

## Model of Green Technology Adaptation in Small and Medium-Sized Tannery Industry

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**Abstract:** Green technology is an applied technology by industry to keep the process of sustainable development. This study aims to discuss the adaptation of green technology to reduce waste produced by the tannery industry. The method used in this study is data analysis approach from the research survey which was followed by reviews of the causal relationship between model of green technology adaptation and Small and Medium-sized Enterprises (SMEs) of Tannery Industry in Sukaregang, Garut, Indonesia. The originality of this study focuses on adaptation pattern of green technology in small industry that encounter various resource limitations. The discussion findings showed that the adaptation pattern in the development of green technology for the Tannery Industry of SMEs need to consider the harmony with SMEs organization conditions, technological condition and environmental influences. The significance of this study is to identify intervention patterns from the parties concerned with (stakeholders) to drive green technology in SMEs Tannery Industry.

**Key words:** Technology adaptation, green technology, tannery industry, sustainable development, Indonesia

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### INTRODUCTION

Small and Medium-Sized Enterprises (SMEs) have a significant role in a country's economy in both developed and developing countries including Indonesia (Purwaningsih and Kusuma, 2015; Wahyuni *et al.*, 2016; Nugroho, 2015). In addition to providing jobs contribution, small and medium-sized enterprises are seen to be reliable sector in facing the economy crisis. In Indonesia, 2013 based on their quantity, 99.99% of the total enterprises in Indonesia were the SMEs sector and able to absorb 96.99% of employees in Indonesia.

SMEs in Indonesia are supposed as a sector that has a significant role in the national economy in accelerating the distribution of economic growth through its mission of providing employment and business field increasing public revenues and contributing in increasing foreign exchange and strengthening the structure of national economy (Sukmawati and Sumertajaya, 2015).

Tannery industry is one the growing and developing SMEs industries in Garut Indonesia. Tannery industry constitutes a nucleus that has made Sukaregang a leather industry cluster. Tannery industry as a chemical industry from which >90% of its process use chemicals that produce dangerous waste there are various attempts of waste handling from both industry process and waste produced (through waste management installation). In the recent time, it was introduced the use of organic material

as an alternative process of tannery, so that the waste it produces can be degraded by nature quickly. This study presented a research that elaborated the adaptation pattern of green technology for SMEs Tannery Industry which took place in the Industrial area Sukaregang, Garut.

### MATERIALS AND METHODS

The methodology used in this study is a survey research which was followed by reviews of the causal relationship between model of green technology adaptation and Small and Medium-sized Enterprises (SMEs) of Tannery Industry. The discussion was then followed literature review. The literature review of article follows the suggestion given by Ramdhani and Ramdhani (2014) and Ramdhani *et al.* (2014). The objects of this study are 5 Tannery industries located in leather Industrial Area Sukaregang, Garut District, Indonesia (Fig. 1). The discussion in this study uses the analysis of the stages of innovation adoption model formulated through four main stages (Purba, 2006) namely:

- Knowledge; knowing innovation and having understanding how the innovation researches
- Persuasion; determining an attitude of like or dislike the innovation
- Decision; engaging in an activity that brings a person to a situation whether to accept or reject

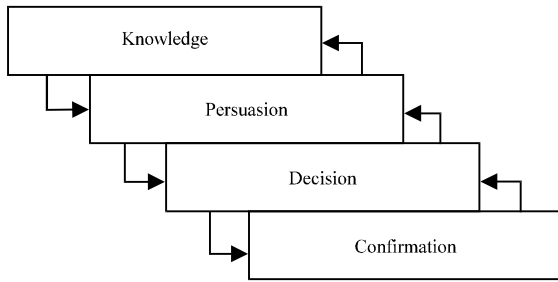


Fig. 1: Systematic analysis of technology adoption (Purba, 2006)

- Confirmation, looking for decision reinforcement that has been previously taken. If the obtained information is contradictory one can change the decision

## RESULTS AND DISCUSSION

Sustainable development is a development process optimizing natural resource and human resource, by harmonizing natural resource with human in development. Sustainable development is characterized by not damaging the environment where humans live and it is carried out with an integrated and comprehensive policy as well as considering the needs of future generation. One model for undertaking sustainable development is the implementation of green technology. The green technology is recognized as the application of environment science to conserve the natural environment and resources for the purpose of curbing the negative impact of human activities (Fauziah and Taib, 2015) it is a technology that seeks not to produce waste (Udin *et al.*, 2015).

