MODEL OF TECHNOLOGY VALUATION SYSTEM OF PATENT-ORIENTED PROCESS (CASE STUDY ON COMPOSITION OF CAJUPUT CANDY AS THROAT RELIEF)

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ABSTRAK

Penentuan nilai dan prediksi harga sebuah teknologi merupakan hal yang sulit dilakukan dalam proses komersialisasi karena sifat penemuan dalam bentuk teknologi yang tidak dapat diukur secara kuantitatif (*intangible*). Sifat tersebut mempersulit proses penilaian suatu teknologi. Berdasarkan hal tersebut maka sistem penilaian teknologi diharapkan mampu membantu inventor dan Kantor Hak Kekayaan Intelektual (HKI) dalam menilai dan memprediksi harga sebuah teknologi baru. Tujuan dari penelitian ini adalah: (1) menilai komposisi permen kayu putih untuk pelega tenggorokan sebagai sebuah teknologi baru yang potensial untuk dikomersialisasikan; dan (2) memberikan prediksi harga lisensi untuk komposisi permen kayu putih untuk pelega tenggorokan. Inventor dan investor memiliki persepsi yang berbeda dalam menilai sebuah teknologi baru. Persepsi ini mengidentifikasikan variabel dan atribut. Penentuan peringkat dari variabel penilaian teknologi dilakukan dengan metode *Ordered Weighted Averaging-Operator*. Penentuan risiko komersialisasi dilakukan dengan metode *Expert Panel*. Prediksi harga lisensi teknologi dilakukan dengan metode *Discounted Cash Flow*. Penilaian dan prediksi harga lisensi teknologi dilakukan melalui pendekatan sistem dalam pengambilan keputusan dengan dibuat dalam paket program yang disebut V-Tech v1.2. Berdasarkan analisis didapatkan bahwa komposisi permen kayu putih untuk pelega tenggorokan memiliki faktor risiko 0,4947 dengan kelas teknologi di risiko sedang, berada pada tahapan pertumbuhan dalam siklus hidup teknologi dan berada pada tahapan difusi dalam siklus hidup produk. Keuntungan lisensi bernilai Rp 111.701.422,00 dan berada pada tahapan pertumbuhan dalam difusi inovasi kepada konsumen baru.

Kata kunci: sistem valuasi, permen kayu putih, keuntungan lisensi, faktor risiko, siklus hidup teknologi, siklus hidup produk

ABSTRACT

Determining value and predicting price of a technology is difficult to be done in the process of commercialization because invention's character in the form of technology could not be measured quantitatively (intangible). This character complicates process valuation of technology. Based on that, technology valuation system was expected to be able to assist inventor and intellectual property rights center in assessing and predicting the price of new technology. The objectives of this research were (1) to value composition of cajuput candy as throat relief as new technology that is potential to be commercialized; and (2) to give license price prediction for composition of cajuput candy as a throat relief product. Inventor and investor have different perception in assessing new technology. This perception identified its variables and attributes. Rank of technological valuation variables was carried out with Ordered Weighted Averaging-Operator method. Commercialization risk judgement was done with Expert Panel method. Technological license price prediction was done with Discounted Cash Flow method. Assessment and prediction of technological license price was done with system approach in decision making with program package called V-Tech v1.2. Based on the analysis result the composition of cajuput candy as throat relief had risk factor of 0.4947 with technology class in moderate risk, stayed at growth step in technological life cycle and stayed at diffusion step in product life cycle. License profit was equal to Rp 111,701,422.00 and stayed at growth step in innovation diffusion to new consumer.

