*International Journal of Engineering & Technology*, 7 (2.29) (2018) 933-938

International Journal of Engineering & Technology

*Website: www.sciencepubco.com/index.php/IJET*

***Research paper***

# A Study to Investigate Technopreneurship Talent for Higher Education Students [Engineering, Agriculture Engineering, and Information Technology Students in Universitas Andalas Indonesia]

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**Abstract**

Lack of new business and jobs has led unemployed issues. This problem can be settled by increasing the number of new technopreneurs, entrepreneurs creating new business and jobs through technological innovations. The study is to find out technopreneurship talent of the students of faculty of engineering, agriculture engineering and information technology of Universitas Andalas. Then, they are compared by four criteria or dimensions: [1] Entrepreneurial Characteristics, [2] Absorptive Capacity, [3] Knowledge and Learning Skills, [4] Business and Communication Skills. A set of indicators is developed for each criterion and assessed qualitatively using questioners as tool. The assessments are carried out in three stages: indicators, criteria, and technopreneur talent assessment. Attitudes measurement technique is used for indicators assessment while Weighted Sum Model [WSM] is used for criteria and technopreneur talent assessment. The overall technopreneur talent assessments show that engineering students are relatively better with information technology students and agriculture engineering students are adept in some aspects of technopreneurship.

***Keywords***: *Technopreneur talent; students; WSM*

## 1. Introduction

Unemployment is a socio-economic problem, not only individually, but also for organizational, community, and other related social issues [1]. The effect of unemployment can divided into two major categories: individual and social [2]. In individual level, the economic costs of unemployment are reduction of income level, social status, health, human resources capabilities. As addition, unemployment is also the cause of skill degradation and even underemployment. Not only underemployment will affect individual, but it also can influence society because its potency to reducing educational attainment that will ultimately lead to "de-skill" of labour force. But the most significant problems will come in the form of social: the loss of production output [goods and services] [1]. High unemployment rate also limit nation tax revenues and continuously will lose income from indirect tax [3]. This influence will be more apparent in times of economic crisis. The research result shows that in Great Recession Era, high unemployment rate became burden in American state budget [2]. The other social cost appear in form indirect health costs and illicit activities which can lead to increased feelings of insecurity caused by unemployment, especially in urban area [1].

The development of social-economics condition in Indonesia still can face those problems, despite the lowering of unemployed rate in the last few years. The projection of Indonesia population gives estimation that Indonesia will gain demographic bonus in the coming years [4]. Demographic bonus comes from the increasing number of productive age population. As can be seen In Fig. 1, the percentage of productive age will peak at 2035, reaching 68.65% of total Indonesia population before start to decline. Demographic is an opportunity for economic development. An increasing number of productive age population means an increase in labour force, and this could increase Indonesia production output. The question is the ability to provide jobs for those labour forces. Without job availability, those labour forces will become unemployed. It will not only give social-economy problems, but it also can create miss opportunity in economic development.

Entrepreneurship always considered as panacea for unemployment problems [1]. An entrepreneur creates new jobs through establishing new business – usually small and medium enterprises [SMEs]. Job creation in USA come from developing small business [5]. Similar research in UK also found the same conclusion [6]. The growing importances of technology also affect entrepreneurship development. This is demonstrated by the increasing role of technology-based industries in international trade [7]. Although the importance of traditional industries declining, new technology and other knowledge-based sectors thrive because the role they played in industrial renewal and economic development [8]. This condition has shifting focus from traditional entrepreneurship to technology-based entrepreneurship or technopreneurship.

