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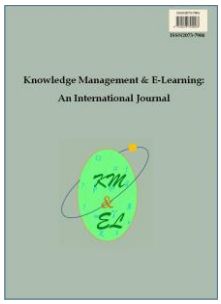

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The learning process on utilization foresight technology of patent information: Sorghum plant from bioethanol

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Abstract: The learning process through forecasting patent information based on technology can provide the direction in which technology is needed, especially supporting developments into the future. Technology mapping through patent information in the market becomes leverage development of products. Foresight technology in a patent is a tool to predict advanced technology that brings a competitive product to the market needs. This paper discusses patent information that becomes useful for developing technology through emerging market segmentation through a portfolio, innovation, and emerging market based on the WIPO database. This paper used a qualitative method with descriptive analysis and study literature using Innography software to see related information utilization of bioethanol from sorghum plants. This paper aims to obtain information technology from the patent analysis in bioethanol from sorghum plants to develop foresight products. The results show 310 patents registered in WIPO fields from 2006 – 2021 with dominant IP Class dominate from sectors C and A, also economic value range held by the Republic of Korea. Foresight technology through patent analysis provides information for industry and stakeholders who need the impact of the implementation of the latest technology and the appropriate level of competition in the commercialization of bioethanol products from sorghum plants.

Keywords: Foresight technology; Learning process; Patent information; Renewable energy; Sorghum plant from bioethanol

Biographical notes: Tommy Hendrix is a senior researcher at Research Center for Industrial Economy, Trade, and Services - National Research and Innovation Agency in Jakarta, Indonesia. His research topics are management innovation technology, business, IPRs, technology transfer, and public policy.

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1. Introduction

Information technology, in the transition of its development, is used widely as a reference in decision-making. In its implementation, the need for information is closely related to how the process can be obtained through stages of learning with specific methods. The achievement and purpose of the learning process in IT education are by using a process designed and carried out creatively and innovatively (Sudarsana et al., 2019). IT equipment was provided not only as a tool but also to make more accessible access to any information. For example, one of the pieces of information that can be searched easily is patent information. Learning is a long-term process; the outcomes are perceived after students have invested significant time and effort. The ability to sustain interest, and invest in hard work over extended periods, varies significantly from individual to individual (Sohrabi et al., 2019). Concerning the learning process, IT can be used as the basis for online learning technology where the utilization can be a central element and can explore several solutions for using existing technology through data mining. Process mining is a process-centric technique used in educational data mining to extract knowledge of event logs commonly available in current information systems (Romero et al., 2014). It is a new method based on process model-driven approaches and data mining that provides a complete toolkit to produce fact-based insights and promote process enhancements (Van der Aalst, 2011).

Patent as an indicator of invention and innovation shows the different outcomes of the part of Scientific, Technology, and Innovation (STI) that emerged activities that have a specificity and generate business impact (Nagaoka et al., 2010). On the other side, the database of patents also can be used as a framework for competitor intelligence to identify the opportunity for new business (Lee & Lee, 2017). The lessons learned from this stage, especially in capturing knowledge, can enhance innovation for new businesses, such as small and medium enterprises (Mohannak, 2014), and also applies to existing industries. Sometimes linearity in research and innovation with scientific breakthroughs leads to new technology or innovation, but the opposite is with technology leading to a new understanding of science (Kline & Rosenberg, 2009). A patent is a legal document with established standards. A formal semantic structure also uses standard terminology in protected technology (Andersson et al., 2017). Patents offer a wealth of information and, if properly processed and analyzed, can give information on competitors' activities, R&D trends, emerging fields, and collaborations, apart from uncovering relevant prior art and decreasing the risk in huge R&D investments (Burhan & Jain, 2012). Not all patents have an economic impact. Some patents can be issued but cannot be adopted because of their quality and usefulness. Determining the quality of a patent has a complex analysis, and it should be captured in a multidimensional context (Higham et al., 2021).

In the case of patent data analysis, the learning process from using the database of sorghum patents is limited. This condition could be due to the development of sorghum processing technology is still being developed. The need for renewable energy is an obligation so that the development of new technology processing bioethanol based on sorghum can be conducted based on the existing patent database. Although sorghum is also used in the food industry and animal feed, the scope patent of sorghum has many diversification areas (Visarada et al., 2019). Based on identifying the existing technology of bioethanol (based on the patent database) found that cellulosic bioethanol is the most popular in this era (Karvonen & Klemola, 2019).