Keywords: valuation system, cajuput candy, license profit, risk factor, technology life cycle, product life cycle

INTRODUCTION

Mastery of science, technology, information, and telecommunications play an important role in the progress of industry and commerce of a nation, especially in facing the globalization era (Cohen, 2004). Intellectual Property (IP) is a commercial asset because it has value or economic benefit for life (DITJEN-HKI, 2006). System of legal protection of commercial assets is created to protect IP, which is known as a system of Intellectual Property Rights (IPRs). One form of legal protection

in the field of IPRs are patents in addition to IPR instruments, such as Copyright, Trademark, Geographical Indications, Trade Secrets, Industrial Designs, Layout Designs of Integrated Circuits and Plant Variety Protection.

Developing a technology valuation mechanism which would be commercialized has aim to facilitate technology commercialization activities between inventors and investors as a potential candidate technology users (Dietrich, 2001; Jeffery *et al.*, 2003). Valuation of these technologies as a result of research activities that require investments in the form of knowledge, time and funds will be economically rewarded (Lück, 1996).

The composition of cajuput candy as throat relief is a composition of candy which can be developed into a wide range of diversified forms of candy, which are soft candy, hard candy, bubble gum and pastilles. Risk on scale of development stage was estimated small because form of invention lies in the formula and can be applied to the existing candy-making technology. Candy with sense of eucalyptus was a new flavor for Indonesian consumer, because kinds of candy that available only have sense of expectorant from eucalyptus and mint flavor (Wijaya, 2005). Therefore, introduction of sense and image for this candy that has good nutritious for health is one of good marketing effort in achieving market share of late-adopters consumer at the level of maturity.

Currently, pricing technology centers conducted by IPR center in Indonesia still vary and depend on their policies (Matsuura, 2004). Pricing may varies in each center of IPRs due to technology and methods of data analysis tools. Problems that may arise from the lack of a standardized method in determining the price of technology are: (1) center for IPRs difficult in predicting the price of new technologies in different commercialization; and (2) investors (industry) difficult in estimating the price of new technology because of its business in accordance with each center for IPR have different rates of new technology that have similarity purpose. Based on that, the technology valuation system is expected to provide price outlook for potential new technology to be commercialized. The objectives of this study were to: 1) produce technology valuation system as an input to the process of technology commercialization; 2) conduct assessment of a potential new technology to be commercialized; and 3) provide price prediction to potential new technology to be commercialized.

RESEARCH METHOD

Research Framework

The value of an invention will be seen from the perception of different inventors and investors. Different perceptions of the inventors and investors showed that both inventors and inventors seems have an interest in assessing technology (Mun, 2003;

Matsuura, 2004). Because of this divergence of interests, the achievement of fair market value of a technology is the main purpose of the valuation (Smith and Parr, 2000). Fair market value is the price that sellers are willing to pay and buyers are willing to accept after an agreement (Smith and Parr, 2000).

Technology valuation is done by identifying inventors and investors' perceptions. The identification was done because both inventors or investors have the determinants valuation in accordance with their own technology perceptions. Determinants of the valuation of technology were assessed and formulated. Based on the results of this formulation, the risk for the commercialization of technology can be determined. Risk factors can also be used in categorizing the new technology in the stage of technology when such technology will be commercialized (Razgaitis, 2004).

The data used were primary and secondary data. The primary data was obtained through observation, interview and questionnaire to experts in the field of technology patents, i.e. the theoretical experts and practitioners were come from management offices of IPRs, inventor for composition of cajuput candy and investors who were interest to commercialize cajuput candy. Secondary data was obtained from documentation and literature, i.e. books, articles, internet and journals. Data Processing conducted on primary data that have been collected used various processing methods covered in the Model of Decision Support System (DSS) of technology valuation, called V-Tech v1.2. Configuration model of technology valuation consists of identification system elements submodel, risk of technology commercialization submodel and pricing of technology licensing submodel.

