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DOES ENVIRONMENTAL HOSTILITY MODERATE TECHNOLOGY-PERFORMANCE RELATIONSHIP?

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Abstrak

Telah lama disepakati bahwa teknologi membantu perusahaan untuk meningkatkan kinerja, untuk memperoleh keunggulan kompetitif, dan menciptakan hambatan dalam persaingan. Adopsi teknologi dan kekuatan-kekuatan teknologi secara langsung terkait dengan pendorong persaingan seperti kecepatan proses, tingkat cacat produk, ketepatan penghantaran dan produktivitas. Beberapa studi sebelumnya menunjukkan bahwa tingkat kompetisi dalam persaingan bisnis memoderasi hubungan teknologi-kinerja. Studi ini memfokuskan pada peran environmental hostility terhadap hubungan teknologi-kinerja. Data dikumpulkan melalui survey surat yang ditujukan kepada pimpinan perusahaan mamufaktur di Indonesia. Studi ini menemukan bahwa teknologi lunak dan teknologi keras berpengaruh positif terhadap seluruh indikator kinerja. Environmental hostility memoderasi hubungan teknologi keras dengan semua indikator kinerja kecuali pertumbuhan kinerja manufaktur. Selanjutnya studi ini juga menemukan bahwa environmental hostility memoderasi hubungan teknologi lunak dengan kinerja finansial, pertumbuhan kinerja manufaktur, dan kinerja keseluruhan.

Kata Kunci: lingkungan, hostility, teknologi, kinerja

1. INTRODUCTION

With increasing global competition for manufacturers, interest has grown among researchers and practitioners in the role of technology in assisting firms to maintain their competitive advantage. There is an abundant of literature that have analyzed the relationship between technology adoption and performance (e.g. Abernathy & Clark, 1985; Maidique & Patch, 1988; Harrison & Samson, 1997). Technology is powerful force for industrialization, increasing productivity, supporting growth, and improving the standards of living (Clark & Abernathy, 1985). Maidique and Patch (1988) argued that technology is a critical force for a business organization in a competitive environment, while Stacey and Aston (1990) argued that technology advancement play a vital role in long term profitability. Although there have been many studies focusing on the technological adoption and innovation, there is still a dearth of empirical results that relate to technology adoption and performance, especially in the Indonesian manufacturing sector.

Another issue raised on the relationship between technology and competitive advantage is whether the relationship is the same in all environmental contexts. Relating to this issue, several prior researches have reported that the degree of competition in the business arena (Miller & Friesen, 1982; Zahra & Covin, 1993) has a moderating impact on technology-performance relationship. In a hostile environment (where competition is intense), if technology is properly deployed in product, process or its value chain, it will differentiate the company from its rivals, thus gaining competitive advantage.

This study was motivated by the following considerations: (1) The dearth of knowledge and empirical research concerns with technology adoption by Indonesian manufacturing firms. (2)

The lack of research that investigates the moderating effect of environmental variable on the relationship between technology and performance. Other than to investigate the moderating role of environmental hostility on the technology-performance relationship, this study investigates the impact of the level of technological adoption on financial and manufacturing performance in the Indonesian manufacturing sectors.

2. CONCEPTUAL FRAMEWORK

2.1. Technology and Performance

It is generally accepted that technology helps a firm to increase performance, to gain competitive advantage, and to create barriers to competition. Although many prior studies have investigated the impact of a particular technology on performance very few have examined the impact of hard and soft technology comprehensively, in general, the findings tend to indicate that technology has a positive impact on the firm's performance. Numerous studies (such as Youseff, 1993; Mechling et al., 1995; and Mc Gregor & Gomes, 1999) have emphasized the potential strategic benefit of flexible responsiveness and improved productivity through purposeful adoption of advanced manufacturing technology (AMT).

There are also numerous articles and empirical studies that investigated the impact of soft technology (e.g. TQM, JIT, TPM, MRP and benchmarking) on a firm's performance. Sohal and Terziovky (2000) argued that the effective implementation of quality improvement practices (TQM, benchmarking, process reengineering) lead to improvements in organizational performance in terms of both productivity and profitability, along with improved customer satisfaction. Research has also shown that JIT practices provide several potential benefits (e.g. eliminate waste in production process, reduce lead-time, decrease throughput time, improve product quality, increase productivity and enhance customer responsiveness)

Further, adoption and implementation of TPM help increase the productivity of plant and equipment in order to achieve maximum productivity (Al-Hassan et al., 2001). Adoption of TPM is a contributing factor to reduce work in process (WIP), improving response to customer through reduced cycle time and improved product quality (Tsang & Chan, 2000). Humpreys (2001) showed that the adoption of MRP2 can enhance firms competitive positions through improved customer service level, increased plan efficiency and more efficient production scheduling. When MRP was implemented with JIT, it reduced cost, increased productivity and integrated all functions to manufacturing (Lowe & Sim, 1993). Benchmarking has also proven to be a common tool for enhancing organization performance (Hinton, et al. 2000). It can be used to transfer the best practices and continuous learning to the other functions or organizations (Zairi & Whymark, 2000).

