

Integrating Ambidexterity into the Modern Manufacturing Era of Industry 4.0

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Abstract - Ambidexterity has caught attention since the first time it was introduced by March. It is believed to be the answer to competitive advantages under uncertainties. Manufacturing companies are among those who try to implement ambidexterity but with no satisfactory result. Confusion and debates on Ambidexterity are real. Previous studies have been numerous, but each of them is focused on one context only, leaving the others behind. The digitalization in Industry 4.0 has made it even worse, the companies know that they need to integrate ambidextrous capabilities but so far, the research have provided no complete step-by-step integration process. This paper aims to answer this problem by conducting systematic literature research and qualitative approach. The writer introduces an ambidexterity integration concept with 9 key steps in order to integrate ambidextrous capabilities within the small, medium and big companies with clear deadlines and goals to gain competitive advantages. We must also pay attention to the transition process in integrating ambidexterity in the manufacturing industry which may be different from other industries.

Keywords: ambidexterity; modern manufacturing; industry 4.0; competitive advantage; supply chain management

1. Introduction

Ambidextrous organizations are the new form of enterprises that are considered as the solution to inevitable ambiguity and disruption. It is the combination of the cross functional teams and strategic units that operate on new technologies. The measures taken are intended to evaluate the influencing practices on supply chain 's performance in manufacturing firms [1]. These measures are important if the firms want to survive in competitive atmosphere and develop competitive advantage [2]. Thus, ambidextrous capabilities are absolutely needed.

March was the first to introduce the term ambidextrous and defined them into two separate activities, exploration and exploitation [3]. Exploration has closer meaning to search, seek, find and others related to new ideas while exploitation is closer to selection, efficiency, refinement and saving resources. This research was continued by [4] with his seminal works on ambidextrous organizations and posited that by having ambidextrous organizations [5], [6], where both exploration and exploitation are done simultaneously in both incremental and discontinuous innovation, then the company will be able to have competitive advantages in both mature markets (where it is critical to develop efficiency and incremental innovation) and emerging

markets (where the developments of new products, services and value to adapt to the markets are very vital). These research underlined the importance to understand and implement the ambidextrous capabilities in the organization, and to be able to understand that both exploration and exploitation are two different things that need to be separated and integrated with different strategies and practices [7]. With ambidextrous capabilities, the organization will be able to solve the problems of structural and cultural inertia, which are caused by the extensive use of exploitation and also at the same time refrain from overusing the exploration without first making sure the company can take benefit [8], [9]. Latter research confirmed the capabilities of ambidexterity to bring organizations toward sustainability [10], [11]. Manufacturing industries are one of the key industries that must be given special attention. Indonesia needs to focus on the ten following transformation to face industry 4.0 based on what was summarized as follow:

Table 1. Ten National Priorities in Manufacturing Industry [12]

No	Goals	Approach
1	Reform Material Flow	Enhance domestic upstream material production.
2	Redesign Industrial Zones	Build a single nationwide industry zoning roadmap
3	Embrace Sustainability	Grab opportunities under global sustainability.
4	Empower SMEs	Empower 3.7 million SME by technologies
5	Build Nationwide Digital Infrastructure	Advance Network and digital platform.
6	Attract Foreign Investments	Engage top global manufacturers with attractive offer and accelerate technology transfer.
7	Upgrade Human Capital	Redesign education curriculum under 4IR era and create professional talent mobility program.
8	Establish Innovation Ecosystem	Enhance R&D Centers by government, private sector and universities.
9	Incentivize Technology Investment	Introduce Tax exemption/subsidies for technology adoption and support funding.
10	Reoptimize Regulations & Policies	Build more coherent policies/regulations by cross-ministry collaborations

This paper aims to show that these ten transformational steps for future manufacturing industries can be answered by integrating ambidextrous capabilities but with careful steps and comprehensive integration of ambidexterity.