Methods of Analysis
Ordered Weighted-Averaging (OWA-Operator)

The Independent Evaluation Preference (IPE) is one way for decision making. Yager (1993) formulated a non-numerical computational method for group decision-making process as fuzzy. Method of computing was done in following stages, i.e. (1) aggregation of the criteria; and (2) aggregation of all the experts with the Ordered Weighted Averaging (OWA-Operators). In the evaluation method of IPE, every decision maker d_j $(j = 1,2,..., m)$ can assess the alternatives s_i $(i = 1,2,..., n)$ on each criterion a_k $(k = 1,2,..., l)$ freely.

Aggregation steps in decision-making with the OWA operator is described as follows:

1. Every policy-makers will get a set of values (L) on each alternative and criterion with the following formula:

$$L = \left[v_j(a_1), v_j(a_1),.., v_j(a_k) \right] \quad ....(1)$$

Whereas,

$v_j(a_k)$: Score evaluation to criterion *k*-th by the *j*-th decision maker

2. Calculating the weighting values by using the formula:

$$w_{(j)} = Int\left[1 + \left(j * \frac{q-1}{r}\right)\right] \qquad \text{....................... (2)}$$

Whereas,

$w_{(j)}$: Weighting the value of *j*-th expert
j : *j*-th expert
r : Number of experts
q : Total scale
Int : Integer

3. Determining the aggregation of the final conclusion by using the formula:

$$v_{(j)} = \max\left[w_{(j)} \wedge b_{(j)}\right] \qquad \text{............................... (3)}$$

Whereas,

max : Maximum
$\wedge$: Minimum
$b_{(j)}$: Solution of equation (2) which are sorted from lowest to highest.

Expert Panel

Calculating the value of risk factors, the first thing to do is to determine the frequency of opportunity emergence score using the following formula (Razgaitis, 2004):

$$F_{(l)1} = \sum_{j=1}^{m}\sum_{k=1}^{n}\sum_{f=1}^{p} X_{jkf1}, X_{jkf1} = l \quad \text{.............. (4)}$$

$$F_{(l)2} = \sum_{j=1}^{m}\sum_{k=1}^{n}\sum_{f=1}^{p} X_{jkf2}, X_{jkf2} = l \quad \text{.......(5)}$$

$$F_l = F_{(l)1} + F_{(l)2} \qquad \text{....................................... (6)}$$

$$P_l = \frac{F_l}{\sum_{l=1}^{4} F_l} \qquad \text{... (7)}$$

The value of risk factors can be obtained by summing the product of the frequency of opportunity and weight of each score with the following formula:

$$k = \sum_{l=1}^{q} P_l \times w_l \qquad \text{... (8)}$$

Whereas,

k : The value of the frequency of risk factors into the score *l*-th
P_l : Frequency of opportunity *l*-th
w_l : Weight score *l*-th
q : Total score.

According Razgaitis (2004), the value of the risk factors can be divided into seven categories, namely: 1) Risk-free, ($k \leq 0.2$); 2) Very low risk ($0.2 < k \leq 0.3$); 3) Low risk ($0.3 < k \leq 0.4$); 4) Moderate risk ($0.4 < k \leq 0.5$); 5) High risk ($0.5 < k \leq 0.6$); 6) Very high risk ($0.6 < k \leq 0.7$); and 7) Extremely high risk ($k \geq 0.7$).

Discounted Cash Flow (DCF)

Discounted Cash Flow method (DCF) is a useful method in which the candidate knows the price of technology that users are willing to pay at the time of the deal as completed. The aim is to gain profit from the acquisition of these technologies (Reilly, 2003 *in* Katz and McCormic, 2005).

$$LA = \left[P_{LC}C_0\left(\sum_{1}^{t}(1+k+P_{LC})^t\right)\right]/n \quad \text{.............. (9)}$$

Whereas,

LA : License Agreement
P_{LC} : Ratio of License / Cost (some probability of existing developing technologies in the future)
C_0 : The investment cost in the first year
t : License Duration
k : Risk returns
n : The number of licensed users.

