

# Role of Advanced Manufacturing Technology, Human Capital and Employee Empowerment to Enhance Manufacturing Industry Supply Chain Performance

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**Abstract-** Human resource and Technology are the important assets of the organization. For this reason, the purpose of the present study was to examine the impact of advanced Manufacturing technology, human capital and employee empowerment on supply chain performance, furthermore, the mediating role of organizational innovation is examined as well. The data is collected from the employees of manufacturing firms in Indonesia in the form of questionnaire. The response rate of the current study is 63.4 percent. For analysis, Partial least square (PLS) software is specifically used for the statistical analysis of data and presenting the results that are obtained for the model, since PLS is capable of flexibly generating, estimating as well as validating the complex models. The findings of the study support all the proposed hypothesis showing the importance of human capital and technology to bring innovation and improve the performance of supply chain. The findings of the present study are important for the practitioners of supply chain sector.

**Keywords;** Employee Empowerment, Human Capital, Advanced manufacturing technology, Organizational Innovation, Supply chain Performance, Manufacturing sector, Indonesia

## 1. Introduction

In order to attain economic growth in Indonesia, it is very important that their manufacturing sector should be upgraded and diversified. The overall economy of Indonesia is needed to be shifted towards upper middle-class economy. Overall, Indonesia is 10<sup>th</sup> largest manufacturing country around the globe. One fourth of the national GDP of Indonesia is gathered from the manufacturing sector of Indonesia. More than 25 million employees are associated with Indonesian manufacturing sector. Currently Indonesia is going through reforms and growing at the rate of more than 5% per year since last two years. It's the perception of the Indonesian government that manufacturing sector of Indonesia will be the economic engine soon in coming five years [1].

Since the evolution of term Supply chain management, there exist confusion that regarding what this term exactly is. In the development of measurement systems, there is very less interest. In the concepts of logistics, a number of scholars and practitioners continue to use these terms interchangeably. It's been observed SCM can be used as the more than one concepts [2]. In order to manage the important processes through-out the organizational network, SCM is continued to be accepted as important factor. The integration of important processes of business from the base supplier to the end user is SCM. Through SCM provides information, services and products which add value for all stakeholders and customers [3].

In the context of business, it is very important for organizations to measure the performance on the regular basis. It is key to understand what performance is in order to understand the measurements of performance. As mentioned by studies, performance of organization is perceived as subjective. Its dependency on the goals and targets which firm make it for themselves. On the other hand, in order to meet goals and objectives of the organization, ability of the organization is the performance [4]. The main purpose of organizational performance is to improve the competencies of managers, accessibility towards the finance and building the organizational capacity to improve the performance of supply chain. There exists competition at the supply chain level among the organizations, therefore it is key to measure the supply chain performance of the organization. Moreover, competition among firms is increasing day by day. In order to compete in the market with other firms, it is very important for them to focus on the performance and measure it on the regular basis on the basis of supply chain [5].

Sustainable competitive advantage can be gained by the organization through innovation. A number of competitive problems are being faced by a lot of organizations in the environment because the environment is changing rapidly day by day. Therefore, the top management of the organization along with other employees must use innovation and creativity to meet the rapid changes of the organization [6].

Empowerment is the philosophy in which the decision makers and managers of the organizations enrich the jobs of other employees and power is given to them to perform a number of different tasks. Knowledge of the workers is the main concern for the industrial organizations in the 20<sup>th</sup> century and the knowledge is the main drivers if the business. Individual participation, proper information and autonomy is the emphasize of empowerment in the organizations. To get the empowerment, top managers must ensure there exist rewards to work, power, knowledge and information [7]. Therefore, autonomy is created among employees through empowerment, power and responsibility is shared among the employees. There are a number of factors which are playing the role of facilitator for empowerment. These factors include self-esteem, maturity, competence, enthusiasm and challenging job. Training and development can play an important role to enhance the mentioned factors because they are playing the catalyst role to promotes the involvement and empowerment. For this reason, technical skills, creativity and experience of the workers are key for the success of organization and also considered as the important organizational asset [8].