2. Literature Review

Ambidextrous organizations allow executives to face uncertainties or disruptions while pursuing competitive advantages. The most important factor that leads to ambidextrous organizations is to have ambidextrous managers [1]. When a firm decides to integrate ambidexterity into the firm, a series of steps should be done accordingly. The first action should be to decide whether both exploration and exploitation are done in separate units or in one integrated unit. Exploration refers to the creation of new values, new ideas and new resources which are very vital for firm's survival. To explore means the firm must allocate funding at the cost of exploitation, because exploitation which refers to efficiency will not be achieved when the company is exploring. Efficiency means cutting cost, time and be efficient. Efficiency is also very important to keep the firm survive [13]. Determinants of Technical efficiency specifically are examined in the machinery manufacturing industry in Malaysia [14]. Another efficiency is achieved by effective knowledge sharing in a suitable internal environment to improve innovation chain in the supply chain network [15].

Having high cost on exploration will jeopardize the firm's financial performance and in the long run will endanger the firm and might drag the firm to bankruptcy. On the other hand, if the firm focuses on exploitation, the expenses will be low. But we must realize that when firms are not exploring, they are not producing new products, services and values. The consumers will soon be shifting to the more appealing offer in a form of new products, services and values from the competitors. The results can be seen with lesser number of sales, reflected in low income. With lower expenses, comes lower income. This condition is not good for the firms and in long run will drag the firm to bankruptcy too. Now the problem lies on how actually exploration and exploitation should be done both simultaneously. The tension between exploration and exploitation is so strong and puts the leader in confusion. This is where the term ambidextrous capabilities needed, an ambidextrous leader is a leader who can balance both exploration and exploitation separated or integrated. The integration process captures the flow of the products to the consumer in a manufacturing industry [2].

The word balance does not refer to fifty – fifty percentage in using exploration and exploitation, but more to the ability to combine them in the required percentage. An ambidextrous leader can assign tasks of exploration and exploitation in different units while at the same time combine both exploration and exploitation in some specific groups. This kind of leaders is highly agile, flexible and efficient leaders and it takes years of trainings and practices to be able to master this skill. Having this kind of leader is a must for a firm to create breakthrough but it will be costly. The action of acquiring an ambidextrous leader into the firm is also known as exploration, to create new values for the firm by obtaining new resources [16]. It is expected that by having an ambidextrous leader, the firm will also be

transformed into an ambidextrous organization. The previous research showed that start - up companies tend to use exploration more than exploitation to gain market share. The study case of an ambidextrous leadership in GE Money Bank illustrated how established company can ensure long – term success by using ambidextrous skills [6]. In the context of modern start – up manufacturing firms, this refers to the massive designing and launching of new products, new services and values with customer satisfaction as the ideal measurement and market share as the goals. Of course, this will put the firm's financial performance in red alert and more investment will be needed to keep the firms running. But this method is inevitable, as it is widely known that as a new comer, financial loss is normal and bound to happen. Some companies even gave their products for free, put the products on big sale or promotion, wasted a lot of money on advertisement and sales marketing team. As time goes by, if things go right as expected, the firm should start cutting unnecessary cost to start reducing the financial loss and start taking profit. A formal structure is needed to form the basis for informal socialization, the relation capital can be used by suppliers and buyers as investments and establish knowledge-sharing relationships. The relational capital during marketing activities is vital to maintain relationship performance [17].

The longer time passes, the efficiency is relatively higher and exploration is smaller. Exploration must still be done in a regular manner to ensure the customers have more options, keep up with the latest trend based on customer expectations and to stay competitive compared to the competitors. This same routine will keep happening creating a cycle until the firm grows bigger in size and time. The problem arises when the firm is getting bigger in size and these same routines will soon disadvantage the firm's future. Disruptive technology innovations are not friendly to routines, for routines refer to the same repetitive actions creating structural and cultural inertia in the organizations causing difficulties for the firms to adapt to changes in the surroundings. To overcome the challenges of disruptions, being agile and flexible are the answers, and trapped in the same routines over time will put the firms at risk of losing the competitions.

