a two-phased project funded by PCIEERD. The first phase of which is a

needs assessment of S&T personnel both in private and public sectors locally and internationally.

Objectives of the Study

The study aimed to assess the R&D professional development needs of R&D personnel/ practitioners and managers of the country. It specifically intended to identify the potential learners/students of MR&DM, determine the market demand for the MR&DM program, and analyze the professional development needs of R&D personnel and practitioners for the curriculum development of MR&DM.

Relevant Studies

Research Development in the Philippines

The Global Competitiveness Report by the World Economic Forum ranks countries in terms of its "competitiveness", which is defined as "the set of institutions, policies, and factors that determine the level of productivity of a country". They believe that a competitive economy is a productive one, and that productivity leads to growth, which leads to income levels and improved well-being. A country's competitiveness is divided into 12 distinct pillars: 1) Institutions; 2) Infrastructure; 3) Macroeconomic Environment; 4) Health and Primary Education; 5) Higher Education and Training; 6) Goods Market Efficiency; 7) Labour Market Efficiency; 8) Financial Market Development; 9) Technological Readiness; 10) Market Size; 11) Business Sophistication; and 12) Innovation.

Three of the twelve pillars explicitly related to S&T are Technological Readiness (9th pillar), Higher Education and Training (5th pillar), and Innovation (12th pillar). Technological Readiness measures the agility with which an economy adopts existing technologies to enhance the productivity of its industries, with emphasis on its capacity to integrate information and communication technology (ICT) in daily activities and production processes for increased efficiency and competitiveness. Higher Education and Training refers to the quality and quantity of higher education, and quality and availability of on the job training. Finally, Innovation refers to the capacity for, and commitment to technological innovations.
For the 9th pillar, or Technological Readiness, the Philippines ranks 83rd out of 137 countries, maintaining its rank from the previous report (2016-2017). For Higher Education and Training, or the 5th pillar, the Philippines ranked 55th, a decline from the previous report which is 58th (2016-2017). The Philippines' ranking in Innovation (12th pillar), also declined to 65th in the 2017-2018 edition, from 62nd in the previous report.

In the Global Competitiveness Report 2017-2018, the Philippines' overall ranking improved from 57th (score: 4.35 out of 7) last year to 56th (score: 4.36 out of 7) this year. However, among ASEAN countries, the Philippines' rank fell from the 6th spot from 2016 to 8th this year.

The Science, Technology, Research and Innovation for Development (STRIDE) program funded by the United States Agency for International Development (USAID) and implemented by RTI International, assessed the innovation system in the Philippines (2017), specifically for the agribusiness in the Philippines. One of the key findings in the study is that the weak relationship between the academe and the industries hinders innovation. The weak academe-industry relationship may result in researchers not understanding the industry's needs for innovation, and industries being unaware of the university's innovations, expertise, and marketable technologies. The identification of need is a critical stage in

innovation-to-growth pathway, and the private sector actors include farmers and agro-input companies or processors. Thus, a strong relationship between research and industry is needed.

In a study conducted by Tullao and Regadio (2018), the R&D funding and productivity of State Universities and Colleges (SUCs) were examined. Results showed that most SUCs have poor R&D outputs and have not been able to optimize the utilization of their R&D funding, except for a few outstanding universities, such as the University of the Philippines, Central Luzon State University, and West Visayas State University. The R&D budget for SUCs for the fiscal year 2014 amounts to 1.43 billion, a 10% increase from the previous year's 1.29 billion (General Appropriations Act of fiscals' year 2013-2014, cited by Tullao & Regadio, 2018). A productive SUC could at least produce 30 researches per year; of the total 112 SUCs, 46% were not able to produce at least 15 R&D per year, and 45% were not able to produce any research output. The study recommended new R&D policies and funding formulas that incentivize both SUCs and private HEIs to optimize their contributions to the R&D productivity of the Philippines.

Quimba, Albert, and Llanto (2017) examined the current status of innovation strategy across business and industry in the Philippines. Results showed that firms have a tendency of viewing their product innovation as trade secrets for the sake of maintaining an advantage over competitors, which results in having low intellectual property applications across all industries.

Research and Development Management

The link between research productivity and economic growth has long been established (Zaman et al., 2018; Stokey, 1995; Lehtinen, 2018). Specifically, economic growth has: 1) a long-run relationship with research output; 2) bidirectional causality with the number of publication; 3) a two-way causal relationship with R&D expenditures; and 4) feedback hypothesis with researchers involved in R&D activities (Zaman et al., 2018).

The key driver of innovation and organizational value in R&D organizations are intangible assets. Intangible resources can be categorized into three groups – human, organizational, and relational. Human capital is essential for R&D organizations since they rely on highly educated scientists. Organizational capital includes brand, intellectual property (IP), strategy, culture, and reputation of the R&D firm. Relational capital refers to the partnering agreements with suppliers, external subject matter experts, and research centers or universities, among others (Pike, 2005).

The accumulation of intangible assets, however, does not necessarily equate toward an increase in R&D performance. According to Del Canto and Gonzales (1999), it is the effective management of resources – both tangible and intangible, that determines the differences in R&D performance. Results in their study showed that a high stock of qualified human capital is positively associated with carrying out R&D activities.

Du, Leten, and Vanhaverbeke (2014) studied the relationship between open innovation and the financial performance of R&D projects. Results showed that management plays a critical factor in the success of the projects: R&D projects with open innovation partnerships are associated with better financial performance if they are suitably managed, and market-based partnerships are associated with lower performance if not managed properly.

At present, different organizations compete in fast-paced environments in developing and innovating products. The research environment, particularly the role of the manager in the

success of R&D projects, and managing these projects requires a deep understanding of both the mechanism and type of knowledge created. Chandraskaran (2015) studied a two-phased multi-method study to understand knowledge creation in high-technology R&D projects. Results showed the importance of adopting a pragmatic view in studying knowledge creation –both objective and intuitive knowledge. Although most high-tech environments place much more importance on theoretical or objective knowledge from various scientific domains, results from the study showed that practical or intuitive knowledge are just as essential.

Sapienza (1995) states that a good manager is also a good leader, one who leads scientists as individuals, while administering the R&D of the organization. The main objective of an R&D organization is to generate knowledge and ideas, and is comparatively harder to predict and measure, and different to judge except in hindsight. A good manager must be able to achieve the right balance in R&D between: 1) ambiguity and challenge to foster creativity; and 2) limitations necessary for producing results within time, costs, and commercial objectives. In reality, not all who became research managers have been trained or educated in management. They rose from the ranks or were appointed to the managerial position, not because of their administrative abilities and organizational skills, but because they were good engineers, research scientists, or technical experts. Hence, on this premise, the DR&DM program got its impetus to be offered formally through UPOU.

