

Contextual-Based Knowledge Creation for Agroindustrial Innovation

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Abstract: This paper discusses the knowledge creation process in one department, in a higher educational context, and the possible actions to take to improve the efficiency and effectiveness of the knowledge creation system in it. We conducted a case study at one department of a university that strives to improve its innovations, in terms of their quantity and quality. We used a soft system methodology to investigate the knowledge creation system in the chosen department. From the study, we conclude that the department can be considered as a learning organization, within which its staff continually create, acquire and transfer knowledge. This department has a learning environment which is conducive, concrete learning processes, and leadership that reinforces learning. In the context of producing agroindustry innovations, the knowledge creation system in this department is considered to be less effective since it frequently happens more at individual or small group levels. To improve its effectiveness, the management may facilitate the institutionalization of knowledge creation processes at every phase of the interactions between tacit and explicit knowledge.

Keywords: innovation; knowledge creation; organizational learning

JEL classification: D83, I23, O31

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Introduction

Innovation has been deemed as an important driver of economic development, and a university is considered to be one important producer of innovations. There are many definitions and concepts of innovation, but it is commonly agreed that the accumulated knowledge in an organization or an individual is an integral part of innovation (Smiths et al. 2005). The accumulation of knowledge is related to how knowledge is created in an organization, and is influenced by the learning capabilities and processes at the individual and organizational levels (Garvin et al. 2008). Knowledge creation can no longer be viewed as an *as-is* process but as a system with components that can be organized to improve organizational performance (Nonaka et al. 2000). An efficient and effective knowledge creation system will improve learning, increase the accumulation of knowledge, as well as improve the quality and quantity of any innovations (Nonaka et al. 2000). An organization that has strategies to create an effective and efficient knowledge creation system will perform better, since it provides a supportive learning environment, concrete learning processes, and leadership in the organization (Garvin et al. 2008). In an effective knowledge creation system, members of the organization continuously create, acquire, and transfer knowledge through a concrete learning process. They are guided by leaders who facilitate learning and provide a conducive learning environment. Learning involves knowledge transformation and the interaction between explicit and implicit knowledge (Nonaka et al. 2000), thus constituting a knowledge creation system.

This interaction of explicit and implicit knowledge takes place in different transformation processes, as suggested by Nonaka

et al (2000), who introduced the SECI (Socialization, Externalization, Combination, and Internalization) model that has been used to evaluate knowledge creation systems to improve learning and innovation at the individual and organizational levels. In the SECI model, knowledge is created through a transformation process between explicit and tacit knowledge, i.e.: socialization, externalization, combination and internalization (Nonaka et al. 2000). This SECI model has been criticized for being difficult to use in empirical research and only specific to certain contextual settings (Gourlay 2006). However, there is research that supports the benefits of the SECI model in empirical research and different contextual settings. Beccera-Fernandes and Sabherwal (2001) used the SECI model to develop a contingency framework in a knowledge management process at Kennedy Space Center, developing a measurement scale, and testing it. Chou and He (2004) used the SECI model to investigate the relationship between knowledge assets and knowledge creation, and tested the framework across various industries in Taiwan. The SECI model has also been adopted by designers in the planning and design of knowledge workspaces (Andreou et al. 2009; Steelcase 2011; Lee and Schottenfeld 2014).

In the SECI model, knowledge is created through continuous and dynamic interactions between tacit and explicit knowledge in an organization. It involves spontaneous collaboration between individuals and teams in these organizations. Every member of the organizations creates knowledge; thus, individuals are the drivers of knowledge creation. However, the achievement of the organization's objectives occurs when the knowledge residing inside each individual is effectively transferred into organizational knowledge creation through socialization,

externalization, combination and internalization. The organizational ability to facilitate this interaction and transformation is an important factor that affects the efficiency and effectiveness of the knowledge creation system in an organization (Nonaka 1994). Failure to facilitate this interaction may influence the efficiency and effectiveness of the knowledge creation system (Nonaka 1994).

In a company, a knowledge creation system has become one important organizational issue. It is deemed important for increasing innovation, reducing costs, and improving the product's qualities (e.g. Ichijo and Kohlbacher 2007; Darroch 2005; Nonaka 1991). Ichiro and Kohlbacher (2007) conducted a case study at an automobile manufacturer and found that Toyota had successfully developed a knowledge creation system and unleashed the power of tacit knowledge within its multinational company, thus improving its competitive advantage. Darroch (2005) conducted a study of firms in New Zealand and found that knowledge acquisition, dissemination and responsiveness have positive relationships to innovation.

However, similar studies in higher education establishments, particularly at their department level, are limited. Considering the role of higher education in advancing science and technology and producing innovations, continuous improvements to the knowledge creating system are important. While innovation has become an important vision and the main objective in universities, the process and transformation needed to produce innovations have been relatively neglected. Unlike in business units, the creation of knowledge is likely to happen spontaneously,

because universities' core business is knowledge creation. The external environment that might shape the creation of knowledge in higher education is also different from that of businesses. Businesses have direct interactions with their consumers, allowing them to acquire the external knowledge necessary to develop innovations. Higher education has a tight relationship with the academic communities, and has been regarded as being distant from the users or consumers or business communities that are necessary to build successful innovations. Thus, understanding the link between the process of knowledge creation and its transformation into successful innovations is important, in the context of higher education.

This study focuses on the knowledge creation system in one department at a university, known hereinafter as 'the department,' which is an organization that conducts teaching and research in a university. This study aims to: (1) Understand the knowledge creating system in this department, and (2) identify possible actions to improve and develop the knowledge creating system in this department. The results of this study are expected to provide an understanding of the knowledge creation system in a higher education establishment, and of the system needed for innovation production. The results are also expected to provide an understanding of the dynamic process of knowledge creation (Nonaka and Toyoma 2003), by providing a systemic view of a learning organization (Garvin et al. 2008), and making the *Ba*¹ explicit by considering the role of leaders in motivating individuals to engage in the knowledge creation process, as depicted by Lakshman (2007). This study also highlights

¹ *Ba* is a Japanese concept that is used to describe a place or a shared space (physical, virtual or mental) that serves as a foundation for knowledge creation (Nonaka and Konno 1998)

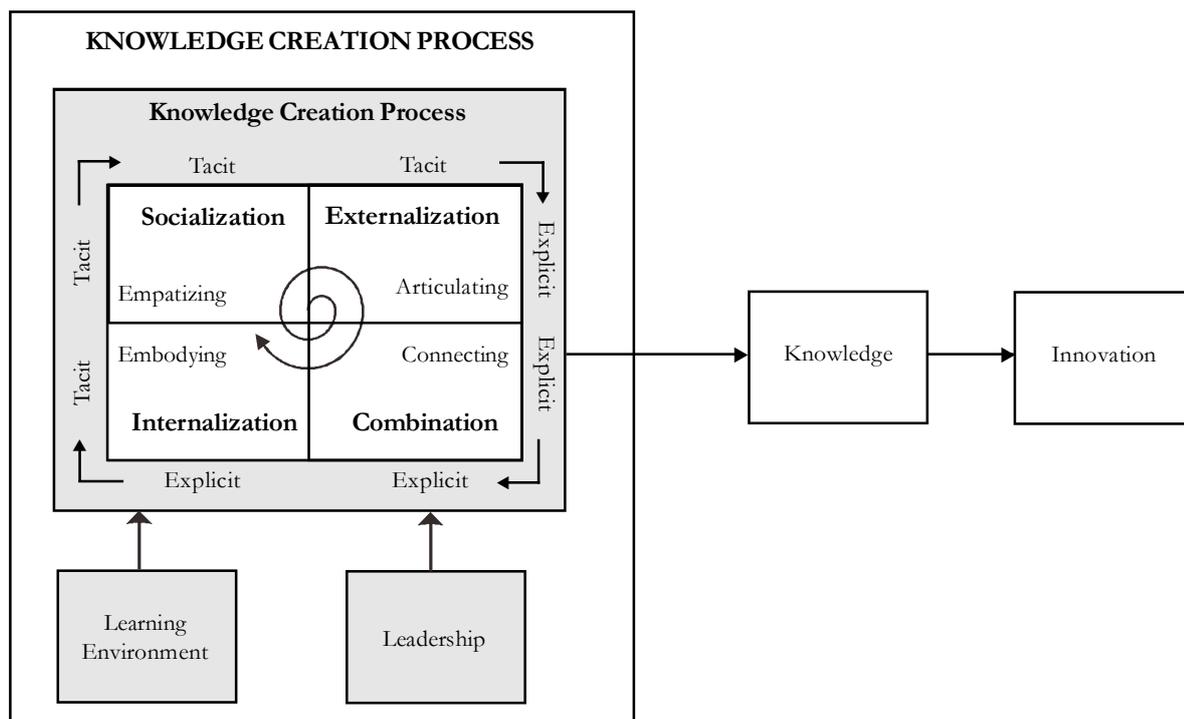
the act of balancing the two types of learning, exploration and exploitation (March 1991), in higher education.

