The Effect of Advanced Manufacturing technologies (AMTs) in Operational performance

(An Empirical Study on Egyptian Electronic & Electrical companies)

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Abstract

This research aims to identify the effect of Advanced Manufacturing Technologies (AMTs) in improving Operational performance (An empirical study on Electronic & Electrical companies in Egypt), it concerns with the dimensions promoting (AMTs) implementation, Expected Benefits from implementing (AMTs) and the Operational Performance Dimensions.

To do that, a Questionnaire was used as a tool to collect data needed with response (89%). The research hypotheses are the result of a pilot study and literature review and testing a number of assumptions and relationships which are connected to the Research problem.

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The results of statistical analysis identify that There is statistically significant effect at level α = 0.05 of the independent variable (AMTs) (Hardware, and Software based technologies) on the dependent variable (Operational Performance) (Dependability, Flexibility, and Speed of Delivery) in the Electronic and Electrical Companies Sector in Egypt, finally, managerial implications and recommendations for further research were stated.

Keywords:
Advanced Manufacturing Technologies (AMTs), hardware, and software based technologies, Operational performance, Flexibility, Dependability, Speed of delivery.

تأثير تكنولوجيا التصنيع المتقدمة في الأداء التشغيلي
(دراسة ميدانية على قطاع الشركات الكهربائية والإلكترونية في مصر)

الملخص

يهدف هذا البحث إلى التعرف على تأثير تقنيات التصنيع المتقدمة في تحسين الأداء التشغيلي (دراسة ميدانية على قطاع الشركات الإلكترونية والكهربائية في مصر)، وتتعلق بأبعاد تعزيز تطبيق تقنيات التصنيع المتقدمة، والفوائد المتوقعة من تطبيق تقنيات التصنيع المتقدمة ومؤشرات الأداء التشغيلي.

وللقيام بذلك، تم استخدام استبيان كأداة لجمع البيانات المطلوبة بنسبة استجابة (89%) فرضيات البحث هي نتيجة دراسة تجريبية ومراجعة الأدبيات واختبار عدد من الافتراضات والعلاقات المرتبطة بمشكلة البحث.

توصلت نتائج التحليل الإحصائي إلى انه يوجد تأثير ذو دلالة إحصائية عند مستوى $\alpha = 0.05$ للمتغير المستقل (تقنيات التصنيع المتقدمة (AMTs) (الأجهزة والبرامج القائمة علي التقنيات) على المتغير التابع (الأداء التشغيلي) (الاعتمادية، والمرونة، وسرعة التسليم) في قطاع الشركات الإلكترونية والكهربائية في مصر، وأخيرًا تم ذكر الآثار الإدارية والتوصيات لمزيد من البحث.

الكلمات المفتاحية:

تقنيات التصنيع المتقدمة, التقنيات القائمة على الأجهزة والبرامج، الأداء التشغيلي، المرونة، الاعتمادية، وسرعة التسليم.

1. Introduction

Nowadays companies struggle to survive in a global competition. Every company tries to find the best philosophy which is suitable with their strategy to gain any and every advantage among their rivals. So, Companies should be more focused on understanding their own structure in terms of processes whether they are in the Manufacturing or service sector. In this situation there is a need to understand the concept of Advanced Manufacturing Technologies (AMTs) and it's role in improving the Operational Performance in manufacturing firms.

This research illustrates the benefits of (AMTs) implementation compared with traditional manufacturing include distributed processing capability, faster throughput, reduced waste, greater dependability and control of processes, quicker responses to changes in product design and customer demand, and extreme flexibility. Thus, (AMTs) offer benefits in terms of flexibility, dependability, and speed of delivery compared with traditional technologies.

