

Framework System of University Technology Based Start-Up Development by University Incubator: Case Study

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Abstract

Pusat Inovasi Teknologi Sebelas Maret University (PIT UNS) is a university incubator that organizes technology transfer activity in Sebelas Maret University (UNS), Indonesia. The main goal of PIT UNS is to create a technology-based startup from UNS research results. As a new incubator, it is necessary to develop the system of technology-based startup development. This paper aims to conduct the development of the system by benchmarking study. The study starts with the identification of benchmarking target and subject. Then the data is collected, analyzed and integrated with a condition in PIT UNS to determine the best practice. After that, it is developed to create a framework system if technology-based startup development in PIT UNS. The system is validated by Focus Group Discussion and pre-implemented by using case study. The result generates a framework with seven main activities and eight Standard Operation Procedures (SOPs). From that framework, PIT officer and tenant able to identify the incubation position based on their feedback. In addition, management's element analysis shows that the system should be supported by enhanced quality resources.

Keywords: incubation, incubator, startup, technology, research results

1. Introduction

Technology transfer service unit is necessary to support the technology commercialization activity. The unit will prepare technology innovation research product to be commercialized-ready in the business world (transfer research product to business activity). The common example of the unit is an incubator, also called as business incubator or technology incubator. The incubator is considered as the most appropriate choice to develop technology innovation and prepare it to survive in the business world (Albadvi, 2006). The growth of the number of a business incubator is continuously increasing and significant due to the development of research activity in the world (B. Becker, 2006). As the name suggests, the incubator will incubate technology innovation researches product to be matured and prepare it to get in the business world. University incubator gives technology transfer services to academician in the university.

University technology incubator is developing as the shifting of the role of the university in recent decades (Bramwell, 2008). University has an important role in, especially development of technology-based economy (Astuti, 2014). University as a regional research center has to keep develops applicable technology in the business world. Thus, the

university plays important role in technology transfer process to grow the regional economy (Leung, 2015) through university technology incubator. Sebelas Maret University (UNS) is one of the universities which tries to realize the role of the university in economic development by the technology transfer process. UNS has established Pusat Inovasi Teknologi (PIT) as the technology incubator for academician in UNS. The technology research product will be incubated to be a technology-based startup or Perusahaan Pemula Berbasis Teknologi (PPBT) (PIT UNS, 2015). UNS also has the policy to expand an effective collaboration and networking to market innovation/product of UNS and develop the revenue-generating scheme.

Studies about university technology incubator have been conducted entire the world (Albadvi, 2006, Aerts,2007 and Yuniaristanto, 2014). One of the topics is the business process. The business process becomes more essential for university incubator in initiating or developing stage such as PIT UNS. A developed or matured business process can be a part of the system for PIT UNS to run activities and obtain the goal. The goal of PIT UNS is to develop a technology-based startup (PPBT). Thus, it is necessary for PIT UNS to build framework system of PPBT development in UNS.

This paper aims to study the system used by incubator in developing technology-based startup. A benchmarking study is used to construct the framework system of university technology-based startup, especially in UNS. The framework is developed by in-depth interview method with benchmarking object officer and literature study. Finally, the system will be pre-applied in PIT UNS by using tenants of PIT UNS as a case study.

2. Methodology

There are five main steps in this study. The first step is identifying the brief of the incubation process in PIT UNS. The second step is benchmarking study about technology-based startup development system in other incubators. Then, the first and second step results are combined to create a framework system of university technology-based startup in the third step. After that, the system will be pre-implemented by using tenants of PIT UNS as case studies in the fourth step. Finally, there is analysis, feedback and recommendation of the system in the final step. The method of this study can be seen in figure 1.