Literature Review

Our conceptual framework that we applied in this study is depicted in Figure 1. We started with the notion of innovation being defined as new or significantly improved products, processes and/or solutions (OECD/Eurostat 2005) that leads to value creation for stakeholders, a driver of economic growth and improving standards of living. Based on this definition, we argue that innovation can only be created from an organization's current accumulated knowledge. These innovations are the results of the search for, and discovery and development of, current accumulated knowledge. This accumulated knowledge arises from the knowl-

edge-creating process through dialogue and practices at *Ba*, a physical, virtual and/or mental space or context within which this knowledge creation takes place and is shared by two or more individuals (Nonaka et al. 2000). Thus, we define a knowledge creation system as a system consisting of the generation, conversion and knowledge sharing that is embedded in an organization where learning continuously takes place. It facilitates learning that involves a dynamic interactive process of implicit and explicit knowledge; hence the efficiency and effectiveness of this knowledge creation process is highly dependent on the conducive learning environment and supportive leadership. This knowledge creation system explicitly considers the learning organization, learning environment and supportive learning which have not been done explicitly by Nonaka et al. (2000).

Figure 1. Conceptual Framework of this Study



Nonaka's knowledge creation theory was developed based on the notion that knowledge is created through a transformational process between explicit and tacit knowledge, both at an individual and a team (organizational level) in a context (Nonaka et al. 2000). This transformational process consists of four processes: Socialization, Externalization, Combination and Internalization, called the SECI model. We used the SECI model developed by Nonaka et al. (2000) to identify processes that occur in this knowledge creation system. This model is developed based on the transformation of tacit and explicit knowledge in an organization. Tacit knowledge is deeply rooted in an individual's actions, ideas and values; therefore it is highly personal, hard to formalize and difficult to communicate with others. Explicit knowledge can be expressed in words or numbers and shared in the form of documents, manuals, specifications, or data (Nonaka et al. 2000).

There are four conversion modes of knowledge, which happen dynamically in an organization. Tacit to tacit conversion occurs as individuals share knowledge through socialization (i.e. presenting results in conferences, training, meetings with customers); tacit to explicit conversion occurs when an individual can articulate their tacit knowledge through an externalization process (i.e. discussions or a dialogue with their peers or colleagues). Explicit to explicit conversion occurs as an individual combines different items of explicit knowledge into a new item through combination processes (i.e. staff engage in planning and writing proposals by assembling and integrating data or literature), and explicit to tacit conversion occurs when the explicit knowledge that is created is shared, understood and used by individuals creating new tacit knowledge through their

internalization processes (i.e. staff engage in knowledge creation by doing research, collaborating with others to search for and share new thoughts and results). The conversion of knowledge originates in the tacit knowledge of individuals who convert it into explicit knowledge, and then convert it into organizational knowledge through this knowledge conversion process. It follows a spiral of learning from the individual level, amplified at the organizational level through interactions, cross-sections, departments, and organizational boundaries (Nonaka et al. 2000). Thus, this conversation process requires a conducive learning environment and supportive leadership to allow it to take place in an organization.

A conducive learning environment is best described as an environment that supports learning, where members of the organization are skilled at creating, acquiring, and transferring knowledge to achieve the organization's objectives (Garvin et al. 2008). It provides the necessary environment that enables individuals to produce knowledge through different modes of knowledge conversion. Garvin et al. (2008) suggests that a conducive learning environment has four distinguishing characteristics, which are: Psychological safety, appreciation of differences, openness to ideas and time for reflections. Each of these characteristics is a factor that stimulates knowledge transformation. When this transformation occurs, each individual learns. Knowledge creation is also influenced by leadership. Leadership is necessary to the knowledge creation process for two reasons: Firstly, by giving it a sense of direction, and secondly, by stimulating and facilitating the knowledge creation process. Leaders work towards an objective and strive to achieve it. Knowing that the driver of innovation depends on knowledge creation and the indi-

viduals in the organization, encouragement, vision, empathy, and pro-activeness are likely to stimulate the knowledge creation process.

To summarize, innovation is the result of an organization's accumulated knowledge, which is created by a system that encourages and facilitates learning. It is more than individual learning, and it is a spiral process of knowledge creation involving continuous and dynamic conversions between tacit and explicit knowledge at the individual, group, organizational and interorganizational levels (Nonaka et al. 2000), and that organizations can stimulate knowledge creation at the individual level, support interaction among individuals, and provide a context for the creation of knowledge (Nonaka and Takeuchi 1995). As part of a learning organization, the knowledge creation system in this study is defined as a system in which each member of the organization continuously creates, acquires, and transfers knowledge through concrete learning processes. This system is related to the transformation of knowledge between explicit and tacit knowledge among individuals, groups, organizations and at the interorganizational level.

Methods

Research Setting

A knowledge-based economy has forced the university to prepare students for this challenge. The university is challenged to foster the knowledge creation capacity that enables students and academic staff to learn continuously and produce innovations that are important in this era. This knowledge creation is done at the individual and organizational levels through a transformational process between tacit and explicit knowledge.

This study was conducted in the Department of Agroindustrial Technology at Bogor Agricultural University. Bogor Agricultural University has a tradition of research and support for innovation. The department focuses on agroindustry improvements and strives to improve its innovation outputs in terms of their quality and quantity. We limited the definition of innovation to technological products that were developed by the faculty members of this department. By studying at this department's level, it enables us to study how knowledge is created and used to produce innovation. Innovation in the agroindustry is important since it increases the added value of agricultural products. The university thus needs to be the locomotive, providing a system that enables continuous knowledge creation, hence, continuous innovation.

Considering the research objective, a qualitative research was chosen, to enable us to conceptualize and explore the knowledge creation system in the organization. This study was set in the organization at the individual and organizational levels. We aimed to have an in-depth knowledge of the knowledge creation system by understanding the actors, processes and infrastructure needed to create the knowledge necessary to produce innovations.

Data Collection

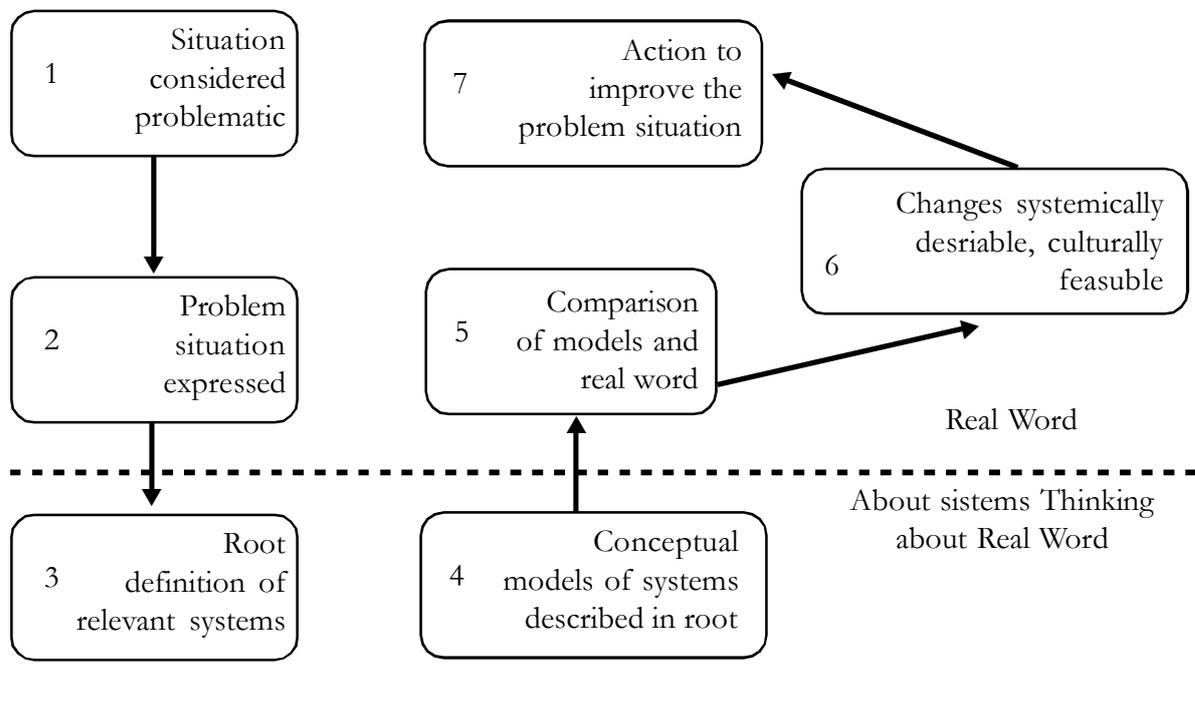
A knowledge creation system is influenced by internal and external factors that enable the creation of knowledge. These knowledge enablers are physical and cultural, and have personal factors embedded in an organization. To capture these factors, we used a Soft System Methodology (SSM) (Checkland 1999). This research used this SSM as it sought to explore a messy social

system, which is usually influenced by complex interactions between humans and the context their activities are embedded in. The soft system embraces different perceptions of the humans involved, to understand how the 'messy' system works and find potential improvements. For such reasons, SSM is considered to be appropriate given the fact that the purpose of the research is to understand a knowledge creation system. A knowledge creation system is a social system in which the actors interact with others to influence the system's performance. SSM allows us to capture and understand the knowledge creation system as a social system that looks into roles, norms, and values.