2. Previous studies

Researcher	Research Title	Research results & conclusion
Demeter, K. et al. 2024	Fourth industrial (r)evolution? Investigating the use of technology bundles and performance implications	Advanced manufacturing technologies build on traditional manufacturing technologies and do not constitute a separate direction that would point towards a fundamental digital transformation of companies. Performance effects are rather weak: out of the three technology bundles identified, only "automation and robotization" have a positive influence on

		cost efficiency, while "base technologies" and "data-enabled technologies" do not offer a competitive advantage, neither in terms of cost nor in terms of differentiation. Furthermore, while the business performance effect is positive, it is quite weak, suggesting that financial returns on technology investments might require longer time periods.
Wonga, D. et al. 2023	The effect of advanced manufacturing technology, sensing and analytics capabilities, and planning comprehensive ness on sustained competitive advantage: The moderating role of environmental uncertainty	The results of this study revealed that all four factors positively influenced SCA, and that environmental uncertainty positively moderated their effect, supporting our research model. We discuss the theoretical and practical implications of these findings. Digital manufacturing is vital to the manufacturing industry because it enables firms to produce increasingly customized, digitalized products of higher quality with a shorter lead time than can be produced without digital manufacturing.
Shahzad, F. et al. 2022	Decoupling the influence of eco-sustainability motivations in the adoption of the green industrial IoT and the effect of advanced manufacturing technologies (AMTs).	Empirical analysis shows that AMT mediates the relationship between GIIoT and GI. These outcomes expand and improve the current literature on the GIIoT and GI and (AMTs) requirements. Also, this study provide practitioners with valuable insights into Advanced Manufacturing Technologies (AMTs) that fulfill their environmental responsibilities and provide a competitive advantage in responding to customer demands quickly.

Stornelli, A. et al. 2021	Advanced manufacturing technologies (AMTs) adoption and innovation: A systematic literature review on barriers, enablers, and innovation types.	The findings of this review identify five main types of barriers and four main types of enablers to adoption. Also this study conceptualize three key stages of the AMT adoption process and classify the barriers and enablers on the basis of whether they apply to an individual stage, or whether their influence is pertinent across the whole process. This study reveal the relationship between categories of barriers and enablers associated to innovation types outcomes: product, process, service or business model innovations. The results of this study provide important implications for both managers and policy makers based on the evidence of the key barriers and enablers.
Singh, R, K.2021	Embracing advanced manufacturing technologies (AMTs) for performance improvement: an empirical study	Improvement in product quality and flexibility of operations are the motivation for (AMTs) implementation.Top management support and sound financial conditions are essential for implementing (AMTs). Successful implementation of (AMTs) helps in reducing the lead time and improving overall business performance.
Rupinderpreet, S. et al. 2021	Analyzing performance indicators of advanced manufacturing technology (AMT) implementation using Multi Criteria Decision	The results of this research illustrates that top management and education, training and incentives of employees are top rated performance indicators for successful implementation of (AMT) in a manufacturing industry. The present research could help the researchers and managers who are doing research in the domain of (AMT) implementation strategy

	Making (MCDM).	
Savastano, M.et al.2021	The interplay between digital manufacturing (DM) and dynamic capabilities (DC) : an empirical examination of direct and indirect effects on firm performance.	Digital ecosystems created by the integration of cyber-physical systems into manufacturing operations, based on Industry 4.0 enabling technologies, can create the conditions for better performance in terms of productivity gains, flexibility, reductions of energy and material consumption as well as their cost, increase in business competitiveness and improvements in working conditions.

After analyzing and evaluating previous studies the researchers concluded that there are only few researches reported how (AMTs) both Hard-ware and soft-ware based technologies improve the operational performance. So, there is a need to empirically explore the (AMTs) dimensions effect on operational performance in Electronic, and Electrical manufacturing companies specially in Egypt.

However, other previous studies like Krisztina Demeter, Levente Szasz, Bela-Gergely Racz and Lehel-Zoltan (2024) discusses Hardware based technologies or Software based technologies isolated from each other in this research hardware and software based technologies integrated and collaborated with each other in order to improve the Operational performance in Electronic, and Electrical manufacturing companies in Egypt.

Also there are only few researches like (Rupinderpreet Singh) (2021), Marco Savastano and Nicola Cucari (2021) reported Dependability, Flexibility , and speed of delivery) as operational performance dimensions.