RESULTS AND DISCUSSION

Configuration of DSS's Model Package of V-Tech v1.2

DSS courses V-Tech v1.2 was built using a computer programming language of Microsoft Visual Basic version 6.0. Configuration of technology valuation of decision support system model in the V-Tech v1.2 is shown in Figure 1.

Elements of Technology Valuation System

Based on a literature review, field observation and discussion with actors and experts, then the component actors/institutions involved in the technology valuation system include: (1) inventor; (2) investor/industry; (3) center of IPRs, and (4) university. Pricing of new technologies can be described by the way of identifying and formulating the needs in order to obtain the fair price. The price of this agreement may not be the highest price that investors and inventors want, but it is a price that inventors and investors can accept (Neil, 1997).

Results of model verification determinants of the technology valuation system were identified based on three factors as follows:
a. Technology factors
b. Market factors
c. Marketing Potential factors

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Rank of Technology Valuation Variables for The Composition of Cajuput Candy as Throat Relief

Rank of technology valuation variables for the composition of cajuput candy as throat relief using OWA-Operators yield weigthening rank of level of importance for each variable. v_{jk} matrix is shown in Figure 2.

Ordering the payoff matrix (b_{ik}) obtained by sorting v_{jk} matrix from the lowest to the highest. b_{jk} matrix is shown in Figure 3:
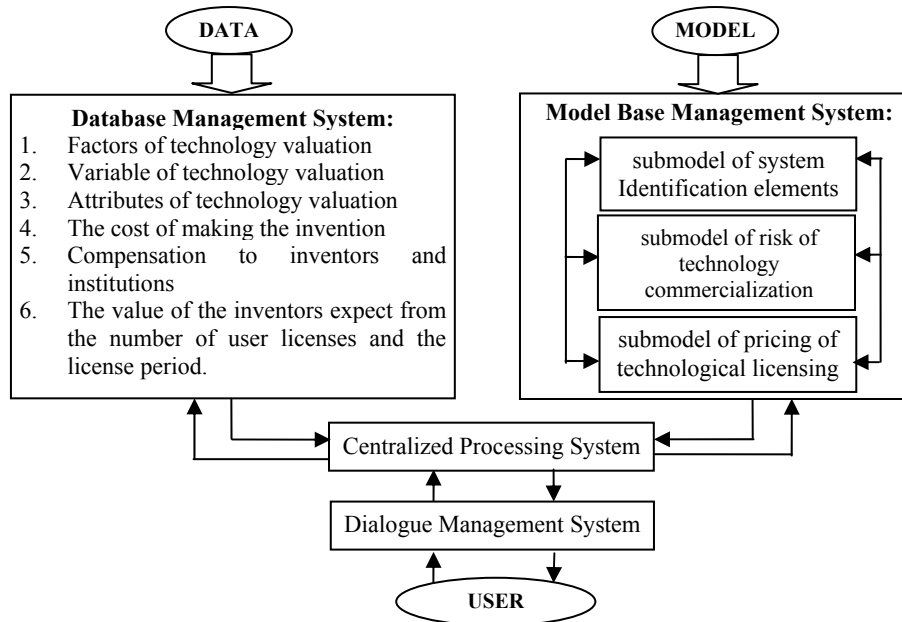

Figure 1. Framework of model of technology valuation system

Technology:

$$v_{jk} = \begin{pmatrix} C & P & C & P \\ C & P & C & C \\ C & P & P & C \\ P & P & P & P \\ C & S & C & P \\ P & P & P & K \\ C & S & P & C \\ P & C & K & P \\ C & P & P & P \\ S & K & S & S \\ S & C & P & P \\ C & C & S & C \end{pmatrix}$$

Market:

$$v_{jk} = \begin{pmatrix} P & P & S & S \\ P & P & P & S \\ S & P & P & P \\ C & K & P & P \\ S & P & C & C \\ C & C & S & S \\ P & C & P & P \\ K & S & C & P \\ K & P & S & P \\ K & P & P & C \\ C & P & P & P \\ P & C & C & S \\ S & C & S & S \end{pmatrix}$$

