

The Influence Factor for the Successful Implementation of Cleaner Production: A Review

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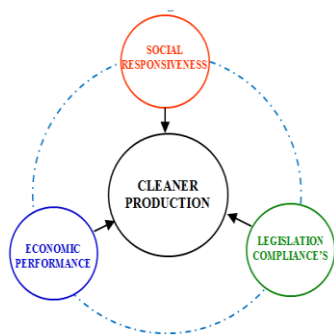
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Graphical abstract



Abstract

Cleaner Production (CP) is an environmental management strategy that is being implemented based on social-technical approach. It has been proved to be adapted at every stage of the manufacturing process, particularly in establishing the green factory. Even so, the implementation performance of this practice is still depends on several critical factors to be successful. The review has disclosed that social responsiveness; legislation compliance's and economic performance are the element that has a high influence level for the successful implementation of this practice. The ability to underline these elements has been seen able to assist manufacturers to identify the strength and weaknesses of the implementation process. This eventually motivates the manufacturer to develop a significant guideline in establishing the sustainable environmental practices and consequently increases the manufacturing performance and strengthens the ability to continuously compete in global markets.

Keywords: Cleaner production; successful factor; manufacturing sustainability

Abstrak

Pengeluaran Bersih (CP) adalah satu strategi pengurusan alam sekitar yang dilaksanakan berdasarkan kepada pendekatan sosial-teknikal. Ia telah terbukti dapat disesuaikan di setiap peringkat proses pembuatan terutamanya dalam mewujudkan kilang hijau. Walaupun begitu, prestasi pelaksanaan amalan ini masih bergantung kepada beberapa faktor kritikal untuk berjaya. Kajian ini telah mendedahkan bahawa kesedaran sosial, pematuhan undang-undang dan prestasi ekonomi adalah elemen yang mempunyai tahap pengaruh yang tinggi kepada kejayaan pelaksanaan amalan ini. Keupayaan untuk menggariskan elemen ini telah dilihat dapat membantu pengilang untuk mengenalpasti kekuatan dan kelemahan dalam proses pelaksanaannya. Ini akhirnya mendorong pengilang untuk membangunkan garis panduan yang signifikan dalam mewujudkan amalan alam sekitar yang mampan dan seterusnya meningkatkan prestasi pembuatan dan mengukuhkan keupayaan untuk terus bersaing di pasaran global.

Kata kunci: Pengeluaran bersih; faktor kejayaan; kelestarian pengeluaran

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1.0 INTRODUCTION

The introduction of Cleaner Production (CP) had promoted the proactive manufacturing practices in reducing the cost to address the problem of environmental degradation, increase the efficient utilization of the resources, promote eco-friendly manufacturing practices and minimize the wastage of the material used. The use of the material at a more efficient level has managed to reduce the demand on natural resources and consequently reduce the emission of toxic waste to the environment [1, 2, 3]. The ability of manufacturers to adopt the CP technology proved able to reduce the risk of hazard in work environment, particularly during the use and the disposal of waste that resulting from the manufacturing activity [4, 5]. This is because several industrial waste and pollutions are resulting from the surplus of the unused materials that eventually jeopardize the quality of the

environmental and human health [6]. Therefore, a paradigm shift is required to shift from the conventional pollution control to CP practices.

The ability of manufacturers to identify the element that influences the implementation of CP has seen to expedite the transformation process of this practice in an orderly manner [7]. This is because the adaptation of CP requires a long-term commitment particularly in education and training along with the comprehensive development of new visions, policies, rules and procedures [8]. Thus, this article has focused to disclose the elements that possibly influence the successful implementation of CP. The findings in this article are seen able to provide a basic understanding and ideas for the manufacturers in developing the best strategy in implementing CP practice. This eventually assists the manufacturer to implement a more sustainable environmental practices particularly in reducing the

From Table 1, there have 12 factors has been identified contribute to the successful implementation of CP. This information was discovered based on review against several research articles that has published from different industrial sectors. From the 28 article that referenced, 58.6 percent were from the manufacturing sector, 10.3 percent respectively are from the mining sector and the agricultural sector, and 3.4 percent respectively are from the energy generation sector, food processing sector, construction sector and pharmaceutical sector. Through the structured analysis against the contribution component that identified, three major classifications of the element that influence in the implementation of CP is recognized. The elements are social responsiveness, economic performance and the compliance's of the legislation. The ability to respond to these elements is seen to have an important role in enhancing the level of adoption and implementation of CP practices.