We are interested in the phenomena of a knowledge creation system and aimed to gather rich data. SSM enables us to study knowledge creation in a guided and staged process, thus, it provides a structure to our inquiry process. This systematic method allows us to develop a deeper understanding

of knowledge creation together with the other stakeholders. To ensure the validity of the results, we used multiple respondents related to the knowledge creation system in the department. The respondents are the academic staff that produce innovations, the management team, and the alumni. The use of multiple data sources and respondents allowed us to corroborate findings and improve the internal validity of the SSM processes. Data collection techniques ranged from in-depth interviews, focus group discussions, and secondary data collection. Each interview was a semi structured interview with the respondents and lasted for about 1-2 hours. Data from the interviews were structured according to the steps in the SSM. Data that had been structured were supplemented by our observation on how the system works in practice. Any discrepancies that emerged between the two were further discussed in the group discussions or clarified by the respondents.

Figure 2. The Soft System Methodology in Summary after Checkland 1975 (Checkland 1999)



Building on the rich pictures obtained, we defined the root definitions of the knowledge creation system in this department (Stage 3 of the SSM). We used CATWOE (*Customer, Actor, Transformation, Worldview, Owner and Environment*) analysis to formulate these root definitions. Based on the rich picture and the root definitions of the knowledge creation system, we developed a conceptual model. We analyzed the system to develop the conceptual model describing the knowledge creation system (Stage 4 of the SSM). The conceptual model was developed in two ways: (1) Analyzing the subsystems of knowledge's creation using the SECI model and (2) analyzing the individuals' perceptions of the learning process in this department using a questionnaire developed by Garvin et al. (2008).

The last stage of the study involved a comparison of the models and the real world (Stage 5), identification of the changes that are systematically desirable and culturally feasible (Stage 6) and the actions required to improve the problem situation (Stage 7). As for Stage 5, we interviewed three alumni that have produced and commercialized their innovations. We asked them to compare our rich picture, root definition, and conceptual model with their own experiences. As for Stages 6 and 7, data were collected through in-depth interviews to elicit opinions about the ideal knowledge creation system to produce quality innovations, and recommendations for further improvements. We complemented these in-depth interviews with observations about the condition of the existing resources, and how the activities and interactions occurred. We also complemented these interviews by reviewing documents in relation to innovation production. Following the results, we conducted another focus group discussion to identify potential changes that are system-

atically desirable and culturally feasible. The result of this focus group discussion became our recommendation for action.

Results and Discussions

Results

The innovation performance of this department is above average, as shown in Table 1. This performance is reflected by the number of patents and innovation awards that have been received by its faculty members: 18 patents have been granted, 7 of them received national most prospective innovation awards. Innovation performance is also reflected by the process indicators, as faculty members frequently participate in scientific meetings (i.e. conferences, workshops, or seminars). All the faculty members are active in their professional associations and about 15 percent of them are active in international professional associations.

In the context of the knowledge creation system, the faculty members' high levels of involvement with, and participation in, professional associations and scientific meetings reflect their socialization and internalization of knowledge at the individual level. The intensity of the faculty members' research activities also shows the externalization and combination processes that have been conducted by the staff of this department. In addition, this department has filed 3 patents on average, each year. These patents have also been rewarded as the most prospective innovations in Indonesia. These achievements are very good as they are higher than the standard university quality standards. Nevertheless, the effectiveness of the knowledge creation system, in the context of the agroindustry's innovation production, should also be reflected by the dissemination and

Table 1. Performance of Department X in its Innovation-Related Activities

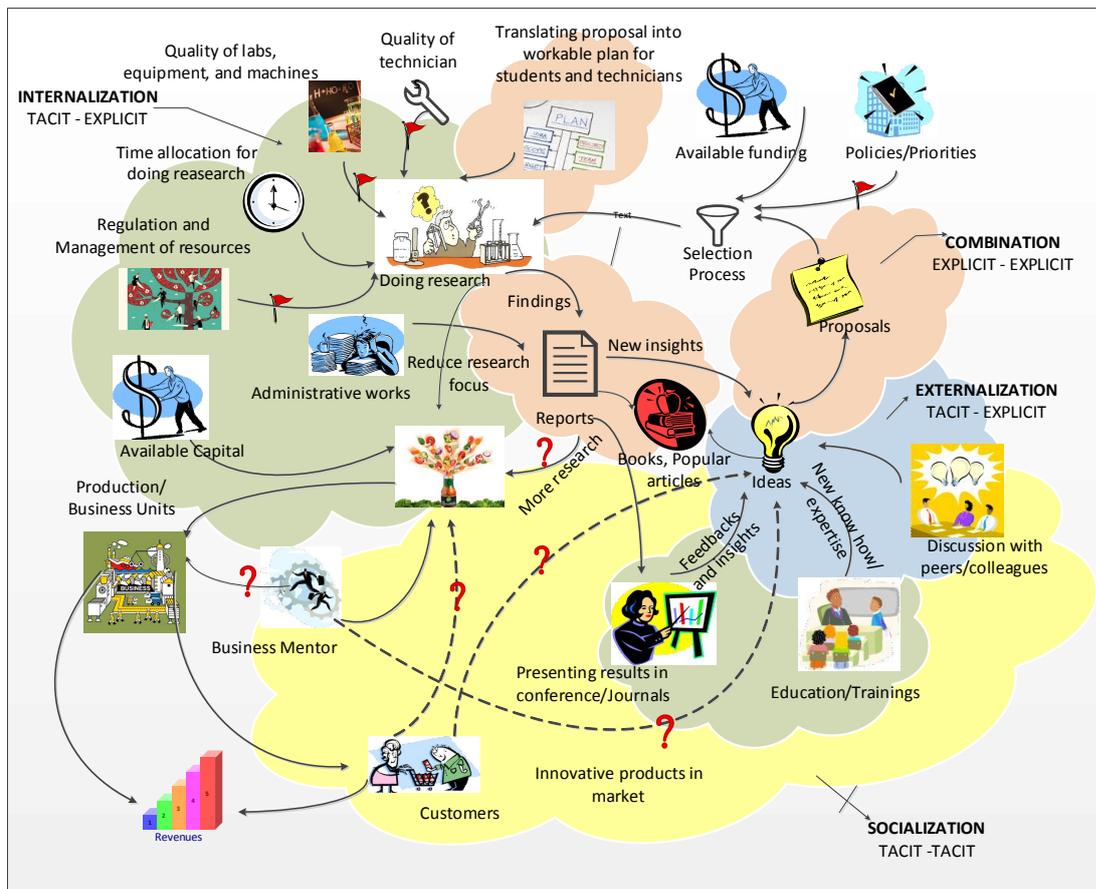
No.	Component	Quality Standards	Department's Achievement (2011)
1.	Percentage of the faculty who took sabbatical leave, followed a post doc, and involved in research activities with foreign counterparts	> 4%	17.39%
2.	Percentage of the faculty who are members of academic society and professions nationally and internationally	> 30%	76.09%
3.	Number of experts or external parties who become speakers in seminars/trainings, guest speakers (faculty per year)	≥ 4	8
4.	Average of faculty research funding (IDR million/per year per faculty)	> 3	75
5.	Average of funding for community empowerment (IDR million per year per faculty)	> 1.5	24
6.	Average of collaborative activities with government in the Department/Study Program	≥ 1	13
7.	Number of articles in respected international journals		66
8.	Number of research activities conducted by members of the faculty (as lead researcher or member) that are self-financed or supported by internal funding or foreign funding (research per faculty per year)	≥ 1	15
9.	Percentage of undergraduate student's involvement in the faculty's research activities	$\geq 25\%$	35.51%
10.	Number of academic articles written by a faculty member (lead writer or member) that are published in the form of books, seminar proceedings, scientific journal (national and international) (articles per year per faculty)	≥ 1	3
11.	Number of registered IPR/patent (IPR/patent per year per department)	≥ 1	3
12.	Number of community empowerment activities that are self-finance, or funded nationally/internationally (activities per faculty per year)	≥ 1	8
13.	Percentage of collaborations with national institutions in relation to tridharma activities (per faculty per year)	$\geq 50\%$	47.83%
14.	Percentage of collaboration with national institutions in relation to tridharma activities (per faculty per year)	$\geq 10\%$	15.22%

commercialization of the research's results. In this context, this achievement by the department is still limited.