3. Research Gap

After reviewing the literature review and conceptual framework, according to the results of the pilot study and previous studies the researcher concluded that there is organizations need to develop competitive manufacturing techniques like Advanced Manufacturing Technologies (AMTs) in their manufacturing processes for sustaining in a globally competitive market, so that the researcher could have identified the following research gaps:

-There is a need to empirically explore and understand the role of (AMTs) dimensions (Hard-ware, Soft-ware based technologies) in improving operational performance indicators by achieving high flexibility in responding to changes in customers preferences and needs, high dependability, better speed of delivery by elimination of all types of waste in Electronic and Electrical companies in Egypt.

-There is a need to identify Factors promoting Advanced Manufacturing Technologies (AMTs) implementation in Electronic and Electrical companies in Egypt.

4. Research Questions

To reconcile the above mentioned gaps, the researcher developed This Questions, they are:

1- What are types of Hard-ware, and soft-ware based technologies should be installed in order to enable manufacturing firms to achieve it’s competitive operational performance objectives?

2- What are Factors promoting Advanced Manufacturing Technologies (AMTs) implementation in Electronic and Electrical companies in Egypt?

5. Research Objectives

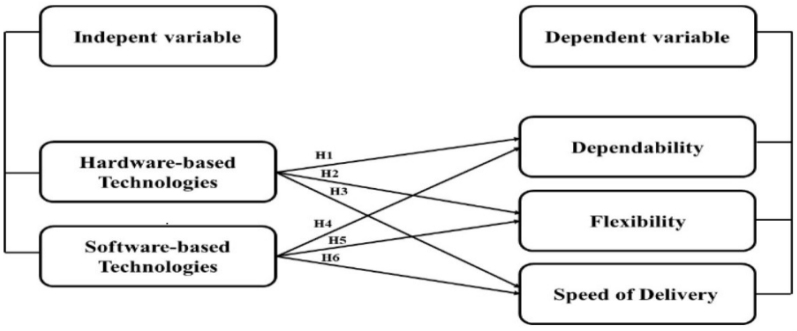
To answer the previous mentioned questions, the research objectives are:

- Identify Hard-ware, and Soft-ware based technologies should be installed in order to enable manufacturing firms to achieve it's competitive operational performance objectives.
- Investigate the factors promoting Advanced Manufacturing Technologies (AMTs) implementation in Electronic, and Electrical companies in Egypt.

6. Research Variables

After reviewing the literature, relying on pilot study results and in order to solve the research problem the researcher concluded that in order to measure the effect (AMTs) on operational performance in Electronic and Electrical companies sector in Egypt the researcher proposed two Variables of the research divided into two categories:

- Independent variable: Advanced Manufacturing Technologies (AMTs) and its Dimensions (Hard-ware, and Soft-ware based technologies).
- Dependent variable: Operational Performance Dimensions (Dependability, Flexibility, Speed of delivery)



Figure(1) Research Model

7. Research Hypotheses

Thus, the review of the literature suggested several researchable hypotheses to find out the effect of (AMTs) on Operational performance**,** The following hypotheses were developed and tested:

H1. There is no statistically significant effect of the Hardware based technologies on Dependability in the Electronic and Electrical Companies Sector in Egypt.

H2. There is no statistically significant effect of the Hardware based technologies on Flexibility in the Electronic and Electrical Companies Sector in Egypt.

H3. There is no statistically significant effect of the Hardware based technologies on Speed of Delivery in the Electronic and Electrical Companies Sector in Egypt

H4. There is no statistically significant effect of the Software based technologies on Dependability in the Electronic and Electrical Companies Sector in Egypt

H5. There is no statistically significant effect of the Software based technologies on Flexibility in the Electronic and Electrical Companies Sector in Egypt

H6. There is no statistically significant effect of the Software based technologies on Speed of Delivery in the Electronic and Electrical Companies Sector in Egypt

8. Research Methodology

The construction of the questionnaire

The questionnaire was constructed based on five successful studies previously conducted in related fields of study, i,e, Samson and Swink, (2023) study. Rajesh Kumar Singh(2021) study, Bruno and D'Antonio (2018) study, Maghazei et al.