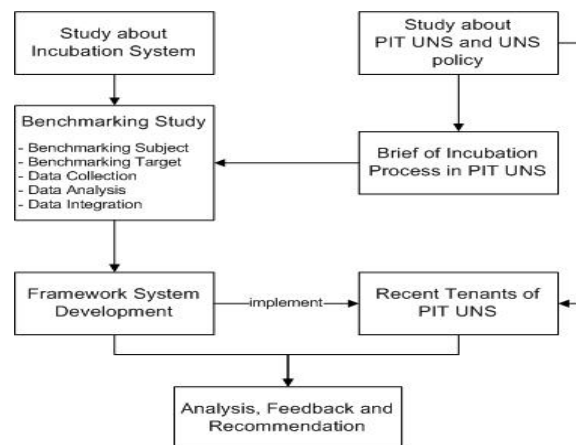


Figure 1 Research Method

The study started with identification the brief of the incubation process in PIT UNS. The identification process is done by studying the PIT UNS business process in its business plan. The business process will be developed by the previous study about university incubator. The output of this step is a brief scheme of incubation process in PIT UNS. There are four main steps in the benchmarking study (Gesperz, 2002). They are planning step, analysis step, integration step, and implementation step. In the planning step, it started with the determination of benchmarking subject and target. There are three benchmarking subjects in this study and will be called as B1, B2, and B3: B1 refers to incubator owned by Government of Indonesia as regulator; B2 refers to university incubator in Indonesia; B3 refers to university incubator in overseas. There are seven benchmarking targets and will be explained more detail in result and discussion part. Determination of benchmarking targets is based on the result in step 1. After benchmarking subject and target are determined, data collection is conducted by an in-depth interview with incubator officer and literature study about related incubators. Then, the data will be integrated with the condition in PIT UNS to determine the best practice for PIT UNS.

Best practice from benchmarking study is developed to be framework system of PPBT development. The development is done by identifying the elements of the system. They are input, process and output element and also SOP (Standard Operating Procedure) of the system.

Once the system is constructed, it is pre-implemented in PIT UNS. The pre-implementation is done by using two recent tenants of PIT UNS as a case study. In the pre-implementation process, the incubation position of the tenant is identified firstly. Then a recommendation of next incubation strategy with SOP attached is given to tenants. Finally, tenants give feedback and recommendation about the system proposed. In the final step of this study, there is an analysis of the system proposed, feedback and recommendation from tenants and managerial implication of the system.

3. Result and Discussion

3.1 Identification of Brief Incubation Process in PIT UNS

There are six processes of incubation in PIT UNS (PIT UNS, 2015). The first process is called a "bank idea". In that process, the technology and business idea of UNS academician will be gathered and collected. The second process is the selection of the idea to get tenant (incubator participant) and the technology based on readiness level. Then the tenant will include in incubation process, started with technopreneurship training (training about technology and business). After that, the incubation process continues with technology enhancement, IP protection, partnership, and funding. The incubation progress will be evaluated periodically. Finally, an exit strategy will be conducted to create PPBT.

It can be concluded that there are eight main activities in the six processes. The first activity is conducted before the incubation process is run. It is the tenant candidate selection. In the incubation process there are several activities. They are technology transfer training, technology enhancement, IP protection, partnership, funding, and evaluation. The final activity is exit strategy and creation of PPBT. Partnership activity also can be conducted in post incubation process.

3.2 Benchmarking Study

The first step of the benchmarking study is a planning step. In this step the benchmarking subject and target are determined. There are three benchmarking subjects in this study and will be called as B1, B2, and B3: B1 refers to incubator owned by Government of Indonesia as regulator; B2 refers to university incubator in Indonesia; B3 refers to university incubator in overseas. Based on the identification of brief of incubation process in PIT UNS there are eight main activities in PPBT development. But the technology strengthening step is not discussed later in this study. It is due to the numerous variation of the step depends on the technical characteristics. The benchmarking target in this study is shown in table 1.

After the benchmarking target is identified, the study is continued with the data collection process. Primary data is collected by interviewing the incubator officer, while secondary data is collected by literature study about the incubator. The data indicates the characteristic of each incubator based on benchmarking target.

Collected data is analyzed by comparing each characteristic of three incubators. The data analysis result is used to determine the best practice for PIT UNS. Condition and policy in UNS and in Indonesia are also considered to determine the best practice. The result of the benchmarking study is shown in table 1.