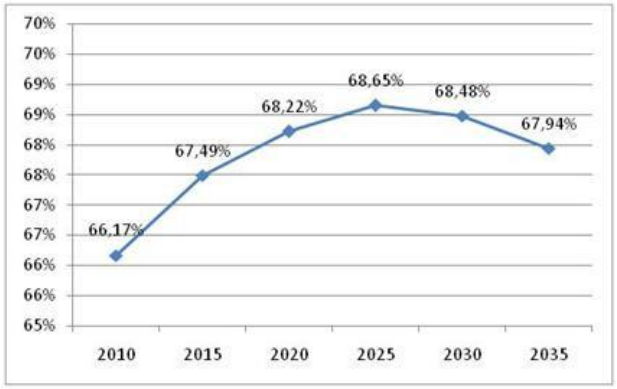


**Fig. 1:** Estimation of Productive Age Percentage in Indonesia Population

In simple term, technopreneur is entrepreneur that creates new business and jobs through technological innovation. The relation between technopreneurship with technology not only helps economic development through creation of new jobs, but also promotes economic expansion through creation of completely new market and industries. Beside those advantages, technopreneurship also help to escalate national competitiveness. Technological readiness, business sophistication, and innovation are three of twelve pillar of national competitiveness [9]. Technological innovation aspect of technopreneurship will help the development of those three pillars. Considered as part of society with relatively better knowledge and perspective, university students are expected to become future technopreneurs, by develop their technopreneur talent. This research tries to assess university student's technopreneur talent, especially from faculty that directly related to technological innovation, such as: engineering, agriculture engineering and information technology.

## 2. Methodology

Technopreneurship is a combination of two concepts: entrepreneurship and technological innovation. The assessment of technopreneur talent cannot neglect the entrepreneurship aspect. Entrepreneurship characteristics can be seen as criteria for basic ability needed to develop technopreneur talent. Entrepreneurship characteristics assessment are based on local uniqueness, or in this research based on Minangkabau entrepreneurship characteristics because it is used to assess students in Padang. There are ten characteristics of Minangkabau entrepreneur [10] and those characteristics are used in this research. Technopreneurship talent assessed using the other three criteria. Indicators for those three criteria developed through literature study. Summary of literature study result and indicator group can be seen in Table 1. In total, there are four criteria to assess technopreneurship talent: entrepreneurship characteristics, absorptive capacity, knowledge and learning skills, and business management and communication skills.
Hierarchical assessment process consists of three stages:

### Step 1 Indicators Assessment

Qualitative approach is used to conduct Indicators assessment, with survey as research method and questionnaire as its tool. The questionnaire consists of two parts: general data of respondent and assessment. General data collected are respondent age and gender to see respondent distribution. Assessment part covers a set of question item that can be assessed by respondent using five point Likert scale. Every question item represents one indicator. Research conducted in Andalas University. 100 questioners are spread to each engineering, agriculture engineering, and information technology student. Data from questionnaire has to go through validity and reliability test first before used in assessment process. Validity test conducted to measure the accuracy of questionnaire to assess aspects to be valued. Test conducted using product moment correlation equation [11]:

$$r = \frac{N(\sum_{i=1}^{N} X_i Y_i) - (\sum_{i=1}^{N} X_i \sum_{i=1}^{N} Y_i)}{\sqrt{\left[N\sum_{i=1}^{N} {X_i}^2 - (\sum_{i=1}^{N} X_i)^2\right]\left[N\sum_{i=1}^{N} {Y_i}^2 - (\sum_{i=1}^{N} Y_i)^2\right]}} \quad (1)$$

Where X is question score, Y is total score, and N is total number of respondent.
Reliability test conducted to measure relative consistency of questionnaire. The test only performed on question items that have passed validity test and conducted using Cronbach's Alpha equation:

$$\alpha = \left(\frac{K}{K-1}\right)\left(\frac{{s_r}^2 - \sum_{i=1}^{K} {s_i}^2}{{s_x}^2}\right) \quad (2)$$

Where α is reliability coefficient, K is the number of question items assessed,
$\sum {s_i}^2$ is the total of question item score variance, and ${s_x}^2$ is variance of each question items. All question items have internal consistency if the reliability coefficient value bigger than 0.70 [12].
Assessment process conducted using Attitudes Measurement Technique developed by [13]. Assessment is not based on the sum but the average score. With this approach, the assessment result can be translated in accordance with the definition represented by the initial Likert scale used in questionnaire.

$$I_j = \frac{\sum_{i=1}^{N} X_i}{N} \quad (3)$$

Where $I_j$ is the assessment result for indicators j, $X_i$ is assessment score from respondent I, N is total number of respondent, and i is respondent index where the value of i = 1, 2, …, N.