For the development of technology, human capital is one of the key factors and important as well for efficient use of technology. Moreover, it is very difficult to chase, control and assess human resource as compare to other resources of organization. It is because they are the assets which are based on knowledge. The strategies of most of the managers are dependent upon the financial resources, physical assets and technologies [11]. Moreover, they want to focus the strategies in which tangible assets of organizations are involved. In today's economy, globalization is the important phenomena. The growth if the organizations is dependent upon the competitive advantage that the organizations develop in this competitive advantage. Dependent upon technology and other physical assets do not create competitive advantage for the organization. For this reason, organizations must keep focus on the intellectual and human capital. So, they can gain and sustain competitive advantage for the organization. Human resource is important for the improvement of organization. On the basis of above discussion, human resource within the organization have gained importance to gain competitive advantage [9].

In order to improve overall effectiveness of organization, advance manufacturing technology (AMT) plays important role. It's been argued in past literature that there are a number of benefits of using AMT. for instance, AMT plays important role to gain profitability, market share, efficiency, productivity, quality and cost reduction. Thus, it has important role to play in improving manufacturing and gaining competitive advantage. In recent past, researchers have focused on manufacturing, planning and design which can be assessed as innovation process. For the utilization of process products, opportunities are provided by AMT. Moreover, it enhances competitive advantage, shorten life cycle and establish competitive advantage for the organization. It's been revealed in past studies that human side is ignored in for using AMT [10].

The objective of current study is to explore supply chain performance relationship with employee

empowerment, human capital, advanced manufacturing technology. Moreover, organizational innovation mediates the relationship of employee empowerment, human capital, advanced manufacturing technology with supply chain performance.

## 2. Literature Review

### 2.1. Supply Chain Performance

The manufacturers have invested heavily to set well defined performance indicators for Supply chain management in order to enhance its productivity, but high frequency of events and their complexity has always hampered this effort [12, 45-46]. When disregarding the critical supply chain management indicators, only a few supply chains are left that can be called as effective or efficient. Classical SCP indicators as defined by past researches include finance, turn-around time, flexibility and customer satisfaction but these measures are incomplete when universality, consistency and inclusiveness criteria is considered. Studies have categorized SCP measures into three broad classes; a) tactical processes, b) strategic processes, c) operational processes. Six categories are: (1) planning metrics; (2) testing of supply linkages; (3) evaluation of production/manufacturing; (4) delivery performance parameters; (5) customer compliance/satisfaction; and (6) logistical supplies. [12] has proposed to include customer satisfaction and other operational indicators in for performance measurement. Similarly, [12] has included cost, process reliability, conformity to agreed specifications and quality improvement in SCP measures [13].

### 2.2. Organizational Innovation

Inclusion of something new or novel (any service, technology, process, an idea) in any organization is defined as organizational innovation. As defined by [15], organizational innovation is "the creation or adoption of an idea or behaviour new to the organization". Similarly, [16] has defined innovation as "adoption of an internally generated or purchased device, system, policy, program, process, product, or service that is new to the adopting organization" [14].

Despite the fact that all innovations are aimed at improving the performance, this is not true for all new inclusions. Invention differs from innovation by the fact that former is based on entirely novel and new product, system or strategy. [15], who has been a leading researcher on organizational innovation has stated that there are three different classes of innovations each one concerning a different research question: 1) structural theory of an organization (e.g. industrial economy theory), 2) organizational cognition theories (e.g. learning), 3) organizational evolution theories (e.g. adaptation) [14].