In supporting sustainable development, SMEs need to develop and enhance its capacity through the use of green technology. The implementation of green technology is a critical issue that must be understood by SMEs in business. To determine the adaptation strategy in green technology for SMEs Leather Industry in Sukaregang Garut appropriately, based on survey and interview it can be seen various problems faced by businessmen. One of the major problems in SMEs Leather Industry in Sukaregang Garut is the waste produced by industrial activities.

**Production process and new technology offer:** Tannery is the process of converting raw skin protein into stable leather which is not easily rotten and suitable for a variety of use. Tanning is usually done with alkaline salt of trivalent chromium. The reaction of salth chrome with carboxylate of skin protein (collagen) make the skin stable

of high hydrothermal which has a Temperature of shrinkage (Ts) >100°C and resistant to attack of microorganisms (Suparno *et al.*, 2010). The whole tanneries in the research places are tanned by chromium (III) sulphate as a consequence of the easy process, broad product use and very satisfying characteristics of leather produced. However, the mineral tannings also contribute to environmental pollution problem. There are several treatments can be done to reduce waste from the leather tanning industry, namely: the recycling of chromium sulfate resulted from waste water treatment (Hadi and Nasution, 2013) or non-mineral tanning process that is more environmentally friendly in manufacturing leather (Suparno *et al.*, 2010).

In this study, the pattern of technological adaptation is limited to the implementation of non-mineral tanning process as alternative process engineering for tanning leather. Here are production processes in leather tanning industry that researchers observed in the object of research.

The offer of green technology that can be obtained by entrepreneurs in SMEs leather tanning industry is material replacement in tanning process of the leather tanning production with non-mineral material, so that the production waste is environmentally more friendly (Fig. 2).

**Technology adoption:** Technology is a manifestation of the four elements and an interaction among its components, namely technoware, humanware, infoware and orgaware. Technoware (T) is a physical facility, production equipment: physical facilities include tool, equipment, machinery, motor vehicles, factories, physical infrastructure and other goods that human used in operating a product transformation. Humanware (H) is human ability: human resource capabilities include knowledge, skills/expertise, wisdom, creativity, achievement and a person or group of people' experience in utilizing natural resources and available technology. Infoware (I) is a document fact: it includes document facts, information device which is related to the process, procedures, techniques, methods, theories specification, design, observation, manual and other facts disclosed through publication, document and blueprint. Orgaware (O) is an organizational framework: it covers organizational framework, organization/ institution device and regulations, required to contain technical device, the ability of human resources and information device consisting of management practices, organizational connection and setting to achieve positive results (Wahyuni *et al.*, 2016). Technology adoption as a part of innovation adoption constitutes a process of mental or behavioral changes in the form of knowledge (cognitive)