(2022) study, Boyer and Pagell (2000) study. The modifications made to these studies were determined by the researcher's own knowledge of the Electronic and Electrical companies in Greater Cairo and the theoretical issues discussed previously.
Four hundred and eighty five questionnaires five questionnaires were sent to 97 selected Electronic and Electrical companies in greater cairo,

Table (1) Research Sample response rate

Sent Questionnaires	485
Total Response	450
Final usable Responses	435
Response Rate as percentage of sending Questionnaires	89%

In this research, Questionnaires constructed based on results of pilot study, literature review, previous studies there are two questionnaires, each questionnaire is designed as a five-point Likert Scale which is: (1= strongly disagree, 2= Disagree, 3=Neutral, 4=Agree and 5= Strongly agree).

Validity the of questionnaire

Having established an approximate schedule of questions relevant to the issues under investigation in the current study, i.e. Questionnaire on (AMTs) (Hardware, and software based technologies), and Questionnaire on Operational performance Dimensions (Dependability, Flexibility, and Speed of delivery), a pilot study was conducted to confirm whether the theoretical and practical issues identified by the author were appropriate to Electronic and Electrical companies in Greater Cairo.
Questionnaires were provided in Arabic language since Arabic is the main language. The Arabic version was translated from English and then back-translated to ensure equivalency. The questionnaire was validated (face validity) by Three levels

Employees (Top, Middle, and First line levels) in each company of 97 Electronic and Electrical Companies in Greater Cairo) selected.

Reliability of the questionnaire

The Chronbach's a coefficient was used to ensure the accuracy and the reliability of the questionnaire since the coefficient describes the degree to which scores on a measure represent something other than measurement error (Glass and Hopkins, 1996, p. 577). Chronbach's a for reliability indicated high consistency of the entire instrument (0.92), which confirmed the cohesiveness of items within the scale itself and the consistency of the conclusions to be drawn from the analysis.

The sample

The population is Electronic and Electrical companies in Egypt, and the sample consists of 97 Electronic and Electrical companies in Greater Cairo (56 Electronic companies + 41 Electrical companies) in greater Cairo,

The sample was collected at the base of the largest companies in Investments and returns and sales of the Electronic and Electrical companies in greater Cairo and this confirms on the necessity of collecting data through Scanning the holding and leading companies in the Electronic and Electrical companies.as illustrated in table (2)

Table (2) performance Indicators for Electronic and Electrical companies in Greater Cairo *Source:(ida) Industrial Development Authority-2023*

	No of Enterprises	Investment costs (in pounds)	Number of employees	Salaries (in pounds)
Electronic	56	3613081175	8762	2850000
Electrical	41	2008458000	14354	444760000

9. Statistical analysis

After collecting Questionnaires with response rate of 89% the researcher will calculate stability of data collection tool using Cronbach's Alpha method to calculate all constructs of the questionnaire, the researcher test the hypothesis of the study through check the relationship between AMTs and Operational Performance through calculation of Pearson correlation coefficient between them, then test the effect of independent variable and dependent variable through using simple and multiple regression models between them.

1. Evaluation of Hardware based technologies

Table (3) shows the answers of the employee's perception for Hardware based technologies which has four statements numbered (1-4) in the survey, and it is clear that it has mean equal (3.970) which is a moderate value, against standard deviation equal (0.859) and Coefficient of variation equal (21.64%). Also, the mean for these four statements ranges between (3.786, 4.113), standard deviation ranges between (0.097, 1.027), and Coefficient of variation ranges between (24.55%, 24.97%) and these results indicate employee's perception for Hardware based technologies is moderate.