### 2.3. Employee Empowerment

Empowerment is defined as an enabling instrument of power that nourishes the sense of control and achievement via both, the perception and process itself. It was revealed in a study that those members of an organization which were given more control were much more likely to achieve their defined goals when compared with other

members [18]. Empowerment is an intrinsic value which drives an employee to perform a task using his or her positively valued experiences. This is due to the fact that empowerment lets an employee feel freedom, discretion and personal connection to the task and fosters their ability to have a positive impact on the organization. The sense of empowerment can be induced in an employee without actually giving him/her the power. This can be done by listening more carefully to the employee, responding to the comments, providing sufficient training, giving them some important tasks, letting them freely access the required information, being more resourceful, encouraging them and evaluating them on the basis of performance. Empowerment has a huge influence on the model of an organizational and it may lead to entire restructuring of the model or reshuffling of job responsibilities. Thus, higher management should always be inclusive about employee empowerment initiatives [17].

#### 2.4. Human Capital

The idea of human capital has its root buried deep in economics literature. Neither physical nor financial capital encompasses Human capital. On the contrary, it includes skill, learning, knowledge and health of an individual. Human capital has a unique character; it can modulate and amplify itself and other inputs. This particular character is the reason behind complex dynamics of global economy [20].

Human capital is defined as a consortium of knowledge, features, motivation and innovation which people use to fuel their goals. Capital includes investment in human resources and its management to increase the efficacy of process. Thus, learning organizations are always investing heavily in human resource because of the valuable outcomes of humans with different qualities. Generally, educational, skill and cultural features are included in the organization capital, thus creating value added for the organization [19].

#### 2.5. Advanced manufacturing technology

AMT is a multi-dimensional idea which is related to the computer-integrated factory automation and included technologies. In order to effectively analyze the adoption of AMT, it is divided into three major categories including designing, process and administrative AMT (keeping in mind prior studies). Process AMT includes those technologies which are directly responsible for controlling manufacturing processes and generating information regarding process. These technologies include robotics, AI systems, computer aided manufacturing and control systems [21].

AMT is defined as a group of computer-based technologies, which includes computer-aided design, computer-aided manufacturing, manufacturing resources planning, robotics, group technology, flexible manufacturing systems, automated materials handling systems, computer numerically controlled (CNC) machine tools, and bar-coding or other automated identification techniques and any technology, which is new or advanced to a company when compared to its previous or current manufacturing technology. The application of AMT in supply chain management leads to the collaboration of tasks upstream and downstream of the process, cost

reduction, uniformity of quality and effective use of raw materials. Thus, AMT ultimately increase competitive advantage and uplifts performance [22].

### 2.6. Hypotheses development

#### 2.6.1. Organizational Innovation and Supply chain Performance

Researcher asserted that performance and effectiveness of organization is heightened due to innovation of organization. Scholars argued that organizational changes are led by innovation at organizational and employees' level. Thus, it has impact on the performance of organization. Scholars noted that the organizations that are open to new ideas and adapt fresh technologies have more chance to improve performance of supply chain [12]. Business problems are solved by innovativeness. Moreover, organizations get success and foundation regarding the success through organizational innovation. The organizational performance is impacted by the capacity of organization to innovate [23]. Generally, the basic pre-requisite of survival and success of organization is innovativeness. Firms can get strategic means by which they can compete external and internal challenges of the organization. A number of different positive outcomes of innovativeness are pointed out by the researchers regarding innovativeness. These positive outcomes include efficiency, effectiveness and different approaches towards distribution all of which have impacts on SCP [13]

Organizations always looks for a number of different ways. In recent past the focus of organizations have shifted from tangibility to the relationship with supply chain. With the help of innovation and relational exchange, organizations can obtain SCP [24]. In the context of logistics, researchers found that there exists positive impact of technology on the performance of supply chain. Technology plays important role in context of innovativeness. Researchers also pointed out that product transformation and innovativeness is involved in the process of innovation. Additionally, processes and services are also involving in the innovation which enhance the customer satisfaction as well [25].

H1: Organizational Innovation and Supply chain Performance are significantly related to each other.