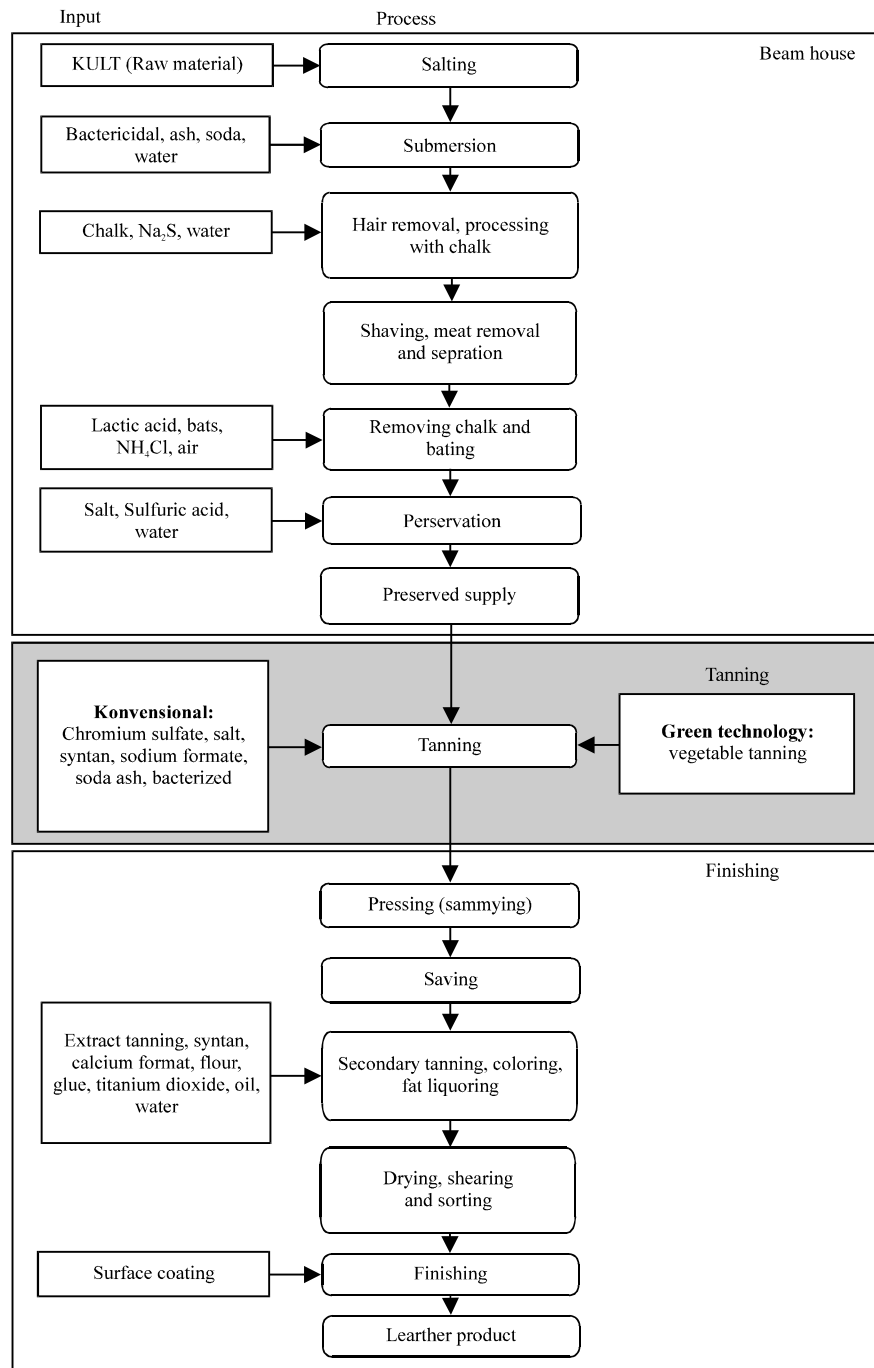


Fig. 2: Changes in tannery process

attitudes (affective) and skills (psychomotor). The adoption process occurs since a person hears a new idea until he finally does it (adopting) (Rogers, 2010). Technology adoption is a decision to use a new idea or technology as a way of action. The decision to adopt technology is a distinctive type of decision making as a process of mental and mindset changes since a person

knows technology until he makes a decision to accept or reject it and then confirms it (Murad, 2014).

