



Biplot-Cluster Analysis on Mapping Company Characteristics in Adapting to a Dynamic Business Environment

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ABSTRACT

This study aims to map companies at PT M Cash Integrasi Tbk based on the variables of *Technological Innovation*, *Knowledge Management*, *Dynamic Capability*, *Organizational Agility*, and *Sustainable Competitive Advantage*. This study uses the biplot analysis method and the *K-Means cluster*. The biplot method and *K-Means cluster analysis* were used to map companies in a two-dimensional graph. The data used in the result of a survey from the sample unit in the study, namely the organization and in the form of a holding company, subsidiary, and branch company PT M Cash Integration Tbk as many as 130 companies. Based on the relationship between variables, *dynamic capability* (Y_1) and *organizational agility* (Y_2) with *sustainable competitive advantage* (Y_3) have a strong positive relationship. based on the results of the *K-Means cluster* analysis, there are three clusters with 51 companies in cluster 1 having good characteristics in adapting to a dynamic business environment. Mapping of companies based on the 5.0 industrial revolution involving *Technological Innovation*, *Knowledge Management*, *Dynamic Capability*, *Organizational Agility*, and *Sustainable Competitive Advantage* variables simultaneously is the novelty of this research.

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1. Introduction.

People who live by utilizing numerous breakthroughs that were created in the era of the industrial revolution 4.0, such as the Internet of Things, Artificial Intelligence, and Big Data, are among the characteristics of the 5.0 industrial revolution, according to a quote from campus.quipper.com. The existence of these three components has made it easier for everyone to access the internet anywhere and anytime. The industrial revolution 5.0 requires companies to create new value through the

power of technological developments that are all digital accurately and quickly (Asriandi & Putri, 2020). The world that has been hit by the Covid-19 outbreak in recent times has also provided stimulus for the use of digitalization in every sector of life.

The shift from manual systems to digitalization has resulted in the use of information technology being significant in all industries. This creates a highly volatile, dynamic, complex, and uncertain business environment that companies face today, causing hypercompetitive markets and posing a major threat to the survival of the company (Nurcholis, 2021). On the other hand, a dynamic economic environment cannot guarantee the achievement of a company's *Sustainable Competitive Advantage* (SCA).

Organizational agility is one of the main competencies that need to be possessed by an organization that experiences continuous changes in the business environment and high competitive pressures (Panda & Rath, 2016). A company's agility in collecting, monitoring, and processing changing environmental signals, making innovative decisions, and adapting processes

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quickly to take advantage of market opportunities can increase its *Sustainable Competitive Advantage* (Bi et al., 2013).

Companies that want to be *sustainable*, must not only have agility in business competition but also must have the ability to move dynamically or *dynamic capability*. According to (Grant, 1996), a *dynamic capability* is a routine corporate activity and strategy in which managers modify their resource base to acquire and release resources integrate and recombine to create new added value. Companies need to develop and implement *dynamic capabilities* to maintain a *Sustainable Competitive Advantage* in a changing and complex external environment (Ambrosini & Bowman, 2009).

According to (Nonaka, 1991), the only lasting *competitive advantage is knowledge*. Knowledge resources are significant to ensure that the company has a *sustainable competitive advantage* because these resources are difficult to imitate and are the basis for sustainable differentiation (Wiklund & Shepherd, 2003). Santoro et.al (2019) state that knowledge management helps manage knowledge for exploratory and exploitative processes, which in turn is very important for developing new products and services. The results of the literature identification conducted by Shehaba (2020) also show that the correlation between *knowledge management* and *sustainable competitive advantage* is very positive which will ultimately lead to an increase in organizational performance.

Companies that want a *sustainable competitive advantage* must pay attention to the development of *technological innovation*. Xiao & Yu (2020) show that companies need *technological innovation* to achieve and maintain a *sustainable competitive advantage*. This is because, in an uncertain business environment, *technological innovation* allows companies to become industry leaders and seize market advantages easily (Zhang et al., 2019).

Based on this description, it can be seen the need for a company to have the ability to adapt, especially technology companies. Apart from the necessity for technology companies to have the concepts of innovation, knowledge, dynamics, and agility, there is something unique about technology companies. Where, so far the giant companies that have gone bankrupt are mostly technology companies, such as Nokia, Kodak, BlackBerry, Myspace, and Pebble. The events experienced by these companies are very strange because the basis of their business activities is a technological innovation that should move dynamically and agilely, but in the end, it must disappear from the business cycle due to technological advances.

