Dear Sir,

- We have modified the article to an extent including English corrections, red coloured expressions and the indications are critical and requesting your most observation.

- Blue coloured segments are extensively modified to our understandings about the model. Kindly requested to have a glance over appropriate segments to check the flow of the connotation.

- Rigorous modifications have been done at Section 4.2 to section 5 Discussions, kindly go through for the confirmation of **'values'** mentioned and terminologies used like 'deviational coefficient' is replaced for 'coefficient'.

- As we lack to understand about AMOS and its method, you kindly check the values indicated in the figures and tabels for the models and add explanation for the astrix (***) used.

- Order of constructs has been changed in table 2. The original article mismatched with the orders

Kindly suggest for further improvement of the paper.

Thank you sir,

G Satish.

Influence of eco-innovation on Indian manufacturing sector sustainable performance

Abstract

Manufacturing firms are striving to improve their sustainable performance in order to satisfy multiple stakeholders. Eco-innovation is a promising approach that decreases environmental impact and helps firms to increase their business value. There are several antecedents which help the firms to innovate and improve their triple bottom line performance. Among the antecedents, management and innovative practices are directly related to eco-innovation. It is not well known what practices and innovations help the firms to eco-innovate as well as to improve sustainable performance. Hence, the research objective of this paper is to identify the suitable combination of management and innovative practices that help firms to eco-innovate as well as to achieve overall sustainable performance. The paper develops an eco-innovation conceptual model which relates the management and innovative practices (antecedents) and overall sustainable performance (consequences) of Eco innovation using institutional theory. Using Indian manufacturing sector empirical data and Structural Equation Modelling (SEM) approach, this paper determines the effect of eco-innovation's antecedents and consequences. In the Indian context, this study suggests that the role of management practice is more significant towards eco-innovation than innovative practices. The results reflect practitioners' view on how to increase innovation rate and to focus more on social aspects. The finding suggests that training on environmental related practices could tackle innovation and social aspects in the Indian manufacturing sector context.

Keywords: Eco-innovation; sustainable performance; green practices; and Indian manufacturing sector.

1. Introduction

Innovation can happen anywhere in the firm and it can be referred as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (OECD, 2009). Innovation has long been seen as central to economic performance and social welfare; it is increasingly recognized as a significant driver of economic growth. Specifically, an innovation that mitigates environmental impacts and makes contribution to the sustainability is defined as eco-innovation which includes eco-

product, eco-process and eco-organizational innovation (Triguero et al, 2013; Wilts et al, 2013). Two major desirable characteristics of Eco-innovation are i) one among the initiatives that contributes towards sustainable development and ii) improves firms' competitive advantage through sustainable product and process design. Sustainable product design is achieved through design for environment, design for disassembly etc. Process design includes optimization of production processes, reduced material, energy use and waste generation etc.

More recently, industry leaders and policy makers have viewed innovation as the key to radical improvements when corporate are concerned more about environmental practices and performance. Recent studies have deliberately expressed that the adoptions of innovative/ Sustainable management practices are the drivers for the performance of any manufacturing industries (Nidumolu et al., 2009). Leading manufacturers having operations in the developed countries such as Apple (reduction in overall carbon foot print), Toyota (recovery and reuse of end of life vehicle components) and HP (environmental protective inks) came out with an excellent eco-innovation solutions to mitigate the environmental as well as social effect.

The above examples reveal that only few firms are taking voluntary initiatives whereas several other firms are subjected to various pressures to Eco-innovate and it can be classified as three major pressures such as institutional pressure (Legislation through government), coercive (to satisfy requirements of various standards and customers) and mimetic (competition from peers and competitors). To satisfy the above pressures, firms follow different strategies and practices. It is evident from previous studies that firms have adapted different management and innovative practices to achieve unique position through environmental and continuous improvement quality practices (Tidd et al. 2005; Herrmann et al. 2008; Yarong and Xin, 2011; Gimenez et al. 2012).

The above discussions reveal that there are few drivers as well as pressures for firms to Eco-innovate. It is also not well known what practices and innovations helped firms to overcome drivers and pressures to eco-innovate as well as to improve sustainable performance. Hence, the research objective of this paper is to identify the suitable combination of environmental and innovative practices that helps firms to eco-innovate as well as to achieve overall sustainable performance. Therefore, the study develops a conceptual model to map the influence of innovative and management practices on eco-innovation and subsequently its

contribution to the sustainable performance. The model is developed using the underpinnings of institutional theory.

There are few more challenges to the research objective in the developing countries as well as to the specific industry context. There is a substantial environmental sustainability challenge, including global warming, energy demand, water and food supplies, behavioural changes, lower consumption, and eco-efficiency due to depleting natural resources (Diedrich et al. 2011). This mandates a deeper understanding of society´s relationship with natural resources.