Curriculum Development Process

The curriculum is viewed as the foundation towards achieving the learning goals and objectives. The curriculum corresponds to the conscious and systematic selection of knowledge, and will answer what, why, when, and how the students will learn (Stabback, 2016).

The curriculum development process, on the other hand, encompasses both the design and development of the consolidated plans for learning, design for the implementation of the plans, and of the evaluation of the plans, their implementation, and the overall outcome of the learning experience (“A Curriculum Development Process”, n.d).

Curriculum development includes four interrelated phases, and these are: 1) curriculum shaping; 2) curriculum writing; 3) preparation for implementation; and 4) curriculum monitoring, evaluation, and review. Phase 1, or the curriculum shaping, includes a period of consultations with key stakeholders including targeted consultations, and its output will guide the curriculum writers for the next phase – the curriculum writing (“Curriculum Development Process”, Australian curriculum, assessment, and reporting authority 2012).
In a study conducted by Noll and Wilkins (2002), the specific skills and knowledge required for Information Systems (IS) professionals were determined as part of the curriculum development process. Results from the study were utilized as the foundation for developing the courses.

University-Industry cooperation during the development of curriculum provides benefits – both mutual and unilateral. Benefits for universities include: (1) improved quality of programs; (2) research collaboration; (3) attraction of funding; and (4) better employment opportunities for graduates. For the industries, benefits include: (1) better-trained graduates; (2) technology transfer; (3) innovation to marketplace; and (4) solutions to industry problems. Cooperation between universities and industries also provides an improved public image between the two (Matkovic et al., 2014).

Needs Assessment

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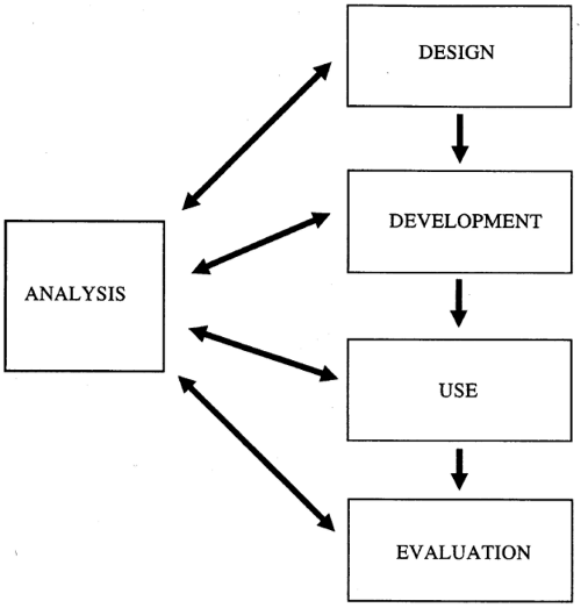

Figure 1. Instructional systems development (Rossett, 1995)

Rossett (1995) describes the role of needs assessment as giving the information needed to improve performance. As shown in Figure 1, needs assessment propels the system – shaping the design, development, implementation, and evaluation decisions (Rossett, 1995). Needs assessment is applicable in various settings including educational institutions, particularly in curriculum development (Bosher & Smakori, 2002; Grier, 2005). In a study conducted by Dousay and Logan (n.d.) where they analyzed and evaluated the different stages of Analysis, Design, Development, Implementation, and Evaluation (ADDIE) on a training for a community resource center, the instructional goals were determined by performing a needs analysis on the program – through needs analysis, designers can determine what gaps exist and which gaps can be addressed through the program. Based on the needs analysis performed, the project team was able to determine that the instructional materials were last updated 5 years before the study was conducted. Furthermore, the parents and learners expressed concerns on the knowledge displayed by the volunteers.

Open and Distance e-Learning (ODeL)

Technology is becoming pervasive in life, with its greatest impact seen in education. Aside from the impact technology has on enhancing education, it also affects the introduction and use of education of future generations and their ability to function in a technology-rich society (Neal & Miller, 2006). According to Bonk (2004), as cited by Neal & Miller (2006), “technology, the art of teaching, and the needs of the learners are converging”. With the prevalence of technology, the current complication is not technology access but how to effectively design and develop instructional materials and activities, and implement them effectively in order to achieve instructional goals and objectives that are as good as or better than the traditional form of classroom instruction.

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Innovations in ICT have enabled educators to develop new technologies for teaching and

learning. These innovations were labeled as “distance education”, “open learning”, and “blended learning” – which now falls under the umbrella of Open and Distance e-Learning (ODeL) (Alfonso, 2014).

Distance education is a learning methodology wherein the teachers and the learners are physically separated from each other – the students undertake a guided and independent study, and a two-way communication exists between the teacher and the student (Alfonso, 2014). Open learning, on the other hand, is a vision of an educational system with minimal restriction – emphasizing the flexibility of a system that eliminates barriers such as age, geographical location, time constraints and economic situation (Alfonso, 2014).
E-learning is the application of networked ICT to teaching and learning (Naidu, 2006, cited by Alfonso, 2014).

Successful distance learning is affected by learner preferences and affinity for learning at a distance (Galusha, 2001). Cercone (2008) examined the characteristics of online adult learners that may influence the design of an online learning environment such as their biology, learning styles, active involvement in the learning process, and valuing of self-reliance (which requires scaffolding from the instructor). Moreover, Cercone (2008) observed that adults have a pre-existing learning theory and are problem centered. They also thrive on a collaborative, respectful, mutual, and informal climate, need dialogue, and must be provided with avenues to collaborate with other students. Cercone (2008) also noted that instructors should act as facilitators and they must be able to acknowledge the adult learners’ prior experience and let them connect it to new knowledge.

Based on the above, adult learners’ characteristics and applying learning theories such as andragogy, self-directed learning, experiential learning, and transformative learning, recommendations for the design of the online classroom include: 1) consideration of each learner’s individuality; 2) provision of discussion forums to encourage students to post responses to questions, read other comments, etc.; and 3) planning the course environment that allows participants responsibility for leadership and group presentations (Cercone, 2008).

Theoretical and Conceptual Framework

General Systems Theory (GST) employs a systems approach in understanding complex problems. The components of a system in GST are hierarchical, interdependent, and permeable. Hierarchical in terms of its components as they are organized into subsystems and supersystems; interdependent because components rely on each other; and permeable because it is an open system and that the components will interact with its environment (Miller, 2012). GST postulates that the four aspects of a system are the component entities, the relationship between them, the attributes of a system, and the environment in which it is located (Littlejohn & Foss, 2007).