Sorghum is one of the best alternatives and potential resources as a promising to produce bioethanol as renewable energy (Ahmad Dar et al., 2018; Velmurugan et al., 2019). Renewable energy development in the global era can be one of the exits in

anticipating the consumption needs of the world's petroleum to substitute the lack of energy sources from fossil fuels. Therefore, it is necessary to find out alternative renewable energy sources (Jasman et al., 2017). The high level of energy consumption is now a problem that needs to be in the way of the exit, considering the energy source has been very thinning, so the energy source is derived from renewable energy. Sorghum (Sorghum Bicolor L. Moench) biomass is considered one of the potential renewable sources of energy for economic development and environmental sustainability. This plant can be an alternative substitute for fossil energy to enhance development energy consumption. For instant development, bioethanol from sorghum plants is used as a fuel produced by the fermentation and distillation process (Wu et al., 2010).

This paper tries to determine how renewable energy learning can be conducted, especially in producing bioethanol from sorghum plants, and how to find the information technology related to research topics about sorghum for renewable energy applications and provide readers with the latest research on patent information. This paper uses all data which correlate with the topic research based on the international patent classification (IPC) on WIPO.

1.1. The learning process on utilization of foresight technology through patent information

In today's digital era, the learning process of technology still looks untapped, especially in the learning process that is looking for answers to some of the main problems in the industrial field. Learners acquire information when provided opportunities to interact with others in their environment through direct experience or observation (Finnegan, 2017). Public awareness of development is still on the way to maturity, especially in science and technology. Information and communication technology (ICT) has become an essential component of advanced educational systems. These educational systems are expanding the integration of virtual learning applications such as virtual learning systems, virtual classrooms, and virtual laboratories in the educational process (Ahmed & Hasegawa, 2019).

On the other hand, enhancing potential issues will bring many obstacles in implementation to gain results. Technology-driven businesses (especially high-technology firms) focus on how firms can find new business opportunities based on their technological capabilities. The learning process in this stage becomes essential. Organizational and individual learning can develop the capability to sense change based on analysis of foresight of a new trend in technology (Rhisiart et al., 2015). It can prevent the organization's internal and external risks by describing the technology's past, current condition, and future trends and saving resources. It also improves the technology management capabilities of the organization and how the organization improves the strategic planning and optimization of resources to produce the appropriate technology (Pietrobelli & Puppato, 2016). Learning processes based on scientific data will also be able to establish a business process for improving company performance (Krumeich et al., 2012).

One way to discover the foresight and trend of technology is by taking advantage of the existing patent database. Patent information is a proxy measure of technological capability for this purpose. Patent data has been considered one of the few precious sources of standardized information for technological knowledge (Sharma & Tripathi, 2013). With the ever-increasing volumes of patent information, patent search and analysis tasks have become vital from both legal and managerial perspectives (Liu et al., 2011). From the perspective of technology foresight, analysis can be conducted based on

theoretical and methodological research; data mining from publication and patent databases; reviewing the process and model framework; determining multi-level technology among enterprises, region, and country; and also determining in the forecasting of technology based on process and application of the technology (Zhao et al., 2021). Deep analysis of patent databases will give deeper learning to provide essential information in forecasting technology in the future (Krestel et al., 2021).

A patent application submits to the patent office until the patent's exclusive right is granted to the inventors. The Includes section describes the invention and provides information about its origin. The General contains the invention title, the results of experiments, and a technical description of the patent. Therefore, it is possible to analyze the process of recording information about the inventors or organizations active in technology (Madvar et al., 2016).

The usefulness of patents in technology development provides a scheme method for the business concept and technology's competitive strategy. An in-depth interpretation of patents' activities can help identify the status of a technology trajectory and determine competitive or collaborative relations among users in certain areas, which can provide valuable information for developing strategies for R&D and marketing activities (Dou, 2004). Patent analysis provides a practical forecasting tool for decision-makers in the public and private sectors (Trappey & Trappey, 2008). Information on patent analysis describes a technology's growth pattern (emerging, maturing, or declining). Ultimately, it can be used for assignee users to collaborate with a researcher.

Through technology foresight and intelligence activities, nations and organizations can adapt to new technology, add value to economic policymakers' decisions, and sustain their competitiveness. Core summary in foresight technology predicts the direction and speed of change in technological trends, facilitating the early detection of revolutionary technologies (Chen et al., 2011). Many aspects should be noticed, for example, the growth and evolution of technology and innovation, the notion of society, and how to mitigate the biases to prevent the mismatch of the forecasting of the technology itself (Apreda et al., 2019). Experts' judgment based on expert knowledge is vital to evaluate the forecasting analysis. Reducing the biases by investigating and evaluating the overall processes with experts is one of the ways to give objective outcomes (Bolger & Wright, 2017).

This paper uses the learning process to analyze, determine and provide information related to the keyword, with much detailed information on the patents database using the software Innography. Until now, the preservation of data related to patent mining in the world is centralized in the WIPO database. The usefulness of randomly retrieved data helps users, especially for industrial development. The state-of-the-art patent analysis becomes very important, such as extracting information from patent data and performing bibliographic analysis to get better results.