**Knowledge:** Knowledge is the result of idea and this occurred after people observed a specific object. The aspects of knowledge are classified into three groups, namely knowledge about special things that include:

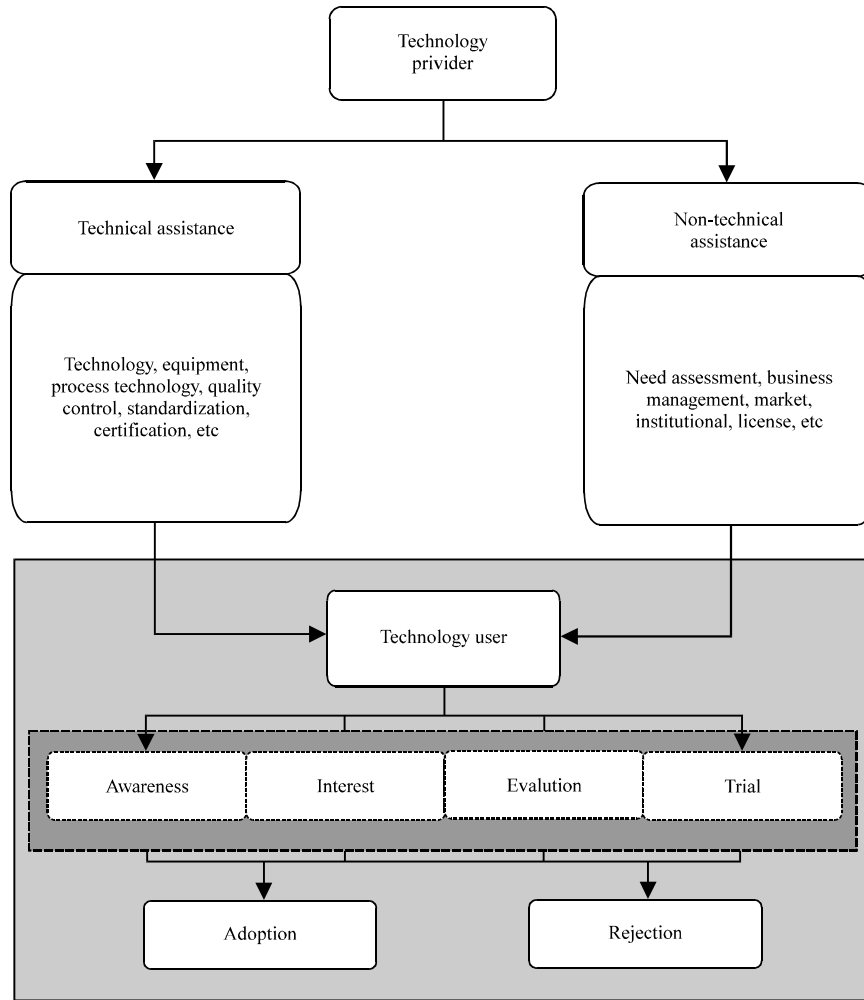


Fig. 3: Mentoring model to increase adoption of technology (Fajri and Magnadi, 2015)

terms and facts knowledge of how to deal with specific issues such as: habit, tendency, classification, category, method and knowledge about the universal rules that cover: principle, theory and criteria (Kadir, 2016). Knowledge is information processed by each individual therefore, the nature of knowledge is subjective, unique and beneficial for individuals. Knowledge is also related to the fact, procedure, concept, interpretation, ideas, observation and assessment (Helmi and Elita, 2016).

In term of technological knowledge, the objective conditions that researchers encountered on the use of vegetable materials in tanning process for tannery industry are as follows:

- Craftsmen/businessmen do not recognize/hear new technology
- Craftsmen/businessmen already heard but they have never seen such new technology

- Craftsmen/businessmen have ever seen the new technology but they have never tried it
- Craftsmen/businessmen ever tried the technology but they could not adopt it because of the following things
  - Too expensive because of low capital ownership
  - Too difficult and it took a long time to understand
  - Not sure it would bring additional advantages
  - Worried to fail

Mentoring for technology adoption by enhancing knowledge of craftsmen/businessmen is an important thing to do. This is in line with the statement (Ismilaili *et al.*, 2015) which said that knowledge of craftsmen/businessmen and information availability on a technology has an influence on technology adoption. The following picture presents one model of SMEs mentoring (Fig. 3) for Tannery Industries that can be done by

technology provider or any party concerned with the implementation of green technology. The process of adoption is divided into several phases as follows (Fajri and Magnad, 2015).