This study aims to map a company based on the 5.0 industrial revolution, namely PT M Cash Integrasi Tbk based on the variables of *Technological Innovation*, *Knowledge Management*, *Dynamic Capability*, *Organizational Agility*, and *Sustainable Competitive Advantage*. *This research is expected to be useful as input in determining companies that can adapt to a dynamic environment.*

2. Literature Review.

2.1. Strategic Management Theory.

Strategic management is described by Jauch & Glueck (1998) as the progression of choices and actions that result in the creation of a successful strategy or strategies to aid in achieving business objectives. The strategic management process is how strategic planners define objectives and draw strategic conclusions. Meanwhile Pearce & Robinson (2014), it is stated that strategic management is large-scale and long-term planning so that organizations can interact effectively in production and optimize the achievement of both strategic and operational goals.

The two main concepts of strategy making and strategy implementation can be used to summarize the strategic management process. The strategy-making and strategy-execution process, according to Thompson & Strickland (1990), is divided into five connected and integrated phases:

1. Create a strategic vision for the company's future that identifies its future product, market, and customer technology priorities. Set goals and use them as benchmarks to measure company performance and progress.
2. Develop strategies to achieve goals and move the company along the strategic path that has been mapped out by management.
3. Effectively and efficiently carry out the selected course of action.
4. Assess performance and begin making corrections to the organization's long-term objectives, strategy, or execution in light of actual experiences, shifting circumstances, fresh perspectives, and new opportunities.

2.2. Resource-Based View (RBV) Theory.

Internal resources that can support a company's Sustainable Competitive Advantage are described by the Resource-Based View (RBV) (SCA). The main argument is that in order for a corporation to qualify for SCA status, it must acquire and possess valuable, rare, unique, and non-replaceable (VRIN) resources and capabilities, as well as have an organization (O) in place that can utilize them (Barney, 1991). The definition of a resource is one of the primary issues that RBV theorists must deal with. Corporate resources have been discussed by RBV researchers and practitioners using a range of words, such as competence (Hamel & Prahalad, 1990), skills (Grant, 1996), strategic assets (Hamel & Prahalad, 1990), assets, and shares (Capron & Hulland, 1999).

The underlying premise of this theory is that firms can maintain a competitive edge by implementing strategies that take use of their internal assets, react to environmental opportunities, counteract external threats, and prevent internal flaws. Barney (1991) provides a critical review of existing approaches since *strategic management* was introduced as a separate discipline outside the economic domain. The majority of research on sources of sustainable competitive advantage has concentrated on identifying the firm's opportunities and threats (Porter, 1980; & Porter & Millar, 1985), highlighting its strengths and

weaknesses (Penrose, 1958; & Stinchcombe, 1965), and/or examining how these factors interact to determine a strategy.

The emergence of RBV in the discipline of *strategic management* which is rooted in the approach of evolutionary economic theories has developed a more integrative approach by involving many behavioral approaches, sociology which has implications for the emergence of new concepts as the development of the *strategic management discipline*. As stated by Barney & Clark (2007) and Barney & Hesterly (2009), responding to the 10 years since the article and introduction of the RBV theory were written and published, companies tend to build their strategies on intangible assets outperforming companies that build their strategies on tangible assets only. This is because RBV assumes that companies exploit their valuable, rare, and expensive resources to imitate resources and capabilities in generating optimum value from *the rent economy*.

2.3. Knowledge-Based View Theory (KBV).

Knowledge-Based View (KBV) theory emerges from RBV theory by focusing on intangible resources, not on physical assets. According to this viewpoint, knowledge is the most valuable resource, and performance discrepancies are mostly caused by the varied knowledge bases held by different firms (De Carolis, D. M. & Deeds, 1999). By arguing that knowledge is the key resource behind new value creation, heterogeneity, and competitive advantage, KBV in strategy has considerably enlarged resource-based reasoning (Grant, 1996; Barney, 1991; Kogut & Zander, 1992). Knowledge is the most crucial strategic asset in KBV's opinion (De Carolis & Deeds, 1999).