On the other side, the research discussion based on a review of the extant literature through a literature review that covered the learning process utilization of foresight technology from patent information and the development of bioethanol as renewable derivative energy should also be considered. The learning process of using foresight technology through patents defines the final results of data related to patent information data from the sorghum plant for bioethanol in renewable energy sectors. In this century, many online patent searching tools are available and easy to use. The development of patent searching based on artificial intelligence is very advanced in this era. These tools can give detailed information in a specific field based on user interest, such as words, images, charts, and many more (Setchi et al., 2021).

1.2. Bioethanol as alternative renewable energy from sorghum plant

The lack of energy preservation becomes a sensitive issue, which refers to consumption that increases yearly, especially in the automotive sector. All becomes a contradiction by producing energy each year based on fossil fuel supply sources. Periodical times related to the energy crisis will come when the reduction of fossil fuel reserves arises. As one of the bioethanol producers, biomass has become a concern today. Based on recent research, biomass has enormous potential to replace energy from fossil (Saleem, 2022). Renewable energy is energy generated from other resources that will not be exhausted and will have sustainability if managed appropriately. (Kalogirou, 2014).

Fig. 1 describes how primary energy demand can impact regular consumption globally, especially in various scenarios in transition by sector, region, and fuel type. The Evolving Transition scenario suggests that growth in emerging markets will outpace that in developed countries. Industrial use will account for about half of the overall increase in demand growth by 2040, while growth in transportation is much slower. Renewable energy is the fastest-growing energy source globally (British Petroleum, 2018).

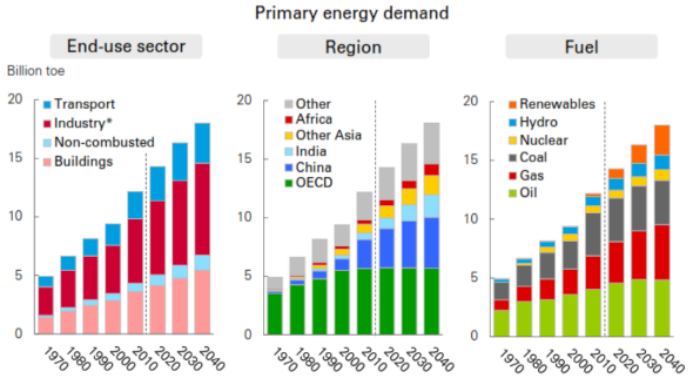

Fig. 1. Primary energy transition demand, Adapted from British Petroleum (2018)

Rapid renewable energy growth is contributing to a more diversified energy mix. By 2040, oil, gas, coal, and non-fossil fuels will provide around 25% of the world's energy. Renewable energy is the fastest-growing energy source, accounting for 40% of the increase in energy. Natural gas grows faster than oil or coal (British Petroleum, 2018).

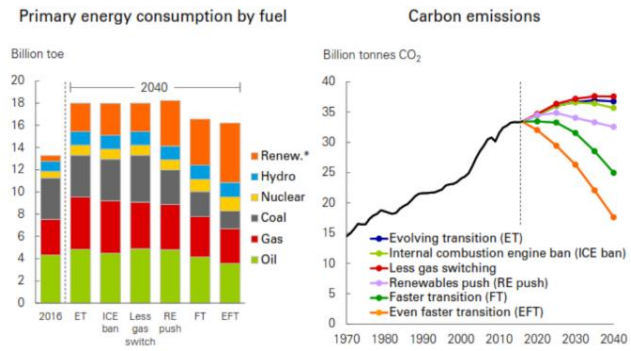

Fig. 2. Primary energy consumption by fuel, Adaped from British Petroleum (2018)

Fig. 2 indicates primary energy consumption has a significant increase in energy demand and its shift towards a lower-carbon fuel mixed with particular policy or technology assumptions.

The advantage of bioethanol is not only for energy substitution but also to reduce the world's energy crisis. On the other sides, bioethanol is also more environmentally friendly than fossil fuels. Besides reducing the energy crisis, bioethanol also helps to protect environmental sustainability.

Further, bioethanol also can be produced from lignocellulose biomass. (Hamelinck et al., 2005). The production process from lignocellulose biomass follows these steps: feedstock handling, pretreatment, biological conversion, product recovery, utility production, and waste treatment. (Cardona & Sánchez, 2007; Lynd et al., 2008). As a petrol additive/substitute, wheat, sugar beet, straw, corn, and wood can be converted into bioethanol (Demirbas, 2009). In this case, three primary raw materials can produce bioethanol. First is starchy materials, second is sugary materials (such as molasses, sugarcane, sugar beet, and sweet sorghum), and the last is cellulose materials (such as branches, sawdust, and plant fiber waste) (Quintero & Cardona, 2009). However, researchers and investors have become increasingly enthusiastic about another biofuel feedstock, lignocellulose, and the most abundant biological material on Earth which can produce both ethanol and biodiesel (Schubert, 2006). Bioethanol can be used directly in the transport sector, and vehicles can run on pure ethanol or blended with gasoline to make "gasohol" (Demirbaş, 2009).