**Awareness:** This stage is very simple; if craftsmen businessmen do not recognize the green technology they will not implement it. Therefore the parties concerned with green technology should introduce it to craftsmen businessmen.

**Interest and information search:** After craftsmen businessmen are aware of green technology they will look for related information. The fundamental question at this stage is “can green technology solve the problem of waste reduction while maintaining the quality of product?”

**Evaluation and trial:** This stage is an activity where craftsmen/ businessmen will try green technology offered then they evaluate its results.

**Adoption:** This stage is a final stage where craftsmen/ businessmen finally decide to adopt green technology offered by the company. All these steps are related to the implication of adequate knowledge of craftsmen/businessmen toward green technology. The completeness of information toward the benefit and impact of green technology is strongly believed to enhance the technological adaptation of craftsmen/businessmen.

The problems generally appear in SMEs tanning industry is knowledge factor of craftsmen/businessmen who stated that the degree of loss risk is still big, due to consumers who have not been educated well in product use of green technology, not competitive selling price and not efficient marketing system. As a result, the improvement of green technology is supposed to affect the decline in revenue/profit of SMEs tanning industry. This resulted in low interest of SMEs tanning industry to adopt new technologies. In general, SMEs tanning industries are comfortable to perform their business with conventional processes.

**Persuasion:** Adoption is a result of delivering message, meanwhile the process of diffusion and adoption can be described as a process of communication that begins with the innovation delivery to behavioral change. The process of innovation diffusion is the derivative of a person’s innovation adoption who has adopted another individual in the same target of social system.

The processes of knowing, understanding, interesting and implementing real production business

that craftsmen/businessmen experience is a good communicator process for good communication achievement (Sinurat, 2016). A new communication seems to be successful when both parties are equally ready for it which is designed in a systematic and planned way. These preparation and planning are to be fulfilled by previously preparing a communication design (Nasution, 1989).

An activity to encourage craftsmen/businessmen to implement green technology is called counseling in this study. In doing counseling, delivery factor of counseling materials is very important. Therefore, counseling previously requires design preparation which describe the following primary subject matters in detailed and specific (Nasution, 1989):

- Problem to be encountered
- People to be counselled
- Objectives to be achieved from any counseling activities
- Message development
- Method or channel used
- Evaluation system “has been set” or “built-in” in the overall plan of intended event

Here are several points to be considered in performing counseling in order that craftsmen businessmen can implement green technology, namely.

**Counseling media:** The use of learning media as learning tool functions to be a reliable intermediary connecting counselor and counseling target so that the message or information will be more clear and apparent. In the learning process there are several learning media such as objects (samples, imitation model) printed materials (brochures, posters, pictures, leaflets, sheet), projected images (slide, film, filmstrip, video, movie-film) and graphics lambing (bar chart and line graph, diagram, schematic, map) (Ramdhani and Muhammadiyah, 2015).

**Communication material:** Counseling material is everything delivered in counseling program such as information or message. Message is a set of verbal and non-verbal symbols that represent feeling, value, idea or intention. Message has three components, namely meanings (idea and value) symbols used (language or word) and message format (verbal and non-verbal). The counseling material should be appropriate to the needs of the target and can solve the problems that the counseling target face.