The major contributions of this study are twofold i) develop a conceptual model to relate management & innovative practices (antecedents) and sustainable performance (consequences) of Eco-innovation and ii) empirically validate the model in a specific country and industry context to identify the suitable combination of management and innovative practices to achieve sustainable performance.

Out of several sectors in India, this study specifically focuses on manufacturing sector due to the following reasons: i) higher potential to affect environment such as air pollution, effluent run-off and improper disposal of solid wastes; ii) new technologies to cleaner processes as well as operations are not proceeding at a fast enough pace to address the urgent need for environmental protection; iii) 42.67 % growth in number of manufacturing firms from 1987 to 2007 (98,379 to 1, 40,355) (India planning commission report, 2013).

The rest of the paper is organized as follows: Section 2 reviews the literature to identify the pattern of practices on eco-innovation and the effect of eco-innovation on performances. Section 3 delineates the conceptual model development. The research methodology especially the structural equation modeling approach is expained in section 4. Section 5 discusses the findings of the study. The major findings, limitations and highlights of the potential future research directions are summarised in section 6.

2.   Literature review

This section reviews the studies related to anecdotal practices and its effect on eco-innovations. In addition to that this section also reviews the relevant studies to capture influence of eco-innovation on sustainable performance.

2.1 Management practice, innovation and eco-innovation

As a reaction to the international institutional pressures, organizations pay more attention to adapt management practices that such as ISO 14001, Total Quality Environmental Management (TQEM), eco-auditing and other decisions like employee training, R and D Investments etc. Cozaaring and Jeffery (2014) stated that management practices such as human resource management focusing on flexible job definitions, cross-training and work teams, along with extensive reliance on incentive pay, result in substantially higher levels of productivity. Studies have found that there is a correlation between such management systems and labour productivity. Proper training for employee by itself increases productivity and training with management practices also increases productivity.

Since the greenhouse effect is worsening and the resource is scarce, sustainable development becomes a considerable concern in business practice (Despeisse et al. 2012[a]). There are several drivers for enterprises to meet the need of sustainable development. The first and foremost reasons for organizations are in respect to external regulatory and policy pressures which limit environment index such as carbon and toxic emission and water or air pollution level (Hitchcock, 2012; Beske, 2012). For example, some of the earlier initiatives are, the European Union (EU) Emission Trading Scheme (Hitchcock, 2012). Moreover, except the official policies and regulations, the pressure from some communities and non-governmental organizations also serve as an important force in sustainable development (Beske, 2012). According to Porter (1996), in order to employ the differentiation strategy to gain competitiveness over its competitors, an enterprise has to focus on the Research and Development (R&D) with innovations to win the market share. The most important reason for such high attention on environmental factors is that they are regarded by an increasing number of companies as great opportunities to drive business efficiencies, stimulate innovation, reduce costs, improve brand positioning and enhance business communications. Also, companies may further strengthen their competency and add value to their business with those environmental benefits (Simon, 2008). The use of processes like Design-for-Environment (DfE) helps to reduce the environmental impact of products from the initial stage of conceptual design (Kurk and Eagan, 2008). The ideal situation is that products will be made, distributed and used without harming the environment as well as being recyclable and reusable. In terms of this eco-product innovation, designers will integrate environmental

considerations at the very first step of product development which can contribute to the ideal goals of environmental friendly product (Kurk and Eagan, 2008; González-García et al., 2012).

Technological development plays an important role in eco-innovation (Horbach et al. 2012), and helping companies benefit more from eco-innovation in various areas. According to Cook et al. (2012), the technological development provides new ways for sustainable development, and it has also shown that the improvement of technology can stimulate eco-innovation (Horbach et al., 2012). In addition, along with the globalization over time, sustainability has drawn attention from technical to political area, which has further developed into a mainstream in business area (Liu et al., 2012). Therefore, it is reasonable for people today to pay more attention on eco-innovation. Several attempts have been made in defining the concept of eco-innovation and generally, it illustrates that eco-innovation can result in positive environmental impacts, whether the purpose of the implementation of eco-innovation is related to the environment or not (Carrillo-Hermosilla et al. 2010). Moreover, Esty & Winston (2006) have pointed out that with environmental factors, the companies tend to be more innovative and entrepreneurial. In addition to the environmental benefits, many economic advantages should not be neglected in eco-innovation. Particularly, Boons et al. (2013) hold the opinion that the concept of sustainable innovation is much broader than eco-innovation. However, it is determined to define eco-innovation with the social aspects and in the model as well. It is commonly accepted that today's economic benefits should not be at the expense of the long-term benefits. Thus, eco-innovation is significant in the innovation system. Taking environmental, social and economic aspects into consideration, it may contribute to the whole innovation system to a large extent (Carrillo-Hermosilla et al., 2010).

