

# The Relationship between Intensity of Competition, Advanced Manufacturing Technology and Organizational Performance

Lukluk Fuadah<sup>1</sup>, Muhammad Nasir<sup>2</sup>, Jaka Isgiyarta<sup>3</sup>

<sup>1</sup>Economics Faculty, University of Sriwijaya, Palembang. Jl. Raya Prabumulih-Indralaya 30662, Indralaya, [lukluk.asmawi@gmail.com](mailto:lukluk.asmawi@gmail.com)

<sup>2,3</sup>Faculty of Economics and Business, University of Diponegoro, Jl. Prof. Sudarto, SH Tembalang Semarang. 50275.

<sup>2</sup>[mnasirundip@yahoo.com](mailto:mnasirundip@yahoo.com); <sup>3</sup>[jaka\\_igiyarta2@yahoo.com](mailto:jaka_igiyarta2@yahoo.com)

**Abstract-** *The aim of this study is to investigate the relationship between intensity of competition, advanced manufacturing technology and organizational performance in Indonesian manufacturing companies that listed in Indonesian Stock Exchange. The data of this study was collected from survey to chief financial officers, or controllers or accounting managers from manufacturing companies listed in the Indonesian Stock Exchange. 477 questionnaires were distributed and 115 questionnaires were returned, only 108 respondents used in data analysis. This study used Structural Equation Model (SEM) and used AMOS 19 program software. The findings from this study showed that the relationship between intensity of competition; advanced manufacturing technology and organizational performance have positive relationship and significance. However, the relationship between intensity of competition and organizational performance was not significant.*

**Keywords-** *intensity of competition; advanced manufacturing technology; organizational performance; manufacturing companies; contingency theory.*

## 1. INTRODUCTION

Indonesia is one of developing countries in South East Asia. In globalization and liberalization era, manufacturing companies in Indonesia face higher competition especially in free trade area for Association South East Asia Nations (ASEAN) countries since 2004.

The research questions in this study is whether there are direct and indirect relationship between intensity of competition and organizational performance through one mediation variables such as advanced manufacturing technology. The aim of this study is to investigate the relationship between intensity of competition, advanced manufacturing technology and organizational performance at manufacturing companies at Indonesian Stock Exchange.

Previous studies that investigated the relationship between intensity of competition and use advanced manufacturing companies such as Baines and Langfield Smith (2003), Heijltjes, and Witteloostuijn (2003), Isa and Thye (2006), Sohal, Sarros, Schroder and O'Neill (2006), Tuan Mat, Smith and Djajadikerta (2010a), Tuan Mat, Smith and Djajadikerta (2010b), Abdel Maksoud (2011), Abdel Maksoud, Abdallah and Youssef (2012).

Previous studies that examined the relationship between use of advanced manufacturing technology and organizational performance such as Jaikumar (1986),

Parthasarthy and Sethi (1992), Dean and Snell (1996), Gupta, Chen and Chiang (1997), Small and Yasin (1997), Kotha and Swamidass (2000), Sun (2000), Raymond and Pierre (2005), Idris, Rejab and Ahmad (2008), Tuan Mat and Smith (2011), Ismail and Isa (2011).

The previous researchs that examined the relationship between intensity of competition and organizational performance such as Khandwalla (1972); Govindarajan (1984); Mia and Clarke (1999), Hoque Mia, and Alam (2001), Ambe and Sortorius (2002) and Hoque (2011).

The earlier studies from three relationship such as intensity of competition and advanced manufacturing technology (AMT), advanced manufacturing technology and organizational performance, intensity of competition and organizational performance. Their results showed the different result such as significance, not significance and have different direction. This study aim to seek the empirical evidence form manufacturing companies that listed in Indonesian Stock Exchange.

## 2. REVIEW OF LITERATURE

### 2.1. Contingency Theory

General proposition of contingency theory is organizational performance should fit with other factors. These factors are external factor such as environment, organizational factor, control system factor, technology factor that all will come from organizational performance

(Drazin and VandeVen 1985). This explained from Chenhall (2003), in the following:

*“Researchers have attempted to explain the effectiveness of management control systems by examining designs that best suit the nature of the environment, technology, structure, strategy and national culture. In recent years, contingency-based research has maintained its popularity with studies including these variables but refining them in contemporary terms. The identification of contextual variables potentially implicated in the design of effective management control systems can be traced to the original structural contingency frameworks developed within organizational theory”.*

“fit” of different organizational constructs were assumed based on organizational performance. This “fit” can increase for better organizational performance (Chenhall 2003).