#### 2.6.2. Employee Empowerment and Organizational Innovation

The features related to social structure such as leader's performance, culture of organization and working environment play important role and linked to the empowerment of employees. Some of the other structural factors that impacts the empowerment include effectiveness along with innovation [26]. From the level of entry, it is critical for employees to assess the opportunities and minimization of obstacles. Empowerment of employees is also dependent upon eliminating the hierarchy of organization, support in terms of socio-political and information as well. The level of structural and social empowerment depends upon making sure that employees will take part in the process of decision making and making the organizational hierarchy small. As a result, management of organization get more

space as responsibility and authority is shared among employees. It brings innovativeness, creativity and improve the performance of organization. It is safely to say that the empowerment of organization is removing all the circumstances which weaken the relationship of organization with employees [27].

H2: Employee Empowerment and Organizational Innovation are significantly related to each other.

H3: Organizational innovation mediates the relationship between Employee Empowerment and Supply chain Performance.

### 2.6.3. Human Capital and Organizational Innovation

Researchers mentioned in a number of different studies that human is the most important capital of the organization. The main dependency of human capital is upon the knowledge of an individual. Within the organization, each and every employee is important for human capital. When an employee leaves the organization, the knowledge leaves the organization as well. Scholars defined human capital as the ability of a person, skills and knowledge through which professional services are produced. The beginning of innovation is also dependent upon human capital [28].

Studies revealed that human capital plays very important role in order to introduce innovation and holding the required knowledge within the organization. Therefore, the most important and critical factor of organizational productivity and performance is human capital [29].

H4: Human Capital and Organizational Innovation are significantly related to each other.

H5: Organizational innovation mediates the relationship between Human Capital and Supply chain Performance.

### 2.6.4. Advanced manufacturing technology and Organizational Innovation

Past studies have pointed out that there are a number of benefits of using AMT. These benefits include enhancing profitability and market share, improving quality, reducing cost, reducing delivery time, enhancing flexibility and improving productivity of organization. As a result, the performance of firm is increased, and organizations get competitive advantage. In the current decade, it's been pointed out by the researchers that AMT is the basic source of organizational innovation. By using AMT, organizations can minimize the pollution, management techniques are shared, enhance the organizational capability to work, bring enhancement to organizational and employee performance, thus develop competitive advantage [30].

Additionally, organizations may also get engage in activities like innovation through the usage of AMT. Most of the times, AMT bring dramatic changes to the operations and technologies of the organization. From the point where AMT is adopted by the organizations in the beginning, the usage of AMT brings usage of innovation in the process and green products for the organization [31].

Transformation is the basic function of supply chain management. Moreover, responsiveness of customers and

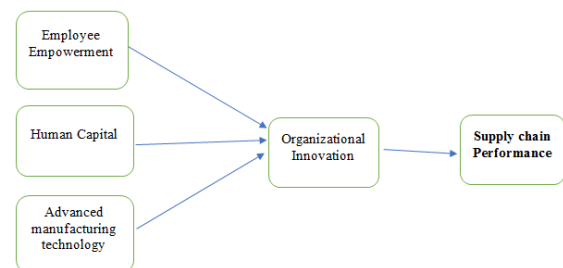
cost effectiveness is another important function of SCM. For all of these functions, innovation is the basic requirement of the organization. By using AMT by organization, the firms can improve performance, quality, being flexibility, reduce cost and time to the market [32].

H6: Advanced manufacturing technology and Organizational Innovation are significantly related to each other.

H7: Organizational innovation mediates the relationship between Advanced manufacturing technology and Supply chain Performance.

## 2.7. Research Framework

Following framework is developed from the above literature:



## 3. Methodology

Once the data collection process is carried out, we obtained the descriptive as well as inferential statistics as the data analysis techniques. The hypotheses that have been established based on the literature review were examined using various analyses techniques. The Statistical Package of Social Sciences (SPSS) v.23 and Smart PLS 3.0 were employed for analyzing the data obtained in this study. For the purpose of this research, data analysis methods were chosen subject to the characteristics of the variables and the research questions [33]. Therefore, this study adopted a structural equation modeling (SEM) approach for analyzing the data in this research.