Due to its difficulty in imitation and position as the foundation for long-term difference, knowledge resources play a significant role in providing a sustained competitive advantage (Wanasida *et al.*, 2021). The only competitive advantage that endures, according to Nonaka (1991), is knowledge. The primary determinants of firm performance may include elements like management skills and competencies, technological expertise, or organizational routines (Dess *et al.*, 1995). It will contribute more to the company's performance than property-based resources in a dynamic economy where many businesses use knowledge-based resources (Miller & Shamsie, 1996).

According to current strategic management literature, intangible elements are typically linked to variances in firm performance to determine competitive advantage (Rouse & Daellenbach, 2002). Due to their scarcity, social complexity, and near non-imitation, intangible resources, in contrast to monopolies on raw resources, have a higher likelihood of creating a competitive advantage (Hitt *et al.*, 2001). According to Grant (1996) and Volberda (1996), a stronger knowledge base can lead to more strategic flexibility and quicker responses to environmental changes (Umemoto, 2002).

2.4. Technological Innovation.

The act of mixing and rearranging knowledge to produce fresh concepts is known as technological innovation. Companies that innovate drastically typically confront a lot of uncertainty. According to Mumford (2000), businesses that put an

excessive amount of emphasis on results will exhibit little technical innovation. In the meantime, emphasizing innovation outcomes too much might cause managers and staff to focus on the dangers of failure and the loss of their interests, leading them to drop higher-risk innovations. According to Mehr & Shaver (1996), there is no correlation between innovation and particular performance targets. Managers and staff, however, won't be concerned about losing economic significance and social acceptance as a result of the failure of technical innovation if they use process assessment and control. They will therefore be eager to engage in technological innovation activities.

Organizational architecture and work systems must encourage technological innovation. Madsen *et al.* (2005) analyze actual cases of new company growth at Ericsson Denmark in-depth in order to explore issues with the process of merging technology innovation with human resources. This study represents radical innovations based on disruptive internet technologies and explores all stages and facets of the innovation process, from conception to field trials. This integration is referred to as dysfunctional. It demonstrates that new enterprises are doomed to failure when inventive human resources are not properly incorporated into the host organization's procedures. In order to respond to the changing demands in entrepreneurship and technological innovation, organizational systems must be reformed.

Particularly, efforts for technological innovation may result in discontinuities that either bolster or undermine the current competency base (Bessant & Tidd, 2009). To adapt to the external environment and changes, such as new markets or new technical discontinuities, businesses must constantly modify their internal and external strategic competences and business models, in accordance with the principle of "dynamic capabilities" (Schilling, 2010 & Teece, 1997). Developing internal requires relying on fundamental competencies (Prahalad & Hamel, 1990).

2.5. Knowledge Management.

Understanding *knowledge management* is a management system that is sourced from the knowledge presented by the company and intelligence assets that function to improve the characteristics of the company's performance and can provide additional value if the company applies intelligently in business processes (Khan & Quadri, 2012). Wiig (1997) and Desouza & Paquette (2011) explain that *knowledge management* is understanding, focusing, and managing the development, updating, and application of systematic, explicit, and deliberate knowledge that is, managing an effective knowledge process. Meanwhile, according to McElroy (2000), *knowledge management* is getting the right information in front of the right people at the right time. Based on some of the definitions above, it can be concluded that *knowledge management* is an effective knowledge system that is applied to the management of an organization/company so that it can be useful for improving the characteristics of an organization's/company's performance at the right time.

There are 2 (two) types of *knowledge management*, namely *tacit knowledge*, and *explicit knowledge*. *Tacit knowledge* is personal, developed through experience that is difficult to formulate and communicate. According to its concept, tacit knowl-

edge is classified as personal knowledge, or knowledge acquired from people (individuals). Conversely, explicit information is structured and methodical and is simple to transmit (Carrillo et al., 2004). The knowledge acquired is in written form or a documented statement so that each employee can learn it independently, making the application of explicit knowledge simpler.

2.6. Dynamic Capability.

The process of attaining new resource configurations as markets form, collide, divide, evolve, and perish is known as dynamic capability (Capron & Hulland, 1999). In industries where cutting-edge information is required for effective strategy and performance, dynamic capacity comprises knowledge creation processes where managers and others develop new ideas within the firm (Hampshire & Policy, 2013). This includes joint ventures and acquisition strategies that attract fresh assets from outside the organization. A very efficient approach for acquiring information that allows managers to amass a variety of evolving product and engineering expertise and improve performance. *Dynamic capability* produces capabilities that do not wait for a crisis from the external environment because an organization's *dynamic capability* is a form of the process of integrating resources, reconfiguring, acquiring, and releasing resources (Kor & Mesko, 2013).