### Step 2 Criteria Assessment

Criteria assessment conducted using Weighted Sum Model [WSM]. Assessment process based on the result of Step 1 [Indicator Assessment]. The assessment result of all indicators adjusted to the weight of each indicator and then summed using equation:

$$C_k = \sum_{j=1}^{J} w_j \times I_j \quad (4)$$

Where $C_k$ is the assessment result for criteria k, $w_j$ is the weight of indicator j, $I_j$ is the result of indicators assessment, J is the total number of indicator from criteria assessed, and j is criteria index where j = 1, 2, …, J.

**Table 1:** Indicators and Criteria for Technopreneur Talent Assessment

| Level 0 | Level 1 [Criteria] | Level 2 [Indicator] | | | | References |
|---|---|---|---|---|---|---|
| Technopreneur Talent | Entrepreneur Characteristics | M1 | Confidence | | | [10] |
| | | M2 | Hard work | | | |
| | | M3 | Careful calculation/ Economical | | | |
| | | M4 | Independence | | | |
| | | M5 | Tenacity | | | |
| | | M6 | Contributions to the family | | | |
| | | M7 | Consistency | | | |
| | | M8 | Ingenuity | | | |
| | | M9 | Flexibility | | | |
| | | M10 | Dare to face the business challenges | | | |
| | Knowledge and Learning Skills | Absorptive Capacity | A1 | Technological skills | | [14] [15] [16] |
| | | | A2 | Experience in product/ service development | | [17] |

| | | | | | |
|---|---|---|---|---|---|
| | | | A3 | Experience in marketing | [17] |
| | | | A4 | Knowledge of business process standard | [18] |
| | | | | | [19] |
| | | | A5 | Idea sharing | [18] |
| | | | A6 | Knowledge transfer ability | [8] |
| | | | A7 | Technological forecast | [20] |
| | | | | | [21] |
| | | Other Knowledge and Learning Skills | K1 | New idea development | [18] |
| | | | | | [8] |
| | | | | | [19] |
| | | | K2 | Ability to conduct research | [8] |
| | | | K3 | Learning ability | [8] |
| | | | K4 | Problem solving ability | [15] |
| | | | K5 | Information Technology skills | [16] |
| | Business Management and Communication Skills | B1 | | Business planning skills | [22] |
| | | | | | [18] |
| | | | | | [16] |
| | | B2 | | Commercialization skills | [8] |
| | | B3 | | Empathy | [14] |
| | | B4 | | Communication skills | [15] |
| | | | | | [18] |
| | | | | | [16] |
| | | B5 | | Team work ability | [15] |
| | | | | | [23] |
| | | | | | [24] |
| | | B6 | | Adaptability | [18] |
| | | B7 | | Network building | [22] |
| | | | | | [16] |

Where T is the technopreneur talent assessment result, $w_k$ is the weight of criteria k, $C_k$ is the result of criteria assessment for criteria k, K is the total number of criteria, and k is criteria index where k = 1, 2, …, k.

Those steps used to assess student technopreneur talent from each engineering, agriculture engineering, and information engineering faculty separately. The assessment result from each faculty then compared at each stage to obtain the level of relative excellence.

## 3. Results and findings

General data recapitulation shows good data distribution. Age distribution shows that most of respondent are in range of 19-22 years old. This means the assessment involves students in their active years, between their sophomore and junior year, reflecting the direct effect of university life into their technopreneur talent. Respondent age distribution can be seen in Fig. 2.