Contingency approach in management accounting based on the premise that there is no accounting system that apply universally and used for all organization in all condition (Otley 1980). Therefore, accounting system is depend on the condition of company itself (Otley 1980). In conclusion, management control is different in each company based on organizational factor and circumstances factors.

General proposition from contingency theory to evaluate organizational performance depend on contextual factors in company (Cadez and Guilding 2008). Basic essence of contingency theory mentions that we should adaptation with contingency structure such as environment, organizational measurement and business strategy so organization will run well (Gerdin and Greve 2004). Chenhall (2003) and (Chenhall 2007) do meta analysis from several research that already done and find that contextual factors influence to management control systems.

## 2.2. The Development of Hypotheses

### 2.2.1. Intensity of competition and Advanced Manufacturing Technology

Increased competitive environment which may cause company use innovative products and production techniques to provide increased flexibility, and to satisfy customer demand (Foster and Gupta 1994); (Otley, 1994). In order to compete in a high competitive market, many organizations consider to use advanced manufacturing technology. By Using this technology may result not only improving the quality, but also the ability to deliver the products or service and to satisfy specific market segment or even individual customers (Elliot 1993).

Advanced manufacturing technology increased flexibly make it more attractive to increase the production of a broad line, so the more frequent change and produce in small quantities to meet customer preferences satisfaction (Milgrom and Roberts 1995). Advanced manufacturing technology has ability to compete based on quality, productivity and flexibility (Bhimani 1994); (Bruggeman

and Slagmulder, 1995); (Parthasarthy and Sethi, 1992); (Pfeffer, 1994).

Companies use advanced manufacturing technology has increased, their aim is to gain or maintain competitive advantages (MacDougall and Pike, 2003). For manufacturing companies, the use of advanced manufacturing technologies is a requirement to remain competitive and to achieve performance (Ismail and Isa, 2011).

Prior studies were about the relationship between intensity of competition and use of advanced manufacturing technology for example (Baines and Langfield Smith, 2003); (Sohal, Sarros, Schroder and O’Neill, 2006); (Tuan Mat, et al., 2010a). Baines and Langfield Smith, (2003) stated that there is no relationship between intensity of competition and advanced manufacturing technology. Isa and Thye (2006) showed that negative relationship between intensity of competition and the use of advanced manufacturing technology. However, Heijltjes, and Witteloostuijn. (2003); Tuan Mat, et al., (2010b); Abdel-Maksoud (2011); Abdel-Maksoud, Abdallah and Youssef (2012) explained that there is a positive relationship between intensity of competition and advanced manufacturing technology.

Based on contingency theory in Chenhall, (2007) revealed that the environment refers to the specific attributes such as market competition from existing competitors and potential competitors. Based on Chenhall, (2007), p.172, environment refers to the competition. Uncertainty environment is a contextual variable in contingency-based research. One of way to face competition is use technology such as advanced manufacturing technology. Thus, the hypothesis is as follows:

*H1: Intensity of competition has a positive relationship with advanced manufacturing technology.*

### 2.2.2. Advanced Manufacturing Technology and Organizational Performance

Based on contingency theory in management accounting state that if company implement management accounting systems fit with organizational and environment factors tend to have better performance (Chenhall, 2003);( Otley, 1980). Furthermore, Waterhouse and Tiessen, 1978) state in contingency theory, technology have relationship with organizational performance.

The company uses advanced manufacturing technology as part of a strategy to improve performance. Advanced manufacturing technology is a modern manufacturing technique that includes the use of computers to integrate the manufacturing process. Advanced manufacturing technology can improve performance due to the ability to produce products in large quantities at a faster manufacturing process.