Table (3) Employees' perception for Hardware based technologies

Ser.	Hardware based technologies	Mean	Std. Dev.	Cov. Var %
1	The company uses robots to apply modern technologies in manufacturing.	4.113	1.027	24.97%

2	The company uses computer numerical control machines.	4.025	0.999	24.84%
3	The company is activating an autonomous material handling system.	3.786	0.930	24.58%
4	The company applies a flexible manufacturing system.	3.955	0.097	24.55%
Mean and Std Dev.		3.970	0.859	21.64%

To confirm the significance of the previous results in the population (1 sample t) test was performed between the employee's perception for Hardware based technologies of the independent variable (AMTs) and expected value (3) and the results of this test are shown in Table (4):

Table (4) (1-Sample T) for Hardware based technologies

Hardware based technologies	**Mean**	**Stdev**	**Std error**	**P value**
	3.970	0.859	**0.043**	**0.000**

It is clear from Table (4) that there is a significant difference between employee's perception values for Hardware based technologies which greater than the expected value (3) proposed by researcher and that proved through (P value = 0.000) which is less than (0.05) and this means reject Null hypothesis, and accept alternative hypothesis which validate that there is a significant difference for employee's perceived value for this dimension of independent variable that greater than the expected value.

2. Evaluation of Software based technologies

Table (5) shows the answers of the employee's perception for the second dimension Software based technologies which has three statements numbered (5-7) in the survey, and it is clear that it has mean equal (3.963) which is a moderate value, against standard deviation equal (0.832) and Coefficient of variation equal (20.99%). Also, the mean for these three statements ranges between (3.882, 4.005), standard deviation ranges between (0.910, 0.969), and Coefficient of variation ranges between (24.12%, 24.95%) and these results indicate employee's perception for Software based Technologies is moderate.

Table (5) Employees' perception for Software based technologies

Ser.	Software based technologies	Mean	Std Dev.	CovVar %
5	The company relies on computer-aided design and innovation.	**4.005**	**0.910**	**22.72%**
6	The company relies on some computer-aided manufacturing techniques.	**3.882**	**0.969**	**24.95%**
7	The company applies Integrated Manufacturing Techniques to products.	**4.003**	**0.965**	**24.12%**
Mean and Std Dev.		**3.963**	**0.832**	**20.99%**

To confirm the significance of the previous results in the population (1 sample t) test was performed between the employee's perception for the Software based technologies and

expected value (3) and the results of this test are shown in Table (6):

Table (6) (1-Sample T) for Software based technologies

Software based technologies	Mean	Stdev	Std error	P value
	3.963	0.832	0.042	0.000

It is clear from Table (6) that there is a significant difference between employee's perception values for Software based technologies which greater than the expected value (3) proposed by researcher and that proved through (P value = 0.000) which is less than (0.05) and this means reject Null hypothesis, and accept alternative hypothesis which validate that there is a significant difference for employee's perceived value for this dimension that greater than the expected value.

3.Evaluation of Operational Performance (OP)

Table (7) shows the answers of the employee's perception for Operational Performance (OP) in the survey, and it is clear that it has mean equal (3.987) which is a moderate value, against standard deviation equal (0.808) and Coefficient of variation equal (20.27%). and these results indicate employee's perception for independent variable is moderate in sample.

Table (7) Employees' perception for Dependent Variable (OP)

Dependent Variable	Mean	Std Dev.	Coefficient of variation %
(Operational Performance (OP))	3.982	0.779	19.57%

To confirm the significance of the previous results in the population (1 sample t) test was performed between the employee's perception and expected values for the study and the results of this test are shown in Table (8)

Table (8) (1-Sample T) for the dependent variable(OP)

Dependent Variable	Mean	Stdev	Std error	P value
	3.982	0.779	0.039	0.000

It is clear from Table (8) that there is a significant difference between (OP) which greater than the expected value (3) proposed by researcher and that proved through (P value = 0.000) which is less than (0.05) and this means reject Null hypothesis, and accept alternative hypothesis which validate that there is a significant difference for employee's perceived value for (OP) that greater than the expected value, and to validate these results the study prove this for (Dependability, Flexibility, Speed of Delivery) as presented in following sections:

3.1Evaluation of Dependability

Table (9) shows the answers of the employee's perception for Dependability which has three statements numbered (1-3) in the survey, and it is clear that it has mean equal (3.970) which is a moderate value, against standard deviation equal (0.859) and Coefficient of variation equal (21.64%). Also, the mean for these four statements ranges between (3.786, 4.113), standard deviation ranges between (0.097, 1.027), and Coefficient of variation ranges between (24.55%, 24.97%) and these results indicate employee's perception for Dependability is moderate.