There are many sources of renewable energy. One of them is sorghum plants that can provide ethanol from fermentation of about 40-55% depending on the quality of sorghum juice, fermentation, and sterilization processes. Sorghum is a bioenergy plant that can be used for producing bioethanol. In producing sorghum bioethanol, some essential factors must be considered because they can influence the quality of bioethanol products. The factors that influenced the result of bioethanol production are the length of the fermentation and scarification, the number of new starters, fermentation temperature, sterilization equipment, and the success of the distillation process. (Suryaningsih & Irhas, 2014).

2. Methods

This research paper used qualitative methodology with descriptive analysis, study literature, and Innography software analysis to determine the answers regarding the needs of patent data, including industrial applications in the portfolio and strength factors with economic movement regarding commercialization in R & D results. Fig. 3 describes patent searching focusing on information foresight technology.

In practice, this study's learning process was conducted using Innograph software. This software is an artificial intelligence patent-searching tool based on text mining. Patent mining is a vital technique for searching for cutting-edge technology that would benefit production and development (Supraja et al., 2015). Text mining is another helpful method, mainly advantageous for extracting proper knowledge from a large bank of unstructured patent data and seeking the answers to the problems—the study mainly uses information on renewable energy from bioethanol sorghum. Data mining is one of the methods or processes for extracting hidden patterns from a collection of detailed data, emphasizing that data mining is the most critical stage that transforms data into patent information (Liang & Tan, 2007).

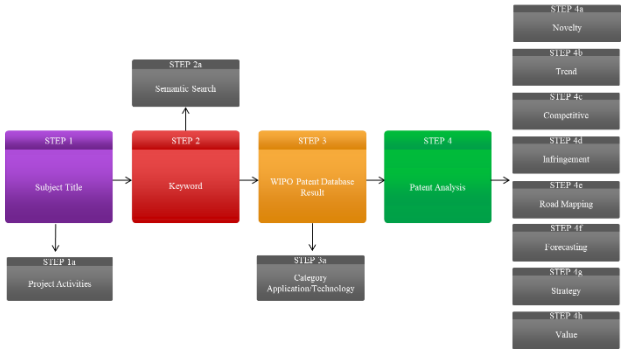

Fig. 3. Process of patent searching on information foresight technology

Data mining and database searching for this paper using two approaches:

1. A literature study was conducted by browsing information on the topics and issues from various sources such as books, journals, articles, or other scholars' papers.
2. Using a document on the utilization of foresight technology from sorghum plant for bioethanol in renewable energy, Patent Benchmark using the Innography software with the source from the World Intellectual Property Organization (WIPO) field.

This paper uses all data which correlate with the topic research based on the international patent classification (IPC) on WIPO. The target was to find the potential market and users already applying for commercial interest and know the technology trends and current research in progress. This paper expects to become the input for potential technology users and be a valuable source of information in the development of science and technology, especially for developing renewable energy based on sorghum plantations. The learning process of technology information will provide the modification process's nature through the implementation and reverse engineering of technical information sourced from the patent.

3. Results and discussions

In the era of technological development, the role of intellectual property in educational and research activity has dramatically increased. The attitude of society toward intellectual property identifies the development of a state as a whole (WIPO, 2008). The quality of the information provided during the creation, protection, and promotion of intellectual property helps to improve the efficiency of educational, scientific, and technical activities (Tolstaya et al., 2017). The development of the current learning process needs to be carried out with technological innovations that can provide complete information. One of them is through online learning by utilizing patent search software. If we compare it with free patent search engines, it will provide incomplete results and even need more information. Free patent search engines could be more efficient even though they have pretty decent results. However, the resulting data needs more detail used as a reference for information technology being developed now.

Learning technology through patent information has many advantages, especially in creating innovative products and processes. The mapping technology process expands

the scope of knowledge as the basis of development, such as in the search utilization of Foresight Technology of Patent Information: Sorghum Plant from Bioethanol. Regarding the industry, technology creation must be elaborated with another linkage to gain many prospective patent information. Based on the search results of sorghum plant utilization for bioethanol using the software Innography, with the keyword "bioethanol from sorghum" as a single phrase, we can find 310 patents registered in WIPO fields. Then, by reselecting the title connected with the subject keyword, we find nine patents that substantially match. We can find data as mentioned below in the range of 7-year publication date (July 30, 2006, until July 30, 2012) and use them in a pie chart.