The obstacles of implementing ambidexterity have been the focus of the researchers with constant debates and arguments. One of the studies of implementing ambidexterity was to divide into two categories, structural ambidexterity and contextual ambidexterity. The structural ambidexterity separates exploration and exploitation in separate units with arguments that the separation of both exploration and exploitation ensures long-term success because both units have clear focus of attention when they are separated. The structural ambidexterity allows both units to work independently and interdependently to achieve ambidexterity through coordination of vision and common culture of the firms. On the other hand, the contextual ambidexterity focuses on the explanation of behaviors toward ambidexterity, within the culture and mindsets of the firm employees. The contextual ambidexterity allows and encourages individuals within the firm to allocate time on how to do the activities efficiently to achieve targets (focusing on exploitation) and also learn to be adaptive to the changes around them (focusing on

exploration). It was stated that the contextual ambidexterity is highly suitable to be implemented in a single business unit as a whole, allowing individuals to act in both alignments, focusing on targets and adaptability achieving ambidexterity.

Based on the explanation above, the structural ambidexterity is likely to be implemented in medium to large sized companies where they have the ability to support different units for innovation while the small and some of the medium sized companies prefer to have contextual ambidexterity because of the limitations of providing extra units for innovation. Though as mentioned earlier, medium sized companies implemented structural ambidexterity, it was observed that this separate unit was not really dedicated for breakthrough innovations and in the implementation, tend to act more to the contextual ambidexterity, known as the false structural ambidexterity.

Another approach of ambidexterity is through leadership [6], by dividing the company structure platform into four, namely top management, middle management, line management and human resources manager. These four have their own characteristics in doing the interplay between exploration and exploitation. Leadership is needed to identify the repeating problems, analyze them and work for solutions both in manufacturing and assembly lines that are caused by the weak performances of some lack of experience and trained employees [18]. The higher the managerial level, the more explorative and the less exploitation it is. The top managerial spends their time thinking about new ideas to develop the company, which requires him to be more explorative and grants autonomy to the lower managerial levels, while at the same time stays involved to keep good track and to manage any changes or conflicts within the managerial levels. The middle management is well informed about the top managerial new ideas and is responsible to execute these ideas and at the same time provide visions to all managers and leaders. The line manager is in charge of the execution instructed by the middle manager by having more exploitation to ensure targets are accomplished. The line manager must be able to control his subordinates who have different backgrounds. The last is the human resources manager who is responsible to appoint an ambidextrous leader through planning, selection, training and development and also giving rewards for accomplishments. The business and HR managers need to collaborate and learn from one another to achieve their goals ambidextrously.

Ambidexterity was regarded as the correct action to overcome changes in dynamic surroundings by creating dynamic capabilities [4]. Dynamic capabilities in innovation and efficiency enable the firm to adapt and change from time by time with two strong arguments, one that favors adaptation and the other that favors evolutionary change through the process of selection–variation–retention. Data have shown that both arguments are valid with their own examples, lead the researches to try to understand how to understand, both theoretically and empirically, under what conditions the firms can sustain their competitive advantages using the arguments and how being ambidextrous helps to combine both arguments. Senior leaders have an important role to integrate and collaborate both new and existing resources to overcome inertia and path dependencies problem in order to achieve

sustainable competitive advantage by using dynamic capabilities. Many problems arise when the firm tries to integrate ambidextrous capabilities into the organization, clearly having a sequential change with one focus at one time, either exploration or exploitation and having a simultaneous change with both exploration and exploitation done at the same time, have their own challenges, such as conflicts, tension, disagreement and poor coordination. A clear vision from the senior leader is needed to overcome these challenges by staying focused to the firm goals.

Table 2.1 Integration of Exploration and Exploitation in three approaches

	Exploration	Exploitation
Firm Activities	Absorb and integrate diverse and broad knowledge	Focus on depth of knowledge and efficient means to leverage this knowledge in the market.
Structural	Facilitate flexibility and autonomy with decentralized hierarchies and semi-formalized routines and guidelines	Facilitate focus and speed with centralized hierarchies and higher levels of formalization and standardization.
Cultural	Willingness to accept experiment, risk and uncertainties, encourage radical innovations	Require certainties, short-term goals, and commitment to focus on incremental innovations and market-based actions

Getting ready for the transition

Nowadays, all types of industries are facing uncertainties in highly dynamic environments and the competitions are going sharper. To integrate ambidexterity and create an effective and efficient balance of exploration and exploitation, we need to pay attention to several aspects. Though steps of implementing those have been studied by researchers, the transition process of different types of industries for different types of markets must taken into consideration. There are five key tools that can help firms solve problems in transitioning between exploration and exploitation [19]. First, forming teams and transforming when necessary. Second, set clear goals and expectations. Third, draw a detailed timeline and expected achievements. Fourth, develop contingency plans. Fifth, justify changes.