Boumount and Schroeder (1997) found that although sophisticated technologies, JIT and TQM are not strongly associated with cost reduction and dependability, these technologies give benefits in terms of increasing flexibility (reduction in new product development time) and increasing employees' morale. Sim (2001) investigated the impact of TQM, JIT, and AMT on performance. The study concluded that: (1) Both TQM and JIT improve manufacturing performance and their synergy often exists when both techniques are implemented together. (2) Investing in technology is not a panacea for all the operational problems. Unless technology is managed appropriately, the companies are likely to be disappointed with the pay-off. (3) The success of technology needs integration between technology, managerial policies and practices. The above literatures indicated that neglecting improvement techniques and management systems (soft technology) may result in companies not getting a pay off from investment in technology. Thus, the following hypothesis is proposed:

H1: There is a positive relationship between the level of technological adoption and firms performance.

2.2. Technology-Environmental Hostility-Performance Relationship

Hostility of environment concerns with the degree of competition in the local and international market (Badri et al., 2000). The degree of hostility is measured on various dimensions e.g. degree of competition in local market and foreign market, rate of demand in local and foreign market and the changing customer's taste. Miller (1987) defined hostility as the degree of competition, number of areas of competition such as product feature, quality and service and restrictive legislation. In a hostile business environment, technology is needed to survive and create competitive advantage (Zahra & Covin, 1993). To achieve this objective companies have to develop technology policies that are consistent or that 'fit' into the business strategy. In a hostile environment (where competition is intense), if technology is properly deployed in product, process or its value chain, it will differentiate the company from its rivals, thus gaining competitive advantage. A hostile environment will also open the windows of opportunities to exploit technology for greater returns to the more innovative and risk taker firms. In hostile environment, firms with high technology competencies and capabilities will be able to overcome the pressures and threats. These firms will successfully differentiate themselves and perform better than its competitors, thus gaining competitive advantage. Thus, we formulate the following hypothesis.

H2: The impact of technology on performance is greater in a more hostile environment.

3. METHODOLOGY

3.1. Sample and Response Rate

For this study, a list of medium and large companies was obtained from the Directory of Manufacturing Industry, published by the Indonesian Statistic Center Bureau (Biro Pusat Statistic Indonesia, 2000). Data was collected through mailed questionnaires, which were addressed to the CEOs of the selected companies in Indonesia. The unit of analysis is organization and the sample were selected randomly from the directory. The sample selected were the manufacturing firms with more than 250 full time employees.

A total of 1000 questionnaires were distributed, of which, four companies have moved to unknown addresses and another two companies refused to participate. In addition, 47 responses were incomplete, thus leaving a total of 183 usable responses for the purpose of this study, an 18.41% response rate.

The profile of the sample revealed an interesting spread of Indonesian large companies. Majority (60%) of the responding firms have less than 1000 full time employees with only 11.5% are very large, having in excess of 2500 full time employees. It is not surprising that about 90% of them have assets in excess of 25 million Rupiahs (1 USD equal to 9.850 Rupiahs). Most of them (80%) have been in existence for more than 10 years with only 8 companies (4.4%) being relatively new. In term of industry, 28.4% of the companies are in fabricated metal, machinery and automotive, and electronic industry, while 19.1% in food, beverage, and tobacco industry. The smallest (14.8%) group came from rattan, bamboo, furniture, and handicraft industries. Approximately 87% of the sample is Indonesian owned, while the remainder is either joint venture companies or totally foreign owned. However, locally owned companies do have some degree of alliances, with 47% indicating that they do not have any kind of cooperative arrangement with foreign entities.

3.2. Variables and Measures

The variables of this study were measured using instruments derived from various sources.

Level of technological adoption. The two dimensions include hard technology and soft technology. Hard technology refers to a family of advanced manufacturing technologies and computer based technologies, which include 13 types of hard technology. Five point Likert type

scales (1 = not adopted to 5 = very high) are used and in order to measure the level of adoption of hard technology, an instrument developed by Youseff (1993).

The level of sophistication, cost and complexity of the various hard technology varies. Thus to equate one technology with another in coming up with a measure of extent of adoption of hard technology is inappropriate. For this study, we adopted the methodology used by Jantan, Ramayah, Ismail, and Salehudin (2001), where the extent of adoption is measured using the following formula:

$$\text{The extent of hard technology (AMT) adoption} = \frac{\Sigma\, i_j \times w_j}{\Sigma\, w_j}$$

Where:

i_j = Level of hard technology, where the value of i_j become 1 if the hard technology is not adopted at all and 5 if the hard technology is adopted at very high level.

w_j = The importance (radicalness) index that was obtained from a panel of experts., where, w_j become 1 if the hard technology is considered very unimportant and 5 if the technology is considered very important.

To establish the degree of radicalness or importance of hard technology, a separate questionnaire was prepared and sent to experts (technical or production managers) from large manufacturing companies. These managers have had experience in working with hard technology system. They are also considered as experts, and knowledgeable of the benefits of each type of hard technology and the difficulty in implementing the systems. The purpose of this part of the study is to determine the weights attached to each type of hard technology, in measuring the sophistication or extent of adoption of hard technology by the responding firms.