2.2 Eco-innovation and sustainable performance
The existing research has discussed the measurement of eco-innovation and "Tripple Bottom Line" separately, and this paper will build up a model to evaluate evaluating eco-innovation with the measurement of "Tripple Bottom Line". According to Cetinkaya et al. (2011), realistic funding and measurement are necessary for the sustainable development and thus, suitable performance measurement is significant for sustainability (Chaabane et al., 2012). However, the integration of tangible and intangible performance of eco-innovation adds to the complexity of the measurement selection (Bai et al., 2012; Giannakis, 2007). "Tripple

Bottom Line" has been introduced by Elkington in 1997. It advocates equal treatment of all three dimensions, economic, social and environmental aspects for sustainability (Beske, 2012). In this model, it is **choosen** such that to measure eco-innovation with not only environmental performance, but also social and economic performance. That is, Triple Bottom Line measurement will be taken into account in eco-innovation, providing a more considerable evaluation. Triple bottom line includes economic, environmental and social performance. Table 1 summarizes the studies that have been carried out with respect to three performance measures. It is visible from table 1 that non-economic performances have received lesser attention from researchers than economic performances.

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It is evident from the literature review that various studies have proven that eco-innovation has the greatest potential to overcome environmental effect as well as social effect. It is obvious that eco-innovation has been achieved by firms by modifying its products, process, organization level and marketing techniques. Interestingly, the researchers have not noticed any typical study which discusses the management & innovative practices (antecedents) of eco-innovation and its overall sustainable performance (consequences). Moreover, the objective of various studies is to mitigate environmental effect and not to larger extent social aspects. It is argued that eco-innovation could contribute to triple bottom line performance. The above intriguing aspects have motivated the researchers to develop a conceptual model and relate antecedents & consequences of eco-innovation and to validate the model with empirical data in a specific country and industry context.

3. Conceptual model

Institutional theory aims to explain the extent to which "individual firms' practices should mimic industry best practices versus reflects the participants' unique characteristics". There are three major pressures within institution and they are coercive, mimetic and normative. Coercive institutional pressures, which stem from political and legitimate forces, are exerted on a dependent firm by other organizations (on which the firm depends) and by cultural expectations in the society within which the dependent firm exists (Lai et al. 2006). Simply,

coercive pressures come from organizations in power (Sarkis et al. 2011). Examples of coercive isomorphism include governmental laws and regulations (Sarkis et al. 2011), standard operating procedures and rules (Dimaggio and Powell, 1983), etc. The recent decades have been witnessing the increasing adoption of the coercive isomorphism to explain why companies engage in environmental management practices (Sarkis et al. 2011).

Mimetic institutional pressures are mainly from a firm's peer firms who are more successful. Firms tend to mimic or imitate their successful competitors to "replicate their successful paths" (Sarkis et al., 2011). The core reason for firms' imitative behavior is "uncertainty" (Dimaggio and Powell, 1983). When a firm faces operational uncertainty about the environment and market it is operating in, its goals even the firm itself, one can mimic from the other is the least possible and simpler techinc. According to Sarkis et al. (2011), globalization has been facilitating the imitation between firms, as it creates opportunities for firms to learn from international counterparts. But problems remain as "To what extent companies can mimic industry best practices?" and "How well the learned practices can work in other contexts?" (Ketchen Jr and Hult, 2007[a], 2007[b]).

Normative pressures are believed to come from professionalization (Dimaggion and Powell, 1983; Lai et al. 2006). Examples of normative pressures include the standards formed on a sector level or market level force individual companies in this particular sector or companies operating in this market to adopt a certain practice. In the context of environmental and socially-responsible practices, companies' adoption of such practices will be largely influenced by the market and consumer requirements (Sarkis et al. 2011).

Zhu et al. (2013) provide a holistic framework to analyze the institutional pressures that companies are facing and successfully related the institutional theory with firms' environmental management systems. They divided the coercive, normative and mimetic pressures into international pressures and domestic pressures. Their findings suggest that international institutional pressures play more important role in adoption of green practices such as ISO 14001, Total Quality Environmental management (TQEM) and eco-auditing.

3.1 Model

The need for organizations to engage in environmentally responsible operations includes: government policies and regulations; pressures from consumers and the life-threatening of global ecosystem deterioration. Collectively, the level of institutional pressures perceived by firms has impacts on the adoption of organizational practices. In the current study, it is belived that institutional pressures act as main driver for companies to engage in different sustainable practices. Based on the institutional theory, it is aimed to develop a conceptual model as shown in figure 1 to link management and innovative practices as the major drivers for eco-innovation and its effect in terms of sustainable performance.

