



Overview of Neurogenesis Growth and Glia Cell to Cloudle Architecture in Cloud Manufacturing

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

By realizing on future view of manufacturing, demand intelligent became a challenge for any manufacturers. Many manufacturing concepts emphasize rapid responses to demand change or fluctuation demand in the current market. Cloud manufacturing offers better service between a supplier to manufacturer and user to a manufacturer. In cloud manufacturing, all manufacturing process is linked together in cloud pool and this lead to time reduction in data processing. However, this concept will be successful if cloudle as agent-based searching engine able to implement brain emulation in the cloud

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manufacturing system. Brain emulation is emphasizing the neurogenesis phenomenon in the system by supporting with glia cells concept to expedite the searching process.

Keywords: Cloud manufacturing; cloudle; neurogenesis; glia cells.

1. INTRODUCTION

Brain emulation concept typically beendiscussed in medical view on capability to simulate and mimicking the uploading or downloading information gained. However, this concept has a compatibility to be adopted in manufacturing. Uploading or downloading activities is recognized to be occurred in brain emulation [1].

Cloud Manufacturing is a system that currently gained attention in a variant sector. However, CM still has not achieved the steady state or stability to be implemented in any industries. The details of objective are to present the adopting of brain emulation concept in CM by emphasizing the neurogenesis and glia cell approach. The integration of artificial intelligent (AI) in manufacturing become necessary due to its potential's impact to make the organizations become competitive. By using AI as a medium to integrate the brain emulation in the manufacturing system, the new concept of Cloud Manufacturing (CM) nowadays became questioned due to several issues such as security. Typical review on CM is a manufacturing process that optimizes the information technology usage to complete the customer demand. More can be described that CM is manipulated of pull concept for the manufacturer to process the demand and comply with on-time delivery. By combining these concepts (brain emulation and artificial intelligence) with CM, the manufacturing process will become more effective in variant aspect such as scanning, translating, decision-making and simulation. These hybrid concepts willlead to cost reduction in manufacturing process by utilizing the application of information technology where it became a must in most of the organizations.

Intelligent demands force manufacturer to produce products in high speed of manufacturing process to fulfil the customer requirement.

Customer-centric manufacturing system that CM promotes has the ability to cope with that issue by rely on cloudle. In this study, cloudle need to have brain emulation with anoriginal brain to accomplish the task at a certain speed. The critical issue in CM is security. One of the cloudle abilities is to control all the data gained, uploading or downloading activities in the cloud pool. The algorithm for controlling the data security in the cloud pool will be developed to prevent the data is freely to be copied or extracted out from the system.

As a foundation of the studies, that is very important to find the similarities concept between neurogenesis development process (NDP) and product life cycle (PLC). The objective of the similarities concept is to prove that there are more new ideas, activities occur in cloud manufacturing and providing an agent to capture all the activities occurred in the networks. By having the searching agent to look at those activities, the security issues can be overwhelming optimizely. Hypothesis 1 and 2 will become a key point for this study in order to look on the similarities between NDP and PLC. Hence, it's also lead to create the inter-relation between NDP and intelligent manufacturing process.

- H1: If NDP have similarities with PLC, then NDP can be adopted into because NDP give utilization in its functional.
- H2: If NDP and PLC have similarities, then the dead neurons in NDP can be assumed as disposal in PLC because having the same functionality in its platform accordingly.

2. BACKGROUND

2.1 Brain Emulation

The origin of emulation term was in computer science where it leads to mimicking the program function or computer hardware by having its low-level functions simulated by another program [1]. If compared to simulation, emulation only mimicking the internal dynamic causal instead of copied the external results that are done by simulation. The key of successful factor is achieved once emulated system will result in exactly original with external behavior but with dissimilar speed. Brain capabilities are well known such as copied the external resources, observing, translation, simulating, etc. The idea to emulate the brain into artificial intelligent is generated due to seek the inter-linkage between brain emulation, and agent based searching engine in CM.