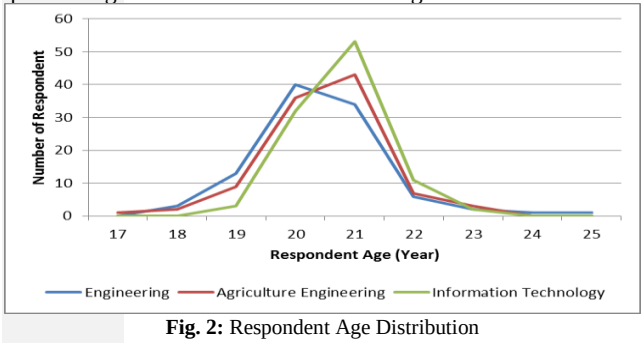


**Fig. 2:** Respondent Age Distribution

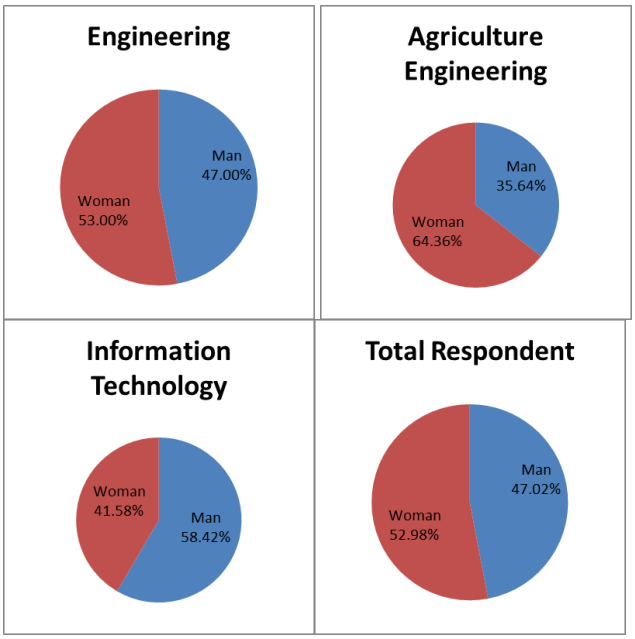


**Fig. 3:** Comparison of Respondent Gender Percentage

Recapitulation result for respondent gender data show a fairly balanced proportions for respondent from engineering faculty: 47% male and 53% female. A less balanced proportions show in respondent from other two faculty: 35.64% male and 64.36% female for Agriculture Engineering, and 58.42% male and 41.58% female for Information Technology. Nonetheless, gender distribution for overall data fairly balanced: 47.02% male and 52.98% female.

Validity testing shows that all question items are valid. This mean questionnaire have had sufficient accuracy in assessing research indicators. The result of validity test can be seen in Table 2. Reliability testing show that the questionnaire is reliable, which means research questionnaire will give consistent result if assessment process repeated again. Cronbach's Alpha value is 0.858, greater than 0.700. Both testing result show that all indicators used in three assessment steps and no indicators discarded

**Table2:** Validity Test Result

| Indicators | r count | r table | Result |
|---|---|---|---|
| M1 | 0,326 | 0,113 | Valid |
| M2 | 0,393 | 0,113 | Valid |
| M3 | 0,311 | 0,113 | Valid |
| M4 | 0,309 | 0,113 | Valid |
| M5 | 0,369 | 0,113 | Valid |
| M6 | 0,396 | 0,113 | Valid |
| M7 | 0,436 | 0,113 | Valid |
| M8 | 0,470 | 0,113 | Valid |
| M9 | 0,582 | 0,113 | Valid |
| M10 | 0,527 | 0,113 | Valid |
| | | | |
| K1 | 0,437 | 0,113 | Valid |
| K2 | 0,475 | 0,113 | Valid |
| K3 | 0,488 | 0,113 | Valid |
| K4 | 0,515 | 0,113 | Valid |
| K5 | 0,470 | 0,113 | Valid |
| | | | |
| A1 | 0,422 | 0,113 | Valid |
| A2 | 0,483 | 0,113 | Valid |
| A3 | 0,536 | 0,113 | Valid |
| A4 | 0,489 | 0,113 | Valid |
| A5 | 0,478 | 0,113 | Valid |
| A6 | 0,368 | 0,113 | Valid |
| A7 | 0,483 | 0,113 | Valid |
| | | | |
| B1 | 0,524 | 0,113 | Valid |
| B2 | 0,507 | 0,113 | Valid |
| B3 | 0,443 | 0,113 | Valid |
| B4 | 0,532 | 0,113 | Valid |
| B5 | 0,410 | 0,113 | Valid |
| B6 | 0,524 | 0,113 | Valid |
| B7 | 0,492 | 0,113 | Valid |