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Insert figure 1 about here

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3.2 Hypotheses development

Management and innovative practices, which are directly related to eco-innovation, are the two among several antecedents helpful for the firm to innovate and improve their triple bottom line performance. From the internal aspect within the organizations, the efforts to contribute to the environmental protection will build an image of Corporate Social Responsibilities (CSR) of organizations in customer mind (Ho and Choi, 2012; Triguero, 2013). Data indicate that most of the surveyed organizations believe that the green efforts will have the greatest impact on "reputation and brand" (Baskaran et al., 2011; Ho and Choi, 2012). As a result of the increased brand equity and CSR reputation, organizations will be able to maintain the current customers' loyalty as well as attracting new customers. Since customer loyalty is difficult to imitate, this intangible asset will create the sustainable competitive advantages for organizations (Beske, 2012; Ho and Choi, 2012). Not only the efficient use of materials and energy will be considered, but also waste prevention, feasibility of recycling and expansion of product life cycle are also important elements in eco-product (Yang and Chen, 2012; González-Garcíaet al., 2012). As a result, compared with the traditional product, the finished eco-product is beneficial to the sustainable development of society which in turn brings profitability for organizations. Nowadays, since some resources are non-renewable and DfE cannot solve the problem of scare/scarce resources, organizations should come up with other strategies. Moreover, the remanufacture of returned product can

assist organizations to save material purchase costs and inventory costs and these returned products can be easily converted into salable finished goods (Mondragon and Lalwani, 2011). Based on the above argument, the following hypothesis is postulated relating management practices and innovation.

H1: Management practices improves eco- innovation

Employing sustainable development will save costs for organizations. Although green efforts require considerable investment in Research and Development (R&D), the actual revenue gain will outweigh the inputs (Triguero et al. 2013). Not only does the advanced technology improve the productivity in organizations, but also it will help them to avoid punishment from the tightening environmental regulation. Taking these factors of pursuing environmental friendly development into account, the word 'sustainability' addresses the efforts and concerns about relieving the impact on environment. The concept of sustainable manufacturing is that the management of materials, information and capital flows will in line with environmental, social and economic requirements (Beske, 2012; Ho and Choi, 2012). For instance, Hewlett Packard innovatively removes an adhesive that makes recycling of ink cartridges challenging, which brings about 2.4 million dollar saving in two years (González-Garcíaet al., 2012). Furthermore, by simplifying the design of cartridge packaging, the materials used is more efficient and the product cost per unit is also reduced. In order to achieve the goal, innovations serve significant function. As Schumpeter claims, 'the process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old ones and incessantly creating a new one. This process of creative destruction is the essential fact about capitalism (Schumpeter, 1954)'. This work addresses the significance of innovation for sustainable development. Innovative practices especially training and investment in research and development have significant effect on eco-innovation (Ulusoy, 2003). The following hypothesis states the effect of innovative practices on eco-innovation.

H2: Innovative practices improves eco-innovation

Horbach et al. (2012) have mentioned that eco-innovation is quite successful, because research has proved that around 80.4% of eco-innovation may result in lower or constant cost, and among those eco-innovations, 32% of them even related to higher turnover. Furthermore, new business models built up related to sustainable innovations can create a win-win

situation (Boons et al. 2013). For example, Liu et al.(2012) point out that compared to closed-loop supply chains that aim at improving economic benefits, sustainable supply chain management pays more attention on the coordination among social, environmental and economic dimensions. Firms' performance should be evaluated through economic, environmental and social performance (Beske, 2012; Chaabane et al., 2012). A research project called "Measuring Eco-Innovation (MEI)" taken by EU cares more about the environmental risk and pollution problems (Horbach et al., 2012). Sustainable performance arguments state that there is higher plausibility for the firms, that eco-innovated to improve on triple bottom line performance leading to sustainable performance.

H3: Eco-innovation drives sustainable performance

4.0 Research Methodology

An empirical survey is carried out to test the hypotheses. Questionnaire with standard measurement scales is used to collect the data. Given that one of the key purposes of this study is to confirm the effect of management and innovative practices that support eco-innovation and sustainable performance. A pilot test of this research is conducted with academic experts and industrial practitioners who have substantial experience in sustainability. Aiming the scope and objectives of the research, the survey instrument is developed with seven categories as follows: general respondent and company related items, environmental aspects of product and process items, items related to environmental protection practices, items corresponding to sustainable innovation practices like investments in research and development (Ulusoy, 2003); Initially, comments are received for the adapted questionnaire and gradually, several modifications are incorporated in the questionnaire that greatly influence respondents through proper transformation of messages that conveyed in receipt of better understanding about the question, for the response scales' face and content validity. In addition, the feedback has guided in changing the order and wording of several survey items that are difficult. Further this has insisted removal of questions of high complexity and unnecessary items. Besides the development of the questionnaire, the responses are structured with the five point Likert scale (1: strongly disagree and 5: strongly agree). The description for every scale is also elaborated and that has helped the survey's respondents to provide the most valid, consistent, and reliable responses (Patel and Jayaram, 2014; Chachamovich et al. 2009). The respondents of the study are executives of the manufacturing industries in the class of General manager, Works /finance   manager,

Supervisor, Experts from the pollution board, environmental / industrial consultants of Environmental manager/auditor and Environmental policy makers such as Executives from pollution board , Research and Development and NGO's.