3.0 SUCCESS FACTORS FOR CP PRACTICES

CP was a group of an integrated technology that consists of several series of individual techniques that able to be integrated into every stage of the manufacturing process [2]. The adaptation of CP with precisely in manufacturing practice has allowed manufacturers addressing the environmental issues in a better position [6]. It subsequently has been seen to have a major influence against manufacturing sustainability performance primarily to continue remains competitive in the global market [14].

A different manufacturing sector normally produces a different product group. Hence, every manufacturer surely has objectives and approaches that differ in managing the environmental concern, although using the same environmental management strategies including CP. Hoof and Lyon [15] has claimed that the manufacturing of different product requires a different manufacturing recipes. This includes the manufacturing method, the material used, the manufacturing formulas, the processing sequence, the processing time and the equipment required for the execution of the tasks. Therefore, every manufacturer requires an approaches and methods that differ to evaluate the best opportunities for the implementation of the CP practice [16].

The findings from the review has discovered that the successful implementation of CP was influenced by the element of social responsiveness, economic performance and the compliance of the legislation's as illustrated in Figure 1. These elements are seen to have a major influence on the successful implementation of CP practices particularly in the manufacturing sector.

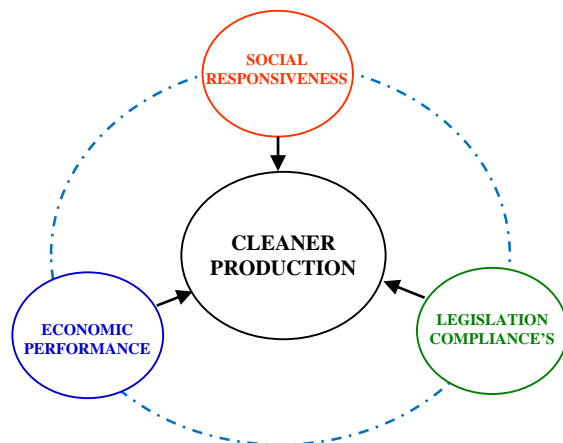


Figure 1 Influence elements for the successful implementation of CP

The global awareness against social and environmental performance has contributed in increasing the adoption of CP in manufacturing practice. It is seen to be essential primarily in developing the manufacturing sustainability in business for long term [16, 17]. Besides, the review has shown that the increase of the social responsiveness level also influences the manufacturers in adapting the proactive action such as CP in dealing with the environmental issues that arise. This possibly caused by the high enforcement level against the legislation compliance's that eventually increase the sustainability of the social lifestyle with the use of environmentally friendly products [19]. Therefore, the enhancement against social responsiveness perspective is essential and has been seen to have a major influence in developing the sustainable CP practice and increase the efficiency of the organization in implementing this practice [20]. This eventually provides better economic benefits particularly in reducing the pollutants and increasing the reuse or recycling of the existing resources [21].

The strict enforcement against environmental laws by the authorities and local government bodies was the other elements that influence the implementation of CP practices [22]. By strengthening the action in enforcement, the public awareness level and social responsiveness in managing the environmental issues has improved. The ability of the manufacturer to comply with the environmental acts and regulations also apparently has increased the focus in developing the best strategy in implementing CP practices. This is because, pre-compliance and full compliance against applicable laws and regulation of environmental was the basis in developing the sustainability of CP practices [23]. In addition, a harmonized regulatory framework through pollution prevention that be integrated with the application of CP technology was the important action in increasing the economic growth [24]. Therefore, the initiative in the regulatory compliance's has been seen to be the key driver in managing the supply of materials that eventually become the important transitional element against CP practices [25]. The ability of manufacturers to formulate the policies that are able to be streamlined against environmental standards in accordance is able to smooth the implementation process of CP practice.