Table (9) Employees' perception for Dependability

Ser.	Dependability	Mean	Std. Dev.	Cov. Var %
1	The company calculates the percentage of delay in delivering orders to customers.	4.121	0.964	23.40 %
2	The company is studying the reasons for deviation from the specified delivery dates.	4.040	0.942	23.31 %
3	The company adheres to set production schedules.	3.907	0.926 0	23.70 %
Mean and Std Dev.		4.023	0.832	20.67 %

To confirm the significance of the previous results in the population (1 sample t) test was performed between the employee's perception for Dependability and expected value (3) and the results of this test are shown in Table (10):

Table (10) (1-Sample T) for Dependability

Dependability	Mean	Stdev	Std error	P value
	4.023	0.832	**0.042**	**0.000**

It is clear from Table (10) that there is a significant difference between employee's perception values for Dependability which

greater than the expected value (3) proposed by researcher and that proved through (P value = 0.000) which is less than (0.05) and this means reject Null hypothesis, and accept alternative hypothesis which validate that there is a significant difference for employee's perceived value for this dimension of dependent variable that greater than the expected value.

3.2 Evaluation of Flexibility

Table (11) shows the answers of the employee's perception for Flexibility which has four statements numbered (4-7) in the survey, and it is clear that it has mean equal (3.934) which is a moderate value, against standard deviation equal (0.796) and Coefficient of variation equal (20.22%). Also, the mean for these four statements ranges between (3.869, 4.015), standard deviation ranges between (0.834, 1.009), and Coefficient of variation ranges between (21.04%, 26.08%) and these results indicate employee's perception for Flexibility is moderate.

Table (11) Employees' perception for Flexibility

Ser.	Flexibility	Mean	Std Dev.	CovVar %
4	The company calculates the time needed to develop a new product or service.	**3.965**	**0.834**	**21.04%**
5	The company has the ability to change the assortment of products offered.	**3.887**	**0.943**	**24.25%**
6	The company has the ability to operate at its maximum capacity.	**3.869**	**1.009**	**26.08%**
7	The company has the ability to modify and develop production	**4.015**	**1.007**	**25.09%**

	schedules.			
Mean and Std Dev.		**3.934**	**0.796**	**20.22%**

To confirm the significance of the previous results in the population (1 sample t) test was performed between the employee's perception for Flexibility and expected value (3) and the results of this test are shown in Table (12):

Table (12) (1-Sample T) for Flexibility

	Mean	**Stdev**	**Std error**	**P value**
Flexibility	**3.934**	**0.796**	**0.040**	**0.000**

It is clear from Table (12) that there is a significant difference between employee's perception values for Flexibility which greater than the expected value (3) proposed by researcher and that proved through (P value = 0.000) which is less than (0.05) and this means reject Null hypothesis, and accept alternative hypothesis which validate that there is a significant difference for employee's perceived value for this dimension of dependent variable that greater than the expected value.

3.3 Evaluation of Speed of Delivery

Table (13) shows the answers of the employee's perception for Speed of Delivery which has three statements numbered (8-10) in the survey, and it is clear that it has mean equal (3.934) which is a moderate value, against standard deviation equal (0.796) and Coefficient of variation equal (20.22%). Also, the mean for these four statements ranges between (3.869, 4.015), standard deviation ranges between (0.834, 1.009), and Coefficient of variation ranges between (21.04%, 26.08%) and these results indicate employee's perception for speed of delivery is moderate.