3.1. Capturing learning process from patent information (case: Bioethanol from sorghum)

3.1.1. Inventors

An inventor's name was a person who made an inventive contribution to the invention as defined by the patent application claims. This paper, especially on bioethanol from the sorghum plant shown in Fig. 4, has resulted in 9 Patents and 14 Inventors and only describes five inventors. Most of them have already joint in private corporate and universities such as:

- Dr. Arsen Badalov, a professional executive consultancy for Exploration, Mining, Metallurgy, Industry, Oil/Gas & Energy with four patents (12.1%);
- Mario Moises Alvarez, Ph.D., a Professor at the Centro de Biotecnología-FEMSA and the Bioengineering Department, and a Rómulo Garza Insignia Professor at Tecnológico de Monterrey in Monterrey, México with three patent (9.1%);
- Prof. Sergio Roman Othon Serna Saldivar, a full-time professor, and researcher from the Institute of Technology and Higher Studies of Monterrey (Tec de Monterrey) specializing in food engineering with three patents (6.1%);
- Ester Perez Carrilo, working at the Department of Biotechnology and Food Engineering of Tecnológico de Monterrey, with three patents (9.1%);
- Bon Cheol Koo, working at the Korea Institute of Science and Technology, Institute of Advanced Composite Materials, and Carbon Composite Materials Research Center, with two patents (9.1%).

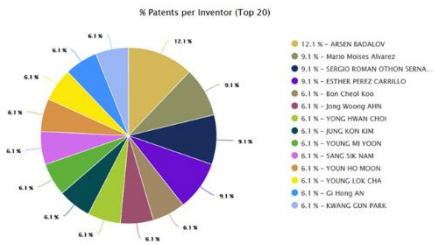

Fig. 4. 14 Inventors in sorghum plant from bioethanol (Innography software result)

Five dominant inventors in Fig. 4 perform a step within the engineering and product development processes in the sorghum plant for bioethanol. Those registered the patent to attract R & D investment and venture capital for commercialization, especially from R & D results.

3.1.2. Assignee

The patent assignee is a name (a person, a group of persons, or an organization that receives intellectual property ownership rights). In this field, as shown in Fig. 5, we discover that the majority of group organizations are assigned to use the patent application, with a description of three assignees (organizations) such as:

- Nasamax Limited, a private company and shareholder in fields of vehicles and products for locomotion by land, air, or water, Clothing Products, Toys, and Sporting Goods Products with four patents (44,4%);
- Instituto Tecnologico Y De Estudios Superiores Demonterrey (ITESM) with three patents (33,3%);
- The Republic of Korea (management: Rural Development Administration) turned the Korean agriculture industry into a leading export industry, generating advanced agricultural technologies with two patents (22,2%).

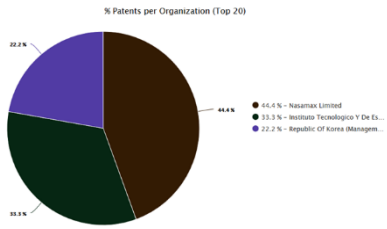

Fig. 5. Current assignee in sorghum plant for bioethanol (Innography software result)

Based on Fig. 5, only three major companies have implemented patent registration in industrial applications. It indicates that renewable energy from bioethanol still needs to be regularly used.

3.1.3. International patent classification (IP class)

International Patent Classification (IP Class) provides a hierarchical system of independent language symbols for the classification of patents and utility models according to the different areas of technology to which they pertain, shown in Fig. 6, with classifications such as:

- C12P7/00 has three patents (33,3%) with descriptions C Chemistry; Metallurgy, C12 Biochemistry; Beer; Spirits; Wine; Vinegar; Microbiology; Enzymology; Mutation or Genetic Engineering, C12P Fermentation or Enzyme Using Processes to Synthesize The Desired Chemical Compound or Composition or to Separate Optical Isomers From A Racemic Mixture, C12P7/00: Preparation of oxygen-containing organic compounds;
- C13B5/00 has two patents (22,2%) with description C Chemistry; Metallurgy; C13 Sugar Industry; C13B Production of Sucrose; Apparatus Specially Adapted Therefor; C13B5/00 Reducing the Size of Material From Which Sugar is to Extracted;
- A01G1/00 has one patent (11,1%) with description A: Human Necessities; A01: Agriculture; Forestry; Animal Husbandry; Hunting; Trapping; Fishing; A01G: Horticulture; Cultivation of Vegetables, Flowers, Rice, Fruit, Vines, Hops or

Seaweed; Forestry; Watering; A01G1/00: Horticulture; Cultivation of vegetables;