Table 1 Benchmarking target

No	Activity	Benchmarking Target	Best Practice for PIT UNS	Justification
1	Tenant Candidate Selection			
1a	Tenant Candidate Submission	Submission /Business (BP)	Proposal Proposal BP for technology product by offline or online in PIT website	- PIT concept: develop technology-based business (PIT UNS, 2015) - Website promotion

	Tenant Candidate		<ul style="list-style-type: none"> - From academician of UNS - By invitation or volunteer 	<ul style="list-style-type: none"> - UNS' Rector Decree: PIT for UNS environment (Sebelas Maret University, 2014) - The number of patent filling in UNS (Sebelas Maret University, 2015)
	Submission Process		<ul style="list-style-type: none"> - Invitation and regular lines - SOP 1a (invitation) - SOP 1b (regular) 	<ul style="list-style-type: none"> - Invitation lines to utilize potency in UNS - Regular lines to create awareness of academician
1b	Tenant Candidate Selection	Registered Candidate	Tenant Passed in desk selection (administrative examination)	Candidate able to fulfill the target of PIT
		Selection Team	Practitioner, businessman, investor, technology expert, Head of PIT, PIT's partner	To evaluate the technology readiness and business readiness level
		Selection Criteria	<ul style="list-style-type: none"> - Criteria for tenant - Criteria for technology 	Two main inputs for PIT incubation process (PIT UNS, 2015)
		Selection Process	<ul style="list-style-type: none"> - Desk evaluation and presentation if necessary -SOP 2 	<ul style="list-style-type: none"> - Desk evaluation: resource efficiency - Presentation: ensure candidate selection
2.	Technology Transfer Training and Mentoring	Trainer Team	<ul style="list-style-type: none"> - Decided by PIT, tenant and tenant's LO 	Each tenant has different needs and requirements
		Training Process	<ul style="list-style-type: none"> - As long in the incubation process - Reported on each period - SOP 3 	<ul style="list-style-type: none"> - Depend on the tenant's need and progress - Tenant is expected to be a trainer after the incubation process
3.	Certification, License and IP Protection	Certificate, and IP	License, Owned by inventor based on the product characteristic	IP concept: exclusive right for the inventor (K. Diharjo, 2014)
		Service Provider Unit	Government institution	Government regulation (Government of Republic of Indonesia, Law No. 14, 15, 28, 29, 30,31,32 years 2000, 2001, 2014)
		Submission Process	<ul style="list-style-type: none"> - By tenant self, PIT provides the cover letter - SOP 4 	There is another unit in UNS which in charge of IP management (Ministry of Education and Culture, 2014)
4.	Funding	Source	UNS budget, sponsor, stakeholder cooperation	<ul style="list-style-type: none"> - PIT Business Plan ((PIT UNS, 2015) - UNS' grant (Sebelas Maret University, Guideline for Implementation, 2014)
		Management	<ul style="list-style-type: none"> Funding just for operational needs - SOP 5 	<ul style="list-style-type: none"> - Government policy (Ministry of Cooperation, 2015) - Avoid ownership conflict
5.	Networking	Type	Government, RnD institution, company, private	PIT Business Plan (PIT UNS, 2015)
		Management	<ul style="list-style-type: none"> Based on the cooperation contract (MoU, MoA) - SOP 6 	<ul style="list-style-type: none"> - UNS policy (Sebelas Maret University, Rector of Sebelas Maret University Degree, 2008)
6.	Evaluation of Incubation Program	Evaluator Team	PIT officer, tenant's LO, partner of PIT if necessary	<ul style="list-style-type: none"> - Tenant's LO: evaluate work performance of the tenant - PIT officer: evaluate the progress of tenant
		Method	<ul style="list-style-type: none"> - Each semester or anytime by database if necessary - Result: recommendation, tenant's graduation/drop out - SOP 7 	<ul style="list-style-type: none"> - Adapt the academic schedule - Anytime if there is a guest evaluator
7.	Exit Strategy	Time	3 years with maximum 1-year extension	<ul style="list-style-type: none"> - Government rules (Government of Indonesia, 2013 and Ministry of Cooperation, 2015)

Type	The spin-off, license, joint venture, strategic alliance	- Timing model (Astuti, 2014) - PIT Business Plan (PIT UNS, 2015) - National guideline (Taufik, 2004)
Exit Process	- After evaluation by creating a contract - UNS get 60% of royalty - SOP 8	- UNS policy (Sebelas Maret University, 2015 and Government of Indonesia, 2013)

3.3 Framework System Development

The framework system is created by developing the benchmarking result. The development is done by identifying the elements of each activity (subsystem): input, process and output, and the connection between the activities. After that, the system is developed by creating the required SOPs. Based on the benchmarking study, there are 8 required SOPs in the system. The general framework system is illustrated in figure 2.