Besides, the success of the implementation of CP practice also depends how manufacturers able to streamline the core of business against the evolving market power [26]. The ability of the manufacturer to respond against this concern has been seen able to increase the success level in adapting a CP approach in manufacturing practice. This is required primarily in managing the constraints of manufacturing cost that always increase and allocating the enough funding in realizing the CP strategy [6]. For example, the ability in reducing the excessive material use and reducing the waste produced during manufacturing the product able to increase the focus in leverage the existing resources [27, 28]. The high focus in this matter has been seen to have a major influence to the economic performance level of the manufacturer. This has shown that the economic performance was also the element that has a major influence to the success rate of CP besides social responsiveness and legislation compliance's. Moreover, it also influences the social responsiveness level and the legislation compliance's level. Therefore, the high focus on this element is significant primarily when combined with the expectation to gain the high benefits level in increasing the economic and environmental management performance [15, 24, 29, 30].

3.1 Social Responsiveness

Social responsiveness is an active process that used to measure the human consciousness level against problems that arise in the work environment. From the review, this element has identified plays an important role primarily in determining the success of the adaptation of the CP approach in manufacturing practices [9, 19, 20]. The high social responsiveness level evidently has brought a better understanding to find the best solution in

managing the environmental concern [31, 32, 33]. The ability to understand this element also has been seen to influence the decision that being made particularly during the adaptation stage of CP practice in the manufacturing activity. Therefore the adaptation of CP practice needs to reflect on the actual needs in analysing the opportunity for implementing this practice. This eventually assists the manufacturer to formulate and develop the efficient guidelines in managing the environmental concern and subsequently improve the efficiency of manufacturing activity [34, 35]. Hilson [6] has claimed that the high responsiveness level has encouraged the proactive action in establishing the best CP practice in manufacturing. This is implemented through high focus on the usage of materials and energy, the execution of environmental audits, the emphasis on training, pollution control and waste reduction programs, the development of the holistic environmental policy, redesign the manufacturing plants to accommodate the waste and develop a more comprehensive environmental goal.

Andrews *et al.* [36] has found that 85 percent of the manufacturer has implemented a CP practice because of having a high responsiveness level against the environmental and economic concern. The implementation of this practice evidently has reduced 23 percent the use of raw material and energy, the reduction of water usage (29 percent), the reduction of noise level (14 percent), increase the reuse of waste (46 percent) and lower the cost of disposal (40 percent). This eventually gives the financial benefits about 51 percent to the manufacturer in increasing the economic performance. In addition, the high responsiveness level also has successfully encouraged the participation of the employee in adopting CP practices that be implemented. As a result, it has increased the ability of the manufacturer to develop and formulate a holistic environmental policy and transparent procedures primarily in developing the best techniques and practices in managing the environmental concern [37]. This is consequently increases the employee participation in pollution prevention practice and eventually make sure the requirements of the environmental laws and regulations are fulfilled [38, 39]. For example, the high responsiveness level in manufacturing organization against environmental concern able to avoid the release of the contaminated and toxic waste into the environment [2, 28]. As a result, the ecological damage of environment able to be reduced or prevented [40]. Besides, the transformation towards CP is also influenced by the relationship of firm-internal, inter-firm and firm-external. This consequently seen to influence the management style of leadership, the development of strategic plans, the application of tools and technology and the process analysis for continuous improvement activity [11, 41]. Moreover, to attain the successful implementation of CP also requires the continuous improvement process, primarily in establishing the sustainable CP practice based on the manufacturing perspective and social perspective [20]. This subsequently improves the internal communication amongst the management and department and consequently improve the individual performance in achieving the implementation goals of CP practice [27].

In addition, the necessity of the CP implementation is not merely come from the internal needs but also has influenced by the external pressure such as customer needs, regulatory authorities and external bodies [35, 42]. As a social-technical approach in managing the environmental issues, the selection of CP practices has been seen as the best approach to fulfil this requirement. Laforest *et al.* [5] has identified that the characteristics of the CP implementation were influenced by many actors such as manufacturers, experts, finances and even customers. Their research in the metal finishing process shows that customer specifications have the weight index of 0.22 and the strategy to gain customer loyalty have the weight index of 0.43 against cleaner and safer manufacturing practices. Tseng *et al.* [11] also found that the customer focus also a part of the important attributes in implementing CP practice. The increases

of the environmental awareness by the customer against environmentally friendly products has proved to encourage manufacturer to adopt CP in manufacturing green products [15]. This is because the demand that consistent and the high awareness level against environmentally friendly products is a part of the characteristic that be offered by CP [41]. The ability to understand this opportunity is seen able to increase the successful implementation of CP practice in manufacturing environment.