The results of Stage 1 and Stage 2 of the SSM are shown as a rich picture in Figure 3. Rich picture is a tool to express the process and issues in a system, within a context. It provides an expressive tool using pictures to depict the structure, process, climate, actors, conflicts, and issues in the knowledge creation system. In developing the rich picture, we conducted in-depth interview and participatory observations. While the in-depth interviews were aimed at studying the structure, process, perceptions and beliefs in the knowledge creation system, our participatory observations were to collect any relevant

hard and soft data (the beliefs, trust, conflicts, and cultural factors in the knowledge creation system). The rich picture was developed in three iterations. The first iteration of the rich picture was developed by two of the researchers. As they are also faculty members, they have knowledge and perceptions about the knowledge creation system in their department. The second iteration was started with in-depth interviews with four faculty members who had produced innovations. Their innovations have either been commercialized or patented. In the interviews, the respondents were asked about their involvement in the knowledge creation process. They were encouraged to tell of their experiences, issues, perceptions, and beliefs about the process

Figure 3. Rich Picture of the Department's contextual-based Knowledge Creation System



that produced their innovation. Data from these interviews were used to develop and enrich the rich picture. The third iteration was carried out in a focus group discussion, and the result of this discussion is the one that we used for our further analysis.

In this rich picture, the knowledge creation system is depicted as a process ranging from the generation of an idea, through the product's development, resources' mobilization, the innovative product's creation and the innovation's commercialization and applications. The process, activities, and actors' points of views and perceptions are expressed in this rich picture. From Figure 3, we can identify the 4 phases in the knowledge creation process using the SECI model.

At this ideas' generation stage, ideas are generated and, further, crystallized into a new form of tacit knowledge at each individual level. The generation of ideas is highly related to exploratory activities through various socialization processes with other faculty members, students, users and/or other external actors.

"A challenge from a company made us start the APG's (Alkyl Polyglycoside) production to improve the effectiveness of herbicides."

"After reading my publication on DEA (Diethanolamine) production based on Palm Kernel Oil, a company in the coconut industry would like us to provide a similar technological innovation using coconuts as the raw material."

"My research starts from problems the users have. As a researcher, I search for information on the topic or similar experiences from journals or research projects. From this preliminary inquiry, I develop and research the initial ideas."

The socialization process entails knowledge sharing and learning that need to be translated into ideas. This requires the crys-

tallization of the learning that allows the conversion of knowledge into innovative ideas. The crystallization of ideas or knowledge occurs at an individual level, and articulation requires individuals to share and discuss it with their potential collaborators.

"Knowledge creation occurs at the individual level within which expertise, discipline and knowledge reside."

"Lack of synergy in the research and resource allocation at group level."

"At an individual level, the innovation process runs well as each individual has the knowledge necessary to produce innovations and the freedom to interpret them when engineering the technology."

"At the group level, the success of an innovation requires good collaboration. Good collaboration occurs when each member understands and carries out their tasks and responsibilities."

As crystallization requires knowledge sharing, a willingness to cooperate and trust is needed.

"Due to no designated resources for research, especially funding, it is difficult to plan and direct faculty members' roadmaps, hampering the research agenda."

Further collaboration among individuals is needed to transform ideas into explicit knowledge, in the form of proposals, books, or articles. This process requires the combining of the knowledge residing in each individual. This process seems to happen organically because it is driven by the need to secure the resources needed to perform or implement their ideas. Having secured their resources, the faculty members have to perform or implement their ideas through their research and development activities. In conducting these activities, faculty members internalize their explicit knowledge through the development of procedures, manuals, plans,

and by conducting experiments. This internalization process results in tacit knowledge. As members of the faculty, they are required to disseminate their research and development activities in the form of reports, articles in journals or at conferences. They are further challenged to bring the results of their research and development activities to communities outside their academic community.

“Ideally, the innovation system is the responsibility of the university. The university has the responsibility to commercialize these innovations. Ideally, the research results should be transformed into commercial applications for industrial use or other applications. Commonly, a company has their own R&D unit, and little collaboration with the

university. The innovation system is not very well integrated yet. Appreciation for the innovator is still low.”

“The department has to have a good network with the various industrial sectors for research and new products’ development”

“There is a gap in the innovation process, which is in the scaling up process that bridges the research results in labs and the commercial application, although it is a crucial stage for the success of an application in the business sector. The university’s policy regulates that any commercialization activities could not be done by the university. They should be done by a business unit, but there is still a lack of clear rules of the game, for example, royalties and faculty member assignments on R&D collaborations with industry.”

Table 2. CATWOE Analysis

Aspects	Definition
Customer (who (or what) benefits from this transformation)	Members of the Department (students, alumni, faculties, and staffs)
Actors (who facilitate the transformation to these customers)	Faculty members of the Department
Transformation (from “start” to “finish”)	Accumulated knowledge (knowledge, expertise, publication, and projects) from stakeholders of the Department are the assets necessary to create innovation of agroindustry products, through academic activities, formal and informal meetings among the staff in the Department.
Weltenschaung - world view (what gives the transformation some meaning)	Improvement in the efficiency and effectiveness of innovations for agroindustry products requires understanding of how the organizational system of knowledge creation works
Owners (To whom the “system” is answerable and/or could cause it not to exist)	The Department
Environmental factors that influence but do not control the system	Policies from the university, Directorate General of Higher Education, Networks of the Department, and business sectors behavior

Based on the above rich picture and findings from the interviews, the root definition of the knowledge creation system was done using a CATWOE analysis as shown in Table 2. We formulated the knowledge creation system of this department as follows:

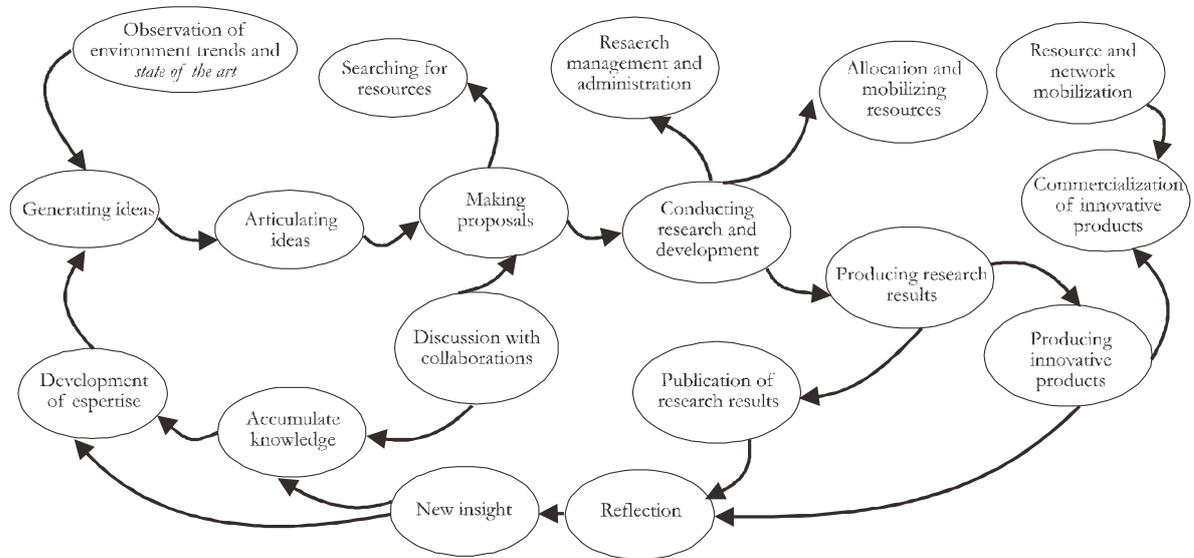
“The contextual-based knowledge creation system of this department is a system within which knowledge creation takes place, allowing for the synergetic processes of transforming resources and the knowledge assets of members and the organization, as well as synergetic academic activities and formal and informal meetings to produce innovations for agroindustrial products that solve real problems in the agroindustry sector.”

In reference to the rich pictures and root definition of the knowledge creation system, we developed a conceptual model as shown in Figure 4.