Quantitative scholars have extensively discussed the significance of SEM approach as an effective tool to examine multiple associations existing among the variables [34]. However, the SEM models were considered as superior in estimating moderation and mediation effects as compared to the regression models [35].

Partial least square (PLS) software is specifically used for the statistical analysis of data and presenting the results that are obtained for the model, since PLS is capable of flexibly generating, estimating as well as validating the complex models. Studies have referred PLS-SEM as a second-generation SEM, which is relatively new and works well for SEM models involving an array of cause and effect relationships and latent variables [36]. Data collection was done from the employees of firms of manufacturing sector Indonesia. The response rate of the current study is 63.4 percent.

## 4. Results

There are two steps involved in PLS-SEM, i.e. assessing measurement model or outer model and the structural model or inner model, while for the covariance-based SEM, the two important criteria are Goodness of measure (GOM) and Goodness of fit (GOF) [37]. According to [38] the outer or the measurement model is the depiction of structural relationships existing between the latent variables and their indicators.

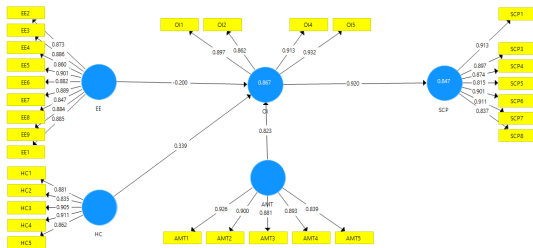


Figure 1. Measurement Model

Calculating PLS algorithm for the first time presented poorly loaded items, such as, SCP3 (0.517), and was removed from the model following the above-mentioned criteria for outer loadings. Afterwards, OI3 (0.649) was also deleted leading to an increase in the average variance extracted and composite reliability values. In addition, the item AMT6 (0.642) was also deleted to improve the constructs' AVE and CR values.

Table 1. Outer Loadings

	AMT	EE	HC	OI	SCP
AMT1	0.926				
AMT2	0.900				
AMT3	0.881				
AMT4	0.893				
AMT5	0.839				
EE2		0.873			
EE3		0.886			
EE4		0.860			
EE5		0.901			
EE6		0.882			
EE7		0.889			
EE8		0.847			
EE9		0.884			
HC1			0.881		
HC2			0.835		
HC3			0.905		
HC4			0.911		
HC5			0.862		
OI1				0.897	
OI2				0.862	
OI4				0.913	

OI5				0.932	
SCP1					0.913
SCP3					0.897
SCP4					0.874
SCP5					0.815
SCP6					0.901
SCP7					0.911
SCP8					0.837
EE1		0.885			

The convergent and discriminant validities must be considered while measuring the model, i.e. through observing the average variance extracted (AVE) and composite reliability (CR) [39]. In addition, the cross loadings and outer loadings were also computed to assess the indicators reliability. Studies suggests composite reliability as a powerful analytical technique which can efficiently determine the internal consistency reliability of the measures. For assessing composite reliability, researches have recommended to follow [40] criteria i.e. the CR value must exceed 0.70, whereas, 0.60-0.70 range is somehow tolerable when there is exploratory type of research. Moreover, internal consistency is considered as scarce if the CR value turns out to be less than 0.60 [41].