In this context of study, brain emulation behavior and brain emulation activities assume a synonym. The behaviors that will be focused by searching agent based are uploading or downloading, mimicking, observing, control, store and maintain. However, the ability to delete emulations still became questioned. The data store and maintain in a cloud pool nowadays became an issue and challenge to be adopted in any industries. In emulation view, saved state data to storage, the task replicates can be executed and deleted immediately in order to accomplish the next job [2].

Neurogenesis is a stage for functionalities of neuron in the human brain. Based on the findings is assumed there are similarities between neurogenesis and manufacturing process where the focus is fixed in the product life cycle. Generally, in neurogenesis there are three types of cells with different functions is generated which are glial cell, the neuron and dead cell. Neurons in maturing stage will execute all the functions assigned while the glial cell is to support the neuron cell from newborn until matured cells. Most researches are neglected the dead cell functions. Cell division, migration, and differentiation are such process that occurred in neurogenesis. Only two areas of the brain where stem cells initially reside and proliferate prior to migration and differentiation to be appeared at present. [3]

Multiple dissociable changes in the brain involve many levels of organization, from molecules to systems, with changes in neural elements occurring concurrently with changes in supportive tissue elements such as glia and blood vessels. [4] It should also be made, in principle, to generate glia to cover any eventualities that affect neuronal function. [5]

2.2 Cloud Computing

American National Institute of Standards and Technology (NIST) defined the cloud computing (CC) as an enabling ubiquitous model, on-demand network access to a pool sharing of configurable computing resources that provisioned and liberated rapidly with minimal management effort or service provider interaction [6].

Cloud computing maybe mentioned into combination of applications delivered over the internet and the hardware and software systems in the data centres' that offer those as a services. Private cloud is referring to a business or other organization's internal data center but it's unreachable to the general public. The services provided is based on demand and the application is referred as Software as a Service (SaaS). Typically people maybe users or providers of SaaS in a cloud term. There are three new aspects in CC from a hardware point of view [7]:

- i. The infinite computing resources illusions is available on demand and end-up the need for CC users to plan far ahead for provisioning.
- ii. The elimination of an up-front commitment by Cloud users, thereby allowing companies to begin small and increase hardware resources only when there is an addition in their demands.
- iii. The ability to pay for use of computing resources on a short-term basis as needed (e.g., processors by the hour and storage by the day) and release them as required, thereby rewarding conservation by will machines and storage go when they are no longer useful.

The CC model involves computational resources (e.g. server, storage, network, software) and provides services for user in the three models [8]:

- i. Infrastructure as a service (IaaS): The storage and compute capabilities are offer as a service.
- ii. Platform as a service (PaaS): The program is supplied as a service which enables the growth and deployment of applications without the cost and complexity of buying and managing the underlying hardware and software layer
- iii. Software as a service (SaaS): The application and software are offered as a service in which the application operates on the clouds. Therefore, the need to install and run the application on the client's computer are eliminated [9].

There are several types of cloud that are envisioned such a public cloud, private cloud, community cloud and hybrid cloud [10]. However the concentration is only in private cloud. The infrastructure of private cloud is operated solely for an organization. It may be managed by the governing body or a third party and may exist on or off the premises of the organization [10].

The adoption of CC in the manufacturing sector, the key areas are around IT and new business models that can readily support, such as pay-as-you-go, the convenience of scaling up and down per demand, and flexibility in deploying and customizing solutions [11]. The application of cloud into manufacturing processes and development became reliable due to its compatibility in a cloud provider. Typical adoption in manufacturing such as in human resource (HR), customer relationship management (CRM) and entrepreneurship resources planning (ERP) are easily to be implemented due to less secrecy data required. The other applications in manufacturing can be questioned.

Intel IT has adopted the cloud computing into their operation after realizing on the yielded benefit such as cost savings, improved agility, and faster time-to-market, as well as increased flexibility in scaling to support more users as necessary. CC has also provided a venue for experimenting with new capabilities [12]. The cloud computing taxonomy has been adopted by Intel in order to them to create efficient SaaS as a cloud hosting. Cloud client or end user have used the SaaS for variant purpose such as request service consume service,

and request service removal. Cloud client acted as a client centric services and run-time software for cloud execution [12].