Systems Analysis allows instructional designers to view problems broader – each system is composed of subsystems that are interrelated, and each change in each of the subsystem changes the whole system (Gomez-Ortigoza & Wedemeyer, 1985). The concepts of systems theory that are applicable to the research study were:

1. **Elements** – components of each system, and sometimes considered as a system itself (subsystem).
2. **Inputs and resources** – can be viewed as system resources, which, in many cases, initiate action within a system. System inputs can be in physical form or can be pure information or data.

3. **Outputs** – are the results of the conversion process within a system, and can also be considered as the by-products of the conversion process.
4 **Environment** – defined by boundaries around the system under study, and is immediately outside the system under analysis. The environment influences the internal workings of the system under study.
5. **Purpose and function** – the purpose of a system is determined by its relationship with other systems (both sub and meta).
6. **Structure** – the relationships that bind the subsystems together form the structure.

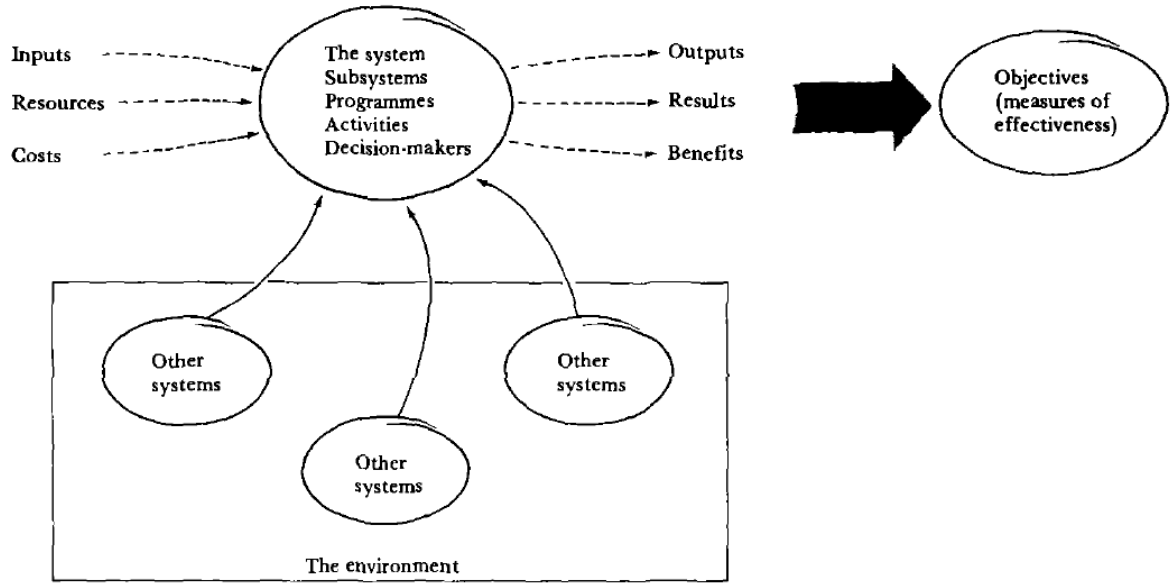

Figure 2. A system and its environment

Using the systems framework, R&D professional development needs were determined by identifying the demand for the MR&DM program and the needs of researchers, scientists, and managers in different industries, institutes, and academe with consideration of the current trend of R&D. Using the framework below, findings from this study will be used in developing the curriculum of the MR&DM program.

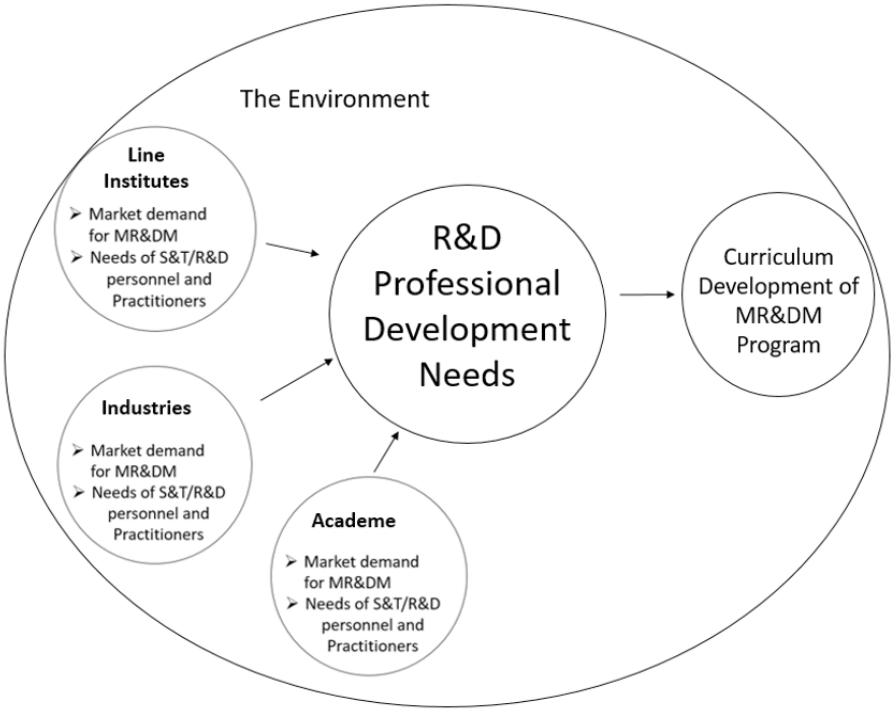

Figure 3. The research framework for the project's phase 1

Materials and Methods or Methodology

The survey questionnaire, administered both online and paper and pen, were answered by 182 respondents were DR&DM students and alumni, members of Philippine Association of Research Managers, Inc. (PHILARM), participants from the "Symposium on R&D Management: Discipline and Practice" and "Colloquium on R&D Management: Innovation and Trends", and employees of DOST agencies.