4.1 Sampling and data collection

The questionnaire is distributed to the manufacturing firms (electronics, leather, textile dyeing) located in the tropical regions on the Industrial parks, special economic zones, Small Industries Promotion Corporation of Tamilnadu (SIPCOT) formed by the Govt. of Tamilnadu, India with various industrial clusters in Tamilnadu, a state in southern India. The data necessary for the research are received by sending questionnaires to the contacts collected from the directory available at the Confederation of Indian Industries. The questionnaire is distributed to respondents of manufacturers through electronic mailing, hardcopies and by direct interviews. Apart from the list retrieved, contacts from several association's publications, conferences and websites are gathered. To encourage respondents' participation, as a token of gratitude, they are promised with the provision of the executive summary of the article developed through the current research. In order to increase the sample diversity, other Internet channels such as Email, online survey and MSN etc. are also used to distribute the questionnaire.

Three remainders are sent to the respondents, to complete the survey, within the defined time intervals; Initial respondents (37%) are compared with the respondents which are received secondly (9%) and the final respondents (54%) serve as a proxy for non-respondents. The objective values such as respondent's experience, employee size, and existence of companies are taken to check for non-respondent bias and we didn't notice any significant difference is noticed among early and late respondents.

4.2 Structural equation modeling approach

Fornell (1992) developed Structural Equation Modeling (SEM) approach to measure customer satisfaction in marketing studies. SEM is a method that can address several restrictions and provide a robust technique for studying interdependencies among a set of correlated variables. Malaeb et al., (2000), have identified several limitations over regression models to Select Structural Equation Modeling (SEM) techniques for analyzing data from experimental/observational studies and the use of the best-fit model for inference and hypothesis testing. SEM is a multivariate statistical methodology that encompasses factor and

path analysis (McCune and Grace, 2002; Pugesek et al., 2003; Subramanian et al., 2014). One among the multivariate statistical method is the structural equation modeling, by which the evaluation of a network of relationships between manifest and latent variables can be performed (Arhonditsis et al., 2006). Later on use of SEM has become popular for measuring various performance measures in different domains that include examination of the relationship between factors. Numerous studies used SEM to figure out direct and indirect effects of the relationship between factors and performance (Lin, 2007; Joo and Sohn, 2008). There are two step approaches that are adopted in SEM for the construction of the measurement and testing the structural model (Anderson and Gerbing 1988). This study employs the SPSS 20 for confirmatory factor (Measurement) and AMOS 20 for path analysis (Testing).

Sir shall we delete this? – Vague and contradictory

Even though the major advancements towards generalization of the method occurred after 1970s (Keesling, 1972; Joreskog, 1973), attempts to analyze multiple causal pathways and partition direct and indirect relationships among variables that date back to approximately 80 years.

4.2.1 Measurement model – Validity and reliability

Figures 2a – c show the measurement models along with the correlation values of the constructs management practices, innovation practices and sustainable performance. Table 2 shows the constructs, composite reliability, Cronbach's Alpha and the Average Variance Extracted (AVE) of each construct. AVE is utilized to assess the discriminant validity, the square root of which should be larger than the correlations between constructs (Chin, 1998). The reliability or internal consistency is assessed through Cronbach's alpha coefficient and composite reliability. As suggested by Nunnally (1978), a value greater than 0.60 show good reliability for newly developed constructs. Measurement scales for all constructs are greater than 0.60, which means all of them have adequate reliability. The results show that composite reliability values for all constructs are greater than 0.50, which indicate good internal consistency. The results show that all items meet the requirement.

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Insert figure 2a-c about here

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4.2.2 Testing of structural equation models

The confirmatory factor analysis model and its fit statistics are shown in figure 3 and table 3 respectively. Figure 4 shows the AMOS test results of the structural equation model of antecedents of eco-innovation and its consequences. Table 4 provides the fit indices of the path model of our study given in figure 4. The cutoffs for the fit indices recommended by Shah and Goldstein (2006) and given in table 5 have been used for testing the SEM. The indices Chi-square, comparative fit index, incremental fit index and root mean square error of approximation are within the suggested cut-off.

Insert figures 3 & 4 about here

Insert table 3, 4 & 5 about here

5. Discussions

Eco-innovation conceptual and path models that are developed in this article relate and show the influence of the two antecedents' of Management and Innovation on Eco Innovation. The study made with the path model (figure 4) and analyzed using the experimental data, which is obtained through questionnaire developed to assess the sustainable performance to various practices, reveal the following:

- The deviational coefficient between management practice on eco-innovation '0.19' reveals that management practice is significant. It means that management practice contributes and supports eco-innovation and subsequently sustainable performance. Hence the hypothesis "H1: Management Practices improves Eco-Innovation" is validated.