- A01B79/00 has one patent (11,1%) with description A: Human Necessities; A01: Agriculture; Forestry; Animal Husbandry; Hunting; Trapping; Fishing; A01B Soil Working in Agriculture or Forestry; Parts, Details, or Accessories of Agricultural Machines or Implements, in General; A01B79/00 - Methods for Working Soil;
- C12P1/00 has one patent (11,1%) with description C Chemistry; Metallurgy; C12: Biochemistry; Beer; Spirits; Wine; Vinegar; Microbiology; Enzymology; Mutation or Genetic Engineering; C12P Fermentation or Enzyme Using Processes to Synthesize The Desired Chemical Compound or Composition or to Separate Optical Isomers From A Racemic Mixture; C12P1/00 Preparation of compounds or compositions, not provided for in groups C12P3/00 to C12P39/00, by using micro-organisms or enzymes;
- C12N1/00 has one patent (11,1%) with description C Chemistry; Metallurgy; C12: Biochemistry; Beer; Spirits; Wine; Vinegar; Microbiology; Enzymology; Mutation or Genetic Engineering; C12N1/00 Micro-organisms, e.g., protozoa; Compositions thereof; Processes of propagating, maintaining or preserving micro-organisms or compositions thereof; Processes of preparing or isolating a composition containing a micro-organism; Culture media therefor.

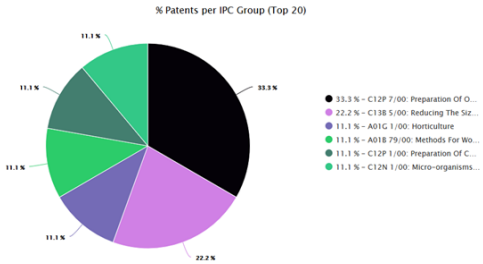

Fig. 6. IP class for sorghum plant for bioethanol (Innography software result)

The description above in Fig. 6 defines that the scope of fields of sorghum plants for bioethanol in renewable energy still dominates sectors C (Chemistry, Metallurgy) and A (Human Necessities). It covers derivative functions in an application, such as process synthesis, horticulture cultivation, agriculture machine, enzyme composition, and micro-organism.

3.1.4. Patent portfolio by assignee

A patent portfolio defines a collection of patents owned by a single entity (an individual or corporation) that has already run into the commercial segment. Patent as a part of the intellectual property suitable scheme commonly becomes a significant output of research and development activities. This portfolio will describe the entities of the assignee (organization) related to the business process and count the total revenue that has been earned. The creation of identified structure business can show in the global capacity report in patent engagement. Listing assignee still in the top 3 organizations:

1. Nasamax Limited, with current assignee four patents (44.4%), total revenue $ 0.- All U.S. Patent Litigation 0. Nasamax Limited has a resume portfolio in business activity in 10 years, shown in Fig. 7.

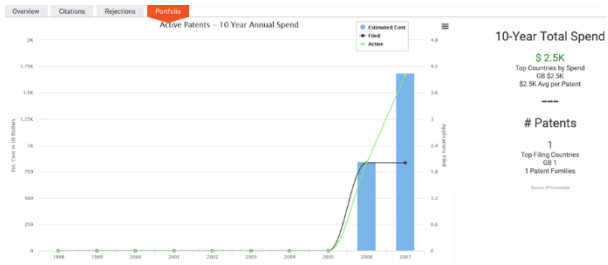

Fig. 7. Portfolio business Nasamax Limited in 10 years (Innography software result)

Fig. 7 shows that in 2007 with a high estimated cost of around $1.686, Nasamax Limited filed two and four active applications. It means this company has slow motion in an income-generating statement through advanced technology, also still waiting for the subsequent turnover in commercialization.

2. Instituto Tecnologico Y De Estudios Superiores Demonterrey, with current assignee three patents (33,3%), total revenue $ 0.- All U.S. Patent Litigation 0. ITESM has a resume portfolio in business activity in 10 years, shown in Fig. 8.

Fig. 8. Portfolio business ITESM in 10 Years (Innography software result)

Fig. 8 shows that in 2016 with a high estimated cost of around $515.603, ITESM filed 17 and 378 active applications. This company has a high acceleration in an income-generating statement through advanced technology. Also, each year has shown graphic bars have peak performance on-trend income statements and try to find a new model related to enhancing commercialization.

3. Republic of Korea (Management Rural Development Administration), with current assignee two patents (22,2%), total revenue $ 0.- All U.S. Patent Litigation 0,3. Republic of Korea (Management Rural Development Administration) has a resume portfolio in business activity in 10 years, shown in Fig. 9.

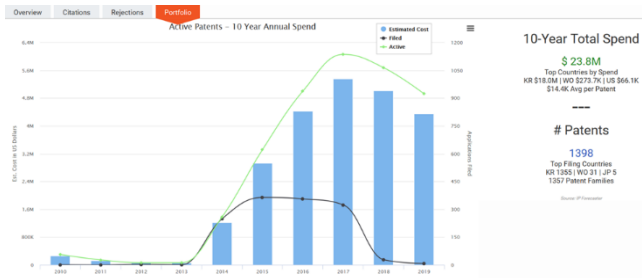

Fig. 9. The portfolio business Republic of Korea (Management rural development administration) in 10 years (Innography software result)

Fig. 9 shows that in 2017, with a high estimated cost of around $5.361.704, the company filed 324 and 1136 active applications. This company has significant revolving in the income statement, endorsing the patent application database already in use in processing.