Significant changes in organizations from exploration to exploitation can produce uncertainties on employees regarding positions and roles in the firm, job security, and so on. Maintaining boundary-spanning ties during employee shifting can maintain stability and key knowledge throughout the transition and reduce employee concerns. Setting expectations for roles and responsibilities

provide some structure and certainty to positions before and after the transition. Remember to re-establish expectations when there is a change. The transition process begins the shift between a long-term focus in exploration to the short-term focus of exploitation. A detailed timeline with milestones needs to be drawn to facilitates this temporal mindset shift and provide pre-established dates to gather and discuss progress and problems. Thus, the firm can decide if a change is needed for the transition and develop learning capabilities for future transitions. Unpredictable actions of competitors, economy, technology, politics/legal, and other trends, and industry forces can reduce or enhance the firm's radical innovation values and the need for speed in transition. These changes may lead to sharp changes in the roles, responsibilities, and expectations of employees. Contingency plans are needed to provide expectations for potential. Not every source of change can simply be predicted in contingency plans. Employee concerns is necessary to be taken care of to ensure a smooth transition between exploration and exploitation by using various means to justify change and create perceptions of fairness with necessary change. Employees need to be allowed to give out voices in the process of decision making and provide feedbacks for smooth transition.

Another research suggests that the firm's structural and contextual attributes foster ambidexterity, but theory and testing on their combined effects remain rather poor especially in their knowledge creation and financial performance. Using data from 112 hi-tech firms in Italy, the results show that the attributes of organizational context only influence ambidexterity through the mediation of an ambidextrous knowledge creation in the processes of innovation. They also find that the structural separation of the organization, affects ambidexterity significantly and produces greater firm performance than when firm achieve

ambidexterity only through an appropriate organizational context. This research confirms the way firms develop ambidexterity and how superior performance is obtained from it. [20]

3. Methodology

This research uses a qualitative analysis with study cases approach from the experts in the manufacturing companies. The researcher summarizes the data gathered through observations, seminars, and in-depth interviews in a one – year period, from September 2018 to October 2018 located in Jakarta and Tangerang. The eight respondents are the top managers and stakeholders of the modern manufacturing companies as seen in table 4.1. The researcher collected qualitative data on what are needed to face disruptive challenges in manufacturing industry and what are going to happen to the future of modern manufacturing companies. These qualitative data are then used by the researcher to understand the steps of implementing the ambidextrous capabilities into the modern manufacturing industry.

4. Findings and Results

Entrepreneurship holds a crucial role in firm performance, for all kinds and sizes of industries. A clear path is needed to develop cultural competitiveness [21]. Ambidexterity is assumed to be able to clear this path by either combining or separating both exploration and exploitation in the company. This paper addresses the integration of ambidextrous capabilities into the organization by doing steps in all aspects of the firms, leadership, organizational, time and process. Based on the previous studies and qualitative approach, the research comes up with the following findings in table 4.1 and 4.2.

Table 4.1. Findings on Qualitative Data.

No	Job Title	Company's name	Summary
1	CEO Center Indonesia Leadership Transformation & Executive Coach for Transforming	NexGen Leader for VUCA and Industry 4.0	The ten transformational steps for future manufacturing industries can be conducted by taking careful steps in each of the challenges. (exploration and exploitation)
2	SMB Channel Manager	Microsoft Indonesia	Using the newest resources to face the technology advancement especially in handling big data by IT modernization and Teamwork (exploitation)
3	Head of Business Development	Mospaze Warehousing	On the demand side, they need to assess customer needs (exploitation), while on the supply side, they can share their asset bases, leverage a network to provide a platform, and increase customer experience (exploration).
4	Director	General of Customs and Excise (DJBC)	Government ease the procedures and documents handling to help the firms (exploitation)
5	Chief of Compliance & Network	Lion Parcel	Using value added service, i.e : transparency of information, collaborative efforts, and digital source of knowledge.
6	Director	Digico Platform	Digico urged on the needs to digitalize and connect the ecosystem, driving true information sharing, faster Collaboration, and spurring innovation (exploration).
7	Manager	INSW	put productivity at the center, increase end – to – end visibility to Inventory, orders and shipments across the supply chain, centralize command and control, and ease of monitoring performance metrics.