Soft technology refers to the system, which controls the technical processes within the organization such as TQM, JIT, TPM, MRP2, and Benchmarking. TQM measure are obtained and modified from Sohal and Terziovsky (2000). For the level of JIT adoption the components from Yasin, et al. (1997) as well as Sakakibara et al. (1997) were adopted and modified based on the objective of this study. The level of TPM and MRP2 adoption is measured with the instrument developed by Tsang and Chan (2000) as well as Warnock (1996), respectively. For the level of benchmarking adoption is measured based on the general benchmarking practices (Hinton, Francis &Holloway, 2000). A five-point Likert scale anchored by 1 (not practiced) to 5 (very high) is used to measure the level of soft technology adoption.

Environmental hostility. It is related to pressure and degree of competition in the market place (Friesen and Miller, 1983). It is measured by six items that were derived from Miller, (1987) and Badri et al. (2000). These items measured the degree of competition in local market and foreign market, demand in local market and foreign market and quality demand by customers.

Performance. This study looks at performance from the perspective of the firm performance compared to average performance in its industry. Five-point Likert-like scale ranking from 1 (much lower) to 5 (much higher) is used to measure firm performance compared to average performance in industry. The performance measures used include financial performance and non-financial performance. Financial performance refers to performance as measured by ROI, ROA, ROS, growth is sales, and profit (Beaumont & Schroeder, 1997), while non financial performance covers performance on five dimensions of manufacturing e.g. productivity, cost, quality, flexibility and delivery (Stonebaker & Leong, 1994; Leong et al., 1990).

These measures were subject to factor analyses to identify the structure of interrelationship (correlation) among the items used. Factor analyses were conducted on the 13 questions of hard technology, 32 questions of soft technology, and 13 questions of firms performance. The factor analysis was conducted separately for extent of advanced manufacturing

technologies and 32 organizational practices. Two factors emerged and named as hard technology (Cronbach's alpha .9496) and soft technology (Cronbach's alpha .9518.). The results of factor analysis for firms' performance identified two factors, which are named accordingly, financial performance a (Cronbach's alpha, 9026) and manufacturing performance (Cronbach's alpha .8762). Finally, second-order factor analysis was done to see whether the four dimensions of performance are unidimensional factor. The result shows that one factor emerged, and the factor is named overall performance, with the cronbach's alpha value .7845. High Cronbach's alpha values of each of the derived factors indicated acceptable reliability level for further analyses (Nunnaly, 1978)

4. FINDINGS

4.1. The Impact of Technology on Performance

Hypothesis 1 examines the impact of hard and soft technology on performance. To test this hypothesis, multiple regression analyses were done with the extent of hard and soft technology adopted as the independent variables and performance (financial and manufacturing performance, growth in financial and manufacturing performance and overall performance) as the dependent variable. The results are summarized in Table 1. The findings can be summarized as follows: Firstly, both hard and soft technologies have positive impact on all indicators of performance. Secondly, hard and soft technologies jointly are able to explain 28.1%, 33.6%, 15.7%, 23.1%, and 36.4% of variations in financial performance, manufacturing performance, financial performance growth, manufacturing performance growth, and overall performance respectively. Thirdly, hard and soft technologies in tandem better explain performance rather than growth of performance. Further, we find that hard and soft technologies explain manufacturing performance better than financial performance.

Table 1
The Impact of the Level of Hard and Soft Technology Adoption on Performance

Independent Variables	FP	MP	FPGR	MPGR	OVPERF
R^2	.281	.336	.157	.231	.364
Adjusted R^2	.273	.329	.148	.222	.357
Sig. F	.000	.000	.000	.000	.000
Standardized Coefficients (β)					
Hard Technology	.184**	.158**	.264***	.241***	.243***
Soft technology	.402***	.475***	.181**	.298***	.431***

*** : significant at 0.01 ** : significant at 0.05 * : significant at 0.1

Note:
FP: Financial Performance
FPGR: Financial Performance Growth
MP: Manufacturing Performance
MPGR: Manufacturing Performance Growth
OVPERF: Overall Performance

4.2. The Moderating Impact of Environmental Hostility

Hierarchical regression analysis is used to analyze the moderating impact of environmental hostility on the relationship between technology and performance. Hypothesis 2 in this study states that the impact of technology on performance is greater in more hostile environment. Tables 2 to 6 display the results of the hierarchical regression analysis used to test this hypothesis.

Table 2 summarizes the regression results for testing the moderating impact of environmental hostility (EH) on the relationship between technology and financial performance. This table

clearly shows that the introduction of environmental hostility into the second step is not significant. However, the change in F-ratio and R^2 are significant with the introduction of the interaction terms. Both the beta coefficients of the interaction terms are significant at 1% level. Thus, environmental hostility moderates the impact of both hard and soft technology on financial performance.