Besides, the increase of public awareness against environmental issue also seen has encouraged the manufacturer to adopt the integrated environmental management practice such as CP in managing the environmental concern primarily to achieve the high performance level in environmental and economic [27, 43]. This consequently has prompted the manufacturer to enhance the manufacturing ability in implementing green manufacturing environment particularly through the adaptation of CP practices [24, 30, 33, 44]. Moreover, the public-private partnership also able to strengthen the sustainable environmental management practice that predominantly prompted by the high public responsiveness level [15, 37]. However, the implementation of CP practice has to be maintained through high commitment level with a simple solution and a small investment to make sure the benefits from the implementation of CP practices is continuously obtained [16, 44, 45, 46]. UlhøI [47] has claimed that the value, expectations and the trajectory of technological development is important to establish the sustainable CP practice. This significantly has influenced by a large variety of public programs and policies that subsequently has prompted the manufacturer to improve the technical skills and capacity, increase the monitoring of resource utilization and implementing the radical innovation in green technology to fulfil the continuous improvement in environmental management [41, 48].

In addition, the awareness in improving the performance, reputation and image of the manufacturer itself also seen had motivated the manufacturer to take the proactive action in managing the environmental issues. Unlike the approach of EOP, CP is seen potentially to allow manufacturers to develop and implement an efficient plan to reduce the ecological damage and eventually improve the manufacturer image [40]. High commitment in this matter in continuously also seen has successfully improved the corporate image of the manufacturer and subsequently increases the performance of environmental management for long term [37, 41]. Therefore, CP practice is seen as the best practices in increasing the performance, reputation and image of the manufacturer primarily in reducing the usage of resources and increase the efficiency of industrial waste management [31]. This is because the expansion of manufacturing activity has resulted in increasing resource utilization, the energy consumption, and the dependencies on transportation and the management of infrastructure. This subsequently has produced the high industrial waste volume as well as the release of high pollution rate that caused by the manufacturing activity carried out [49]. This evidently proves that component was also influential in increasing the manufacturer responsiveness level particularly to in make sure the objective of CP practice is successfully achieved [8]. This was in accordance with the normative in environmental management in CP practice as a self-regulation practice primarily in managing and controlling the environmental concerns in the manufacturing environment [4].

3.2 Legislation Compliance's

The increase compliance's of legislation predominantly in environmental laws and regulations had influenced the level of environmental management performance. This was a consequence of the strict enforcement by the government, the awareness to comply with environmental laws and regulations, to comply with safety and health regulations and the needs to

fulfil the environmental policy and standard primarily in adapting CP practices. Thus, it has become a major reason in establishing an efficient CP practice primarily in managing the environmental concerns. For example, the introduction of new environmental legislation has prolonged the manufacturer responsibility in managing the industrial waste. This eventually forced the manufacturer to develop a more proactive CP framework in manufacturing organization to obtain the benefits of this practice in short term and long term [8]. Besides, the ability of manufacturer to respond to the laws that are enacted by a responsible legislature against environmental protection has successfully increased the adaptation rate in CP practice. It is indirectly has enabled the manufacturer to manage the environmental issues that arise in more efficient manner [4]. This has shown that the support from the authority bodies in enhancing the enforcement of environmental laws has proved important and play a major role in strengthening the establishment and adaptation of CP practices in the manufacturing environment [12].