Based on Teece' (1997) research, state that three things are needed to form *dynamic capability*, namely *paths dependence*, *positions*, and *processes*. There are several assumptions in the development of *dynamic capability*, namely first, the *nature* that emphasizes capability. Second, the *role* means the ability to integrate external and internal factors. Third, *context* means focusing on rapid environmental changes. Fourth, is *creation and development*, which means that many things are developed rather than purchased. Fifth is *heterogeneity* which means that each organization has different resources. And lastly, the *outcome* means that each company has a different performance because of the difference in their *dynamic capability*.

2.7. Organizational Agility.

Organizational agility began to be developed in the 1990s as a solution to dealing with changes in the market environment that continues to grow and is dynamic. *Agility* is the ability to survive and continue to grow in a competitive environment with continuous and unpredictable changes. These changes can be overcome by quick and effective reactions that are driven by products or services based on consumer needs [58] (Gunasekaran in Nafei, 2016). Meanwhile, according to Zitkiene & Deksnys (2018), *organizational agility* continues to grow significantly in ways to obtain and maintain the *competitive advantage* that the organization has in a changing market environment. *Agility* is one of the main characteristics of organizations used by companies to continue to adapt and compete in a fluctuating environment.

When it comes to the flexibility and adaptability attained via organizational activities, organizational agility can be defined as the key component of organizational performance. Organizational agility is a collection of practices that enable an

organization to recognize change and react rapidly, effectively, and economically to both the external and internal environment. *Sensing* in question is the organization's ability to capture, detect, and interpret opportunities owned by the organization (Seo & Paz, 2008). Meanwhile, the *response* is the organization's ability to mobilize and change existing resources to respond to the emergence of perceived opportunities (Oosterhout et al., 2006). These two capabilities must go hand in hand to achieve optimal *organizational agility*.

2.8. Sustainable Competitive Advantage.

According to Besanko & Régibeau (2000), a company can be said to have a *competitive advantage*, if the level of economic income is higher than other companies engaged in the same field or producing the same goods. *Competitive advantage* is the company's ability to generate economic value that exceeds its competitors (Barney & Hesterly, 2009). Meanwhile, according to Stevenson (2009), *competitive advantage* can be measured based on the company's success in utilizing its resources to meet consumer needs compared to its competitors.

The current high level of global competition makes achieving and maintaining a *sustainable competitive advantage* one of the main focuses for many companies in the last few decades. Barney (1991) states that a company is considered to have a *competitive advantage* when the company implements a strategy that can create value for them and has never been used by its competitors. So that the company gets the maximum benefit from a *sustainable competitive advantage when other companies cannot use the same strategy*. According to Barney (1991), *competitive advantage* is divided into two types, namely sustainable and temporary. Many companies only get a temporary competitive advantage, because *the competitive advantage* they have is only an advantage in the company's income, the ups, and downs of which can be influenced by many factors.

The method to obtain a *sustainable competitive advantage* is to consider the perspectives of consumers and competitors. In addition, core competencies can determine the outcome of a *sustainable competitive advantage* and companies need to utilize their resources and capabilities so that they can adapt to changing opportunities. Barney (1991), the establishment of a *sustainable competitive advantage* can be based on four indicators, namely, the value of scarcity, which cannot be imitated, is expensive to imitate, and is irreplaceable.

2.9. Biplot Analysis.

The biplot is a multivariate analog of the *scatterplot*. The biplot estimates the multivariate distribution of the sample in several dimensions and places it on the display representing the variable that the sample measures. In this way, the relationship between the individual sample points can be seen easily and as we shall see, the biplot can also be associated with the measurement values. Thus, like the *scatterplot*, the biplot is useful for providing graphical descriptions of data, detecting patterns, and for displaying results found by more formal analytical methods (Gower & Hand, 1995).