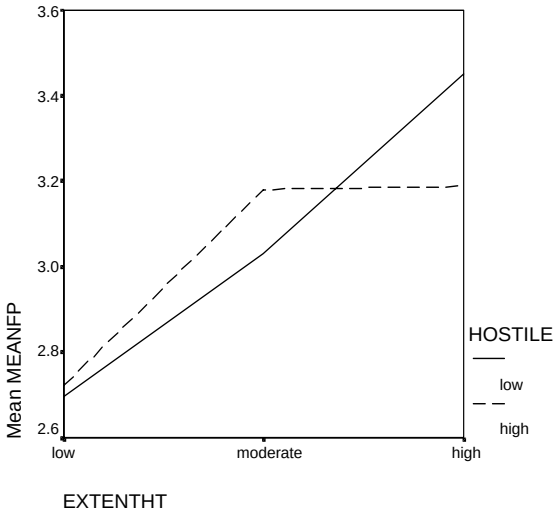
Table 2
The Moderating Effect of Environmental Hostility on the Relationship between Technology and Financial Performance

Variables	Step 1	Step 2	Step 3
	Standardized Beta		
HT	.184**	.155*	.128
ST	.402***	.415***	.340**
EH		-.068	-.107
HT x EH			.674***
ST x EH			-.567***
R^2	.281	.285	.328
R^2 change	.281	.004	.043
F change	35.147	1.011	5.687
Sig. F change	.000	.316	.004

*** : significant at 0.01 ** : significant at 0.05 * : significant at 0.1

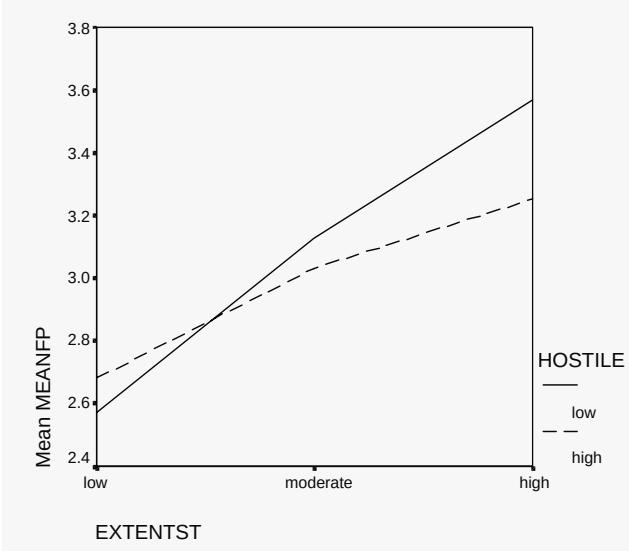
(Note: Step 1 refers to regression with the independent of hard technology (HT) and soft technology (ST); Step 2 refers to regression with the independent variables and the moderator (EH), whilst step 3 refers to the regression with the independent variables, the moderator and the interaction terms)

The impact of environmental hostility on the relationship between hard technology and financial performance is displayed is Graph 1. When the level of hard technology is low to moderate, the impact of hard technology on financial performance is greater for those companies operating in very hostile environment. However, when the extent of hard technology shifts from moderate to high, any further increase in hard technology has no effect on financial performance when the environment is hostile. Whereas, hard technology positively impacts financial performance, when environment is less hostile (friendly).



Graph 1
The Impact of Environmental Hostility (EH) on the Relationship between Hard Technology (HT) and Financial Performance (FP)

The effect of environmental hostility on the relationship between soft technology and financial performance is displayed in Graph 2. In general, the impact of soft technology on financial performance is positive. However, the impact of soft technology on financial performance is greater under less hostile environment (friendly).



Graph 2
The Impact of Environmental Hostility (EH) on the Relationship between Soft Technology (ST) and Financial Performance (FP)

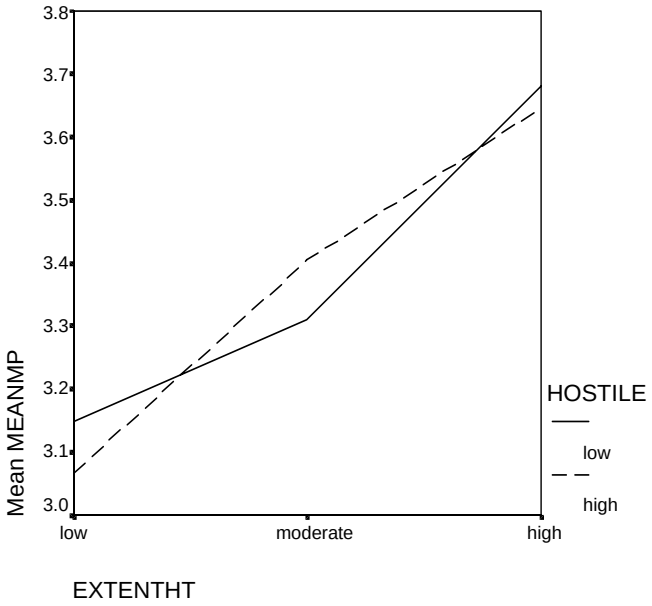
Table 3 tabulates the regression results that test the moderating impact of environmental hostility on the relationship between technology and manufacturing performance. The addition of environmental hostility in the second model is not significant, but the introduction of interaction terms in the third model is significant at 5% level. The interaction between hard technology and

environmental hostility is significant at 1% level. Thus, the relationship between hard technology and manufacturing performance is moderated by the hostility of environment.