- The deviational coefficient between innovation on eco-innovation '0.98' reveals that innovation is not much significant. It means that the data set does not support the hypothesis "H2: innovation improves Eco-Innovation" and is not validated.

- The deviational coefficient between Eco-Innovation and Sustainable Performance is with a value of '1.00'. This points out that the data is not sufficient enough to prove the hypothesis "H3 Eco-Innovation drives Sustainable Performance" and hence not validated and as well industries adopt variety of quality practices. Possibility of non-supportive to our hypotheses H3 (Eco-innovation and performance) are due to the non-availability of appropriate sustainable performance measurement. Still more understanding is essential in the Indian manufacturing sector.

- Though, the contribution of management practices towards improving eco-innovation is significant, it has been achieved mainly through environmental audit '0.19' rather than the quality practices '0.99'.

- The deviational coefficient of training on ERMS '0. 64' and expenses on R&D '0.70' on innovation indicate that the practice of them differs in large extent by the industries.

- It is also to be noted from figure 3 that the deviational coefficient between management practice and innovation is negative (- 0.09), which is the indication of non coexistence of management practice and innovation in most of the industries.

- The proactive environmental management practices will positively influence the innovative solutions to environmental challenges and improves organization's sustainability operations.

- In addition to the benefit of environmental protection, ERMS and R&D play a major role in sustainable performance and provides competitive advantage in product innovation, process innovation, and sales growth (Herrmann et al. 2008).

The findings of Wehrmeye and Tyteca, (1998) on environmental performance measurement and the study carried out by Zhao et al. (2008) on the environmental linkages concentrate on the policies and governance, and are indicated as: Social and environmental responsibilities can be improved through strong legal enforcement by the government; Principal policy commitments must be supported by the governments to enhance green growth concept. They stated further that the policies should not only concentrate on environment and must embrace the social aspects of economic and negative impacts. As this study explores the linkages of management practices, innovation practices, eco-innovation and their resultant sustainable performance, it demonstrates the drivers of sustainability and the action that managers need to focus to improve sustainability, and examines the impacts of social and environmental initiatives on overall corporate profitability. This can help managers to suggest the ways to

improve the measurement and management of sustainability issues, and provide guidance on how managers can translate sustainability strategies into action. However, to implement strategies generally and sustainability strategies particularly, managers need to understand better both the implications of their decisions and the actions that they can take to produce improved performance.

To build sustainable strategy, Wu and Hunt (2000) suggested the companies to improve the quality of its dialogue between all interested parties and stakeholders, when they are preparing their environmental policy besides minimizing its impacts on the environment and they should also ensure the buy in concepts. (This paragraph may be appropriately referred here – IJSDWE paper)

There are substantial differences in management approach and goals between eco-efficiency and eco-effectiveness: eco-efficiency practices are generally more quantifiable measurements while eco-effectiveness has been more conceptual and qualitative. Eco-efficiency assists companies more concretely in continuous improvement by minimizing their use of resources, encouraging innovation in environmental management throughout the whole life cycle, and creating tangible economic benefits. Eco-effectiveness is oriented to the redesign of the whole production and consumption system, by encouraging ecologically appropriate design of products, by closing material flows, recovering resources and using materials that result in minimal environmental impact. Eco-innovation incorporates the essence of both technological and environmental approaches towards the design and development of every aspects of process and product development. However, the innovation practices majorly concentrate towards the economic enhancement of the industry. The system of performance fails to support both the hypothesis developed for the relationship between the innovation practice and eco-innovation and also for the hypothesis developed for the eco-innovation and performance.

Socially acceptable management and innovative practices would concurrently achieve sustainable environment through eco-innovation as the primary objectives. Eco-innovation is a part of the CSR activity to magnetize the customers to realize the positive performance. It should not surprise us to find Malaysia, India and other East Asian states among the strongest supporters of initiatives to keep environmental standards, among others, out of international

trade agreements (Mol, 2003). An interesting note from Ooi et al., (2012) points out about the "Ranking of the World's Most Innovative Countries". China ranked No. 54, India is positioned No. 56, Thailand was ranked No. 58, and Indonesia ranked No. 74. It is very clear that India has to make enormous effort to increase its innovation potential. On aggregation, India is the fourth largest consumer of resources and the largest ecological destructor among those countries surveyed (Selles, 2013). Indian manufacturing sector managers have to focus more on sustainable practices in future to survive.

