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To cite this article: Mahyuddin K M Nasution et al 2019 J. Phys.: Conf. Ser. 1235 012114

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The Excellent Center: Center for Artificial Intelligence Technology

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Abstract. To overcome the slow development of knowledge due to the weakness of knowledge management, innovation about organization is done by establishing a center of excellence related to the importance of that knowledge developed. However, without objective derivation and target establishment, such an organization will not achieve its excellence. This paper aims to describe the center of excellence in science, with the example of a review about Center for Artificial Intelligence Technology and with showing a number of measurements that can be done from it.

1. Introduction
Artificial intelligence has become one of the scientific disciplines in an academic way for a long time, that is, since the birth of a computer as a programmable machine \cite{1}, a machine that receives commands based on human reasoning \cite{2}. When the superiority of the human brain is able to process data in detail to produce meaning and that advantage gives an obstacle to processing data that is more in terms of speed and magnitude \cite{3}. Thus, the superiority of human logic is then translated into computer machines, so that the consistency of computer capabilities can be empowered to process data \cite{4}. The limitations of human, giving birth not only science, but it is related to the development of the fields of science and the accompanying technology, which is specifically identified with the name of the Artificial Intelligence (AI) \cite{5}.

To develop science and technology related to the artificial intelligence needed in the industry 4.0 era, several study centers are competing to have been recognized and established by universities or research institutions \cite{6}. The establishment of the study center is usually characterized by their own mission and vision \cite{7}. The mission and vision emphasize the development of knowledge and direction \cite{8}. This is translated into various focus of related studies so that it touches the fundamental side, application and downstreaming to the users who need it \cite{9}. This paper aims to explain the establishment of a center of excellent that is specifically related to the AI.
2. A review to the goals

The center of excellence (COE) or the excellence center [10] is initiated by various different names for the first part of the naming, namely development agencies, research center, center, study center, research center, technology center, work group, research group, or institution, etc, while the second part is focused on the direction of study or related scientific fields. Thus, an Excellence Center is a work team consisting of a group of scientists who work or study the scientific field seriously. For example, the center of artificial intelligence technology is an excellence center tasked with developing artificial intelligence technology. A study center that accelerates the outcome of research and downstreaming about the AI to help users, industry, government, community members or other stakeholder for improving their welfare [11, 12].

In Indonesia, the institutional acceleration of research with a particular scientific focus is called the center of excellence in science and technology (in Indonesia we called it as “Pusat Unggulan Ilmu Pengetahuan dan Teknologi” or “Pusat Unggulan Inovasi” abbreviated as PUI) although this naming may be different in other countries, but its existence can be traced to information sources [13]. The use of the word excellent as general naming gives the meaning of the form of institutional tracking that must be achieved. A study center is generally not directly superior. After the pilot step by defining the scope and the focus of the study, research, and downstream that will be carried out. Defining it becomes the basis for the presence of a mapping of potential related to the establishment of a study center to become the foundation for the establishment of the excellence center [14]. There needs to be a complete study and information about human resources, content, processing, management, cost of programs, facilities and infrastructure, test and evaluation, and result or product so that a strategy for accelerating scientific development can be arranged specifically in accordance with the name of the center of excellent [15].

In the industry 4.0 era, the artificial intelligent become increasingly foothold after its first implementation in the 20th century. Studies that came into contact with this field were increasingly incentivized [16]. Various systems are created that are generally to process, analyse then give meaning to big data, so that behaviour and trends in change can be anticipated according to their needs [17, 18]. At present, future predictions of accumulated data are no longer needed without being able to provide an overview of what should be done in the near future, which counts no more than one week even in just minutes. What actions must be taken so that it can be established and implemented on a mobile basis, and for this reason the center for the study of artificial intelligence is present on mobile basis through the online system [19].

The goal of the excellence center is to increase the capacity, capability and continuity of institutions in research, development and application of science and technology resources, and science and technology networks in certain fields in order to increase relevance and productivity and utilization of science and technology in certain sectors so as to grow the national economy and have an impact on improving welfare society [9]. In that framework, the center of excellence has the ability to access information technology, streamline the use of existing resources, and prevent the overlapping of research, and has the capacity in science and technology through the potential for adoption [20], adaptation and technology development by increasing the filtering of goods and/or services through optimization of input, process, and management of industry, thus leading center can improve the ability to disseminate research results whose benefit are felt by technology users [21]. Users are society, industry, and government.