Mathematically, a biplot can be thought of as a graphical representation of matrix multiplication. Given a matrix G with

m rows and r columns, and a matrix E with r rows and n columns, they can be multiplied to give matrix P as the third matrix with m rows and n columns. If $r = 2$, then the matrix G can be represented as m points in a two-dimensional plot, with column 1 being the abscissa (x-axis) and column 2 being the ordinate (y-axis). Similarly, the matrix E can be represented as n points in a two-dimensional plot, with the first row being the abscissa and the second row being the ordinate. A two-dimensional biplot is formed if the two plots are superimposed, which will contain $m + n$ points. An interesting property of this biplot is that it not only displays matrices G and E but also implicitly displays the $m \times n$ values of matrix P since each element of P can be visualized as:

$$P_{ij} = X_i X'_j + Y_i Y'_j = \vec{g}_i \vec{e}_j \quad (1)$$

Where (x_i, y_i) are the coordinates for row i and (x_j, y_j) are the coordinates for column j. \vec{g}_i is a vector for row i and \vec{e}_j a vector for column j. These equations are the basis for visualizing patterns in matrix P, including row rankings relative to any column, column rankings relative to each row, comparing any two rows relative to each column, and identifying the row with the largest (or smallest) value for each column. , or vice versa (Yan & Tinker, 2006).

2.10. Cluster Analysis.

A statistical study known as cluster analysis is used to categorize objects or variables. Each produced object or variable, according to Hair et al. (2010), has nearby properties and traits. Several respondents (individuals or organizations) are divided into groups (clusters) using cluster analysis based on the similarity of some stated attributes.

Using cluster analysis, items are categorized according to how similar their traits are. Consequently, the following traits of a good cluster include:

1. Internal homogeneity (inside clusters); this refers to how similar cluster members are to one another.
2. External heterogeneity, or the distinction between one cluster and another cluster (between clusters).

In cluster analysis, segmentation techniques include:

1. Hierarchical Method; Begin segmenting the objects that are most similar to one another. the cluster will eventually take the form of a kind of "tree" with a distinct level (hierarchy) between objects, going from the most similar to the least similar. "Dendrograms" are tools that aid in the clarification of this hierarchical process.
2. Non-Hierarchical Method; the desired number of clusters is first decided upon in advance (two, three, or the other). Following the determination of the number of clusters, the clustering procedure is carried out without adhering to the hierarchical approach. The term "K-Means Cluster" is a common name for this technique. If K-means cluster is used to group a lot of objects, it is very effective and efficient. When there are more than 100 objects, K-means clustering is employed.

3. Hybrid approach: The hybrid approach combines hierarchical and non-hierarchical approaches, utilizing the advantages of each to choose the optimum cluster.

3. Methodology.

The K-Means cluster and the biplot analysis technique are both used in this study. A plot of observations for both n and p variables are shown simultaneously in a two-dimensional plane using the multiple-variable technique known as biplot analysis. Plots of data for n and p variables presented simultaneously can reveal more details about the relationship between the variables and the observations (Jolliffe, 2002).

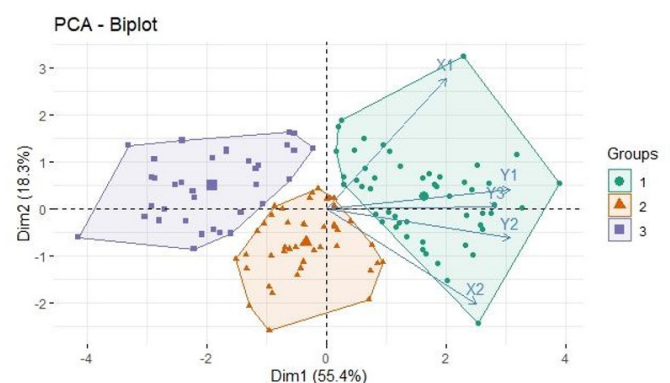
Cluster analysis K-Means, according to (Ediyanto & Satyadewi, 2013), is a non-hierarchical cluster analysis method that attempts to divide existing objects into one or more clusters or groups of objects based on their characteristics, so that objects with the same characteristics are grouped into the same cluster and objects with different characteristics are grouped into another cluster.