The new capabilities between cloud computing with manufacturing as a business entities still in development or review stage. However, Intel admitted that the business process, application, and data integration required depends on the extent to which a SaaS application is tightly coupled with the environment found that the key has been to evaluate the intersection of each SaaS solution with our existing business processes, systems, and data.

Hewlett-Packard (HP) Development company was an earlier inventor in cloud computing. HP concluded that CC gives a bunch of benefit to the business and organization from Chief Financial Officer (CFO) perspective's. Cloud solutions are available for a broad range of business functions and applications. Cloud solution have an agility respond to fill the lack caused from sudden or rapid changes in demand for capacity and usage [13]. Deployment of CC in manufacturing may improve the quality of service between manufacturer and customer, accurate decision making and give major impact on the fortunes of an enterprise. The idea of CC is only to get the leverage from cloud technologies and for this study only.

2.3 Cloud Manufacturing

It is known that CM is invented after CC where CC is a core technology for CM. The contrary and relationships between CC and CM are illustrated by Fei Tao et al. (2012). Therefore there is a relationship between CC and CM in addition to the IT resources that involve in whole manufacturing life-cycle. The whole life cycle is aimed to be furnished to the user in different service models based on IaaS, PaaS, and SaaS, including the next examples [8]:

- i. Design as a Service (DaaS): The design resources and capability are offered as a service.
- ii. Manufacturing as a Service (MFGaaS): The manufacturing resource and capability are offered as a service.
- iii. Experimentation as a Service (EaaS): The experimentation resource and capability are offered as a service.
- iv. Simulation as a Service (SIMaaS): The simulation resource and capability are offered as a service.
- v. Management as a Service (MaaS): The management resource and capability are offered as a service.
- vi. Defend as a Service (MAaaS): The maintain resource and capability are offered as a service.
- vii. Integration as a Service (INTaaS): The integrated resource and capability, information system, and platform are provided as a service.

The definition of CM, that's been proposed by NIST is a customer-centric manufacturing model that exploits on-demand access to a shared collection of diversified and distributed manufacturing resources to form temporary, reconfigurable production lines which enhance efficiency, reduce product lifecycle costs, and allow for optimal resource loading in response to variable-demand customer generated tasking [14]. Cloud manufacturing is compatible to be adopted in manufacturing due to its characteristic and capability.

These models help small and medium enterprises (SMEs) in cost reduction by outsourcing their operations and funding helps. Agility is one feature of CM where it has allowed for flexibility in manufacturing system to fit the rapidly shifting customer need. Cloud

manufacturing also has the potential to allow the gathered information to be processed, handled or manage, and shared within and across the organization in CM networks. This potential occurs if an increasing amount of data and unstructured information about product design and manufacturing collected by information and communication technology (ICT) systems [9]. The characteristic of CM are as follow [15]:

- i. Service and requirement-oriented
- ii. Dynamic and uncertainty
- iii. Knowledge-based
- iv. Initiative
- v. Physical distributed and logical centralized
- vi. Wikipedia style and group innovation based manufacturing
- vii. Lower threshold and outsourcing

The example model of CM services that synchronize all the manufacturing models and the potential impact of CM across the sector also being identified has been proposed [14]. Main activities emphasize in CM services is a collaboration between provider (manufacturer) and consumer. With some help from a broker, the process became high efficient in performance and help consumer to understand the all terms and regulation on CM services. Knowledge management inside the CM services become important to the cloud pool entities for accurate data or information towards initiating the distributed manufacturing. CM services have been used as Cloud Based Design Manufacturing (CBDM) model for open innovation and rapid product development with minimum costs through a social networking and negotiation platform between service providers and consumers [16]. CBDM is a virtual business application where enables consumer to communicate with the manufacturer as an on-demand self-service. Beyond year 2010, the most challenger needs to be defeated by the manufacturer is an intelligent customer. Product quality, rapid execution the demand and on-time delivery became a critical aspect in manufacturing processes. In engineering and design sector, CM allows on design collaborative with aims to improved efficiency, ubiquitous access to design information and affordable computing resources [14]. In the manufacturing sector, the concentration more on improved resource sharing, rapid prototyping and reduce cost. While in marketing and service sector, the customer co-creation is targeted such a reduce time-to-market, improved service quality and enhanced customer needs elicitation.