The Integrated Pollution Prevention Control (IPPC) and Directive of Industrial Emission (IED) in Europe are the example of implementation how the legislation compliance's has been formulated to make sure the manufacturer always involved continuously in practicing an efficient environmental management in the manufacturing environment [5]. In China, the promotion against CP laws and regulation seen has strengthened and increase the adoption level of this practice. It is subsequently also seen to increase the public awareness against the importance of green practices in manufacturing, particularly through the media, the protest publicly and high enforcement by the responsible agencies [27]. In addition, the strict enforcement also evidently encourages the manufacturer to have the best practice in dealing with the environmental issues to avoid any penalties against the violation of the laws and regulation that possibly able to cause the withdrawal of the business licenses [31]. It also evidently proves that the continuous development against CP practices is also influenced by the strengthening level against environmental act and regulations that be formulated and enforced [22]. Thrane *et al.* [44] has claimed that the reduction of water consumption in a fish processing plant has managed to reduce the amount of waste discharge to the environment is resulted from the high compliance level against regulations implemented. This indirectly has urged the manufacturer to respond through a significant effort to make sure the CP practices successfully implemented [11]. Besides, the enforcement against manufacturers in complying with laws and regulation also able to influence the style of environmental management practices to be at a more efficient level. It consequently has increased the ability of the manufacturer to continuously reduce the cost primarily in managing the environmental issues and manufacturing activity in establishing the manufacturing sustainability.

Moreover, the implementation of CP that combined with the environmental measurement and management tools such as ISO 14001, the safety and health regulation (such as OHSAS 18001) and other environmental regulation such as eco-labelling, eco-packaging and the management of eco-audit have profoundly influenced the successful implementation of CP practice [50]. The adaptation of ISO 14001 in the implementation of CP practices is seen able to develop a more comprehensive approach in managing the environmental concern. This subsequently able to increase the total of manufacturers that sustainable in CP practice and also reduce the violation rate against the environmental laws that be enforced [12]. In addition, the CP also known as a practical approach to protect human safety and health and the environmental performance to support the goal towards the development of sustainable manufacturing practices [29]. The environmental problems not just threaten the ecology and human health, but also able to reduce the competitiveness of products in the global market [20]. The high requirement on environmentally friendly products and the high

awareness level against safety and health has directly forced the manufacturer to adopt CP practices in managing this concern [24]. Conversely, the noncompliance against applicable environmental laws and regulations has been seen to reduce the adoption level in the implementation of CP practices. This subsequently increases the threat against the quality of the environment and human health [6]. This is because, the ability of manufacturers to comply with the laws and regulation not just able to reduce the risk on human safety and health, but also has prompted to the minimization of waste material and the reduction of industrial waste that eventually increase the manufacturing performance [11, 29, 31, 42].

Besides, the comprehensive corporate policy includes the environmental mission statement and standard practice is required for developing the strategic approach in implementing CP practices [37, 51]. This is to make sure that every employee has enough information about CP and able to understand the role and responsibility respectively in adopting CP practice. This subsequently able to increase the employee participation in CP practice particularly in promoting the process of innovation in establishing a high quality work environment [3, 38]. The formation of CP as a self-regulation in complying with normative legislation to manage the environmental concern able to increase the manufacturing performance predominantly through the action in waste reduction, the design of energy conservation process, the efficient utilization of resources, the reduction of pollution emission, the manufacturing of green product and the provision of environmentally friendly services [1, 4, 14]. This subsequently has allowed the manufacturer to improve the financial arrangements primarily to increase the efficient adaptation and implementation of CP practices [6].

3.3 Economic Performance

As an environmental management strategy that able to be entirely integrated in manufacturing organizations, CP evidently has succeeded in increasing the environmental and economic performance [27, 43]. This not just able to reduce the concern over environmental issues, but also increases the opportunity to survive financially in the competitive market environment [49]. However, there still have various reasons that possibly jeopardize the implementation of CP. Therefore, the performance of economic must be taken into account besides the flexibility of operation in adapting CP practice to make sure the manufacturer able to sustain economically in competitive market environment [45]. The willingness of the manufacturer to improve the operation efficiency is seen influences the successful implementation of CP practices. Altham [31] has claimed that the high focus in CP has successfully increased the manufacturing efficiency and consequently increases the efficient utilization of energy by 9 percent in dry cleaning industries. This subsequently has improved the financial performance of this industry. By streamlining the core of the business, the manufacturer able to respond quickly against the evolving market power through the efficient manufacturing cost management. This eventually increases the ability of the manufacturer to produce high quality products and services. In addition, it also allows the manufacturer to reduce the use of material by leveraging the existing resources and reduce the production of industrial waste [3]. This consequently reduces the risk of hazard to humans and the environment that predominantly implemented through the elimination or reduction the source of pollution, increase the reuse and recycle of the material and increase the efficiency in managing the industrial waste streams [14, 21].