Biplot method and *K-Means cluster analysis* were used to map companies and variables of *technological innovation* (X_1), *knowledge management* (X_2), *dynamic capability* (Y_1), *organizational agility* (Y_2), and *sustainable competitive advantage* (Y_3) together in a two-dimensional graph. This mapping includes the diversity and correlation between variables to the identification of grouping objects based on the results of *cluster analysis*. The data used is the result of a survey from the sample unit in the study, namely the organization and in the form of a holding company, subsidiary, and branch company of PT M Cash Integrasi Tbk as many as 130 companies. The text must be concise, clear, complete and precise. The text as a whole must be in the impersonal form.

4. Result and Discussion.

The following biplot graph and *clustering results* that show the mapping of the company's characteristics in adapting to a dynamic business environment are presented in Figure 1.

Figure 1: Biplot and Cluster Graph.



Source: Authors.

Figure 1 shows that the value of data diversity that can be described from dimensions one and two in the biplot-cluster *analysis display* is 73.7%. This can be interpreted that the results of the analysis providing information of 73.7% of the total available information. The value of the diversity of the data is quite large because it is greater than 70% so the biplot-cluster *approach* can provide a visual presentation of the data matrix of the company's characteristics in adapting to a dynamic business environment.

The biplot displayed in Figure 1 also shows the correlation between variables. This is indicated by the large angle formed between variables, where the smaller the angle formed, the greater the relationship between the variables. It can be seen that the *dynamic capability* variable (Y_1) with *sustainable competitive advantage* (Y_3) and the *organizational agility* variable (Y_2) with *sustainable competitive advantage* (Y_3) each form a very small angle so that it has a strong positive relationship. This shows that the higher the *dynamic capability* and *organizational agility*, the higher the *sustainable competitive advantage*. Then the relationship between *dynamic capability* and *organizational agility* is also strong because the angle formed is also very small. In addition, it can be seen that the angle formed between *technological innovation* (X_1) and *dynamic capability* (Y_1) is smaller than that of *technological innovation* (X_1) with *organizational agility* (Y_2) and *sustainable competitive advantage* (Y_3), which means the relationship between positive *technological innovation* with *dynamic capability* is greater than its relationship with *organizational agility* and *sustainable competitive advantage*. Meanwhile, *knowledge management* (X_2) has a greater relationship with *organizational agility* (Y_2) than its relationship with *dynamic capability* and *sustainable competitive advantage*.

K-Means cluster analysis is performed on each object against all vector variables in the resulting biplot display. In each *cluster* that is formed, there is a characterizing variable or the most dominant variable. Characteristic variables can be seen based on the length of the vector of the variable which is longer than the vector formed by other variables in the same *cluster*. Based on Figure 1, *dynamic capability* (Y_1) is a characterizing variable from *cluster 1*. This means that companies in *cluster 1* tend to have better characteristics in terms of *dynamic capability*. The characteristics of the three *clusters* formed from 130 companies in the biplot analysis can be presented based on the average value of each variable in Table 1.

Table 1: Cluster Characteristics.

Cluster	X_1	X_2	Y_1	Y_2	Y_3
Cluster 1	3.8660	3.6499	3.8621	3.8519	3.7663
Cluster 2	3.1212	3.5676	3.4134	3.4571	3.4238
Cluster 3	3.3571	3.1709	3.1302	3.0159	3.1304

Source: Authors.

Based on Table 1, *cluster 1* can be stated as the best *cluster* in terms of the mean of the variables. This shows that 51 companies in *cluster 1* have good characteristics in adapting to

a dynamic business environment. Then *cluster 2* with 44 companies tends to have sufficient adaptability characteristics and *cluster 3* with 35 companies tend to have poor characteristics in adapting to a dynamic business environment.

Conclusions.

The results obtained that the diversity of data that can be described from mapping and grouping biplot-cluster *analysis* is 73.7%. This means that the biplot-cluster *approach* can provide a visual presentation of the data matrix of the company's characteristics in adapting to a dynamic business environment. Based on the relationship between variables, *dynamic capability* (Y_1) and *organizational agility* (Y_2) with *sustainable competitive advantage* (Y_3) have a strong positive relationship. In addition, *dynamic capability* and *organizational agility* also have a strong positive relationship due to the small angle formed between the variable vectors. Based on the results of the *K-Means cluster analysis*, there are three *clusters* with 51 companies in *cluster 1* having good characteristics in adapting to a dynamic business environment. This is clarified by the characterizing variable in *cluster 1*, namely *dynamic capability* (Y_1) which means that companies in *cluster 1* tend to have better characteristics in terms of *dynamic capability*.

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