**Time and place of counseling:** In counseling, the right time and place appropriate to the condition of counseling

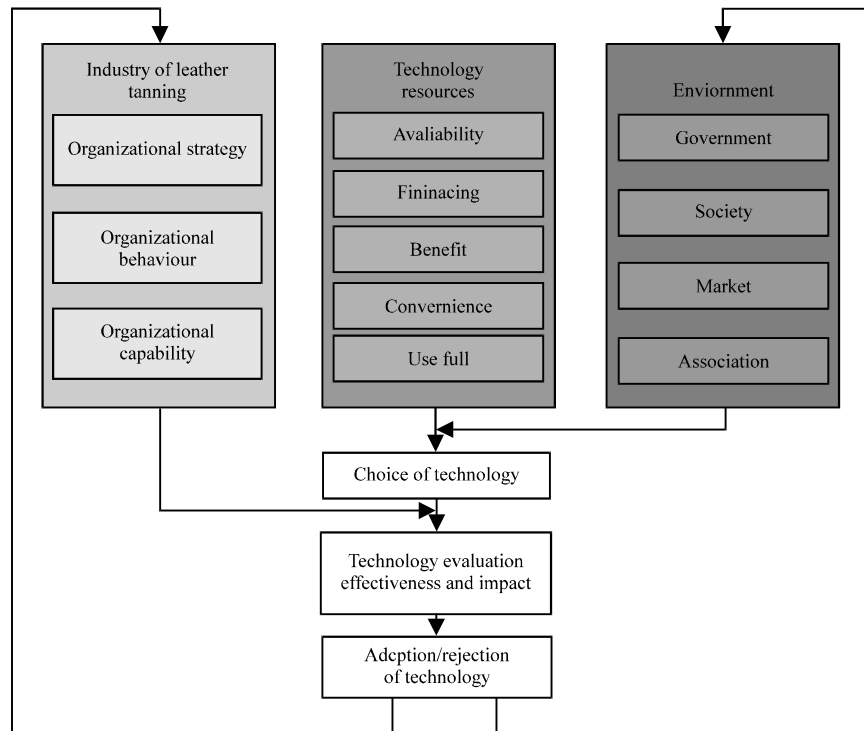


Fig. 4: Adoption decision making model/rejection of technology

target (craftsmen/businessmen) are essential and interrelated in achieving the objectives of counseling. The time and place where counseling program is performed should not disturb and harm craftsmen/businessmen.

In counseling process in which change in attitudes of behavior that lead to action is one of its objective, the process of gradual innovation adoption is always not the same for every individual. Speed in adopting an innovation is sometimes different between one individual and the other individual; this really depends on the character of the individuals.

**Decision:** Decision-making process is a deep thought and consideration process with a systematic approach to decide a series of specific actions as the best option to solve a specific problem (Winarsih *et al.*, 2016) (Fig. 4).

There are several factors to be important considerations in deciding technology adoption in SMEs Tanning Industry, namely.

**Technology:** Green technology adoption in SMEs tanning industry is done by choosing the technological innovation which is expected to meet the following criteria.

**Availability:** Several dimensions of technology should be available and/or utilize existing resources. Technology for

craftsmen/businessmen should be available and it should use the resources that they have already possessed. When external resource is absolutely necessary, it must be ensured that the resource is inexpensive and can be obtained regularly and easily from a fixed reliable source.

**Benefit:** Green technology should provide concrete benefits for craftsmen/businessmen. The innovation of green technology to be applied should be guaranteed to provide extra advantage over existing technology innovation. This will increase the interest of craftsmen businessmen to adopt the technology.

**Financing:** Green technology implementation must be affordable to the financial capability of craftsmen businessmen. Adoption obstacle that comes within innovation is that innovation is considered to be expensive by craftsmen/businessmen. While adoption obstacles that come from outside are business orientation, market and the availability of supporting means and others. How good the technology is when not affordable to craftsmen/businessmen financial capability, it seems difficult to be adopted. Moreover because most craftsmen/businessmen have limited capital, innovation with low cost will be more rapidly adopted than high-cost innovation.

**Convenience:** Green technology should be perceived necessary by most craftsmen/businessmen, so that craftsmen/businessmen and employees feel comfortable to use green technology. Innovation will be craftsmen businessmen necessity when the innovation can solve the problem they face.