In addition, the desire to increase the profit from sales of products and the expectation to reduce high expenses in industrial waste management also motivate the manufacturer to adopt CP practices. This is because, the efficient implementation of CP proved able to reduce the material cost, the energy cost and eventually reduces the manufacturing cost [29]. This shows that

the reduction of internal cost not just increase the efficiency of manufacturing practices, but also allows manufacturer to achieve the highest profit margins. This has consequently enhanced the position of the manufacturer in a competitive global market [38]. Moors *et al.* [41] has claimed that the development of CP practices was an important instrument in developing eco-friendly product at lower cost. The evaluation of economic efficiency by several manufacturers in Lithuanian has shown that a good economic performance is achievable by focusing on process optimization and improving the manufacturing efficiency primarily in managing the environmental concern [16]. Therefore, the high monitoring against economic and environmental performance was important in establishing a sustainable implementation in CP practices [19].

Besides, the desire and ability of the manufacturer in resource management also influence the successful establishment of plans and action towards the implementation of CP practices. The ability to optimize the utilization of resources planned seen positively able to influence the economic performance primarily in reducing the operation cost. This is because the comprehensive resource utilization against available resources was significant particularly as an index in evaluating the effectiveness implementation of CP practices. Furthermore, it also able to bring a great influences on the reduction and the efficiency in resource consumption [30]. This shows that as a key in the implementation of the ecological management, CP practices able to encourage the manufacturer to manage the use of resources in more efficient that subsequently allows the manufacturer to achieve a high economic benefit [1, 24, 32]. For example, Hicks and Dietmar [27] have found that through CP practice, the manufacturer able to save approximately 5% of the total manufacturing cost in the electroplating process industry. This saving includes the reduction of material cost, energy cost, manufacturing depreciation cost and expenses in industrial waste management [29]. The willingness of manufacturers that serious in streamlining the economic performance has brought good return either politically and financially. This is seen to be practically used in developing the best practice in implementing CP practices particularly to manage the issue that correlated with environmental [49].

Additionally, the pressure from stakeholder also evidently influences in the implementation of CP particularly in fulfilling the new requirements in managing the environmental concern [46, 48]. The insistence to address the costs of pollution, industrial waste management as well as the increase in material costs is seen to be a major influence against manufacturers in implementing CP practices. The consideration against market opportunity, the reduction of costs and the increase of the competitive advantages are the driving force that influences the stakeholder in achieving the goals of the CP implementation [4]. This is subsequently seen has motivated the manufacturer to implement CP with more systematically particularly through the involvement in implementing the innovation process [7]. This has proved that CP was best practice in managing the environmental concern primarily in establishing the sustainable manufacturing practice [1, 52]. This eventually provides the opportunity and space for the manufacturer to use new technology or enhance the current technology use via a variety of engineering technique and discipline to meet the objective of CP implementation. This not just provide a benefit to the manufacturer through high economic performance, but also to the surrounding community primarily in the manufacturing environment [16, 42].

■4.0 DISCUSSION AND CONCLUSION

This article had disclosed that social responsiveness levels, compliance's against environmental legislation and economic performance was the important element that have high influence in the implementation of CP practices. The adaptation of the CP

in manufacturing practices is seen predominantly influenced by the responsiveness level of manufacturers and the surrounding community against safety awareness level and the concern in managing the environmental issues. This is possibly stems from the increase in enforcement by the government and authority in strengthening the implementation of the environmental management laws and regulations. Besides, the increase of public awareness on environmental also seen has urged the manufacturer to adopt the best practices in managing the environmental concern. This subsequently increases the effort of the manufacturer in adapting the CP practice proactively, primarily in responding against increasing pressure that results from the environmental regulations that be enforced [11]. Besides, the ability to adopt CP practices also depends on the continual knowledge in managing the demand and supply of material as well as resources in the supply chain [7, 41]. The implementation of CP practices in supply chain particularly through green supply chain has urged the business partner in the supply chain to actively implement better environmental management practices such as CP. This subsequently allows the manufacturer increases the environmental awareness level that has a potential to increase the success rate in the implementation of CP practice. Conversely, the limited knowledge as well as the slow development particularly in establishing a green supply chain evidently seen able to obstruct the successful implementation of CP practices [39].