As shown in Figure 4, knowledge creation starts with the accumulated knowledge and expertise of each member of the organization. This accumulated knowledge and ex-

pertise are the result of a large number of activities, observations, and training conducted by the faculty. To acquire and mobilize the resources needed to fund some of their activities, the faculty members develop proposals and plans. They create partnerships and collaborate in research and development. When conducting research and development, they have to perform both the research and the project management activities. They need to manage their facilities, time, and the administrative work that are required by their donors or collaborators. Further, they are also required to publish their research findings in the form of reports or in journals or similar publications. Even more, they need to disseminate and commercialize their research’s outputs to benefit the wider community. In this transformation of knowledge assets to product innovation, they learn to reflect, resulting in new comprehension, insights, and knowledge that increases the existing knowledge accumulated at the individual, group or organizational levels.

Figure 4. Conceptual Model of Contextual-based Knowledge Creation System



Having the rich picture, root definition, and a conceptual model of the knowledge creation system, we analyzed the existing problematic situation in this department. Analysis of the existing problematic situation was conducted by identifying the various modes of knowledge conversion using the SECI model, and questionnaires to identify the understanding of the faculty members' perceptions about the knowledge creation and learning aspects that take place in their department.

As shown in Table 3, there are some knowledge conversion activities that can be identified using the SECI model. From this table, we recognize that knowledge creation is a result of the interactions between tacit and explicit knowledge, which take place in various activities at the individual, group or organizational levels. However, most of the knowledge creation takes place at the individual level, and in their close groups to a lesser extent. This, of course, negatively influences the effectiveness of new knowledge creation (Schilling 1998). From the interviews, it can be observed and concluded that the management of this department has provided several facilities and policies to encourage organizational level knowledge creation and learning; however, more improvements could still be done. The institutionalization of this process of creating knowledge and learning can be facilitated by this department at each level, with the interaction of the tacit and explicit knowledge.

To understand the faculty members' perceptions of the knowledge creation and learning aspects, we distributed questionnaires to the faculty members of this department. We received 15 responses, giving us a response rate of 39 percent. The analysis of the faculty members' perceptions was carried out on three aspects: (1) The learning envi-

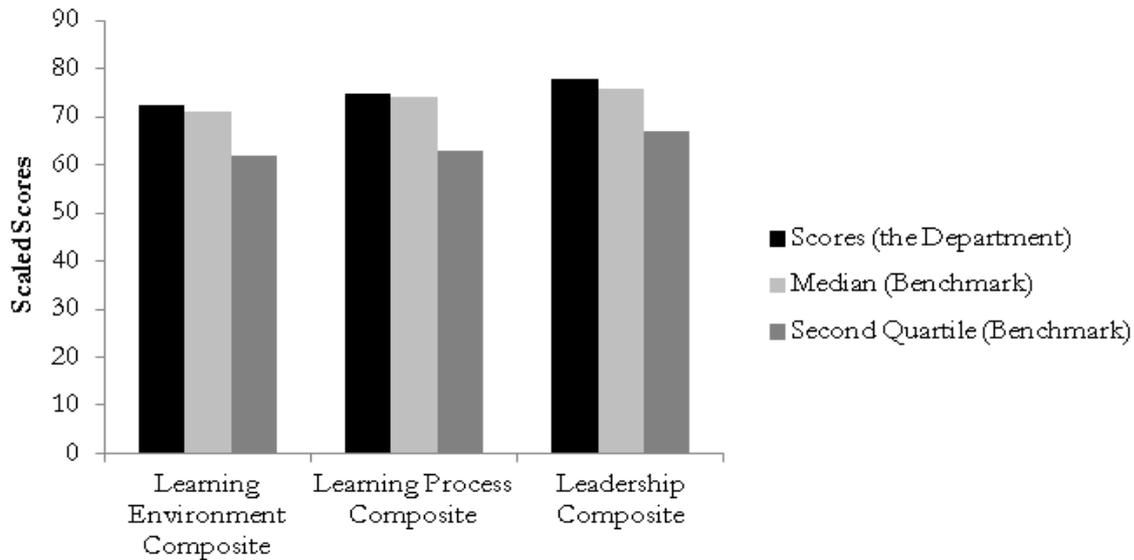
ronment, (2) the learning processes and practices, and (3) the leadership. Looking at the composite score of the three aspects, as shown in Figure 5, this department can be considered to be a learning organization, with positive scores for each of the three aspects. Their scores are above 70 out of 100, and above the benchmark scores.

From the analysis of the organization's learning environment, we can conclude that this department has a supportive learning environment, as shown in Figure 6. In general, the faculty members show an appreciation of the differences in perspectives and ideas, and allocate sufficient time for reflection on their findings and experiences. They also show a positive psychological security to propose new ideas, make mistakes, and show different points of view. One of the sub-aspects considered to be lower, compared to the benchmark, is the openness to new ideas and the willingness to explore new approaches and things. This is an intriguing finding. While the faculty members appreciate differences and feel safe by being different, they can be considered to be reluctant to explore new areas. Being safe in their own domain may hamper the creation of new innovations. This might also be an indication that exploring an outside domain is complicated for the staff members. The reward system and their teaching and administrative obligations require them to exploit their capabilities, and do business-as-usual, while developing new ideas requires an exploration of their capabilities. As the resources are limited at the individual level, in terms of time and energy, balancing these two types of activities might be a problem. Referring back to the rich system picture, balancing the two types of activities might be done by cycling through periods of exploration and exploitation, rather than the simultaneous pursuit of both as sug-

Table 3. SECI Model of the Department’s Contextual Based Knowledge Creation

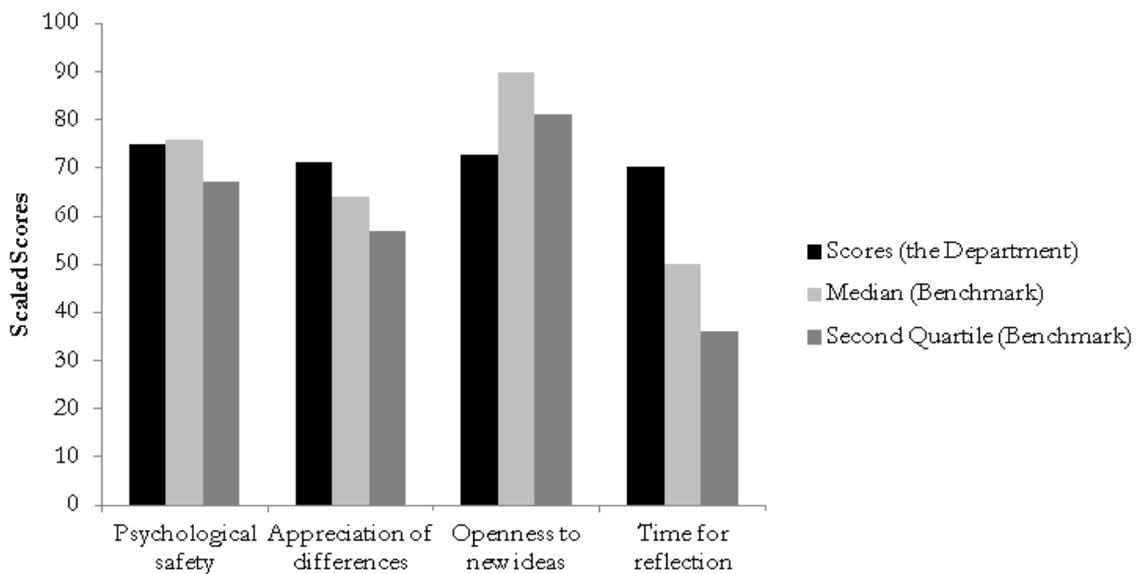
Mode	Knowledge Creation	Activities
Socialization (Tacit – Tacit)	<p>Knowledge Accumulation</p> <p>Faculty members acquire and accumulate various information/data/knowledge that are important sources of ideas</p> <p>Faculty members observe current development and trends in relation to their respective skills and competences in academic, business, or other external communities</p>	<p>To collect and experience through:</p> <ul style="list-style-type: none"> • formal education • participation in trainings, seminars, conferences, and other informal forums • Observation, reading from journals, articles, reports • Participation in field trip, visits, or others
Externalization (Tacit – Explicit)	<p>Idea Generation</p> <p>Faculty members articulate their explicit knowledge in the forms of ideas.</p> <p>Idea enrichment and crystallization are obtained through knowledge sharing with external parties</p>	<p>To interact through:</p> <p>Formal and informal dialogues with colleagues and networks (acquaintances, partners, friends, families)</p>
Combination (Explicit – Explicit)	<p>Idea and knowledge crystallization</p> <p>Faculty members translate ideas into proposals, books or other explicit media</p> <p>Faculty members develop plans or detail guidance for colleagues, technicians, and students during their research</p> <p>Faculty members write reports, and reflection on their reports, articles, and presentation</p>	<p>To synthesize and combine knowledge through:</p> <ul style="list-style-type: none"> • Externalization (translation) Idea and tacit knowledge reside inside each faculty members into explicit knowledge so that it can be understood, shared and learned by others • New knowledge is created through synthesis as the results of synthesis from discussion and learning with collaborators or other external actors
Internalization (Explicit – Tacit)	<p>Personal Mastery</p> <p>Faculty members discover new values and comprehension in certain phenomena that they involve with</p>	<p>Personal mastery through:</p> <ul style="list-style-type: none"> • Conducting product research and development • Developing (writing and presenting) proposals and/or reports to external parties (students, colleagues, and wider communities) • Writing and presenting ideas, thoughts, and concept in forums (seminar, discussion, workshops, etc.)