The result of Step 1 shows that students from the three faculties have fairly good technopreneur indicators score. All indicators assessment have had score greater than 3, which represent "fair" evaluation in 5 point Likert scale [1-5]. Confidence indicators even get score higher than 4 which represent "good" evaluation for agriculture engineering and engineering students. Assessment result of entrepreneurship characteristic indicators dominated by engineering students which relatively excel than students from other faculty in six indicators, more than information technology students [three indicators] and agriculture engineering students [two indicators]. Different result found in other criteria. Assessment of Absorptive Capacity indicators more dominated by information technology students [4 indicators], more than engineering students [3 indicators]. The same result also can be found in the assessment result of Knowledge and Learning Skills, where information technology students excel in three indicators, while engineering students excel in two indicators. Meanwhile, more balance result can be seen in the result of Business Management and Communication Skills indicators assessment. Students of information technology and agriculture engineering equally excel in three indicators, although all three are different indicators, while engineering students only excel than two other faculties in one indicator.

In summary, the result of Step 1 shows that featured technopreneur characteristics are:

**Engineering students:** Hard work, careful calculation/ economical, consistency, ingenuity, flexibility, dare to face the business challenges, idea sharing, knowledge transfer ability, technological forecast, new idea development, learning ability, and team work ability.

**Agriculture engineering students:** Confidence, careful calculation/ economical, empathy, adaptability, and network building.

**Information technology students:** Independence, tenacity, contributions to the family, technological skills, experience in product/ service development, experience in marketing, knowledge of business process standard, ability to conduct research, problem solving ability, information technology skills, business planning skills, commercialization skills, and communication skills.

Those featured characteristics can be used as input and consideration in preparing technopreneur-based curriculum for each faculty.

Criteria assessment process conducted using WSM, based on the result of indicator assessment adjusted to their respective weight. Hence each indicator is considered equally important; the weight of each indicator is determined by the formula:

$$w_j = {}^{1}/_{J} \quad (6)$$

Where $w_j$ is the weight of indicator j, and J is total number of indicators from assessed criteria.

The result of criteria assessment illustrated that students have fairly good technopreneur criteria. This is demonstrated through assessment result all have score greater than 3 which represent "fair" evaluation in 5 point Likert scale [1-5]. Engineering students relatively more excel in *entrepreneurship characteristics*, *absorptive capacity*, and *knowledge and learning skills* criteria than other students. However, information technology students are more excel in *business management and communication skills* criteria. The assessment result can be seen in Table 4 for *entrepreneur characteristics* criteria, Table 5 for *absorptive capacity* criteria, Table 6 for *knowledge and learning skill* criteria, and Table 7 for *business management and communication skills* criteria.

As well as criteria assessment process, technopreneur talent assessment process conducted using WSM, but based on criteria assessment result adjusted to their respective weight. Each indicator weight is also considered equally important, determined by the formula:

$$w_k = {}^{1}/_{K} \quad (7)$$

Where $w_k$ is the weight of criteria k, and K is total number of criteria.

Assessment result show fairly good result, indicated by a score of 3.77 for engineering students, a score of 3.75 for information technology students, and a score of 3.70 for agriculture engineering students. Those result shows fairly good condition, where assessment result are in range of score 3 which represent "fair" evaluation and score 4 which represent "good" evaluation in 5 point Likert scale [1-5]. Result also shows that engineering student have relatively better technopreneur talent than information technology students and agriculture engineering students.