Previous researchs, Idris, et al (2008) stated that there was a positive relationship between investment in advanced manufacturing technology with return on investment. Jaikumar (1986); Parthasarthy and Sethi (1992); Gupta, Chen and Chiang (1997); Small and Yasin (1997); Kotha

and Swamidass (2000); Sun (2000); Raymond and St-Pierre (2005); Tuanmat and Smith (2011) found that a positive relationship between competition environment and advanced manufacturing influence with organizational performance. In conclusion, it can be developed a hypothesis as follow:

*H2: Use advanced manufacturing technology has positive relationship with organizational performance.*

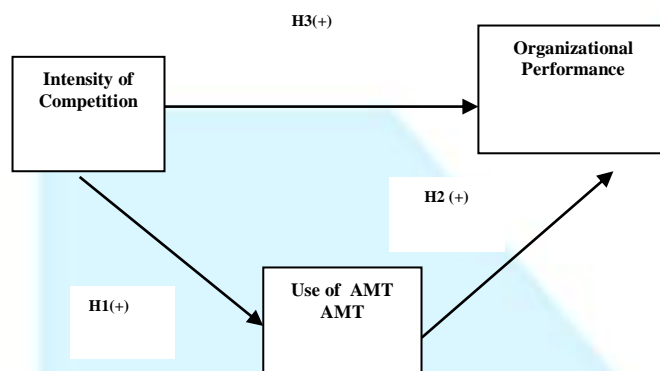
### 2.2.3. Intensity of Competition and Organizational Performance

Contingency theory from management accounting explains that if a company use management accounting system that appropriate with organizational and environment factor that tend to give better performance (Chenhall, 2003); (Otley, 1980). This relationship was explained with contingency theory that mentioned that management accounting practices and internal operation from organization fit in with external environment changes (Abdel-Kader and Luther 2008); (Haldma and Lääts 2002); (Macy and Arunachalam 1995).

Prior researches from Govindarajan (1984); Mia and Clarke, (1999); Hoque, Mia and Alam (2001); Ambe and Sortorious (2002) and Hoque, (2011) showed that there is positive relationship between intensity of competition and organizational performance. However the result study from (Khandwalla 1972) showed that intensity of competition had negatively associated with organization performance. The above discussion suggests that the increase of intensity of competition, the increase organization performance should also increase. Stated formally in the form of the following hypothesis:

*H3: Intensity of competition has positive relationship with organizational performance.*

**Figure 1. Research Model**



## 3. METHODOLOGY

### 3.1. Population and Sample

Participants of this study are financial controllers or chief financial officers or accounting managers. The amount of manufacturing firms which listed in Indonesian Stock Exchange is about 149 based on Indonesian Capital Market Directory 2011. The questionnaires were sent to all manufacturing companies. Sample in this study was the total completed questionnaires returned from survey.

Data was collected by sending questionnaires by mail and contact persons who sent directly to manufacturing companies that listed in Indonesian Stock Exchange.

There are several reasons why choose manufacturing companies as sample. Firstly, because manufacturing companies in Indonesian Stock Exchange especially from Indonesian Capital Market Directory is categorized as a big company (Lau and Sholihin 2005). These companies tend to use Advanced Manufacturing Technology. Other reason is to avoid bias from Industry effect.

## 3.2. Variable Research and Instrument Research

### 3.2.1. Intensity of competition

This variable used Khandwalla (1972) measurement which has five categories such as raw materials, technical personnel, selling, and distribution, quality and variety of product and price. Several researchers used this measurement (Mia and Chenhall 1994); (Libby and Waterhouse 1996); (Hoque et al. 2001).

### 3.2.2. Advanced Manufacturing Technology

Advanced manufacturing technology is technology focus on increasing production technology (Askarany and Smith 2008). This instrument is developed by Askarany dan Smith, 2008. This instrument is used by Tuanmat and Smith (2011).

### 3.2.3. Organizational Performance

Organizational performance is indicator successful level to achieve company goal. Govindarajan, 1984 states that organizational performance is not only financial but also non financial performance in the company. This instrument was developed by (Govindarajan 1984). This measurement consists of ten categories such as operating profit, return on investment, sales growth rate, market share, cash flow from operation, new product development, market development, research and development, cost reduction programs, personnel development. already used by several researchers such as (Abernethy and Stoelwinder 1991); (Chenhall and Langfield-Smith 1998); (Govindarajan and Fisher 1990); (Hoque and James 2000), Hoque (2011).