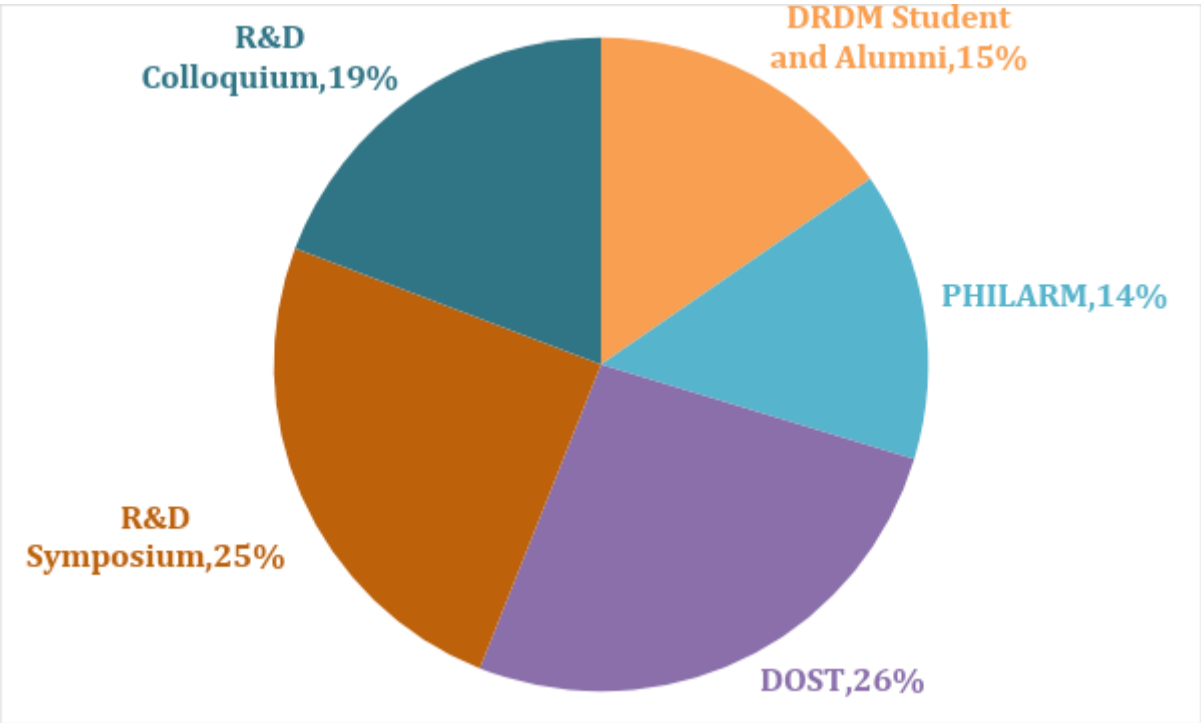

Figure 4. Respondents of the survey questionnaire

A focus group discussion (FGD) was conducted and attended by 14 respondents from PCIEERD. Due to scheduling conflicts among other respondents, key informant interviews (KII) were conducted instead of FGD, where 12 respondents from various DOST agencies served as interviewees. In total, the market needs assessment was participated by 208 respondents.

The online survey was administered to DR&DM students and alumni, and DOST institutes. Three science parks with 63 companies were also invited to participate in the survey. Unfortunately, the research team received no response from the S&T parks, while there were 48 respondents from various DOST institutions, and 28 respondents from students and alumni of DR&DM. For PHILARM respondents, the researchers administered a paper and pen questionnaire during their training-workshop entitled "Training-Workshop on Domain and Distinction of Research Management" that took place in DOST - Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development (PCAARRD) on March 22, 2018. A paper and pen questionnaire was also administered during the "Symposium on R&D Management: Discipline and Practice" and "Colloquium on R&D Management: Innovation and Trends" held on September 5, 2018 and November 14-15, 2018, respectively, at the Centennial Center for Digital Learning (CCDL) Auditorium at UPOU, Los Baños, Laguna.

RESULTS AND DISCUSSION

Survey Respondents

The demographics of the 182 respondents are shown in Figure 5. The majority of the

respondents fall under the ages of 31-40 years old (31%), female (52%), and with Bachelor's and Master's degrees (30% and 29%, respectively).

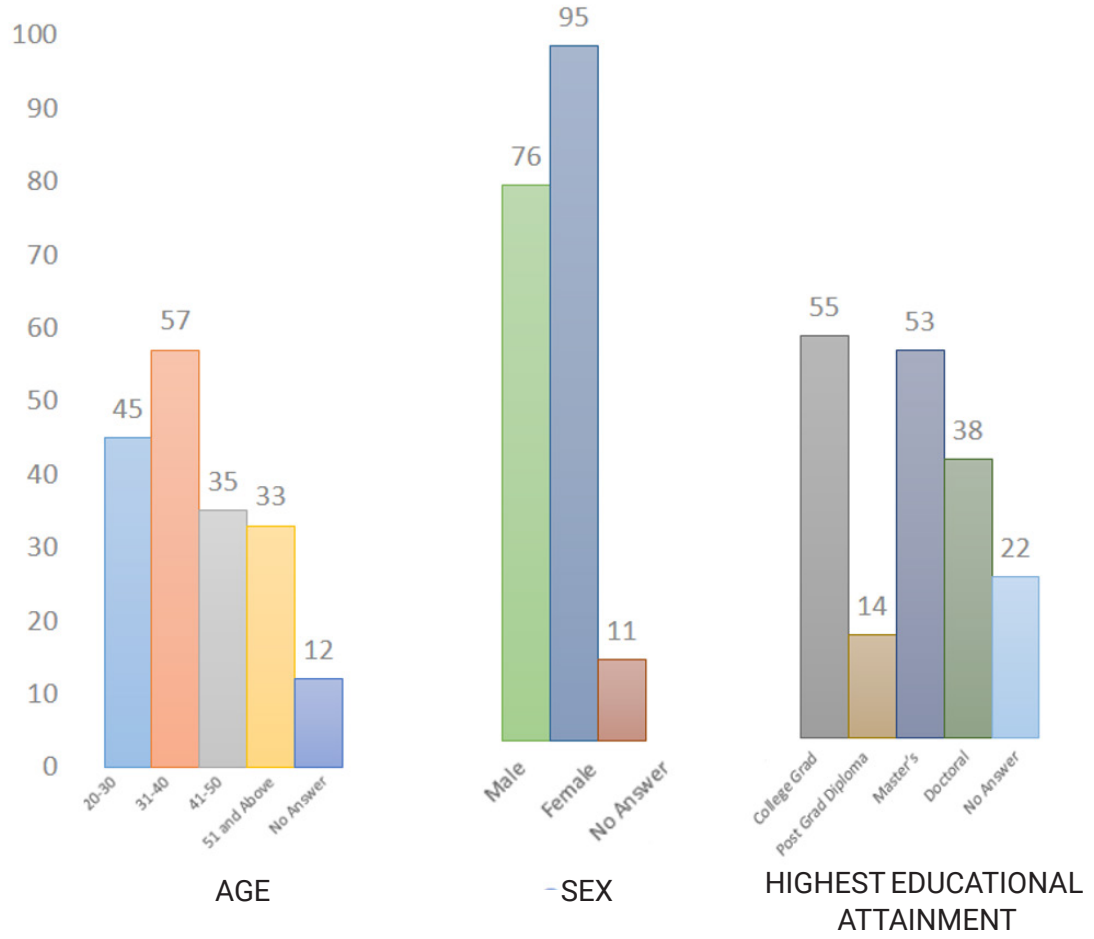

Figure 5. Profile of the survey respondents

As shown in Figure 6, the nature of work with the most number of respondents are R&D (46%), research coordination and monitoring (37%), education (26%) and supervision (25%).