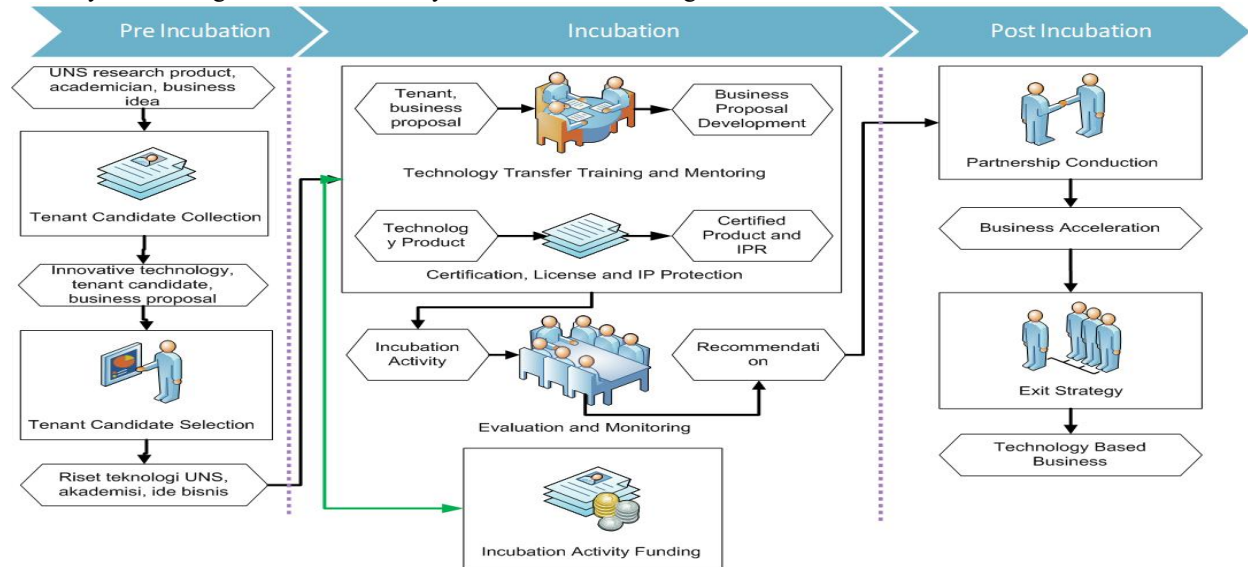


Figure 2 Framework System of Technology-Based Start-Up Development in PIT UNS

The main input of the system is UNS research product, academican and their business idea while the main output is technology-based business. Start-up or spin-off company is the primary target for each graduated tenant. But there are several options except for the start-up for some certain graduated criteria. Each option is applicable for certain criteria. Table 2 shows the exit strategy options with their applicable criteria.

Table 2 Criteria for each exit strategy option

Criteria	Spin-Off Company	License	Joint Venture	Strategic Alliance
Establishment Capital				
Sufficient	√			√
Insufficient		√	√	
Legal Entity				
Have	√		√	√
Do not have		√		
Material and Machine Production Availability				
Available in local	√		√	
Available in national	√		√	
Available in global	√	√	√	√
Human Resource for Mass Scale Availability				
Available in local	√		√	
Available in national	√	√	√	
Available in global	√	√	√	√
Market barrier				
Great		√	√	√

Less √ √ √

3.4 Pre-Implementation of The System

Before the system is pre-implemented, it is validated through FGD (Focus Group Discussion) with the PIT officers. The FGD results in some recommendation and revision in SOPs. But the system is generally applicable in PIT UNS. It is able to be pre-implemented with PIT recent tenants as a case study. There are two PIT tenants for the case study as the PIT officer recommendation. One tenant develops Li-Ion battery product, and the other one develops acoustic panel product. Incubation position of two tenants is identified firstly. Then a recommendation for next incubation strategy is given to them. The SOPs are also attached in the recommendation.

Li-Ion battery tenant has reached a high technology readiness level (TRL). The expected TRL is 8 or more, although the last TRL calculation of the product is done in 2014. Some of the product is also has been sold. The IP protection has been in filling step but not granted yet. Partnership with manufacturer and consumer target has been initiated. It is important for Li-Ion battery tenant to start to initiate the spin-off establishment, more promotion and develop a business proposal to gain capital.