Potency of marketing:

$$v_{jk} = \begin{pmatrix} S & P & P & P \\ C & P & P & K \\ P & P & P & K \\ C & C & C & C \\ K & P & C & C \\ K & K & K & K \\ P & P & C & P \\ C & C & P & C \\ P & C & C & C \\ K & P & C & P \end{pmatrix}$$

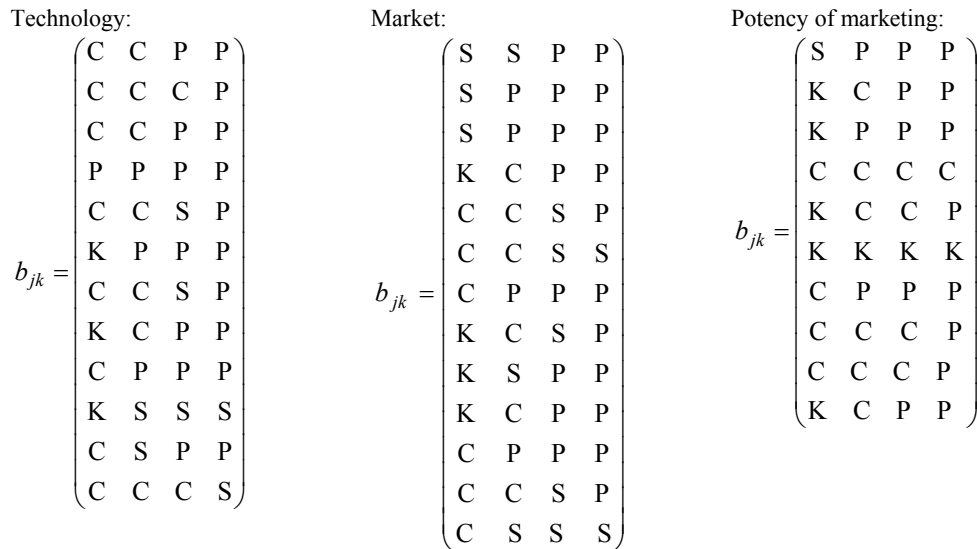Figure 2. Rank of technology valuation variables for the composition of cajuput candy as throat relief

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Technology:

$$
b_{jk} = \begin{pmatrix}
C & C & P & P \\
C & C & C & P \\
C & C & P & P \\
P & P & P & P \\
C & C & S & P \\
K & P & P & P \\
C & C & S & P \\
K & C & P & P \\
C & P & P & P \\
K & S & S & S \\
C & S & P & P \\
C & C & C & S
\end{pmatrix}
$$

Market:

$$
b_{jk} = \begin{pmatrix}
S & S & P & P \\
S & P & P & P \\
S & P & P & P \\
K & C & P & P \\
C & C & S & P \\
C & C & S & S \\
C & P & P & P \\
K & C & S & P \\
K & S & P & P \\
K & C & P & P \\
C & P & P & P \\
C & C & S & P \\
C & S & S & S
\end{pmatrix}
$$

Potency of marketing:

$$
b_{jk} = \begin{pmatrix}
S & P & P & P \\
K & C & P & P \\
K & P & P & P \\
C & C & C & C \\
K & C & C & P \\
K & K & K & K \\
C & P & P & P \\
C & C & C & P \\
C & C & C & P \\
K & C & P & P
\end{pmatrix}
$$

Figure 3. Payoff matrix (b_{jk}) obtained by sorting v_{jk} matrix from the lowest to the highest

Using the formula $w_{(j)} = \text{Int}\left[1 + \left(j * \dfrac{q-1}{r}\right)\right]$, then the weight determination of the expert decision value obtained with the following results:

$w_{(1)} = \text{Int}\left[1 + \left(1 * \dfrac{5-1}{4}\right)\right]$, is resulting $w_{(1)} = \text{Int}[2] = K$