Table (13) Employees' perception for Speed of Delivery

Ser.	Speed of Delivery	Mean	Std Dev.	Cov Var %
8	The company calculates the waiting time for customers to receive their orders.	**4.030**	**0.929**	**23.05%**
9	The company compares the established production schedules with what was actually achieved.	**3.867**	**0.916**	**23.68%**
10	The company calculates the time required to complete the production cycle.	**4.076**	**0.966**	**23.71%**
Mean and Std Dev.		**3.991**	**0.812**	**20.34%**

To confirm the significance of the previous results in the population (1 sample t) test was performed between the employee's perception for Speed of Delivery and expected value (3) and the results of this test are shown in Table (14):

Table (14) (1-Sample T) for third dimension Speed of Delivery

Speed of Delivery	Mean	Stdev	Std error	P value
	3.991	**0.812**	**0.041**	**0.000**

It is clear from Table (14) that there is a significant difference between employee's perception values for Speed of Delivery

which greater than the expected value (3) proposed by researcher and that proved through (P value = 0.000) which is less than (0.05) and this means reject Null hypothesis, and accept alternative hypothesis which validate that there is a significant difference for employee's perceived value for this dimension of dependent variable that greater than the expected value.

Regression Models between dimensions of (AMTs) and dimensions of (OP)

To confirm and validate the correctness of the hypotheses, the researcher tests the hypotheses using six simple regression models between them:

Hypothesis one

Table (15) shows the result of applying regression model between Hardware based technologies and Dependability, it is clear that the model is significant through (P value = 0.000) which less than (0.05) and confirmed by (F Calculated = 859.38) which greater than (F Tabulated = 3.865), and the effect is evaluated through coefficient of determination $\mathbf{R^2 = 0.685}$ that means (68.5%) of the changes in the (Dependability) of dependent variable returned to changes in (Hardware based technologies) of independent variable and its Regression equation is:

Dependability = 0.842 + 0.801 x Hardware

Table (15) First Regression Model between (Hardware) and (Dependability)

Variable	Source	DF	SS	MS	F Calculated	P value
Hard	Treatment	1	187.655	187.655	859.38	0.000

ware	**Error**	**395**	**86.255**	**0.218**		
	Total	**396**	**273.910**			

Hypothesis two

Table (16) shows the result of applying regression model between (Hardware based technologies) and (Flexibility), it is clear that the model is significant through (P value = 0.000) which less than (0.05) and confirmed by (F Calculated = 770.22) which greater than (F Tabulated = 3.865), and the effect is evaluated through coefficient of determination $\mathbf{R^2 = 0.661}$ that means (66.1%) of the changes in the (Flexibility) of dependent variable returned to changes in (Hardware) of independent variable and its Regression equation is:

Flexibility = 0.945 + 0.753 x Hardware

Table (16) Second Regression Model between (Hardware) and (Flexibility)

Variable	Source	DF	SS	MS	F Calculated	P value
Hardware	**Treatment**	**1**	**165.633**	**165.633**	**770.22**	**0.000**
	Error	**395**	**84.947**	**0.215**		
	Total	**396**	**250.580**			

Hypothesis three

Table (17) shows the result of applying regression model between (Hardware) and (Speed of Delivery), it is clear that the model is significant through (P value = 0.000) which less than (0.05) and confirmed by (F Calculated = 784.35) which greater

than (F Tabulated = 3.865), and the effect is evaluated through coefficient of determination $\mathbf{R^2 = 0.665}$ that means (66.5%) of the changes in the (Speed of Delivery) of dependent variable returned to changes in (Hardware) of independent variable and its Regression equation is:

Speed of Delivery = 0.932 + 0.771 x Hardware

Table (17) Third Regression Model between (Hardware) and (Speed of Delivery)

Variable	Source	DF	SS	MS	F Calculated	P value
Hardware	Treatment	1	173.560	173.560	784.35	0.000
	Error	395	87.410	0.221		
	Total	396	260.970			