All these potential impacts required collaboration between CM and artificial intelligent where the agent-based need to accomplish all tasks assigned. Agent-based on the CC is concerned with the invention and exploitation of software agents for bolstering cloud service discovery, service negotiation, and service composition [17].

The focuses of the study has been narrowed down into three fields to be explored which are DaaS, MFGaaS and EaaS in whole life cycle of manufacturing process. The motivation to focus on this area is because of security issues in cloud solution. This lack of security in deployment of private cloud may contribute to information leakage because the agent-based in CM having lots of capabilities that bringing benefits and disbenefits to the company. Those three area required high security in CM in order to ensure the product details or any confidential information was in the permitted boundary.

2.4 Agent-based CM

In CM, the utilization of resources usage is necessary. So the agent operating platform is made in each manufacturing node that could be checked and organized, and then various types of tasks manufacturing resources could be deployed [18]. Sim [17] has discovered the agent-based search engine known as Cloudle for service offer in the cloud. The cloud crawler architecture that provides service in cloud pool. Cloudle consists of a service discovery agent that looks up a cloud ontology for determining the similarities between providers' service specifications and consumers' service requirements, and multiple cloud crawlers for building its database of services. Cloudle supports three types of reasoning: similarity reasoning, compatibility reasoning, and numerical reasoning [17].

Sim [17] explained that a crawling agent, software agent (softbot) and database agent are main entities of cloud crawler. The relevant data to cloud computing services is traverses extract from WWW. As the crawling agent visits a website, its fetcher module downloads a copy of the webpage, then examines the contents and extracts the link data and the contents of the webpage by parsing the downloaded document. The extracted data is stores in a shared content memory and updates the link data in the crawling agent's link database. The URL filter softbot scans the texts in each document that are stored in the shared content database to search for cloud concepts in the ontology. A document that contains more cloud concepts receives a higher score. The database agent examines relevant documents in the shared content memory by extracting the name of the service provider, service type, price, and technical specifications such as CPU speed and RAM capacity. All such information together with the URL of the webpage will be stored in Cloudle's database [17].

Most of us get familiar with agent based in artificial intelligence fields. Once a cloud solution being proposed in the year 2010, the various types of model have been proposed to the public in order to visualize it. However, the work behind the scene become a secret to every inventor. The cloud crawler provide cloudle to do the various tasks in the cloud solution architecture. Besides cloudle, the participant (in example: manager, engineer, designer, supplier, customer etc.) also will determined the efficiency of cloud solution and secure environment of CM. Generally, cloudle act as a transport between manufacturer and consumer in a cloud pool. The data acquisition from consumer will be transmitted for distributed manufacturing. Cloudle became important in CM to provide appropriate data and information required in a cloud pool. In this study, the cloudle is required to support the brain emulation behavior such as uploading or downloading, mimicking, observing, control, store and maintain the data in a cloud pool. It is a novelty approach to emulate the human brain behaviour into cloud manufacturing in order to create the high efficiency of cloud solution and secure environment.

2.5 Adoption of Brain Emulation in Manufacturing

By realizing on similarities functions between neurogenesis and manufacturing process, this concept is proposed. In neurogenesis have neurons to execute and glial to support. Neurons is claimed as direct system while glial is claimed as an indirect system in the manufacturing process. Direct system is functioning to execute the customer demand and indirect system is required to ensure the direct system accomplish the demand. For example in computer added manufacturing (CAM), there are two main activities occur for direct process which are making operation in order to do the work accurately and fast like riveting and drilling. The second direct process occurred in CAM are process control like manual control, computer

control, distant command and automatic control where it is important to ensure no disturbances are allowed for procedures. Yet the case of indirect processes occurred in CAM are computer aided process planning (CAPP), manufacturing planning, inspection, material handling, quality control, various techniques like computer added NC programming (NC, CNC and DNC) and etc. based on this application in manufacturing, it is relevant to claim that neurogenesis have similarity functions with manufacturing process especially once it's connected to future manufacturing concepts like CM.