Table 3
The Moderating Effect of Environmental Hostility on the Relationship between Technology and Manufacturing Performance

Variables	Step 1	Step 2	Step 3
	Standardized Beta		
HT	.158**	.130	.084
ST	.475***	.486***	.211
EH		-.082	-.168**
HT x EH			.566***
ST x EH			-.231
R^2	.336	.344	.376
R^2 change	.336	.006	.032
F change	45.357	1.614	4.532
Sig. F change	.000	.206	.012
*** : significant at 0.01	** : significant at 0.05		

The impact of environmental hostility on the relationship between hard technology and manufacturing performance is shown in Graph 3. This graph shows that when the level of soft technology is low to moderate, the impact of soft technology on manufacturing performance is greater for those companies operating in highly hostile environment. However, when the extent of soft technology is moderate to high, the impact of soft technology on manufacturing performance is reverse. The maximum manufacturing performance will be achieved in condition when the environmental hostility is low, with highest adoption level of hard technology.



Graph 3
The Impact of Environmental Hostility (EH) on the Relationship between Hard Technology (HT) and Manufacturing Performance (MP)

Table 4 shows that environmental hostility moderates the relationship between technology and financial performance growth. It is supported by the fact that the addition of interaction terms in the third model significantly changes the F-ratio and the R^2, and the standardized beta coefficients for the interaction between both hard and soft technology with environmental hostility are significant at 5% level.

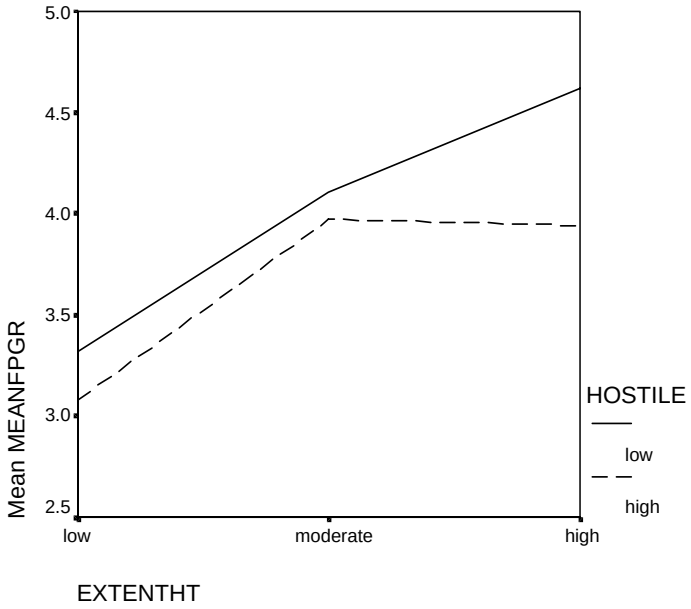
Table 4
The Moderating Effect of Environmental Hostility on the Relationship between Technology and Financial Performance Growth

Variables	Step 1	Step 2	Step 3
	Standardized beta		
HT	.264***	.225**	.213**
ST	.181**	.198**	.215
EH		-.092	-.103
HT x EH			.505**
ST x EH			-.510**
R^2	.157	.164	.192
R^2 change	.157	.007	.027
F change	16.750	1.588	2.989
Sig. F change	.000	.209	.053

*** : significant at 0.01 ** : significant at 0.05

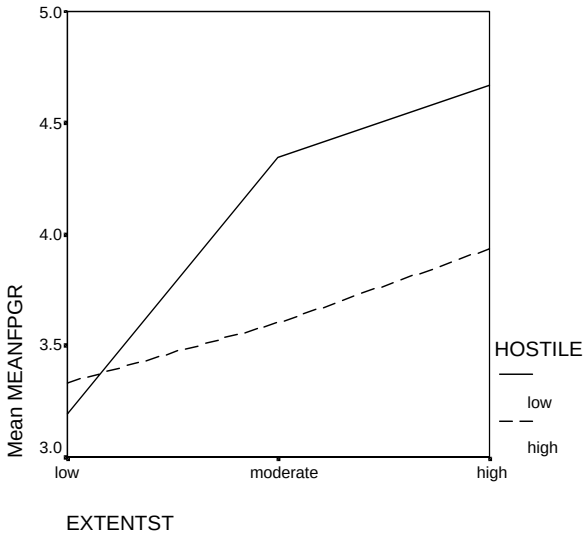
The moderating influence of environmental hostility on the relationship between hand technology and financial performance growth is presented in Graph 4. The moderating influence only occurs when the level of hard technology is moderate to high. In less hostile environment,

hard technology has positive impact on financial performance, whereas in hostile environment hard technology has no impact at all.



Graph 4
The Impact of Environmental Hostility (EH) on the Relationship between Hard Technology (HT) and Financial Performance Growth (FPGR)

Graph 5 illustrates that the differential impact of soft technology on financial performance growth under different levels of hostility in the environment. The impact of soft technology on financial performance is greater for those companies that operate in less hostile environment, when the extent of soft technology is low to moderate. When soft technology is moderate to high there is no moderating influence of environmental hostility.