Hypothesis four

Table (18) shows the result of applying regression model between (Software) and (Dependability), it is clear that the model is significant through (P value = 0.000) which less than (0.05) and confirmed by (F Calculated = 770.13) which greater than (F Tabulated = 3.865), and the effect is evaluated through coefficient of determination $\mathbf{R^2 = 0.661}$ that means (66.1%) of the changes in the (Dependability) of dependent variable returned to changes in (Software) of independent variable and its Regression equation is:

Dependability = 0.802 + 0.813 x Software

Table (18) Fourth Regression Model between (Software) and (Dependability)

Variable	Source	DF	SS	MS	F Calculated	P value
Software	Treatment	1	181.047	181.047	770.13	0.000
	Error	395	92.863	0.235		
	Total	396	273.910			

Hypothesis five

Table (19) shows the result of applying regression model between (Software) and (Flexibility), it is clear that the model is significant through (P value = 0.000) which less than (0.05) and confirmed by (F Calculated = 608.90) which greater than (F Tabulated = 3.865), and the effect is evaluated through coefficient of determination $\mathbf{R^2 = 0.607}$ that means (60.7%) of the changes in the (Flexibility) of dependent variable returned to changes in (Software) of independent variable and its Regression equation is:

Flexibility = 0.983 + 0.745 x Software

Table (19) Fifth Regression Model between (Software) and (Flexibility)

Variable	Source	DF	SS	MS	F Calculated	P value
Software	Treatment	1	151.983	151.983	608.90	0.000
	Error	395	98.597	0.250		

	Total	**396**	**250.580**			

Hypothesis six

Table (20) shows the result of applying regression model between (Software) and (Speed of Delivery), it is clear that the model is significant through (P value = 0.000) which less than (0.05) and confirmed by (F Calculated = 755.76) which greater than (F Tabulated = 3.865), and the effect is evaluated through coefficient of determination $\mathbf{R^2 = 0.657}$ that means (65.7%) of the changes in the (Speed of Delivery) of dependent variable returned to changes in (Software) of independent variable and its Regression equation is:

Speed of Delivery = 0.857 + 0.791 x Software

Table (20) Sixth Regression Model between (Software) and (Speed of Delivery)

Variable	Source	DF	SS	MS	F Calculated	P value
Software	Treatment	1	171.389	171.389	755.76	0.000
	Error	395	89.581	0.227		
	Total	396	260.970			

10. The Managerial Implications

Based on the findings and results of the analyzed data. The following managerial implications will be introduced to the Electronic and Electrical companies in Egypt:

1- Electronic and Electrical companies in Egypt should build strong IT infrastructure in order to facilitate the information sharing internal and external the firms especially, with suppliers.
2- Electronic and Electrical companies in Egypt should change their culture in order to cope with new production systems.
3- Electronic and Electrical companies in Egypt should educate and train their employees in (AMTs) techniques.
4- Electronic and Electrical companies in Egypt should Recruit qualified individuals which help the company to reach their business objectives.
5- Manufacturers need an equally strong company wide commitment to continuous improvement.
6- Electronic and Electrical companies in Egypt should continuously improve their performance and acquire new competitive advantages.
7- Electronic and Electrical companies in Egypt should listen to customers by identifying their needs.
8- Electronic and Electrical companies in Egypt should use Operations performance Indicators always to measure their performance.

11.Recommendations for future research

This study focuses on the effect of factors promoting Advanced Manufacturing Technologies adaption and Human-ware based technologies in improving Operations performance (an empirical study on Electronic, and Electrical companies in Egypt)

This study also focuses on Advanced Manufacturing Technologies Dimensions (Factors promoting Advanced Manufacturing Technologies adoption, and Human-ware based technologies) and Operations performance Dimensions (Dependability, Flexibility, and Speed of Delivery)

Therefore, other researchers can study the following fields:

1- Case studies inside companies that have applied Advanced Manufacturing Technologies system.

2- A framework roadmap for implementing Advanced Manufacturing Technologies in local governmental entities.

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