In neurogenesis development process, three types of cells being created which are glial cells, neuron and dead cell [19]. Every cell created has an own function except dead cell where lack of research to prove its functions during neurogenesis development process. Glial cell function is to support the neuroblast process while neuron is a functional cell in maturing stage. Based on this overview, there are similarities in the product life cycle where the similarities found is a novelty approach. Fig. 1 shows the match similarities in stage form for both neurogenesis development process (in Fig. 1a) and product life cycle (in Fig. 1b).

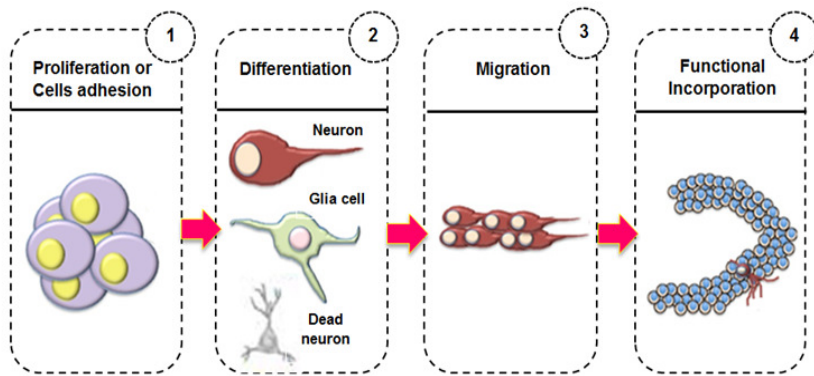


Fig. 1a. The formation of new neurons in thadult brain (Source: Lazarov, O., & Demars, M. P. (2012))

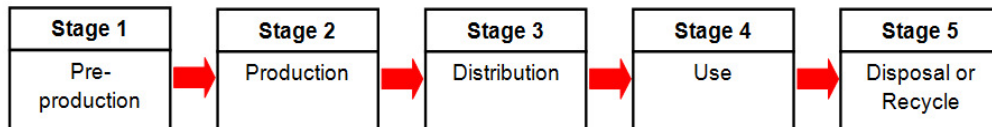


Fig. 1b. The product life cycle

Fig. 1. Similarities between neurogenesis development process and product life cycle

In Stage 1, proliferation cells occurred in human brain. In order to make the similarities, the pre-production activities is more suitable due to idea generations for a new product which is parallel to customer demand is emphasized. In pre-production, only effective and efficient design will be chosen for production in Stage 2. Beside manufacturing process occurred on stage, the indirect activities also required in order to ensure the product and process comply with the requirement. The indirect activities are classified as supportive elements during the manufacturing process in examples: quality inspection activities, maintenance, machine setup, production planning and control and etc. Without the support from indirect elements, the product would not be successful created and the manufacturing process cannot be efficient as well as more wastages created.

During production process in stage 2, a lot of internal movement created in order to ship the product from one process or area to another for completion purpose. In Stage 3, distribution of product in product life cycle has a similarity with cell migration in neurogenesis developmet process. The matured cells will migrate to functional incorporation to do the designed activities. It is similar to distribution activity in product life cycle where the finish good product will distribute to the customer for end usage. Stage 4: Functional Incorporation emphasized on doing the designed task for the cell where product usage is assumed as a similarity in product life cycle. In this stage, the product usage is optimized until the product reaches the fatigue point were leads to the disposal or recycle activities in Stage 5. At this point, the manufacturer or producer will decide either to take back the disposal product for recycling or to dispose the product through the waste management process. The harmful product required waste management in order to save the environment.

3. CONCLUSION

To look future demand and next manufacturing trend in business, the utilization of computer hardware and software become priority. The system that originally has brain emulation potential is necessity to achieve customer centric demand in CM. Security and safety in CM, even in cloud pool became critical and need to overwhelm especially in private cloud. Cloud pool emphasizes the important of agent-based to be successfully implemented in saved manner. Neurogenesis promising on brilliant actions for cloudle to execute any knowledge or information sharing and created is secure in cloud pool. Neurogenesis approach is emphasized on mimicking the human brain function into cloudle to perform human brain activities in cloud manufacturing.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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