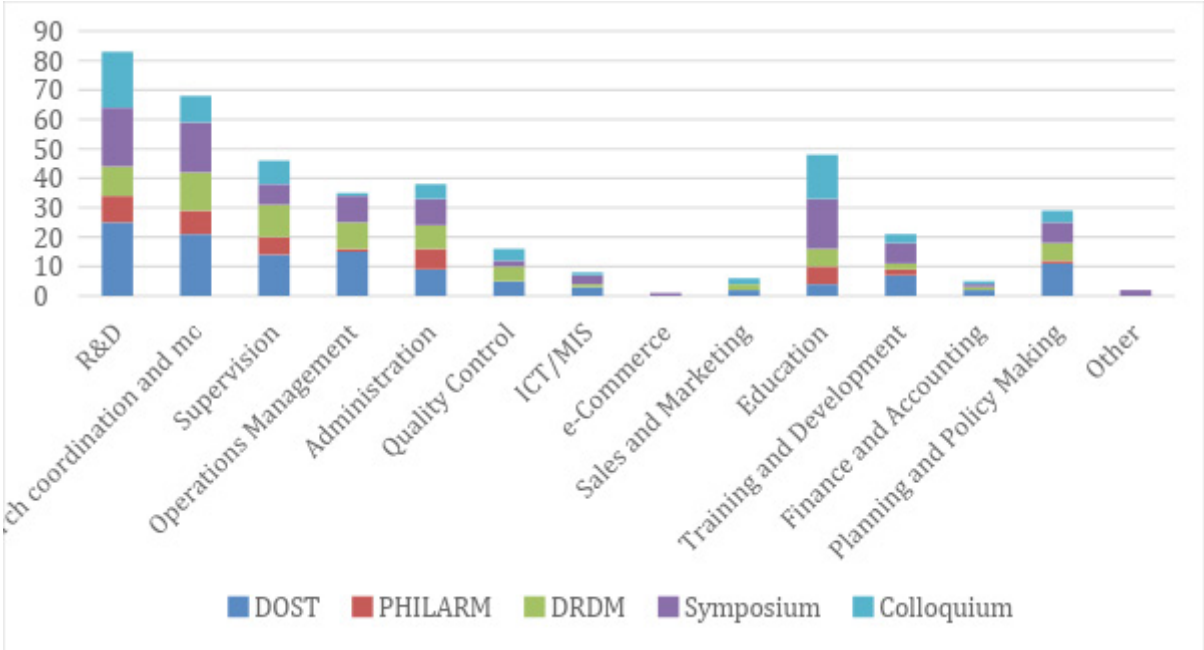

Figure 6. Nature of work of respondents

FGD and KII respondents

The demographics of the FGD and KII respondents are shown in Table 1. FGD participants were mostly 41-50 years old, female, and Master's degree holders. On the other hand, the KII participants were mostly 51 and above, female, and Bachelor's degree holders.

Table 1. Profile of the FGD and KII respondents

Characteristics	FGD		KII	
	f, n=14	%	f, n=12	%
Age				
20-30	2	14	2	17
31-40	3	22	3	25
41-50	6	43	3	25
51 and Above	1	7	4	33
No Answer	2	14	0	0
Sex				
Male	4	14	4	33
Female	10	71	8	67
Highest Educational Attainment				
College Grad	3	22	6	50
Post Grad Diploma	0	0	0	0
Master's	9	64	2	17
Doctoral	0	0	4	33
No Answer	2	14	0	0

Market Demand for the MR&DM Program

Knowledge and Interest on a MR&DM program

Majority of respondents (84%) were not aware of any MR&DM program offerings, but majority (80%) were also interested in taking one. The reasons of the respondents who were not interested in taking the MR&DM program include near retirement and/or already have PhDs, but they will recommend the program to their subordinates.

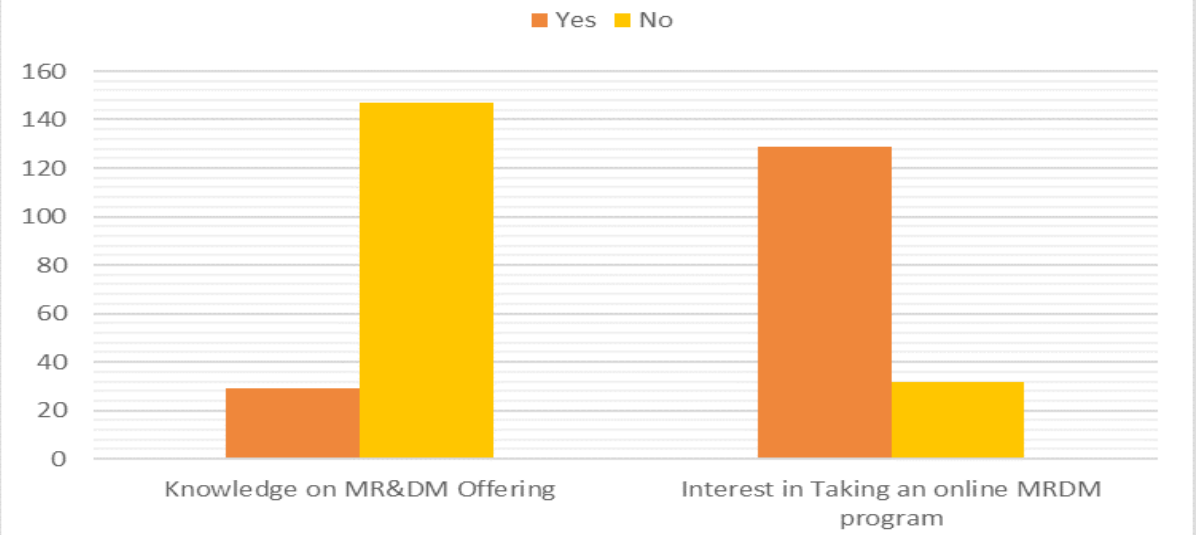

Figure 7. Knowledge on MR&DM Offering and Interest in Taking an online MR&DM program

Part-time vs. Full-time Students

Results showed that the majority (70%) preferred to take the MR&DM program part-time but the preference of respondents within a group varied. Fifty-six percent (56%) of the DR&DM students and alumni preferred to be full-time students while the rest (44%) preferred to study part-time. The opposite was shown by PHILARM respondents as a majority of them (83%) preferred to study part-time, while 17% preferred to study full-time. While a majority of DOST respondents preferred part-time (65%), still 35% would opt for full-time. For the R&DM Symposium and Colloquium, a majority (75% and 88%, respectively) will study part time.