Graph 5
The Impact of Environmental Hostility (EH) on the Relationship between Soft Technology (ST) and Financial Performance Growth (FPGR)

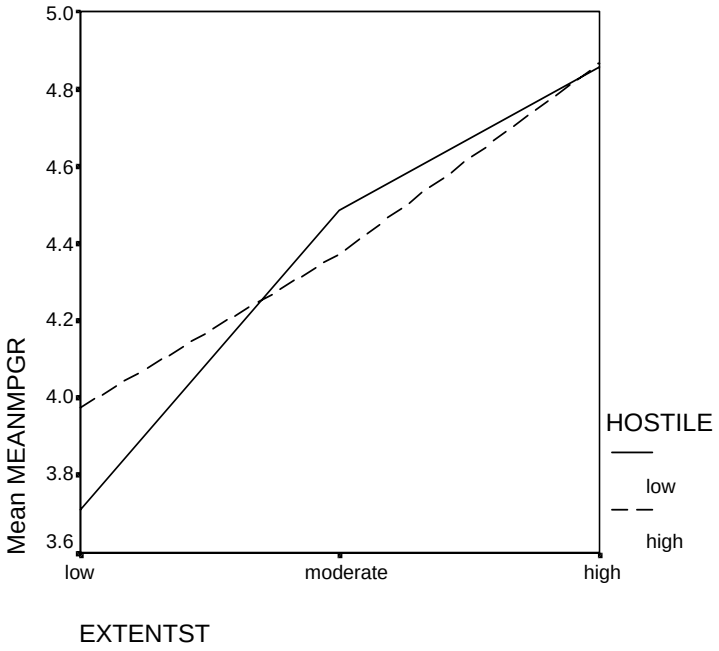
Table 5 shows that the F change from step 1 to 2 is significant at 10% level but the change of F-ratio and R^2 is not significant with the introduction of interaction terms. However, the inspection of beta coefficient of the interaction terms shows that the interaction term between soft technology and environmental hostility is significant at 5%. This indicates that the hostility of environment moderates the relationship between soft technology and manufacturing performance growth.

Table 5
The Moderating Effect of Environmental Hostility on the Relationship between Technology and Manufacturing Performance Growth

Variables	Step 1	Step 2	Step 3
	Standardized Beta		
HT	.193***	.250***	.253***
ST	.345***	.321***	.446**
EH		.132*	.152*
HT x EH			.334
ST x EH			-.467**
R^2	232	.247	.266
R^2 change	232	.015	.018
F change	27.083	3.582	2.195
Sig. F change	.000	.060	.114

*** : significant at 0.01 ** : significant at 0.05 * : significant at 0.1

Graph 6 illustrates the moderating effect of environment hostility on the relationship between soft technology and manufacturing performance growth. This graph shows that in both conditions where the hostility of environment is low and high, the impact of soft technology on performance is always positive. However, this graph says that in the event when the extent of soft technology is low to moderate, the impact of soft technology on manufacturing performance growth is greater for those who operate in less hostile environment. When the extent of soft technology shifts from moderate to high, the impact of soft technology on manufacturing performance growth is greater for those who operating in hostile environment. This graph also indicates that the maximum manufacturing performance growth can be achieved in conditions where the level of hostility is high or low, with adopting the highest level of soft technology.



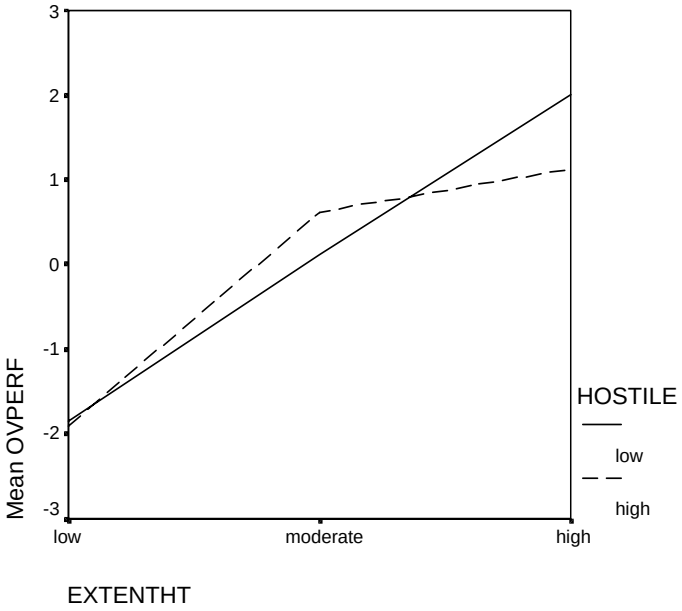
Graph 6
The Impact of Environmental Hostility (EH) on the Relationship between
Soft Technology (ST) and Manufacturing Performance Growth (MPGR)

The last moderating effect that we tested is the moderating effect of environmental hostility on the relationship between technology and overall performance (see Table 6). In this case, the introduction of environmental hostility into the second step is not significant. But the change in F-ratio and R^2 is significant with the introduction of the interaction terms. Here we found that both the interaction terms introduced in the step three are significant at 1% level, indicating that the effects of hard and soft technology on overall performance are moderated by the hostility of environment.