6. Conclusion

The article delineates the inter-relation between the innovative and management practices on eco-innovation and sustainable performance in the Indian manufacturing context. A conceptual SEM has been proposed to test three hypotheses developed in the context of the practices of Indian Manufacturing Sector. Empirical data along with SEM approach are employed to determine the effect of eco-innovation's antecedents and consequences. The study highlights the serious challenges faced by the Indian Manufacturing Sector. The study identifies that Indian Manufacturing Sectors are well positioned in the usage of management practices. They lack in establishing their brand equity and protecting the corporate social responsibility aspects. It is also obvious from the study that in future, the manufacturing sectors have to invest more on research and development activities and the training to the employees related to innovative practices in order to improve sustainable performance. Furthermore, the mindset of manufacturing sector stakeholders have to change and rethink their conventional business models from lower cost to sustainability aspects to survive in the future. Few limitations of the study are with respect to sample size and the number of industries selected within manufacturing sector. Strong voluntary participation of industry leaders in future would champion the sustainability camp. Furthermore, usage of more refined sustainable performance metrics would reflect the exact status of the manufacturing firms.

References

Anderson JC, Gerbing DW. 1988. Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach. Psychological Bulletin. 103(3):411-423.

Arhonditsis GB, Stowb CA, Steinberg LJ, Kenney MA, Lathrop RC, McBride SJ, Reckhowa KH. 2006. Exploring ecological patterns with structural equation modeling and Bayesian analysis. Ecological Modelling 192:385–409.

Bai C, Sarkis J, Wei X, Koh L. 2012. Evaluating ecological sustainable performance measures for supply chain management. Supply Chain Management: An International Journal. 17(1):78-92. (doi: 10.1108/13598541211212221)

Baskaran V, Nachiappan S, Rahman S 2011. Supplier assessment based on corporate social responsibility criteria in Indian automotive and textile industry sectors. International Journal of Sustainable Engineering 4(4): 359-369.

Beske P. 2012. Dynamic capabilities and sustainable supply chain management. International Journal of Physical Distribution & Logistics Management. 42(4):372-387. (doi: 10.1108/09600031211231344)

Boons F, Montalvo C, Quist J, Wagner M. 2013. Sustainable innovation, business models and economic performance: an overview. Journal of Cleaner Production. 45:1-8. (doi: http://dx.doi.org/10.1016/j.jclepro.2012.08.013)

Carrillo-Hermosilla J, Del Río P, Könnölä T. 2010. Diversity of eco-innovations: Reflections from selected case studies. Journal of Cleaner Production. 18:1073-1083.(doi: http://dx.doi.org/10.1016/j.jclepro.2010.02.014)

Cetinkaya B, Cuthbertson R, Ewer G, Klaas-Wissing T. 2011. Sustainable supply chain management: practical ideas for moving towards best practice: Springer. XVIII. :283p.

Chaabane A, Ramudhin A, Paquet M. 2012. Design of sustainable supply chains under the emission trading scheme, International Journal of Production Economics. 135(1): 37-49. (doi: http://dx.doi.org/10.1016/j.ijpe.2010.10.025)

Chachamovich E, Fleck MP, Power M. 2009. Literacy affected ability to adequately discriminate among categories in multipoint likert scales. Journal of Clinical Epidemiology. 62(1):37-46.

Chin WW. 1998. Issues and opinion on structural equation modeling, MIS Quarterly. 22(1):VII-XVI.

Cook M, Gottberg A, Angus A, Longhurst P. 2012. Receptivity to the production of product service systems in the UK construction and manufacturing sectors: a comparative

analysis Journal of Cleaner Production. 32:61-70. (doi: http://dx.doi.org/10.1016/j.jclepro.2012.03.018)

Curkovic S. 2003. Environmentally Responsible Manufacturing: The development and validation of a measurement model. European Journal of Operational Research. 146: 130–155.

Dangayach GS, Deshmukh SG. 2000. Manufacturing strategy: experiences from select Indian organizations. Journal of Manufacturing Systems. 19(2):134-148.

Dangayach GS, Deshmukh SG. 2003. Evidence of manufacturing strategies in Indian industry: a survey. International Journal of Production Economics. 83(3): 279-298.

[a]Despeisse M, Ball PD, Evans S, Levers A. 2012. Industrial ecology at factory level - a conceptual model. Journal of Cleaner Production. 31: 30-39

[b]Despeisse M, Mbaye F, Ball PD, Levers A. 2012. The emergence of sustainable manufacturing practices. Journal of Production Planning and Control. 23.(5):354–376

Diedrich A, Uphamb P, Levidowe L, Hove SV. 2011. Framing environmental sustainability challenges for research and innovation in European policy agendas. Environmental science & policy. 14: 35–939

DiMaggio PJ, Powell W. 1983. "The iron cage revisited" institutional isomorphism and collective rationality in organizational fields. American Sociological Review. 48:147-60.

Elkington J. 1997. Cannibals with Forks: the Triple Bottom Line of 21st Century Business. Capstone.

Esty DC, Winston AS. 2006. Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage: Yale University Press.

Fang Y, Cote RP. 2005. Towards sustainability: Objectives, strategies and barriers for cleaner production in China, International Journal of Sustainable Development and World Ecology. 12:443–460

Fredericks SE. 2012. Justice in sustainability indicators and indexes, International Journal of Sustainable Development & World Ecology. 19(6):490–499.