Acoustic panel tenant has reached a high TRL. The expected TRL is 8 or more, although the last TRL calculation of the product is done in 2014. The IP protection has been in filling step but not granted yet. But the number of the sold product is still minimal. It becomes more difficult because there is no partnership yet and the lab scale production is difficult due to the characteristic of the product. It is important for acoustic panel tenant to strengthen the partnership with manufacturer and consumer target. Beside PIT can give training about market access to the tenant. Framework system and recommendation attached with SOPs are given to the tenants to get feedback. The tenant can identify their incubation position from the framework system illustration. The SOPs and recommendation are able to help tenant planning the next incubation action plan. But they requested to explore more in monitoring and coaching activity.

4. Analysis

The system is analyzed by comparing the recent condition in PIT UNS with the proposed system. The comparison aspects are system component, boundary, environment, input, process, and output. Table 3 shows the comparison summary.

Table 3 Comparison between a recent and proposed condition in PIT

Aspect	Recent Condition	Proposed Condition	Advantages
Component	4 divisions	4 divisions	+ division role enhancement
Boundary	UNS	UNS	-
Environment	Government institution, RnD institution, university, company	Government institution, RnD institution, university, company, a private organization	+ more partnership form to support incubation activity especially funding
Input	UNS academician by the volunteered candidate	UNS academician by volunteered and invited candidate	+ more ideas + higher TRL
Process	Illustrated as business process	Illustrated as SOP	+ clear process illustration + can be a guideline for PIT officer or other parties
Output	the spin-off company, license, joint venture	the spin-off company, license, joint venture, strategic alliance	+ more option to confirm characteristic of the incubated product

Managerial Implication

The framework system is expected to be applicable in PIT UNS. By implementing the system, performance of PIT UNS can be enhanced and able to obtain the goal. But the system should be supported by the condition either in UNS or PIT UNS. 5 management elements (man, material, machine, money, and method) or 5M analysis can be used to figure out the support of UNS condition in technology-based start-up development system. Man aspect represents the

PIT officer. It is still dominated by magister staff. And not all of them come from a business and management background. Although PIT officers have worth more publication about commercialization and incubation compared with another incubator officer in Indonesia generally. There is should be training for the staff about business and management especially for a start-up.

Material aspect represents the main input of PIT: academicians and technology. PIT has an advantage in the number of an academicians. But the quantity of the academicians does not represent the quality. Meanwhile, the number of technology is still low. Motivation to transfer technology result to be commercialized product should be enhanced. Machine aspect represents the facility provided by PIT. It can be facility owned by PIT (building, room, mentoring activity) and not owned by PIT (access facility by the partnership). Generally, the facility provided by the PIT is almost the same with another incubator. But the physical facility is still lack of usage. Money aspect represents the funding provided by PIT. The funding source of PIT majority comes from the government due to university status. The chance to gain the funding is same with other universities. But the UNS budget for commercialization activity is more than average university. It should be utilized optimally to support PIT activity and gain the goal. Method aspect represents procedure in PPBT development. Some incubators have standardized the procedure in SOP and recorded as guidelines. PIT does not standardize the procedure and records it yet.

5. Conclusion

As a new incubator, PIT UNS need to develop their PPBT development system. For the development, a benchmarking study is conducted. From the benchmarking study, there are eight subsystems in PPBT development system in PIT UNS. They are tenant candidate registration/collection, tenant candidate selection, technology transfer training, certification, and IP protection, monitoring and evaluation, funding, partnership, and exit strategy. By those processes, the UNS academicians attached with the technology and their business idea will be transformed into technology-based startup or PPBT as the main output. But the system should be supported with the qualified resource in UNS.

The system has been validated by FGD and pre-implemented by using two recent tenants of PIT UNS as the case study. Feedback from the tenant's state that the system is able to help tenant identifying the recent incubation position and make the action plan. But it is necessary to explore the mentoring and coaching activity more deeply.

As the future research direction, the system can be developed more deeply for each activity. Challenge to create qualified input source and environment in developing technology-based startup can be an alternative for future research. An analysis of the development of graduated startup after the incubation process is another option.

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