Moreover, the adoption level of CP practice also seen has a significant positive relationship with business performance [53]. The ability of the manufacturer to produce environmentally friendly products that in line with the highest environmental management practice level absolutely able to increase the performance and the reputation of the manufacturer in the global market particularly in handling the environmental issues that occur. This was also consistent with the requirement in complying with the regulation of industrial safety, health and environment. This consequently has proved that the successful implementation of CP seen able to increase the ability of manufacturers in managing the resources in manufacturing activity as well as industrial waste management at a more efficient level particularly in reducing the risk of hazard against human safety and health and environmental [11, 42]. Therefore, the focus and intention to fulfil this requirement was a basis for the implementation of CP practice. The ability to fulfil all the established policy and standards in environmental issue management had encouraged the manufacturer to comply with the laws and regulations that enforced. This shows that the establishment of the corporate policy and environmental mission statement is important in achieving an efficient CP practice [37]. The ability to adopt these regulations and fulfilling the corporate policy as well as the environment mission statements is not just beneficial in managing the environmental issues that arise, but also manage to increase the ability of manufacturers to provide a better working environment. This was seen able to influence the participation of employees in adopting of the CP practice in manufacturing environment. Besides, the participation of employees predominantly in the decision making process and the adoption process of CP technology was a significant improvements in encouraging the innovation to develop a high quality work environment [38, 44]. This consequently has encouraged the manufacturer to implement the transformation in the existing manufacturing practices towards the implementation of green manufacturing practice that more sustainable.

Finally, the intention of achieving high economic performance is also seen influenced the adaptation of CP practices in the manufacturing environment. The transformation in improving the economic growth through the pollution prevention and the streamlining in industrial waste management is seen influenced the implementation of CP practices [24]. In addition, the high enforcement level also seen as the main input for manufacturer began adapting CP practice particularly in managing the environmental issues. Besides high investment that

possibly required in the conventional environmental management such as EOP as well as high expectation on return on investment are seen as the critical elements that strongly influence the decisions of the manufacturer in implementing CP practices [2]. This is because the awareness of the manufacturer against the penalty and fines that imposed for the violation of environmental law has increased the manufacturer responsiveness to adopt CP in managing this situation. This subsequently able to change the behaviour of manufacturer by strengthening operational efficiency, reduce the non-product output, improve the performance, reputation and eventually provide a good return in profit [31, 54, 55]. Besides, the awareness against the constraints of resources and material also had urged the manufacturer to reduce their manufacturing cost and increase financial performance. This able to be realized via an efficient resources utilization and reduction of pollution and industrial waste that be produced [20]. The savings obtained from the reduction of manufacturing costs primarily in handling the pollution and industrial waste has been seen allow the manufacturer to increase the budget and investments in utilization of the new CP technology. In addition, this ability also

able to reduce the overall manufacturing cost and subsequently increases the manufacturing efficiency. This eventually able to enhance the manufacturing activity at an efficient level and increases the manufacturing sustainability performance.

In conclusion, each element that has been identified not just contributes directly to the successful implementation of CP, but also has the integration and influences against each other. Each element discussed is beneficial for the manufacturer primarily in identifying the strength and weaknesses to making sure the implementation of CP able to provide the optimum results. The desire of manufacturer to participate in improving the environmental performance is seen motivates the engagement in green manufacturing innovation [52]. The collaboration to encourage the innovation particularly from high social responsiveness level, high compliance's level legislation and high economic and financial performance are able to motivate the manufacturer to develop a sustainable environmental management framework as well as enhance the ability to continually compete in the global market [56]. The summary of the relationship of each element that identified had influenced the successful transformation towards CP is illustrated in Figure 2.