Table 2. Reliability

	Cronbach's Alpha	rho_A	CR	(AVE)
AMT	0.933	0.935	0.949	0.789
EE	0.963	0.965	0.968	0.772
HC	0.926	0.930	0.944	0.773
OI	0.923	0.925	0.945	0.813
SCP	0.951	0.952	0.960	0.773

Moreover, an individual item loading is expected to be higher than 0.70 [41], furthermore, a cut-point i.e. 0.4 was proposed by [42] which states that items having less than 0.40 indicator loadings must not be included in the measurement model. [41] also put forward that 0.40-0.70 range must be considered for ascertaining the acceptable outer loadings of the indicators, and the value which falls below this range should be excluded from the scale, if removing such indicators may improve the AVE and CR values, i.e. within the threshold level.

Table 3. Validity

	AMT	EE	HC	OI	SCP
AMT	0.888				
EE	0.692	0.879			
HC	0.696	0.730	0.879		
OI	0.721	0.685	0.726	0.901	
SCP	0.697	0.700	0.734	0.820	0.879

[41] indicated that it reflects the extent to which a construct is truly represented by its indicators and how it is distinct from the others. Subsequently, [43] criterion was adopted to assess discriminant validity, which

requires a particular construct's AVE square roots to be higher in comparison to a particular construct's correlation with other model constructs.

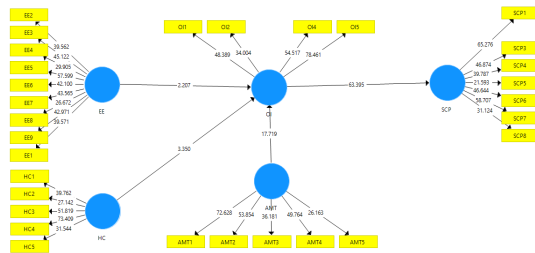


Figure 2. Structural Model

Besides measurement model evaluation, the structural or inner model is also measured as a sequential analysis's requirement in PLS3. This section also presents the discussion regarding procedures, methods and criteria that were considered and performed for structural model estimation in this research. The structural model's significance and relevance was then determined by observing the t-statistics, path coefficients and standard errors.

Table 4. Direct Relationship

	(O)	(M)	(STDEV)	( O/STDEV )	P Value s
AM T -> OI	0.823	0.817	0.046	17.719	0.000
AM T -> SCP	0.758	0.752	0.046	16.470	0.000
EE -> OI	0.200	0.199	0.091	2.207	0.014
EE -> SCP	0.184	0.183	0.084	2.204	0.014
HC -> OI	0.339	0.345	0.101	3.350	0.000
HC -> SCP	0.312	0.318	0.093	3.349	0.000
OI -> SCP	0.920	0.921	0.015	63.395	0.000

Furthermore, the proposed set of hypotheses were tested and evaluated on the basis of given yardsticks by [44], that were carried out by performing bootstrapping for both models in Smart PLS 3, to assess the moderating, mediating and the main effects of the constructs [41].

Table 5. Mediation

	(O)	(M)	(STDEV)	( O/STDEV )	P Value s
AM T -> OI -> SCP	0.758	0.752	0.046	16.470	0.000
EE -> OI -> SCP	0.184	0.183	0.084	2.204	0.014
HC -> OI -> SCP	0.312	0.318	0.093	3.349	0.000

Similarly, based on [44] recommended yardsticks, coefficient of determination was calculated for obtaining the predictive variance in outcome variable that is explained by the predictor variables.

Table 6. R-square

	R Square
OI	0.867
SCP	0.847

5. Conclusion

This is the era of globalization in which organizations are facing intense competition. In this scenario, organizations should focus on their supply chain performance. To improve the performance of the supply chain, the innovation is the basic requirement in the present era for which the employees and technology are the pre-requisites. Therefore, the present study has examined the impact of employee empowerment, human capital and manufacturing technology on innovation and performance of supply chain. The findings of the study revealed that organizations can bring innovation in their overall process by empowering the employees and working on skills enhancement of the employees as well. Technology is also the important factor for the employees to bring innovation and improve the performance of supply chain. All of the proposed hypothesis is accepted in the present study. Current study fills the gap of limited studies examining the impact of technology and human factor to improve the supply chain.

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