## 4. Conclusion

The growing importance of entrepreneurship and technology development in countering socio-economics issues has become stimulant in the rise of technopreneurship concept. Technopreneur is entrepreneur that create new business and jobs through technological innovation. This research tries to assess university student's technopreneur talent, especially from faculty that directly related to technological innovation: engineering, agriculture engineering and information technology. Technopreneural talent assessed on three criteria: [1] Absorptive Capacity, [2] Knowledge and Learning Skills, [3] Business and Communication Skills. The result presented in three assessment level. In indicator level, the result shows that while agriculture engineering students are more excel in some of entrepreneurship characteristics indicators [such as: confidence and Careful calculation/ economical] and business management and communication skills aspects [such as: empathy, adaptability, and network building], most of other aspects relatively dominated by information technology students and engineering students. Indicator assessment result can be used as input and consideration in preparing technopreneur-based curriculum for each faculty. In criteria level, the result shows that engineering students relatively excel in entrepreneurship characteristics, absorptive capacity, and knowledge and learning skills criteria, while information technology students relatively better in business management and communication skills criteria. The result of Technopreneur talent assessment shows that engineering students have relatively better technopreneur talent than information technology students and agriculture engineering students. In general, the assessment result indicate that overall engineering students, information technology students, and agriculture engineering students have fairly good technopreneur talent.

**Table 3:** Indicators Assessment Result

| | Indicators | Engineering | Agriculture Engineering | Information Technology |
|---|---|---|---|---|
| **M** | **Entrepreneur Characteristics** | | | |
| M1 | Confidence | 4,00 | **4,09** | 3,84 |
| M2 | Hard work | **3,86** | 3,84 | 3,77 |
| M3 | Careful calculation/ Economical | **3,99** | **3,99** | 3,70 |
| M4 | Independence | 3,15 | 3,07 | **3,49** |
| M5 | Tenacity | 3,68 | 3,54 | **3,75** |
| M6 | Contributions to the family | 3,56 | 3,56 | **3,67** |
| M7 | Consistency | **3,91** | 3,86 | 3,74 |
| M8 | Ingenuity | **3,93** | 3,79 | 3,75 |
| M9 | Flexibility | **3,97** | 3,63 | 3,76 |
| M10 | Dare to face the business challenges | **3,86** | 3,73 | 3,73 |
| | | | | |
| **A** | **Absorptive Capacity** | | | |
| A1 | Technological skills | 3,67 | 3,62 | **3,70** |

| | | | | |
|---|---|---|---|---|
| A2 | Experience in product/ service development | 3,61 | 3,63 | **3,64** |
| A3 | Experience in marketing | 3,65 | 3,56 | **3,69** |
| A4 | Knowledge of business process standard | 3,47 | 3,40 | **3,69** |
| A5 | Idea sharing | **3,97** | 3,79 | 3,66 |
| A6 | Knowledge transfer ability | **3,94** | 3,90 | 3,79 |
| A7 | Technological forecast | **3,85** | 3,79 | 3,80 |
| | | | | |
| **K** | **Knowledge and Learning Skills** | | | |
| K1 | New idea development | **3,97** | 3,79 | 3,62 |
| K2 | Ability to conduct research | 3,80 | 3,67 | **3,83** |
| K3 | Learning ability | **3,93** | 3,81 | 3,70 |
| K4 | Problem solving ability | 3,73 | 3,59 | **3,89** |
| K5 | Information Technology skills | 3,77 | 3,64 | **3,83** |
| | | | | |
| **B** | **Business Management and Communication Skills** | | | |
| B1 | Business planning skills | 3,57 | 3,57 | **3,73** |
| B2 | Commercialization skills | 3,48 | 3,63 | **3,80** |
| B3 | Empathy | 3,77 | **3,83** | 3,81 |
| B4 | Communication skills | 3,66 | 3,51 | **3,78** |
| B5 | Team work ability | **3,82** | 3,80 | 3,78 |
| B6 | Adaptability | 3,75 | **3,84** | 3,80 |
| B7 | Network building | 3,85 | **3,87** | 3,77 |