Figure 5. Composite Scores of Learning Organization*



*As there is no benchmark for public organizations or education institutions, we use the median score from a survey conducted into the senior executives of companies in multiple industries. Therefore, any interpretation should be done carefully.

Figure 6. Scores of Supportive Learning Environment



gested by Gupta, et.al (2006). This mechanism is viable at the individual level since the faculty members can focus their resources onto doing one type of activity at one period of time. This will give them the focus and efficient use of resources which produce good

quality results. However, at the group and organizational levels, the two types of activities might be done simultaneously. As individuals' resources are limited, they can access resources externally; thus, the limited resources' assumption can be relaxed. There-

fore, the management of this department might set a different reward system and provide different portfolios for teaching, administrative tasks, and research assignments for each individual. In this sense, the department could allocate their resources to the right type of activities/learning, resulting in a balanced mix of exploration and exploitation.

As for the second aspect, this department can be considered to have a concrete learning process and activities as shown in Figure 7. This department possesses formal and informal processes to acquire, collect, produce and disseminate information, and analyze and transfer it. As shown in Figure 7, there are 5 sub-factors reflecting the learning processes that are assessed: (1) Experimentation, (2) data collection, (3) analysis, (4) education and training, and (5) information transfer. Four factors have scores above 70 and one factor that has a score of 65. Three of the sub-factors scored above the benchmark figure, while the other two (experimentation, and education and training) scored below it. Further analysis of these two aspects shows that further improvements can still be made. This department frequently

experiments with new approaches to improve its performance; however the evaluation of how the process takes place and what lessons are learned is not deeply rooted. As for the second one, this department encourages its faculty members and staff to follow the education and training programs. As a result of this, the members are highly qualified, from both their education and the various training programs. However, the informal processes of education and training seem to be lacking. They are not institutionalized within which the mentoring and supervision of juniors or staff is done more systematically. Attention to the hierarchy and a rewards and punishment system needs to be systematically incorporated into the system.

The third aspect is leadership. As shown in Figure 8, all the sub-aspects have high scores (more than 70) which means that the leader’s learning reinforcement levels are high. The management of this department shows a willingness to accommodate different viewpoints, dedicate time and resources, and is actively involved in identifying and providing solutions.

Figure 7. Scores of Concrete Learning Processes and Practices

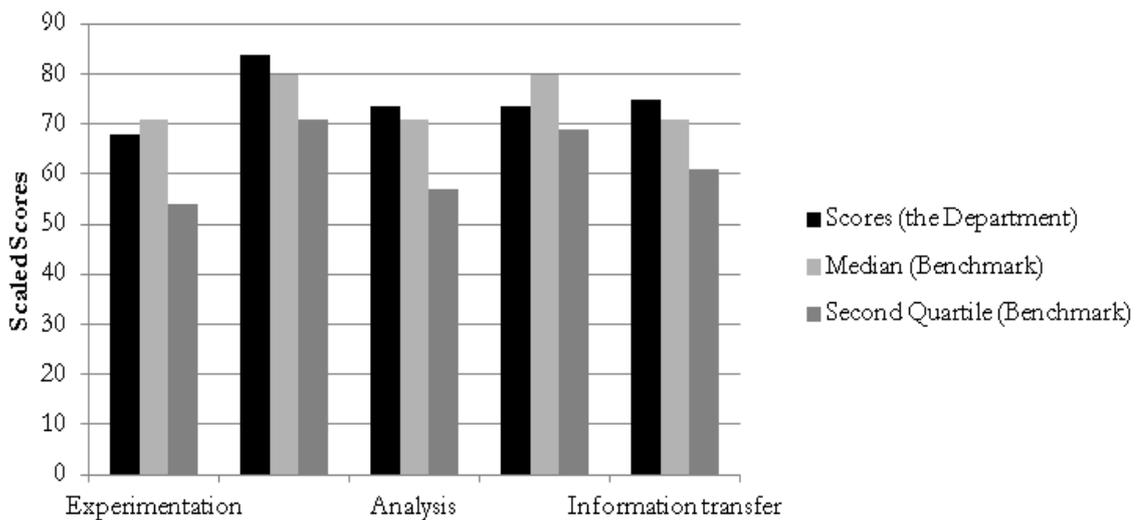
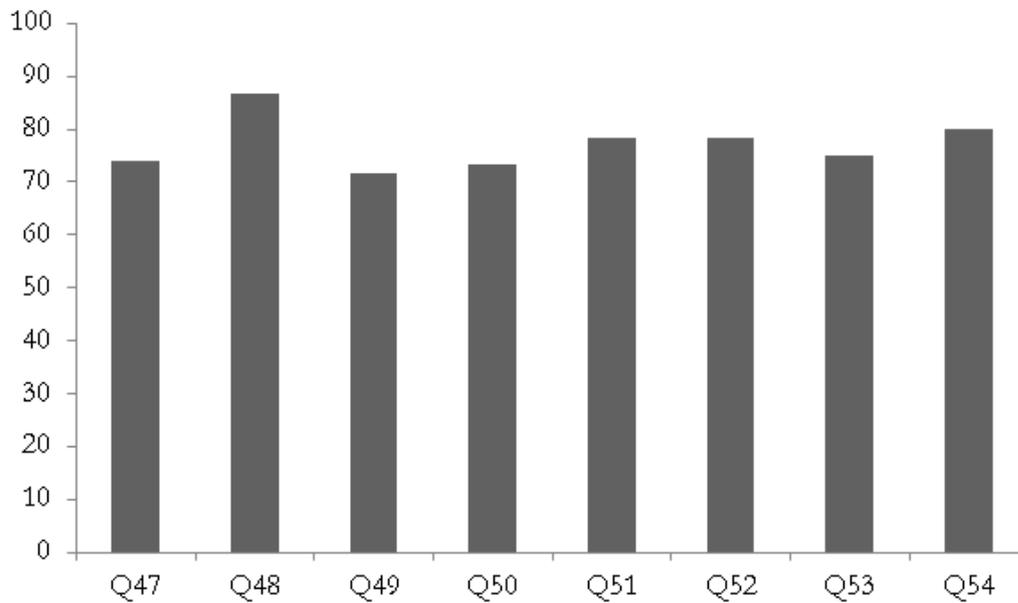


Figure 8. Scores of Leadership



- Q47 My manager(s) invite(s) input from others in discussions (*Atasan saya cenderung meminta masukan dari pihak lain selama diskusi*)
- Q48 My manager(s) acknowledge(s) his/her own limitations with respect to knowledge, information, or expertise. (*Atasan saya menghargai pengetahuan, informasi, atau keahlian pihak lain*)
- Q49 My manager(s) ask(s) probing questions. (*Atasan saya menanyakan pertanyaan yang sifatnya menggali lebih dalam*).
- Q50 My manager(s) listen(s) attentively. (*Atasan saya mendengarkan dengan penuh perhatian*)
- Q51 My manager(s) encourage(s) multiple views. (*Atasan saya memfasilitasi pandangan yang beragam*).
- Q52 My manager(s) establish(es) forums and provide (s) time and resources for identifying problems and organizational challenges. (*Atasan saya mengadakan pertemuan dan menyediakan waktu dan sumberdaya untuk mengidentifikasi masalah dan tantangan organisasi*)
- Q53 My manager(s) establish(es) forums and provide (s) time and resources for reflecting and improving on past performance. (*Atasan saya mengadakan pertemuan, dan menyediakan waktu dan sumberdaya untuk bercermin dan mengembangkan kinerja*).
- Q54 My manager(s) criticize(s) views different from his/her own. (*Atasan saya mengajak diskusi apabila terdapat perbedaan pendapat*).