3. An approach to establishment

To establish a research and development (R & D) to become excellent (the center of excellence) starts from stub. This stub involves planning, and then institutionalizes it with pre-primary, primary, main, excellent predicate status. The predicate status about the center of excellent achieved after fulfilling the conditions set [22].
Efforts to strengthen the pre-primary predicate status consist of: Improving organizational governance; Development of human resource competencies; Increased support for facilities and infrastructure; Strengthening budget management, obtaining accreditation, standardization and certification; Network development and information access; Strengthening the research roadmap supports the institution’s superior focus; Development of demand driven research-based themes; Publication support; Support for the implantation of leading research institutions; and Facilities and calibration support [23].

Efforts to strengthen the status of predicate consist of: Support for obtaining the intellectual property (IPR)/patents; Support for strengthening superior product of research based on demand-driven industry and users; Strengthening the framework of research and non-research cooperation; Development of product databases; Strengthening collaboration and dissemination; Support for strengthening institutional networks (national and international); and Support for industry roadmap, public expose and business matching. Efforts to strengthen the main status are: Support to strengthen the sustainability of institutional productivity; Strengthening national recognition - accessibility to trending issues; Strengthening national references - becoming the national reference center for the superior focus. When this condition has been reached the title status becomes excellent with the focus of strengthening the economic benefits of the institution’s superior products - encouraging the emergence of technology-based startup companies; Strengthening social impact that support community welfare; and Strengthening integration and synergy for the growth of the science technology area (science technology park or STP) [24].

Each criterion is appropriate and the predicate has input, process and output indicators, and then outcomes-impacts indicators. For example, input indicator is the availability of standard operating procedure (SOP) for institutional governance, the process indicator is strengthening budget management, while the output indicator is an invitation to be a speaker at an international conference (minimum target = 3 times), while the next indicator has not been made a requirement. These criteria include sourcing capacity, R & D capacity, and disseminating capacity [25].

4. Center for Artificial Intelligence Technology
At the Academic Enhancement Workshop of the Science and Management System Department - Faculty of Information Science and Technology (FTSM) on July 24, 2005 a proposal was made to establish Center for Artificial Intelligence Technology (CAIT) as a non-profit research institution, with the objective to carry out advanced research in AI in meeting the scientific needs of government and business in AI research, and with a goal for producing IPR and the AI-based products that have high added value to be commercialized. CAIT (http://www.ftsm.ukm.my/cait/) consists of 4 (four) research groups (RGs) [26]:

(i) Data Mining & Optimization (DMO).
(ii) Industrial Computing (IC).
(iii) Knowledge Technology (KT).
(iv) Pattern Recognition (PR).

Each research group of CAIT has research focuses: Bio inspired and natural computing; timetabling and scheduling; heuristic search; solving optimization problem; solving data mining optimization problem; feature selection and meta heuristic search; temporal and time series data mining; and data mining in manufacturing are focuses for DMO; Industrial automation and visualization, computer aided design, computer integrated manufacturing, computer aided supply chain and quality assurance, industrial robotics programming, machine vision and sensors for industrial application, autonomous camera for object detection, and high performance computing as focuses of IComp; Information and knowledge extraction, information retrieval, semantic
Table 1. Number of documents and new academics.

| RGs | Academic Levels | No | New |
|-----|-----------------|----|-----|
|     | Prof | AP | Lect | Docs | Acad. | |
| DMO | 2    | 3  | 3    | 115  | 112  |
| IComp | 0   | 2  | 5    | 28   | 44   |
| KT  | 3    | 2  | 6    | 84   | 124  |
| PR  | 1    | 3  | 7    | 43   | 65   |
| Total | 6   | 10 | 21   | 270  | 345  |

In 2012, information about scientific works related to CAIT from DBLP - computer science bibliography was explored. DBLP is a database that contains a list of publication about computer science, information science, and information technology. Based on an approach, information is obtained about the number of documents (No Docs) and new academics (New Acad.) in academic levels: Professor (Prof), Associate Professor (AP), and Lecturers (Lect.), see Table 1. Since its inception until 2012 (7 years), based on 16 Prof, 10 AP, and 21 Lect. have produced as many as 270 documents, the scientific works indexed by DBLP and 345 prospective researchers or students/alumni [30].