Adaptive learning technology sources through patents describe technology information with performance on competitors' activities, R&D trends, emerging fields, and collaborations, apart from uncovering relevant prior art and decreasing the risk in substantial R&D investments. Technology monitoring systems that allow timely anticipation of technology change within the competitive environment, where a significant portion of the technical information is contained in patent documents and not published in any other form, have become the cornerstone of technology management.

3.1.5. Comparison of patent strength factors (radars) of the three company

The effective national patent systems are comprised of two components: (a) the strength of patent law on the books and (b) the strength of the enforcement of patent law in practice (Papageorgiadis et al., 2019). Identifying the key factors that contribute to the strengthening of patent law protection and enforcement can help policymakers design and implement effective policies that will strengthen the patent system of their country or region. Comparing patent strength factors means defining effective implementation in a company that endorses technology through a patent document already entering market commercialization. Strengthening a country's patent system to a level compatible with a country's development and technological capabilities is desirable as this expect to boost economic growth. Attracting higher levels of Foreign Direct Investment (FDI) and Innovation leads to higher commercialization of intangible assets.

A company in a country will benefit from the capitalization of patents. It can be strengthened significantly for branding in market orientation. Fig. 10 describes radars' position of strength comparison from the three companies that already exist in the patent database Innography.

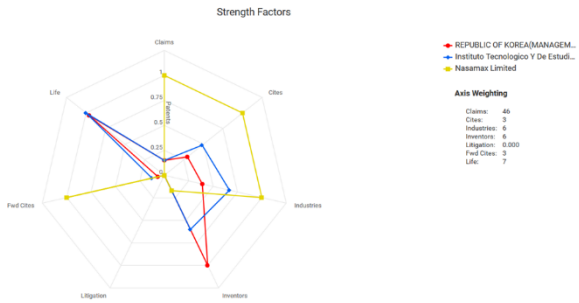

Fig. 10. Radar strength factors of three companies in the field of sorghum plant for bioethanol (Innography software result)

From Fig. 10, it is founded 2691 patents related to opportunities on maturity patentability when it comes to stakeholder interest. With detail, information can be listed, such as:

1. Patent litigation is the act of law when someone who owns the patent for a particular invention enforces their right by using another for manufacturing or selling the invention without permission. Data coverage in three companies shows no patent litigation interaction with an average number of 0 from axis

weighting 0.0000, meaning that patent litigation has a high impact on protecting patents from infringement or violation of the law.

2. Patent Industries mean the implementation of countries' patent rights fall under civil law, and the patent holder needs to sue someone infringing on the patent. Existing data interaction in three companies with average numbers 0.668221, 1, 0.389974 from axis weighting 6 means patent industries have a high impact on a patent application in industrial sectors application and have detailed use to enhance the capacity process.
3. A patent claim defines the scope of the claim as the invention that limits the coverage of patent protection afforded under the patent. A patent inventor has a right to claim, and three companies' data interaction applies for average numbers 0.149132, 1, 0.150011 from axis weighting 46. It means a patent claim has high results of precision to what the patent does and does not cover and becomes a critical case in application.
4. Patent Life is the maximum period it can maintain in force from the filing date of the patent application or the date of grant. Data interaction with an average number from three companies 1, 0, 0.961695 from axis weighting seven means patent life has a low impact in performing from protecting on filling period until granted.
5. Patent Inventor means an inventor, or persons in patent law, who contribute to the claims of a patentable invention. Data interaction with an average from three companies states the value of comparison 0.600991, 0.17008, 1 from axis weighting six means that patent inventor has a low position on producing patent each year.
6. Cites mean a patent citation is a document cited by an applicant, third party, or a patent office examiner because its content relates to a patent application. From listing data interaction with an average from three companies' state the value 0.483718, 1, 0.295845 from axis weighting 3. It means patent cites have very low citations each year. It is possible to target active patent acquisition, which enhances R&D output and, consequently, much improved or new products.
7. Fwd Cites means the applicant and the patent examiner must find and cite documents that may anticipate the claimed invention or might be similar to the claimed invention and limit the scope of the patent protection or generally reveal the state of the art of the technology. Data result from three companies with average numbers 0.126292, 1, 0.064657 from axis weighting three mean fwd cites have a low impact on anticipating claim invention or similar invention from revealing state of the art.

All descriptions indicated that all three companies (Instituto Tecnologico Y De Estudios Superiores De Monterrey, NASAMEX Limited, and Republic of Korea (Management Rural Development Administration)) have similar activities in resulting FDI. They commonly involve the transfer of technology from a company's headquarters to a subsidiary in the host market (Dunning & Zhang, 2008). Foreign firms frequently pressure local governments to strengthen patent law and enforce it in practice to retain the same business model used in their home country and successfully appropriate the returns from their innovations in the host country (Zhang et al., 2010).