Discussion

The department in our study is one of the top performers in the university. Its innovation-related measures are above average, suggesting that its knowledge creation system works well. From the analysis, the knowledge creation system at the department level

conforms to the SECI model suggested by Nonaka et al (2000). This SECI model allows us to identify the knowledge creation in this department in a detailed manner. We could observe that the 4 modes of conversion can be identified in the existing processes. This SECI model also allows us to identify

the two types of organizational learning that are necessary to create knowledge, i.e. the exploration and exploitation. Both exploration and exploitation are needed and the exclusion of either one will hamper the organization's performance (March 1991). The lack of exploitation may cause undeveloped new ideas, and distinctive resource competences are necessary to have good quality innovations (March 1991). The lack of exploration may influence the adaptive ability of the organization, hampering its potential to become the first in the market or the frontier in agroindustrial science and technology (Gawer and Cusumano 2002 and Schilling 1998).

The rich picture gives us an insight that ideas' generation is an important mechanism in a knowledge creation system. Ideas come from the accumulated knowledge which resides in each individual, in combination with stimuli from their external environment. At this idea generation stage, ideas are generated, and then crystallized into a new form of tacit knowledge at each individual's level. Ideas' generation is highly related to the exploration activities within which individuals search for new possibilities that might emerge from the cross-pollination of various internal and external stimuli (March 1991). The search for this new form of possibility requires experimentation using their experiences and accumulated knowledge, proactively improving their skills, as well as proactively sensing and scanning their external environment in terms of the market trends and progress in science and technology or product development (Teece 2007 and Schilling 1998). These activities require interaction with the external environment through various socialization processes. These socialization processes take place during their interactions with other faculty members, students, users and/or busi-

ness actors, in a physical or virtual environment, creating a context, *Ba* as called by Nonaka and Toyama (2003). Interactions during the socialization can only be effective if they involve the right knowledge, thus, it is necessary to connect with the right people. This requires conscious actions to hunt for knowledge, from both internal and external sources outside the environment. Organizations that have individuals and functions acting as boundary spanners, that are crucial to provide an environment where knowledge can be acquired and shared across boundaries, may play an important role in this socialization mode of knowledge creation.

Following the socialization process, crystallization of the learning is needed to allow this knowledge to converge into innovative ideas. This crystallization is done through the transformation of tacit into explicit knowledge, i.e. the externalization process (Nonaka et al. 2000). This externalization process sharpens and materializes the ideas that reside inside an individual into forms that can be shared and communicated to others. It involves the refinement of the information/facts that are accumulated in the socialization process. It is a critical stage since the crystallization of ideas and their subsequent articulation requires individuals to exploit their accumulated knowledge. This kind of exploitation learning occurs individually and collaboratively. The crystallization of ideas or knowledge occurs at the individual level and its articulation requires individuals to share and discuss it with their collaborators.

In order to make this interactive process and collaboration effective, willingness and trust play an important role (Dyer and Singh 1998). A lack of willingness and trust makes the crystallization of an idea difficult at the group level. This issue is recognized

by the faculty members and the management of this department. The willingness to trust, cooperate and share needs to be continuously nurtured and earned (Dyer and Singh 1998), which can be done through frequent face-to-face interactions (Nonaka et al 2000). The management of this department is planning to establish research groups and create a research roadmap that challenge the staff to provide innovative solutions to real problems in society. However, this plan is still hampered by a lack of resources.

Further, the faculty members transformed their ideas into different forms of explicit knowledge, for instance, into proposals, books, or articles. Transforming ideas into a new form of explicit knowledge requires the combination of existing knowledge and ideas. This combination process almost takes place organically for two reasons: (1) Limitations in research funding and (2) requirements of faculty members' career development. As research funding is limited, they need to write proposals in order to secure the necessary funding to do their research. An inability to secure research funding may hamper their careers, as career development in academic communities requires staff to codify their ideas into articles or books. Thus, they naturally follow this mode of knowledge conversion. This finding shows that exploitative learning organically occurs in an organization that has inherent routines and cultures. These routines and cultures allow members of the organization to practice their business-as-usual activities, and over time they will improve their efficiency of doing them (March 1991). While it shows efficiency, the effectiveness of the system can be questionable. Routines and cultures might lock the members into doing the same thing every time, which may hamper the explorative learning resulting in low quality results or innovations.

Having ideas and securing funding or resources are one part of the system, but conducting the research is another big chunk of the system. Research and development activities are the means by which the faculty members collaborate with others (students, technicians, colleagues, and management) to produce innovations. In this process of exploiting their current resources and knowledge through research and development, new knowledge may be created and transferred. In research and development, the faculty members develop procedures, manuals, plans, and conduct experiments. In doing so, they internalize their explicit knowledge. This internalization process provides new insights or understanding. These new insights and understanding, internalized in each individual, become the new tacit knowledge for the respective individual. Further, these insights and findings are published in the form of reports, articles in journals, and presentations at conferences or seminars. The quality of these innovations or other tangible products is highly influenced by how the research is done. It depends on the ability to exploit an organization's accumulated knowledge, which depends on effective and efficient resources' management. It also depends on the quality, availability and management of infrastructure, the time allocated, and the quality of the technicians and students who are involved in the process. Thus, exploitation of the existing knowledge by setting up activity systems and the efficient allocation of resource is an important factor that enables the creation of knowledge and improvements to the existing knowledge and resources (March 1991).

The results of research and development, in the form of publications, seem to be the main objective of the academic community, but the output should benefit the

wider community. Further dissemination or commercialization of these innovations is needed to provide the benefits of the research to the whole community. However, it is acknowledged that bringing their innovations into society is challenging. They recognize the need for facilitation and policies to bridge the academic and business world and to minimize the risks in the innovation's commercialization and dissemination. This finding shows that the commercialization or dissemination process still needs to be further institutionalized in the form of routines and procedures, as well as facilities. The existing accumulated knowledge in relation to the commercialization or dissemination process needs to be further exploited to gain new learning for process improvements. As the commercialization process requires different types of resources and capabilities to ensure its success (Teece et al. 1997), the exploration of new knowledge can be done through connections to external resources. Collaborations with other actors might alleviate some of the resource constraints (Gulati 2007) and induce learn-

ing processes that may create new knowledge (Zaheer and Bell 2005).

Based on the findings as described above, there are areas for improvement in the knowledge creation system of this department. Those areas of improvement can be categorized into the three aspects of a learning organization as shown in Table 4.

As shown in Table 4, these efforts are aimed at having a supportive learning environment. Improvements can be directed at two factors i.e. the faculty members and their culture. It is identified that the faculty members face challenges related to the exploration of new things and areas, the balance between motivation and workload, and have a dilemma between self-actualization within and outside their department. This dilemma highlights that balancing the exploration and exploitation activities is difficult if tried simultaneously; it will be more effective through temporal cycling (Gupta et al. 2006). As for the cultural aspects, openness and appreciation have become organizational challenges.

Table 4. Areas of Improvement in the Department's Knowledge Creation System

Learning Environment	Learning Process and Activities	Leadership
<p>Faculty members</p> <ul style="list-style-type: none"> • Initiatives to explore new things/areas • Motivation and work load (too much to do) • dilemma in self actualization inside and outside of development (university and national) <p>Culture</p> <ul style="list-style-type: none"> • Openness to open sharing • Rewards on achievement 	<ul style="list-style-type: none"> • documentation of learning • management and organizing research and development • supervision and mentoring of technician, juniors and students • facilitation to knowledge creation and sharing • incentives and policies to support application and dissemination of innovative products behavior of business sector in supporting product innovation in university 	<ul style="list-style-type: none"> • Resource mobilization and allocation • Research roadmap • Policies related to research and development as well as application and commercialization of innovative products