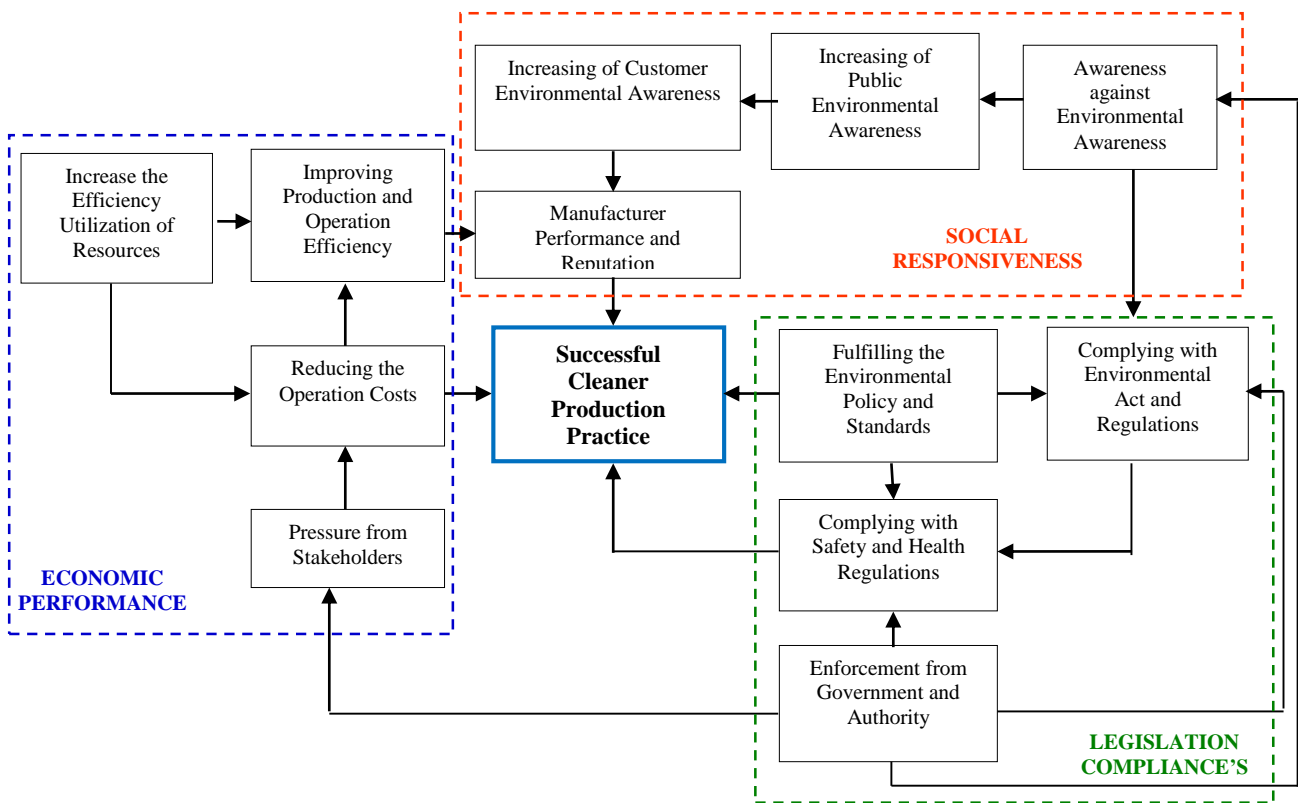


Figure 2 Relationships of the influences elements to the successful implementation of CP

For future research, the elements that had identified influence the implementation of CP in this article able to be expanded via field studies in a various manufacturing sectors. The information from a variety of respondent in various manufacturing sectors are able to validate the element that has identified in this article. The finding from field studies also able to provide more in depth information and comprehensive

benefits to the manufacturer in establishing a suitable platform as well as develop a strategic plan to make sure the implementation of CP is achievable across manufacturing organization. This eventually able to increase the manufacturing sustainability in addressing environmental concerns and continually improves the overall performance in the competitive global market..

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