To elaborate, users know their technology development for market orientation through the patent portfolio, licensing, status, competitor, innovation, and monitoring the emerging market with the patent database. Linkage with innovative and economically

promising technology fields and markets will be identified through technology monitoring and foresight using a learning process based on patent information.

3.2. Learning process from patent information to enhance future research

The learning process can be used as an innovative and measurable step in enhancing new technology through information technology patent analysis. The learning process is performed by searching the WIPO database of registered patents, which is very useful in seeing, measuring, and capturing the advantages of existing technology. So that it can be used within a specific time frame and, of course, also based on agreements made with patent owners. In today's digital information age, it is highly recommended to use tools equipped with data tracing and the learning process, especially against technology-based Innovation needs.

In general, process learning through patent information gives us many opportunities to gain information for benchmarking product development, where mainly users are from industries. For example, the information needs such as (1) scientific monitoring activity, (2) analyzing patent trend, (3) market trend, (4) technology development trend, (5) dynamic of the number of patent applications, and the growing need to access of patent information, (6) road-mapping technology, (7) strategic development planning. Increasing patent analysis becomes vital to:

1. Analyze large amounts of patent data that is expensive to be done manually;
2. Enhance the quality of generating helpful information;
3. Support decision-making processes to improve the quality of the patents eventually;
4. Provide suggestions for further evolution in a particular domain of patents;
5. Determine the patentability of their inventions;
6. Avoid infringing other inventors' patents;
7. Identify key trends in specific technical fields of public interest, such as renewable energy or the environment, and provide a foundation for policy planning.

In the case of bioethanol, research and development to produce bioethanol from sorghum still have high opportunities. Commercialization is still wide open for all derivatives of this product. In addition, the results of the learning process from Innograph show that the need for renewable energy is still wide open. It stated that the chemistry and human necessities sectors were still dominant, meaning that opportunities outside these sectors still have a chance to conduct new research in the future. Based on the data mining mentioned, The Republic of Korea (Management Rural Development Administration) holds the patent portfolio from the economic value range in technology applications as the active user that determines the industrial process. This information also can be used to elaborate and develop a new derivative product based on sorghum plantation.

If we are concerned with the industrial application, as mentioned in Fig. 5, bioethanol from sorghum's renewable energy utilization could be higher. This is considered that the production of bioethanol as renewable energy still has low economic benefits for the industry (Appiah-Nkansah et al., 2019). Investment costs are higher than the beneficial economic obtained. Besides that, there are other constraints to developing this product, such as limited land, limited technology, and diversification utilization of

this product for other purposes such as feed, nutrition, and human needs (Hossain et al., 2022). These challenges provide more significant opportunities for further research regarding the technology, production, quality, and utilization of sorghum-derived products.

On the other hand, Renewable energy from sorghum plants for bioethanol is still in development until now as a supplement to fossil energy. Ethanol produced from derivative fermented sorghum, which is about 40-55% depending on the quality of sorghum juice, fermentation, and sterilization processes, becomes an alternative fuel that is renewable and can be used as a substitute for fossil fuels. The advantages of sorghum plants are drought resistant and more resistant to pests and diseases than other crops. They are unique crops that are essential to consider as zero-waste products.

4. Conclusion

Information management is widely used to analyze data sources from big data with a particular theme. The learning process from these activities will undoubtedly save time, effort, and costs and provide a better picture of the theme being explored. In the field of technology and innovation, the learning process can be carried out more effectively and provide new ideas for future research.

This paper tells us how the learning process on foresight technology can capture information technology, especially from the patent database. The databases can manage technology transfer, especially from research and development results. Meanwhile, the critical utilization of that system must clarify some innovation steps that enhance the capability to produce useful information for stakeholders. Despite the widely shared view that technological knowledge is one of the most critical factors in economic development, many need help measuring and counting technological knowledge.

Also, this paper shows how the patent database can benefit the stakeholder to gain updating information technology that now performs in the markets and the prospect of industrial utilization of royalties' patent application through the learning process. The capture of the information can be used as a learning process to determine the next steps in technology development, innovation, and commercialization. Also, it can open a chance to collaborate with other stakeholders to develop and commercialize this technology.

5. Limitations

This research was conducted based on patent mapping by the Innograph Software, with the result analyzed on existing data based on the WIPO database and combined with a literature review. Please also note that the results of this paper are expected to be a recommendation related to process learning technology through patent data information on the development of a product. The process of involvement in the creation of this paper is an example of the empowerment and enrichment of science that is still not utilized in general. The scientific fields include management, technology forecasting, patent tracing, and business and innovation.

Author Statement

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