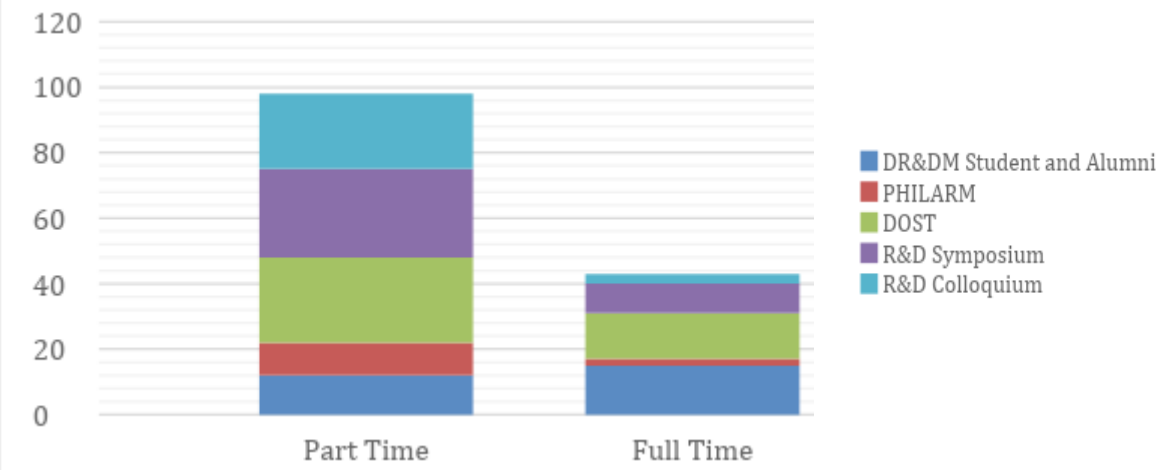

Figure 8. Preference for part time or full time study

Duration in Finishing the Program

Figure 9 shows that a majority of respondents (68%) expressed that they will be able to finish the program within 2-3 years. The MR&DM program will consist of 21 units of core courses, 9-12 units of electives, and 3-6 units of program output (i.e., thesis, special project) for a total of 36 units. Usually at UPOU, part-time students/learners take two courses equivalent to six units (3 units per course) per semester. Hence, for part-time students, the MR&DM program can be completed in at least six (6) semesters or three (3) years.

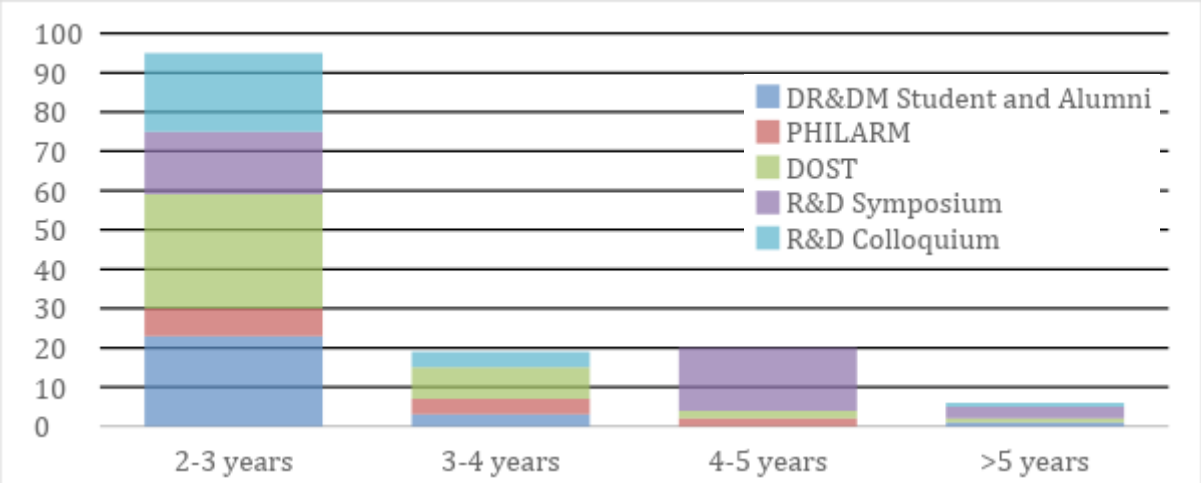

Figure 9. Duration in finishing the program

Financing their Education

The respondents identified several means that could support their studies, which include

self-financing (47%), scholarship (37%), sponsorship (7%), and others (9%). As shown in Figure 10, a majority of DR&DM students and alumni claimed that they could self-finance (81%) their studies, while others said their studies could be financed through sponsorship (11%) and scholarship (8%). PHILARM respondents, on the other hand, will rely on scholarship (50%) and self-finance (38%) then sponsorship (12%). In DOST, more than half of the respondents would depend on scholarship (72%) then self-finance (26%) or through sponsorship (2%) for their study. Respondents from the R&D Symposium and Colloquium can self-finance (39% and 59%, respectively), be sponsored (4% and 9%), get a scholarship (26% and 32%), and 31% from the symposium respondents will get financing through other means.