Table 6
The Moderating Effect of Environmental Hostility Environment Hostility on
The Relationship between Technology and Overall Performance

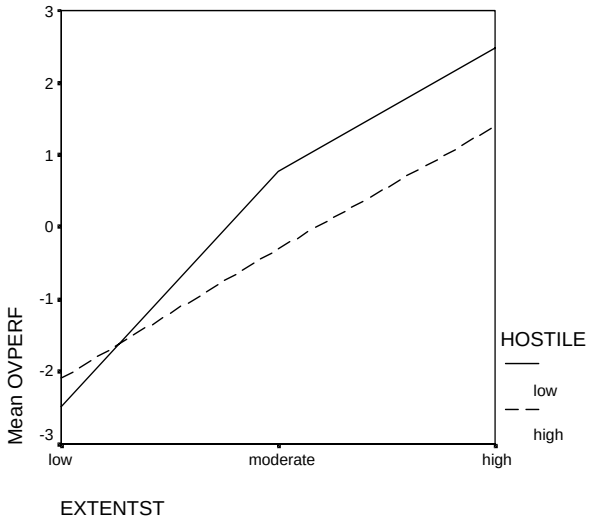
Variables	Step 1	Step 2	Step 3
	Standardized Beta		
HT	.259***	.249***	.221***
ST	.436***	.441***	.371**
EH		-.025	-.063
HT x EH			.619***
ST x EH			-.519***
R^2	.387	.387	.424
R^2 change	.387	.001	.036
F change	56.446	.156	5.526
Sig. F change	.000	.693	.005
*** : significant at 0.01	** : significant at 0.05	* : significant at 0.1	

Graph 7 shows that when the level of hard technology is low to moderate, the impact of hard technology on the overall performance is greater in highly hostile environment. The situation is reverse when the extent of hard technology shifts from moderate to high. The highest overall performance could be achieved when the hostility of environment is low with adopting the highest level of hard technology.



Graph 7
The Impact of Environmental Hostility (EH) on the Relationship between Hard Technology (HT) and Overall Performance (OVPERF)

Graph 8 illustrates that both in conditions of low and hostile environment the impact of soft technology on the overall performance is always positive. The slopes of the lines indicate that the impact of soft technology on performance is greater in the less hostile environment when the level of soft technology is low to moderate. When level of soft technology is moderate to high, there is no difference in impact.



Graph 8
The impact of Environmental Hostility (EH) on the Relationship between
Soft Technology (ST) and Overall Performance (OVPERF)

5. DISCUSSIONS

5.1. Technology and Performance Relationship

Related to the impact of technology on overall performance, we find that both hard and soft technology has positive impacts on performance. Adoption of hard technology will increase financial performance through the cumulative effect of cost reduction and efficiency. On the other hand, soft technology can streamline the production process through the elimination of wastages or non-value added activities and reduction of work in progress. By adopting soft technology the quality of product and process can be improved, leading to efficiency, which in turn increase profitability (Link 1993; Boumount & Schroeder, 1997).

Regarding the impact of technology on manufacturing performance we find that hard and soft technology have positive significant effects on manufacturing performance. Adoption of hard technology is a vehicle to increase process and product quality, process and volume flexibility, as well as delivery reliability, thus improving the manufacturing performance and its growth can be attained. Hard technology is needed in modern manufacturing firms to increase efficiency. The adoption of hard technology has a positive relationship with operation efficiency and effectiveness of companies in producing goods and services. This finding is in line with a large number of previous studies done by Zammuto and O'Connor (1992), Godhar and Lei (1994), Baumounth & Schroeder (1997), Gupta et al. (1997), Buthcher et al. (1999). This finding also shows that the effective implementation of soft technology leads to improvement in manufacturing performance. Implementation of this technology can reduce rework, scrap and product defect. Soft technology also plays an important role in shortening process/product development time and in enhancing delivery capability. The finding of this study appears to be in line with many previous studies about adoption of soft (Sohal & Terziovsky, 2000; Sakakibara, et al. 1997; Tsang & Chan, 2000; Sum & Yang, 1993; Hinton et al. 2000; Kumar & Chandra; 2001).

The impact of hard technology and soft technology is positive on financial performance and its growth. Adoption of hard technology will increase financial performance through the cumulative effect of cost reduction and efficiency. On the other hand, soft technology can streamline the production process through the elimination of wastages or non-value added activities and reduction of work in progress. By adopting soft technology, the quality of product

and process can be improved, leading to efficiency, which in turn increase profitability (Link 1993; Beaumount & Scroeder, 1997).

The impact of soft technology compared to hard technology is greater on financial performance, but lower on financial performance growth. The possible reason for this is due to the fact that hard technology requires higher initial investment, for which the cost to be re-coup cannot be achieved immediately. Furthermore, hard technology investment can be seen as investment for the future and therefore, its impact is more on financial performance growth.

Regarding the impact of technology on performance, the following findings also need to be highlighted: First, hard technology and soft technology jointly better explain performance rather than growth. This finding is in line with Beede et al. (1998) who found that the relationship between technology adoption and growth performance tends to be positive but is often weak. However, they did not explore why the relationship between technology and growth performance is weak. Butcher et al. (1999) explained that the weakness of relationship between technology and growth performance is caused by other factors such as disruption during implementation. This could also be due to the time lag for initial investment to break-even before it shows any return.