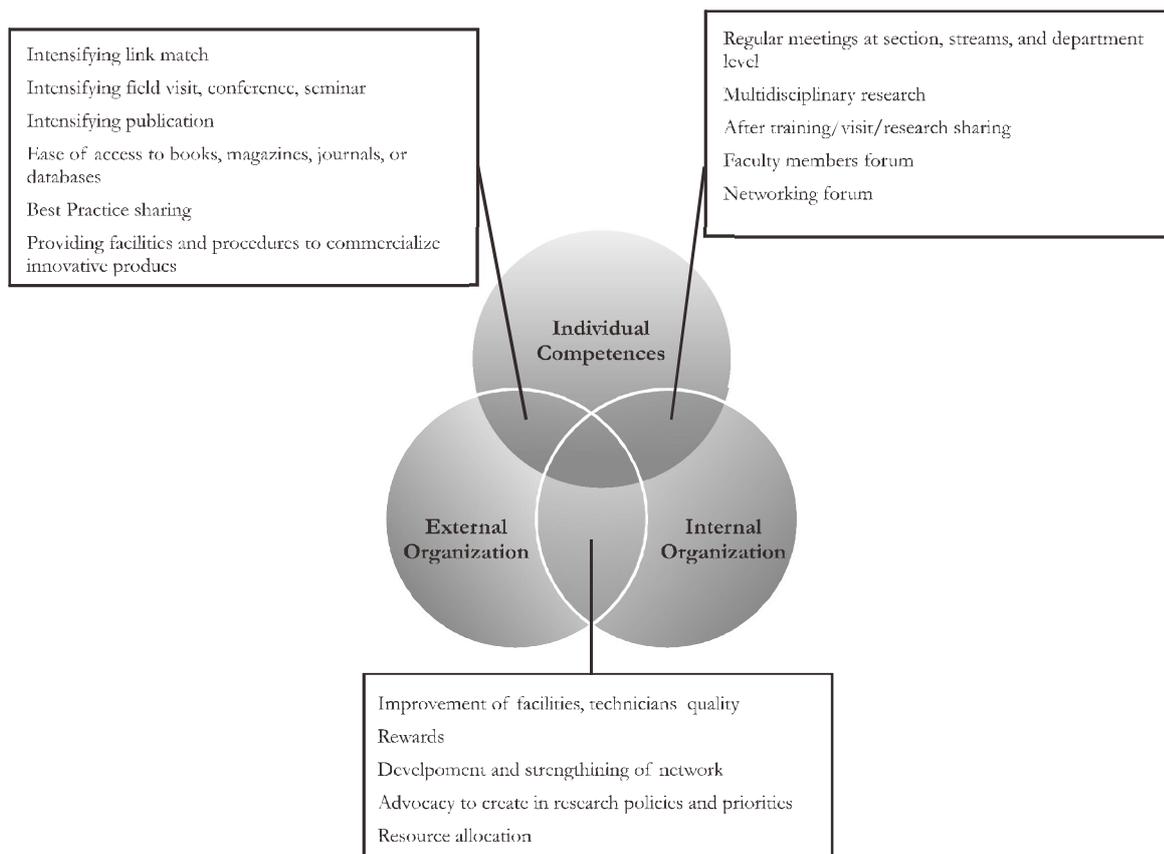
The faculty members recognize that their motivation is, to some extent, dependent on these cultural aspects. These cultural aspects and the dilemma of the individuals in interacting and transforming internal and external knowledge, tacit and explicit knowledge, and exploitation and exploration, shows a dynamic aspect of the knowledge creation process, as proposed by Nonaka and Toyama (2003). It also shows the capacity to absorb internal and external knowledge that are important to the organization's capability to produce innovation (Wuryaningrat 2013).

Based on the second category, aimed at having concrete learning processes and activities, several issues were identified, as shown in Table 4. *The first* challenge is

management's willingness to document the lessons learned from the faculty members' activities, in particular at the group and organizational levels. *The second* is a system of mentoring and supervision for the junior faculty members, staff and technicians. *Thirdly*, is the availability of initiatives and policies that place the focus onto the creation of knowledge. *The fourth* is the needs to have a platform in which the stakeholders of this department can be actively involved in the creation of knowledge. These mechanisms, routines, and activity systems play important roles in learning and knowledge creation (March 1991).

The third category is leadership. Challenges that are identified for this aspect are

Figure 9. Interaction between Individuals, Organizations and the Environment as Their Respective Facilitation



related to the allocation of resources and their mobilization, the research's road map and the priority of research topics and activities, as well as the research and development facilities. Further, analyses using the SECI model show that the transformation of tacit and explicit knowledge plays an important role in the knowledge creation system of this department. Knowledge creation at the individual level is outstanding. However, for the group and organizational levels, knowledge creation can be considered to be lacking. These two levels are important for improving the efficiency and effectiveness of the knowledge creation system of this department; therefore, potential improvements are needed to address the interactions among the faculty members. Intensifying the group and organization levels of knowledge creation requires an approach that facilitates interactions among individual competences, internal organizations and external organizations, as shown in Figure 9.

The faculty members are the drivers of knowledge creation (Nonaka 1994). Each of them has accumulated knowledge that has been built up through their activities and interactions with others. The quality of knowledge can be improved through various hands-on experiences, and the opportunity to experience, reflect and think in a logical manner (Nonaka 1994). Forums that allows interaction with other individuals internally in the organization, such as *Rabuan* (the department's regular meeting), after training visits/research sharing, or research forums, are systematic methods that enhance learning, and thus improve the knowledge creation's effectiveness (Choo 2003). Nevertheless, in order to be effective, the management should put these meetings in a context, as in a form of their vision, or specific objectives, multidiscipline research, or the road map.

Having a context will bring the learning and quality improvements in a direction that is aligned with the objectives of the organization (Johnson 2000; Nonaka 1995). Moreover, it helps the faculty members to understand the importance of interaction, increases motivation and encourages collective learning in the process of knowledge creation (Jakubik 2008).

Individual competence improvement may also benefit from exposure to the dynamics in external organizations. The external organizations provide the opportunities to experience exposure to a wide range of activities, which will increase the transformation of explicit and tacit knowledge. The management can play a role by facilitating the links with the external organizations, socialization forums (conferences, seminars, and field visits), and the access to information.

Leadership is the anchor of the knowledge creation system. It provides the vision that gives it direction and ensures the alignment between the vision and the implemented policies and programs. This alignment will bring effective and efficient organizational resource allocations that drive the activities and provide a focus for the faculty members. The management plays an important role in bridging the internal and external organizations. They connect with organizations to acquire and leverage the external resources that are important to improve the quality of the facilities and academic activities. Further, being aligned with the external organizations may improve the facilities, programs and the reward system that may improve the effectiveness of the knowledge creation system of this department. Thus, this department extends its role not only by creating and transferring knowledge, but also facilitating its faculty members in the identification, creation, retention, and sharing and

knowledge application in producing innovative agroindustrial products.

Focusing on the overlaps between the three aspects, i.e. individual competences, internal organizations and external organizations, the management of this department can encourage proactive behavior that is institutionalized and deeply rooted in this department. Such things are deeply embedded in the norms and values shared by the faculty's members and take place in the form of regular meetings, programs and policies. The development of these norms and shared values will improve this organization's explorative and exploitative capabilities in using its resources (Ireland et al. 2002). An organization that fails to use this mechanism will miss the chance to gain added value from knowledge creation, accumulation and sharing that will lead to good quality innovations.

Conclusions

The objectives of this study are, *first*, to understand the knowledge creation system of a higher education organization (a department) in the context of innovation productions and, *secondly*, to identify possible actions to improve the efficiency and effectiveness of its knowledge creation system. We conclude that the knowledge creation system of this department is already in place and has taken shape. It is a synergetic process using the resources and knowledge assets (accumulated knowledge, expertise, networks, and experiences) of each faculty member through academic activities and informal and formal meetings, to produce innovations that provide solutions for society. The four modes of knowledge transformation (socialization, externalization, combination, and internalization) are identified in this organization. Further, it is also supported by the fact that this

department has the characteristics of a learning organization, where it has a learning environment which is conducive, with concrete learning processes and activities, and a supportive leadership. The four modes represent how knowledge is created and used, and how learning occurs, which creates dialogue between the faculty members and the context within which they are embedded. This dialogue represents the balancing act for both explorative and exploitative learning that occurs through the various activities, routines or cultures embedded in this department. At the individual level, the balancing act happens as a temporal cycling between exploitation and exploration, due to their resource constraints. At the group and organizational levels, the balancing act happens simultaneously as the resource constraint assumption is relaxed. Yet, this simultaneous balancing act requires a system that can facilitate interactions between internal and external knowledge, tacit and explicit knowledge, individuals and organizations, and individuals and a context within which the individuals are embedded.

Nevertheless, some potential areas for improvement can still be identified. In the context of innovation's production, this knowledge creation system is yet fully effective, as only a small part of its output has been commercialized. It is also identified that the four modes of knowledge transformation predominantly take place. The lack of interaction of the tacit and explicit knowledge at the higher level hampers the production and creation of new and better quality knowledge. The management has provided facilities, programs and infrastructure, but improvements can still be made. The institutionalization of the knowledge creation process at each mode of knowledge conversion is needed. Institutionalization can be imitated by initiating ac-

tivities or programs at the intersection between the three important components: The individual competences, the internal organization and the external organization. Also, the institutionalization of resource allocations and assignments that balance the need for the organization to have both exploitation and exploration learning still needs to be investigated further.

Finally, this research is still a case study of one department in a higher education es-

tablishment. Further studies may be done to enable generalizations of the knowledge creation process in higher education to be made. While the soft system methodology allows us to explore the knowledge creation system, any generalization across the organizations may be constrained as each organization has a unique system. Integration with other methods may be required to enable such generalizations.

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