**Table 4:** Entrepreneurship Characteristics Criteria Assessment Result

| | | Weight | Engineering | Agriculture Engineering | Information Technology |
|---|---|---|---|---|---|
| M1 | Confidence | 0,10 | 4,00 | 4,09 | 3,84 |
| M2 | Hard work | 0,10 | 3,86 | 3,84 | 3,77 |
| M3 | Careful calculation/ Economical | 0,10 | 3,99 | 3,99 | 3,70 |
| M4 | Independence | 0,10 | 3,15 | 3,07 | 3,49 |
| M5 | Tenacity | 0,10 | 3,68 | 3,54 | 3,75 |
| M6 | Contributions to the family | 0,10 | 3,56 | 3,56 | 3,67 |
| M7 | Consistency | 0,10 | 3,91 | 3,86 | 3,74 |
| M8 | Ingenuity | 0,10 | 3,93 | 3,79 | 3,75 |
| M9 | Flexibility | 0,10 | 3,97 | 3,63 | 3,76 |
| M10 | Dare to face the business challenges | 0,10 | 3,86 | 3,73 | 3,73 |
| | **Entrepreneur Characteristics** | | **3,79** | **3,71** | **3,72** |

**Table 5:** Absorptive Capacity Criteria Assessment Result

| | | Weight | Engineering | Agriculture Engineering | Information Technology |
|---|---|---|---|---|---|
| A1 | Technological skills | 0,14 | 3,67 | 3,62 | 3,70 |
| A2 | Experience in product/ service development | 0,14 | 3,61 | 3,63 | 3,64 |
| A3 | Experience in marketing | 0,14 | 3,65 | 3,56 | 3,69 |
| A4 | Knowledge of business process standard | 0,14 | 3,47 | 3,40 | 3,69 |
| A5 | Idea sharing | 0,14 | 3,97 | 3,79 | 3,66 |
| A6 | Knowledge transfer ability | 0,14 | 3,94 | 3,90 | 3,79 |
| A7 | Technological forecast | 0,14 | 3,85 | 3,79 | 3,80 |
| | **Absorptive Capacity** | | **3,74** | **3,67** | **3,71** |

**Table 6:** Knowledge and Learning Skills Criteria Assessment Result

| | | Weight | Engineering | Agriculture Engineering | Information Technology |
|---|---|---|---|---|---|
| K1 | New idea development | 0,20 | 3,97 | 3,79 | 3,62 |
| K2 | Ability to conduct research | 0,20 | 3,80 | 3,67 | 3,83 |
| K3 | Learning ability | 0,20 | 3,93 | 3,81 | 3,70 |
| K4 | Problem solving ability | 0,20 | 3,73 | 3,59 | 3,89 |
| K5 | Information Technology skills | 0,20 | 3,77 | 3,64 | 3,83 |
| | **Knowledge and Learning Skills** | | **3,84** | **3,70** | **3,77** |

**Table 7:** Business Management and Communication Skills Criteria Assessment Result

| | | Weight | Engineering | Agriculture Engineering | Information Technology |
|---|---|---|---|---|---|
| B1 | Business planning skills | 0,14 | 3,57 | 3,57 | 3,73 |
| B2 | Commercialization skills | 0,14 | 3,48 | 3,63 | 3,80 |
| B3 | Empathy | 0,14 | 3,77 | 3,83 | 3,81 |
| B4 | Communication skills | 0,14 | 3,66 | 3,51 | 3,78 |
| B5 | Team work ability | 0,14 | 3,82 | 3,80 | 3,78 |
| B6 | Adaptability | 0,14 | 3,75 | 3,84 | 3,80 |
| B7 | Network building | 0,14 | 3,85 | 3,87 | 3,77 |
| | **Business Management and Communication Skills** | | **3,70** | **3,72** | **3,78** |

**Table8:** Technopreneur Talent Assessment Result

| | | Weight | Engineering | Agriculture Engineering | Information Technology |
|---|---|---|---|---|---|
| M | Entrepreneur Characteristics | 0,25 | 3,79 | 3,71 | 3,72 |
| A | Absorptive Capacity | 0,25 | 3,74 | 3,67 | 3,71 |
| K | Knowledge and Learning Skills | 0,25 | 3,84 | 3,70 | 3,77 |
| B | Business Management and Communication Skills | 0,25 | 3,70 | 3,72 | 3,78 |
| | **Technopreneurship Talent** | | **3,77** | **3,70** | **3,75** |

## Acknowledgement

This research has received funding from Faculty of Engineering, Universitas Andalas in PNBP Universitas Andalas [Contract No. 023/UN.16.09.D/PL/2017].

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