In accordance with the performance requirements of a center of excellence, CAIT’s performance can be explained as follows: For example, every Prof produces at least 2 publications a year and an AP produces at least 1 publication a year, by assuming Lect. be co-author, the scientific publications can only be fulfilled for 12 years only or in the range 12.27 years. Or a Prof can complete 6 scientific papers annually for 7 years if it is assumed that AP and Lect. are co-authors. In other words, if the conditions specified for Academic Excellence must produces 20 scientific publications nationally and 5 scientific publications in international, each year CAIT can fulfil these requirements.

In the range of 2005 to 2012 the number of prospective researchers produced or students related to the center of excellence was as many as 345 people who emerged as co-authors of 270 scientific papers. If the timeframe is reduced to 5 years, CAIT produces 69 alumni each year as scientists who will develop AI in various places. However, there are still around 75 people whose scientific works are not indexed by DBLP, but are published according to the requirements for completing studies in other publishers. Moreover, the conditions for completing studies, for example, are for each master program student to produce at least 2 papers through international conferences (at least 1 international journal article), while doctoral programs must produce at least 4 papers through international conferences or at least 2 article in international journals. So, the performance requirements of the excellence center that require output of 2 graduates per year are more than fulfilled by CAIT.

By considering a collection of words around the research focus of each research group, the suitability of research conducted by related professors can be seen in Table 2 (in bold). This conformity is built on the concept of similarity between two words collections. First, the words collection based on the title of the publication relating to the professor. Second, a collection of words about the focuses in a research group. Thus, research mapping based on research focus and its implementation was developed in accordance with the research conducted based on documentary evidence indexed by DBLP.

Other performance indicators as a whole can be seen from the CAIT Web...
Table 2. Relation between Prof and Research Group.

| Prof              | DMO | IC  | KT   | PR   |
|-------------------|-----|-----|------|------|
| Abdul R. Hamdan   | 0.699 | 0.103 | 0.267 | 0.272 |
| Azuraliza A. Bakar| 0.731 | 0.098 | 0.371 | 0.335 |
| Juhana Salim      | 0.132 | 0.088 | 0.351 | 0.138 |
| Khairuddin Omar   | 0.183 | 0.115 | 0.189 | 0.765 |
| Syahrul A M Noah  | 0.243 | 0.117 | 0.847 | 0.207 |
| Tengku M T Sembok| 0.371 | 0.111 | 0.794 | 0.329 |

http://www.ftsm.ukm.my/cait/,

it is also possible to measure the relationship between the number of publications \((np)\) and the number of IPRs \((n_{IPR})\) and the number of products that have been produced \((n_{Prod})\). Everything is scientific work \((sw)\). The relationship might be formulated as follows.

\[
sw = np + n_{IPR} + n_{Prod} \tag{1}
\]

With assumption that \(n_{IPR} = 0.1np\) (10% of numbers of publications) and \(n_{Prod} = 0.01np\) (1% of number of publications), we obtain the number of scientific works \(sw = 299\) where there may be 27 IPRs and 3 products, it is possible!

5. Conclusion

The establishment of a center of excellence, as the acceleration in research in certain fields both science and technology, must be based on a number of people who have abilities in that field even though they come from various scientific disciplines. This capability is based on the amount of human resources with a high level of academics, and thus can subsequently explore the potential that exists with regard to the development of such knowledge, which is the center of excellence like CAIT FTSM.

Acknowledgement

This paper is presented to TALENTA researchers, thanks to the support provided by the Research Institute \((\text{Lembaga Penelitian})\) and Community Service Institute \((\text{Lembaga Pengabdian pada Masyarakat})\) of Universitas Sumatera Utara, Medan, Indonesia. Thanks to also the support by Knowledge Technology (KT) Group Research, Center for Artificial Intelligence Technology (CAIT), Fakulti Teknologi dan Sains Maklumat (FTSM), Universiti Kebangsaan Malaysia (UKM), Bangi, Selangor DE, Malaysia.

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