**Useful/simplicity:** Technology should be simple, applicable not complicated for craftsmen due to their low understanding or knowledge. The easier the new technology is practiced, the sooner the craftsmen can adopt innovations process. Therefore, in order that adoption process can research fast, the innovation presentation should be simpler. In addition, the innovation complexity has a considerable effect on the accelerating innovation adoption.

#### **Environment**

**Government:** As a matter fact that innovation has a positive influence on a country's economic growth, so it is a little bit impossible for the government to issue regulations that could obstruct industry's innovation. The trigger that the government provide for production process innovation is introducing a more biodegradable tanning material and making policy that directs craftsmen to pay more attention to environmental health. The government policy is an important aspect for controlling the quality of environment (Farida and Ramdhani, 2014).

**Community:** Pollution that surrounding community mostly feel is water and air pollution. People there demanded craftsmen to use green technology. However, in the research place because many employees live around the leather tanning industry, this demand sounded weaker than employment interests of employees who live around industrial areas.

**Market:** Consumer response regarding the results of green technology adoption products will take place in a time series this means that market will not respond green technology products instantly. SMEs of Tanning Industry market are craftsmen or businessmen who tend to be pragmatic and prefer high quality goods with low price, neglecting green technology aspect. Based on the interview there should be an education program for leather product consumers to understand that they need to appreciate the products (better price) manufactured by green technology.

**Tannery association:** The attitude of tannery association towards the use of green technology is very significant

because the association can give pressure to craftsmen to use green technology. The association position is very important, the association has made craftsmen market driven, by establishing the price feasibility of leather products and controlling shared facilities in tanning process. However, in the research location, the direction and orientation of the association in handling waste does not lead to the use of raw materials but to the effectiveness of the use of industry waste handling installation. Consequently, the implementation of green technology has not been a priority for the tannery association in Sukaregang, Garut.

#### **Industry**

**Organizational strategy:** In general, company focuses on the economic benefits. Based on survey and interview that tanning industries focused on the implementation of new technology as long as the technology can provide beneficial feedback (profit) as a measure of success.

**Organizational behaviour:** Organization flexibility in implementing green technology. The findings in the research location showed that there was rigid behavior in applying green technology. This is allegedly a result from top management attitude as the most responsible person who felt burdened by the lack of innovation, either as individual or as a leader because innovation will be very time consuming, especially dealing with monitoring innovation implementation in the company that must be directly monitored by him regarding employee's performance, in addition to outside parties when the innovation needed them.

**Organizational capability:** Organizational capability is one of the main factors in selecting technology for tanning process. The finding in the research location showed the objective condition that SMEs of Tannery Industrial generally have limited human and financial resources. Consequently they had problem in adopting green technology. They stated that the cost of new technology experimtn requires big fund and in turn, the big fund of technology experiment does not guarantee big benefits.

**Confirmation:** Confirmation is evaluation and assessment process of a technology to answer a specific problem. Confirmation stage is done through evaluation by craftsmen who apply technology and tell to the other craftsmen. The research findings revealed that in leather tanning process there are several craftsmen who adopt only certain components of the recommended technology

package and it was allegedly indication that most craftsmen who previously had implemented green technology package turned back to the old technology. This symptom can hinder any attempt to institutionalize technology in SMEs of tanning industry.

### CONCLUSION

One of the factors that affect the acceleration of green technology adoption is the nature of technology. Green technology will be easily understood by craftsmen if it has a lot of compatibility (adaptive power) to financial, social, economic, cultural condition and availability of accessible technology materials. Green technology offered to Tannery Industry can be driven by tanning industry environment, namely: the government, community surrounding industry, consumers and tannery associations. On the other hand, the acceleration of green technology adoption is influenced by the objective conditions of SMEs of Tannery Industry, namely strategy, behavioral and organizational capabilities.

The factor that affects the acceleration of innovation adoption and diffusion is the appropriateness of communication methods (counseling). The use of effective methods will be more understandable by craftsmen. Counseling materials must contain technical use of green technology together with the explanation of innovation benefit.

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