Table 4.2 Summary on Previous Research

Approaches On Ambidexterity	Description
<i>Time Reflection</i>	The Past and Present (Exploitation), Future (Exploration) [22].
<i>Leadership and Management</i>	Divided into four managerial levels, top manager, middle manager, line manager and HR managers. The higher the managerial level, the more explorative they must be [6], [23], [24]
<i>Organization</i>	Structural Ambidexterity (In separate units) and Contextual Ambidexterity (focusing on individuals to be aimed at target or to be adaptive) [25]
<i>Leadership Styles</i>	Transactional Leadership (Exploitation) and Transformational Leadership (Exploration) [10], [16][26]
<i>Dynamic Capabilities (strategic leadership in adapting and integrating to match changing environments)</i>	Innovation (Exploration) and Efficiency (Exploitation) [4] [27][28]
<i>Time span</i>	Temporal ambidexterity (simultaneously do both at the same time or sequentially with a higher focus on one side) [29] [30][31]
<i>Marketing Capabilities</i>	customer management (CM) – exploitation and new product development (NPD) – exploration [32]
<i>Process</i>	Activity Vs Outcome [33]

5. Conclusion

The findings from qualitative approach and previous studies from literature review have given insights on how integration of ambidexterity can be done. Among all steps, there is a basic requirement for employees to have proper training courses to improve their work method and raise achievement rates to complete this integration work [18].

The leader must have adequate knowledge before the integration process can start. To integrate ambidexterity into the industry especially manufacturing industry, there are 9 key steps need to be done in order to make sure the integration can be done successfully. The following table 5.1 shows the 9 key steps to integrate ambidexterity capabilities into the manufacturing industry based on the size of the industry.

Table 5.1 9 Key Steps for Integrating Ambidexterity

Steps of Integration	Small-sized Companies	Medium-sized Companies	Big – sized Companies
Step 1 – Preparation	Time Reflection Approach	Time Reflection Approach	Time Reflection Approach
Step 2 – Organization	Contextual Approach	Fake Structural Approach	Structural Approach
Step 3 – Leadership and Management	Centralized (tend to be explorative)	Decentralized into four managerial levels	
Step 4 – Leadership Styles	Combination of high Transactional and high Transformational for Maximum performance	Higher managerial levels require more transformational leadership and lower managerial levels require more transactional leadership.	
Step 5 – Time Span and dynamic capabilities	Higher focus on exploration	Balanced focus on both exploration and exploitation	Higher focus on exploitation
Step 6 – Marketing Capabilities	NPD	NPD shifting to CM	CM with less attention in NPD
Step 7 - Process	Focus on Outcome	Balanced activity and outcome	Focus on Activity
Step 8 – Challenges	Tension and confusion due to limitation of resources	Structural Inertia Cognitive conflict	Structural Inertia and Cultural Inertia
Step 9 – Solutions	Clear goal definitions and tasks from leaders	Intrafirm Approach	Intrafirm Approach

Surely, research on ambidexterity is not new but debates and confusions remain especially on how to integrate this capability into the firm without having to sacrifice the resources. This research offers a concept of integrating ambidexterity in a whole package that as per the writer's knowledge, has never been done before. The 9 steps above need to be taken carefully while at the same time paying

attention to the transition process. The firms with desires for competitive advantages need to consider this paper as parts of the company's plan especially during the worsening situations of uncertainties. This research has two limitations. First, there is no quantitative study to generalize this finding to the industry and second, there have been no comprehensive studies on ambidexterity

implementation in the firms. So far, all the research has been mainly theoretical. Future research needs to address this.

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