## 4. DATA ANALYSIS

Data analysis used Structural Equation Model (SEM) with AMOS (Analysis of Moment Structure) 19 software program. Structural Equation Model (SEM) is the combination between factor analysis and all equation model (Ghozali 2011). Structural equation is figured by path diagram that represent from theory. In other word latent variable is figured out to path diagram from theory. Furthermore, goodness of fit model is will done. If it is fit, it will explain the result and discussion (Hair, Black and Babin 2010), (Ghozali, 2011).

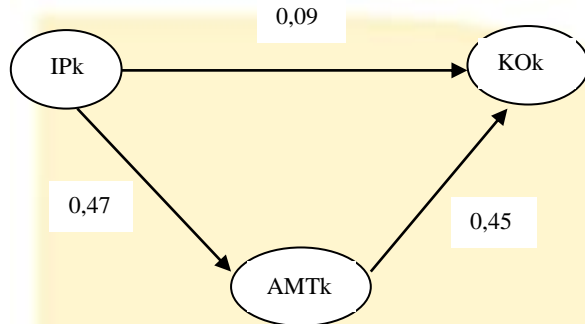
## 5. RESULTS

Total questionnaires were about 447 questionnaires which were sent to financial controller or chief financial officer or accounting managers (each firm is sent 3



questionnaires). The questionnaires was distributed in early September 2012 until mid February 2013. The total resulted in only 115 completed responses. Of 115 returned questionnaires, seven (7) responses were not fully completed and therefore were not useable. Thus, the usable response for this study analysis is about 108.

**Figure 2. The Result of Research Model**



Chi Square = 132,153

Probability = 0,001

CMIN/DF = 1,519

GFI = 0,876

AGFI = 0,828

TLI = 0,933

CFI = 0,945

RMSEA = 0,70

IPk = intensity of competition; AMTk = Advanced Manufacturing Technology; KOOk = Organizational performance

**Table 1. Evaluation of Goodness of Fit Model**

Goodness of Fit Index	Cut off Value	Result	Model Evaluation
Chi-Square (df = 266)	less (< 305,041)	132,153	Good
Probability	≥ 0,05	0,001	Good
RMSEA	≤ 0,08	0,070	Good
GFI	≥ 0,90	0,876	Marginal
AGFI	≥ 0,90	0,828	Marginal
CMIN/DF	≤ 2,00	1,519	Good
TLI	≥ 0,95	0,933	Good
CFI	≥ 0,95	0,945	Good

From table 1 based on the research result by using AMOS program showed that all criteria are good in the goodness of fit model such as chi-square, probability, RMSEA, CMIN/DF, TLI and CFI. However for GFI and AGFI are in the marginal level. From table 1, we can see the goodness fit of model based on the criteria (cut off value). Chi square from full model result is smaller than chi square table as 305,041. All values are required range

which means that all indicator was used in model is sufficient enough to test the hypothesis.

**Table 2. Standardized Result of SEM**

Hypothesis	Estimated Standard	C.R.	P	Explanation
H1	0,474	3,973	***	Supported
H2	0,448	4,456	***	Supported
H3	0,088	0,737	0,461	Not Supported

IPk = Intensity of competition; AMT = Advanced Manufacturing Technology; KOOk = Organizational Performance; \*\*\* = Significant at level 0,05 (two tailed); \*= Not significant at level 0,05 (two tailed)

We can see t- statistic value to test all proposed hypothesis. The border to accept and reject proposed hypothesis is CR ± 1,96. The testing result shows that intensity of competition was not significance in the relationship with organizational performance. However, for H1 and H2 are statistically significance and have positive relationship. The result from hypothesis is consistent with contingency theory (Chenhall 2003); (Otley 1980). However, H3 is not supported.

## 6. DISCUSSION

### 6.1. The relationship between intensity of competition and Advanced Manufacturing Technology

This finding supports the contingency theory. To respond to the uncertainty environment such as intensity of competition, companies use the technology such as Just In Time (Chenhall, 2003, p.178). Thus, it can be said that because of the intensity of competition will cause Manufacturing companies use advanced manufacturing technology to be able to compete with others. It aims not only to maintain a competitive advantage, but also to achieve the competitive advantages.