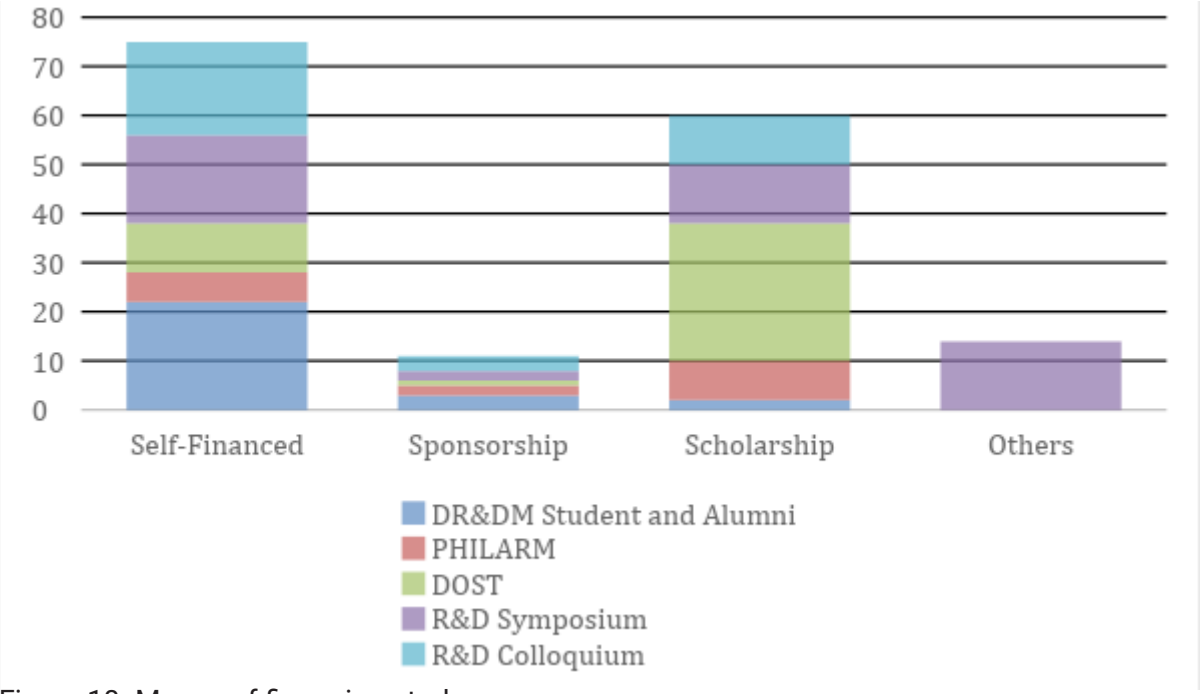

Figure 10. Means of financing study

The DOST implements the Human Resource Development Program (HRDP) in its system which encourages qualified DOST employees to pursue further studies by providing scholarships for Master's and Doctorate degrees, and training opportunities. Those who opted to self-finance their graduate studies (Doctorate and Master's) can receive an incentive instead. A Diploma degree, however, is only equivalent to training; hence, respondents are looking forward to the elevation of the DR&DM program to MR&DM.

The personnel interviewed from the Human Resource Development Office (HRDO) in one of the DOST institutes mentioned that they conducted a study on the employees' interest in a graduate program. The study revealed that there are sixty-one (61) potential scholars in their division, while fifteen (15) staff are on-going scholars enrolled under technical courses.

Preferred Output for the Program

For the DR&DM students and alumni respondents, 53% preferred non-thesis: special project/ problem (SP), 36% preferred thesis as program output, and 11% preferred non-thesis: comprehensive exam (compre). Fifty-nine percent (59%) of PHILARM respondents preferred thesis as the program output, while 41% preferred non-thesis: SP. For the respondents from DOST, 45% preferred thesis, 43% preferred non-thesis: SP, 8% preferred non-thesis: compre, and 4% preferred non-thesis: oral exam as the expected program output. Majority of the respondents from the R&D Symposium preferred thesis (69%) as their program output, while respondents from the R&DM Colloquium mostly preferred non-thesis (SP) (61%). Overall, most of the respondents preferred thesis (48%) and SP (44%) as their program output.

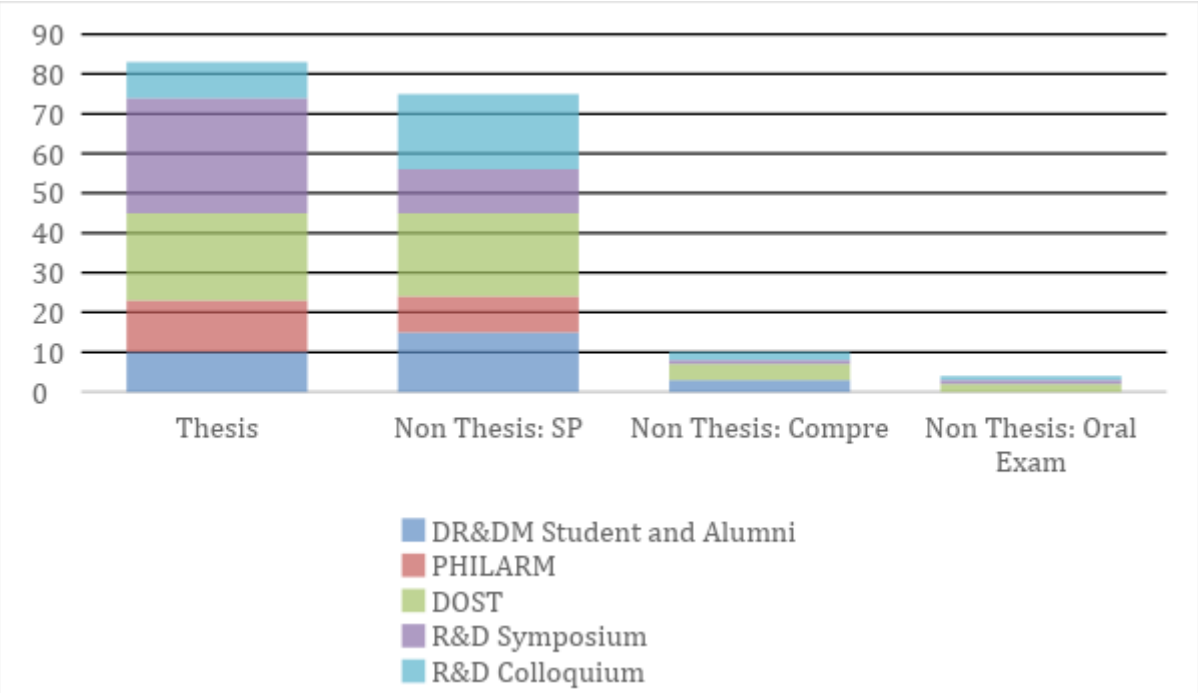

Figure 11. Expected program output

Likewise, FGD participants varied in their responses on their preferences for the output of the program, some preferred thesis while others preferred SP. They also raised concerns, such as: (1) employees studying full-time should be on study leave, if they will be on part-time study, they may not be able to focus on their theses; (2) the employee who will avail the scholarship grant needs to present his/her thesis topic in a technical committee of his/her office to ensure that the topic is related to his/her unit/line of work; and 3) the employee who opted for SP, may encounter funding problems. They recommended the MR&DM program to allow students to choose their preferred output whether thesis, SP, or field study.