$w_{(2)} = \text{Int}\left[1 + \left(2 * \dfrac{5-1}{4}\right)\right]$, is resulting $w_{(2)} = \text{Int}[3] = C$

$w_{(3)} = \text{Int}\left[1 + \left(3 * \dfrac{5-1}{4}\right)\right]$, is resulting $w_{(3)} = \text{Int}[4] = P$

$w_{(4)} = \text{Int}\left[1 + \left(4 * \dfrac{5-1}{4}\right)\right]$, is resulting $w_{(4)} = \text{Int}[5] = S$

Then, expert aggregation process done with the results of aggregation as follows:

$v_{(k)} = \max\left[w_{(j)} \wedge b_{(j)}\right]$, ($b_j$) results of ordering from v_k

From the calculation, results were obtained as follows: criteria for technological factors (P, P, P, P, S, P, S, P, P, S, S, S), market factors (S, S, S, P, S, S, P, S, S, P, P, S, S), and potency of marketing factors (S, P, P, C, P, K, P, P, P, P).

Risks of Technology Commercialization for The Composition of Cajuput Candy as Throat Relief

Risks of technology commercialization is composed by: a) sub submodel of variable rank of technology valuation, and (2) sub submodel of attribute identification of technology valuation. Sub submodel of variable rank of technology valuation aimed to elucidate the variables that are considered important in accordance with the technology being assessed and sub submodel of attribute identification of technology valuation is intended to identify the condition of the technology being assessed. Variable rank of technology valuation used Ordered Weighted Averaging Operators (OWA-Operators). The process performed on the variables that were considered influential technology valuation

according to the technology being assessed (Neil, 1997).

Based on Table 1, we can know uniformity of experts' opinion on composition of cajuput candy as throat relief for risk factor was 0.4947, technology class was in moderate risk, and level of confidence was 100%. This risk factors represent aspects of technology valuation, namely technology quality, market, and potency of marketing, so that development of this technology can be known its position from the fusion curve of S (life cycle) technology, product life cycle of a product and market share growth in an industry (Neil, 1997). It can be seen in Figure 4.

Technology of composition of cajuput candy as throat relief had risk factors of 0.4947 with technology class in moderate risk. Then, it was in the stages of growth with the characteristics of competition, the market and innovation increased (Damodaran, 2004). This technology was at the growth stage because there were competitors for a type of candy that already circulating in the market, namely type of candy expectorant from eucalyptus and mint flavor such as Mentos®, Frozz®, and Fishermen's Friends®. So it needs more frequent organoleptic tests to the consumer to know the level of consumer acceptance for this kind of candy because the smell of typical white wood had already connotations as a liniment.

Based on the life cycle of products, technology was in the process of diffusion, where mass production is feasible and the product is ready to be distributed and commercialized (Bergstien and Estelami, 2002). Products can be developed into a wide range of diversified forms of candy, which were soft candy, hard candy, bubble gum and pastilles (Wijaya, 2005). Risk on scale of development stage was estimated small because form of invention lies in the formula and can be applied to the existing candy-making technology.

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Table 1. Calculating the value of technological risk factors for the composition of cajuput candy as throat relief