The finding of this study is in line with previous research for instance Heijljes and Wittleloostuijn (2003); (Tuan Mat, Smith and Djajadikerta, 2010a); (Tuan Mat, Smith and Djajadikerta, 2010b); (Abdel Maksoud, 2011); (Abdel Maksoud, Abdallah and Youssef, 2012). Their result results showed that there were positive relationships between the intensity of competition and the use of advanced manufacturing technology. In competitive environment, manufacturing companies require advanced manufacturing technology due to more complex production processes (Ismail and Isa, 2011).

### 6.2. The relationship between advanced manufacturing technology and organizational performance

The research findings is consistent with research conducted by (Jaikumar, 1986); (Parthasarthy and Sethi, 1992); (Gupta, Chen and Chiang, 1997); (Small and Yasin, 1997); (Kotha and Swamidas, 2000), (Sun, 2000);

(Raymond and Pirre, 2005); (Idris, Rejab and Ahmad, 2008) and (Tuan Mat and Smith, 2011). Use of advanced manufacturing technology related to the performance showed significant positive results. As competition increases, companies are trying to use advanced manufacturing technology, but the relationship between the use of advanced manufacturing technology and performance is likely to increase.

The argument above showed that the results of this study support the contingency theory. Based on contingency theory of management accounting states that if an organization implements the management accounting system in accordance with organizational and environmental factors, usually perform better (Chenhall, 2003); (Otley, 1980).

### 6.3. The relationship between intensity of competition and organizational performance

This finding do not support prior studies that have been done by Mia and Clarke , 1999 and Hoque, 2011) and Govindarajan , 1984) which showed that there was a positive relationship between the intensity of competition with organizational performance . However, this finding of this study supports Khandwalla, 1972. Khandwalla, 1972 in the United States stated that a negative relationship between firm profitability and the level of product, as well as the network of market competition. In conclusion, it states that higher the level of competition, the lower organization and conversely.

The finding of this study is not in line with contingency theory. This theory has an assumption that the organization has a complex system where the main problems related to greater uncertainty environment, the greater the amount of information required for processing to improve performance. Based on Chenhall, 2007, refers to the competitive environment. Uncertainty Environment stemming from increased competition is a contextual variable in contingency-based research.

In the contingency theory of management accounting states that if an organization implements the management accounting system in accordance with organizational and environmental factors , usually gets better performance ( Chenhall , 2003) ; ( Otley , 1980) . The contingency theory states that competition in an uncertain environment determines organizational performance (Hoque, 2004). Furthermore, the theory states that environmental contingencies related to organizational performance (Waterhouse dan Tiessen, 1978)

## 7. CONCLUSION

This study was conducted with two objectives: (1) assess whether indirect relationship between intensity of competition and organizational performance through one mediation variable such as advanced manufacturing technology, (2) examine whether a direct relationship between intensity of competition and organizational performance.

The intensity of competition is an environmental factor that cannot be controlled. Manufacturing companies to face intensity of competition will usually use advanced manufacturing technology. This is done by companies to maintain or achieve a competitive advantages compared to its competitors. The results showed that the relationship between the intensity of competition and the use of advanced manufacturing technology showed positive results and significance. The relationship between use of advanced manufacturing technology and organizational performance showed that the relationship was positive and significance. However, the relationship between intensity of competition and organizational performance was positive and not significance.

The limitation of this study is in the fit test models show result in marginal. Limitations on the level of *square multiple correlation* ( $R^2$ ), which indicates the ability to explain of the variables is still relatively low, which means there are other variables that have the potential to be further investigated. Therefore the suggestion of future research needs to consider other variables to be studied as an example of information technology and organizational variables such as culture.

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## AUTHOR'S BIOGRAPHY



**Lukluk Fuadah SE, MBA, Akt** is a doctorate degree student at University of Diponegoro. She is a lecturer at University of Sriwijaya



**Prof. Muhammad Nasir, MSi, PhD, Akt** is a professor and dean at University of Diponegoro. His current research is management accounting.



**Dr. Jaka Isgiyarta, MSi, Akt** is secretary at Accounting Master degree at University of Diponegoro. His current research is Islamic accounting.