Secondly, the adoption of hard technology and soft technology explains better the manufacturing performance than in financial performance. This is largely due to the fact that technology directly affects the manufacturing system in organization, whereas, the translation of improved manufacturing performance into financial figures may require some time lag. It is also influenced by other factors (such as strategy, marketing, and contextual factors) within the organization but outside the bounds of production functions. This is in line with Sim (2001), who cited that financial performance is the results of manufacturing performance improvement, such as low cost, high flexibility, high speed and high flexibility, although increases in manufacturing performance does not assure increases in financial performance (Sim, 2001). It can be caused by the instability of business environment, such as high inflation and economic recession so that the purchasing power of buyer decreases too. The impact of technology on performance varies across various contingencies. The finding across various contingencies of strategy and environment are discussed next.

Further, we find that the impact of soft technology is greater than hard technology in these two performance indicators. Adoption of soft technology will give more benefits than hard technology. It largely due to some factors that inhibit adoption and implementation of hard technology such as disruption during implementation, lack of integration of AMT with operation systems, skill deficiency, technical difficulties etc. These difficulties cause the impact of hard technology on manufacturing performance to be lower than that of soft technology. This finding is in line with Butcher et al. (1999) who found that some difficulties during adoption and implementation of advanced technology can inhibit the impact of technology to achieve improvement in production processes.

In addition, the adoption of hard technology and soft technology explains the manufacturing performance better than in financial performance. This is largely due to the fact that technology directly affects the manufacturing system in organization, whereas, the translation of improved manufacturing performance into financial figures may require some time lag to visualize and is also influenced by other factors (such as strategy, marketing, and contextual factors) within the organization but outside the bounds of production functions. This is in line with Sim (2001), who cited that financial performance is the results of manufacturing performance improvement, such as low cost, high flexibility, high speed, and high flexibility.

5.2. Technology-Environmental Hostility-Performance Relationship

This study postulated that the more hostile the environment, the greater is the impact of technology on performance based on the reasoning that hostile environment provides opportunities to exploit technologies for greater returns to the innovative and risk taker firms.

Environmental hostility appears to moderate the relationship between hard technology and all performance indicators, except for manufacturing performance growth.

When the level of hard technology is low to moderate the impact of hard technology on performance (financial, manufacturing, and overall performance) is greater for companies operating in hostile environment. However, when the level of hard technology is moderate to high, its impact is greater for companies operating in friendly environment. This is supported by the findings of Dean and Snell (1996) who found that in hostile environment, competitors in an industry are more likely to have implemented hard technology, thus limiting the performance impact of technology for any firms.

The moderating impact of environmental hostility on the relationship between hard technology and growth in financial performance only occurs when the level of hard technology is moderate to high and its impact is greater for companies that operated in less hostile environment. This is argued from the perspective that amongst high technologies firms, the window of opportunity for differentiation is small to provide for competitive advantage. Further, for firms with high investment in sophisticated technology they will have greater opportunity to make differentiation in the long run (growth) as these investments are future oriented.

This study also found that environmental hostility moderates the impact of soft technology on financial performance, growth in manufacturing performance and the overall performance. In general, the impact of soft technology on financial performance is greater for those companies operating in less hostile environment. This result reflects that in hostile environment (where the environment is risky), the Indonesian manufacturing companies become cautious, reactive, and risk averse. The pressure does not encourage them to be innovative, and innovation will occur when the environment is friendly and they are under less pressures.

This finding is also in line with that of Dean and Snell (1996), who found that technology performance relationship, is likely to be stronger in the case of limited competition. When competition is high, technology-performance relationship is likely to be weaker. It reveals that competitive environment; competitors in an industry are more likely to have implemented soft technology and new management practices, thus limiting the impact of any management practices on performance. On the other hand, in less hostile environment, firms with high soft technology and modern management practices can exploit these practices for greater performance.

6. IMPLICATIONS, LIMITATIONS AND SUGGESSTIONS FOR FUTURE RESEARCH

Several implications are advanced from the outcome of this research. This study finds that technology positively influence performance. Thus, Indonesian manufacturing firms should consider adopting more of both types of technology. In the real world, the evidence shows that the effective adoption and mastery of technology requires not just the establishment of new production facilities, but also the knowledge and expertise for implementing technical change. The finding of this study also implies that the impact of technology on performance is depended on the condition of business environment. Our finding indicates that the more dynamic the environment, the lower is the impact of technology.

We recognize that this study has a number of limitations. Data were collected based on perceived, self-judgment, multiple-choice questionnaire. This approach is adequate to gather a large amount of data within limited time. It should be desirable to develop a longitudinal study, but it was entirely beyond the scope and the possibilities of the study. The questionnaires address to CEO (Chief Executive Officer), thus only CEOs responded as their perception of the extent of technological adoption, the environment to be faced and the performance achieved. In this case the potential mono response bias emerges. The nature of requested data in some cases was considered confidential. It could limit their participation in this study.

Although this study has presented a systematic approach to investigate the extent of technology adoption, however, it could not cover all the important issues in this field. Through this

study, we still know little about the relationship between technology and performance. This study only considers environmental munificence as moderator, and has also not yet considers other environment perspectives such as dynamism, munificence and complexity that may also moderate the technology-performance relationship. Thus, we suggest that taking consideration to these environmental perspectives will open up a new avenue for technology –environmental variable-performance relationship. In term of methodology we suggest that using multiple respondents in an organization can reduce the problem of mono-response bias.

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