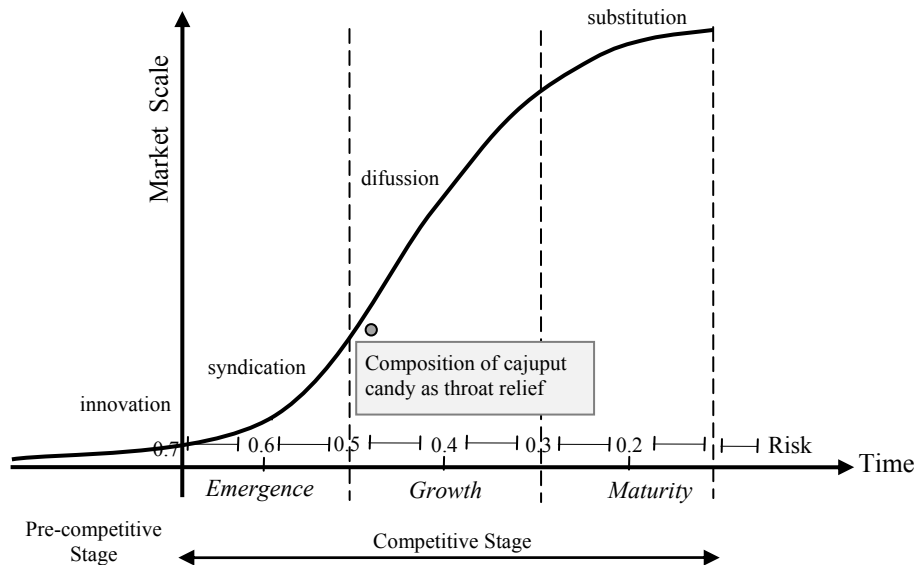| Score	$F_{(l)\ Variabel}$	$F_{(l)\ Atribut}$	$F_{(l)}$	$P_{(l)}$	$w_{(l)}$	k
1	0	9	9	0.0514	0.1000	0.0051
2	2	69	71	0.4057	0.3333	0.1352
3	18	42	60	0.3429	0.5667	0.1943
4	15	20	35	0.2000	0.8000	0.1600
	Total		175			0.4947

Source: own compilation, 2008

Figure 4. Position of composition of cajuput candy as throat relief in the S curve (life cycle) technology, and product life cycle of a product market share growth in an industry

Pricing of Technology License

Technology licensing agreement intended to determine the price between inventors and potential investors after the bargaining process that described on the value of risk factors (Dickens, 1996). Based on this, price of technology licenses for composition of cajuput candy as throat relief that have been assessed was obtained. Investment costs was Rp 111,701,422, it means that from the cost, i.e. cost of expenditures and intellectual property to produce composition of cajuput candy as throat relief was Rp 111,701,422. Licensing agreements was Rp 74,667,022, it means the aggrement between inventor and investor who are interest to commercialize composition of cajuput candy as throat relief worthed Rp 74,667,022. Licence profit was Rp 111,701,422, it means that profit that inventor should receive from the licencing composition of cajuput candy as throat relief was Rp 111,701,422.

Based on the innovation diffusion toward consumer characteristics of new technology, this technology were at the stage of growth, which holds the role of marketing will be critical to the success of a product (Bergstien and Estelami, 2002). Candy with sense of eucalyptus was a new flavour for Indonesian consumer, because kinds of candy that available only have sense of expectorant from eucalyptus and mint flavor. Therefore, introduction of sense and image for this candy that has good nutritious for health is one of good marketing effort in achieving market share of late-adopters consumer at the level of maturity.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the results described in the previous discussion the following conclusions can be drawn. Model of technology valuation system called V-Tech v1.2, which was a Decision Support System (DSS) for the inventors and the management of Intellectual Property Rights (IPRs) in conducting assessments and providing a price prediction of new technology.

Risk of technological commercialization submodel produced risk factors and technology class. Technology of composition of cajuput candy as throat relief had risk factors of 0.4947 with technology class in moderate risk.

Pricing of technology license submodel resulted, i.e. investment costs was Rp 111,701,422, licensing agreements was Rp 74,667,022, and licence profit was Rp 111,701,422. Based on the

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innovation diffusion toward consumer characteristics of new technology, this technology were at the stage of growth, which holds the role of marketing will be critical to the success of a product.

Recommendations

Model of technology valuation system needs to be arranged to wide scope of patent commercialization. It can be done by also analyzing the needs of potential consumers. The respondent of composition of cajuput candy as throat relief can be from existing consumers of candy expectorant from eucalyptus and mint flavor.

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