Professional Development Needs of R&D Personnel

The respondents were asked to rank 18 course titles that were derived from the existing DR&DM program of UPOU and other master's programs related to R&D management from other universities abroad. Table 2 presents the results of the survey. Highlighted are the top seven (7) courses with their corresponding rank enclosed in parentheses.

Table 2. Summary of the preferred courses for the MR&DM program

Courses	Survey (n=182)	FGD (n=14)	KII (n=12)	Consensus N=208
A. Principles of R&D Management	2nd	3rd	2nd	2nd
B. R&D Portfolio Management	8th	13th	17th	14th
C. R&D Strategic Management	1st	4th	4th	3rd
D. Financial Management and Analysis in Research Management	4th	5th	13th	7th
E. Grant and Contract Management	16h	13th	18th	18th
F. R&D Project Planning and Management	3rd	1st	1st	1st

Table 2 continued..

Courses	Survey (n=182)	FGD (n=14)	KII (n=12)	Consensus N=208
G. Intellectual Property, Technology Transfer, and Commercialization	6th	9th	5th	6th
H. Technology Evaluation and Commercialization	15th	12th	9th	12th
I. Technology Business Incubation (TBI)	17th	13th	14th	17th
J. Technologies Used for Research Management	11th	13th	5th	10th
K. Regulatory Environments, Compliance, Ethical and Legal Issues	13th	6th	14th	11th
L. S&T Policy Analysis	12th	9th	14th	12th
M. Public Policy and Program Management	9th	8th	10th	8th
N. Qualitative and Quantitative Research Methods	5th	2nd	7th	4th
O. Administrative/Support Systems for R&D	18th	13th	8th	15th
P. R&D Leadership and Organizational Processes	7th	11th	10th	8th
Q. Methods in R&D Problem Solving and Decision Making	9th	7th	3rd	5th
R. Creativity in R&D	14th	13th	12th	15th

**the top seven (7) courses were highlighted*

The top seven preferred courses are as follows: R&D Project Planning and Management (1st); Principles of R&D Management (2nd); R&D Strategic Management (3rd); Qualitative and Quantitative Research Methods (4th); Methods in R&D Problem Solving and Decision Making (5th); Intellectual Property, Technology Transfer, and Commercialization (6th); and Financial Management and Analysis in Research Management (7th).

Three of the seven DR&DM courses were included in the top seven preferred courses (see Table 3). The remaining four DR&DM courses were ranked 8th (R&DM220: Organizational Structures, Relations, and Processes in R&D Systems), 12th (R&DM251: Technology Evaluation and R&DM252: Technology Commercialization and Utilization) and 15th (R&DM211: Support System for R&D). The results validated that the existing courses in the DR&DM courses are still needed and relevant to potential and incumbent students, as well as professionals.

Table 3. Existing DR&DM Courses and their corresponding rank in the Market Needs Assessment

Rank	Course	DR&DM Course	Course Description
1st	Project Planning and Management	R&DM231. R&D Project Planning and Control	Concepts and principles in program/ project planning; application of tools and techniques in program/project planning and control in research setting.
2nd	Principles of R&D Management	R&DM201. Concepts and Principles in R&D Management	Unique characteristics of research and development management; imperatives of success in research; research organization/system, structure and organization of researches and their management implications; behavioral problems encountered in research management
5th	Methods in R&D Problem Solving and Decision Making	R&DM221. Problem-Solving and Decision Making in R&D Management	Qualitative and quantitative approaches and tools for systematic problem solving and decision-making.
8th	R&D Leadership and Organizational Processes	R&DM 220 Organizational Structures, Relations, and Processes in R&D Systems	Human and organizational relations, processes and behavior, including implications and applications of organization theory to the practice of research and development management; organizational designs in appropriate research environments; institution building concepts and principles as they are applied to research organizations.
12th	Technology Evaluation and Commercialization	R&DM251. Technology Evaluation R&DM252. Technology Commercialization and Utilization	Perspectives and frameworks in technology evaluation; mechanisms in institutionalizing technology evaluation systems; Interdependence of R&D and technology promotion functions in different R&D organizations; technology promotion and commercialization strategies, mechanisms, and techniques; factors in facilitation technology utilization
15th	Administrative/ Support Systems for R&D	R&DM211. Support System for R&D	Importance of the research support system; components and functions of research support system; management system for the research support system.

CONCLUSION AND RECOMMENDATIONS

The systems framework, andragogy, and ODeL concepts guided the study's assessment of the professional development needs in R&D management among the R&D personnel/practitioners and managers of the country particularly with the future offering of a master's program in R&D management. The characteristics and fields of discipline of the R&D personnel/practitioners and managers who participated in the study are varied. This study's market needs assessment

showed a high demand for a MR&DM Program in ODeL through UPOU. It also validated the relevance of the existing DR&DM courses that the MR&DM program will be conjoined with. Additional courses should be instituted in order to address the varied knowledge and professional development needs of learners coming from different fields and/or industries.
The graduate program in MR&DM just like DR&DM will be catering to both incumbent and potential R&D managers as well as to the personnel of R&D organizations in ODeL. Prospective students for the proposed MR&DM program will be coming from DOST. The study will guide its administration in the implementation of the HRDP in its system to encourage qualified DOST staff to take graduate studies. Scholarships and other benefits (i.e. leave with pay, thesis allowance) are available for DOST staff interested in graduate studies. Likewise, personnel in other line agencies (i.e. Department of Agriculture) and HEIs with research units/offices will be able to benefit in the institution of the MR&DM even without scholarship or taking a study leave, as they can avail the postgraduate degree program in ODeL mode. Likewise, the alumni, current enrollees, and those who have taken DR&DM courses will be able to plan their professional development with the offering of the MR&DM.

Despite the existence of the DR&DM program for more than two decades, 80% of the respondents are not aware of its online offering. Although in the last two decades, the DR&DM program has been consistent in its enrollment, this strengthens the need for wider information dissemination by UPOU. With its elevation to a master's program, it is necessary for UPOU to intensify its information campaign not only in S&T in the Philippines but also in ASEAN countries.

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