Foronda-Robles C, Galindo-Pérez-de-Azpillaga L. 2012. Working with indicators: description of states of territorial adjustment for protected natural areas. International Journal of Sustainable Development & World Ecology. 19(4):287–296.

Fornell C. 1992. A national customer satisfaction barometer:The Swedish experience. Journal of Marketing, 56(1): 6–21.

Giannakis M. 2007. Performance measurement of supplier relationships. Supply Chain Management: An International Journal. 12(6):400-411. (doi: 10.1108/13598540710826335)

Gimenez C, Sierra V, Rodon J. 2012. Sustainable operations: Their impact on the triple bottom line. International journal of Production Economics. 140:149–159.

González-García S, Raúl García Lozano RG, Teresa Moreira MT, Gabarrell X, Rieradevall J, Gumersindo P, Murphy RJ. 2012. Eco-innovation of a wooden childhood furniture set: An example of environmental solutions in the wood sector, Science of The Total Environment. 426:318–326.

Herrmann H, Zein A, Thiede S, Bergmann L Bock R. 2008. Bringing sustainable manufacturing into practice – the machine tool case, in: Sustainable Manufacturing. VI. Global Conference on Sustainable Product Development and Life Cycle Engineering. Pusan. Korea. 272–277.

Hitchcock T. 2012. Low carbon and green supply chains: the legal drivers and commercial pressures. Supply Chain Management: An International Journal. 17(1): 98-101.

Ho PYH, Choi TM. 2012. A Five-R analysis for sustainable fashion supply chain management in Hong Kong: a case analysis. Journal of Fashion Marketing and Management. 16(2): 161-175.

Horbach J, Rammer C, Rennings K. 2012. Determinants of eco-innovations by type of environmental impact-The role of regulatory push/pull, technology push and market pull. Ecological Economics. 78:112-122. (doi: http://dx.doi.org/10.1016/j.ecolecon.2012.04.005)

Jayal AD, Badurdeen F, Dillon OW, Jawahir IS. 2010. Sustainable manufacturing: Modeling and optimization challenges at the product, process and system levels. CIRP Journal of Manufacturing Science and Technology. 2: 144–152.

Joo YG, Sohn SY. 2008. Structural Equation Model for Effective CRM of digital content industry. Journal of Expert System with Applications. 34: 63-71.

Joreskog, K.G. 1973. Analysis of covariance structures. In Multivariate Analysis-III, P. R. Krishnaiah, ed. New York: Academic Press. 263–285. - Might be deleted

Keesling JW. 1972. Maximum likelihood approaches to causal analysis. Ph.D. Thesis, University of Chicago. - Might be deleted

[a]Ketchen Jr DJ, Hult TM. 2007. Bridging organization theory and supply chain management: The case of best value supply chains, Journal of Operations Management. 25:573–580

[b]Ketchen Jr, DJ, Hult TM. 2007. Toward greater integration of insights from organizational theory and supply chain management, Journal of Operations Management. 25(2):455-458.

Klassen RD, McLaughlin CP. 1996. The Impact of Environmental Management on Firm Performance'. Informs a journal of The Institute for Operations Research and the Management Sciences. 42: 1199-1214.

Kurk F. Eagan P. 2008. The value of adding design-for-the-environment to pollution prevention assistance options. Journal of Cleaner Production. 16:722-726

Lai K, Wong CWY, Cheng TCE. 2006. Institutional isomorphism and the adoption of information technology for supply chain management. Jounrnal of Computers in Industry. 57: 93–98

Leitham S, McQuaid RW, Nelson JD. 2000. The influence of transport on industrial location choice: a stated preference experiment. Journal of Transportation Research Part A. 34:515-535.

Lin H. 2007. Effects of extrinsic and intrinsic motivation on employee knowledge sharing intentions. Journal of Information Science. 33:135-149.

Liu S, Kasturiratne D, Moizer J. 2012. A hub-and-spoke model for multi-dimensional integration of green marketing and sustainable supply chain management. Industrial Marketing Management. 41(4):581-588. (doi: http://dx.doi.org/10.1016/j.indmarman.2012.04.005)

Liu F, Zhang H, Wu HP, Cao HJ. 2002. A model for analyzing the consumption situation of product material resources in manufacturing systems. Journal of Materials Processing Technology. 122: 201–207.

Malaeb ZA, Summers JK, Pugesek BH. 2000. Using structural equation modelling to investigate relationships among ecological variables. Environmental and Ecological Statistics. 7:93–111.

Malarvizhi P, Sangeeta Y. 2008. Corporate Environmental Disclosures on the Internet: an Empirical Analysis of Indian Companies. 2(2): 211-232.

McCune, B. and J.B. Grace. 2002. Analysis of Ecological Communities. MJM Press.

Meyer MW. 2002. Rethinking Performance Measurement. Cambridge University Press.

Mol APJ. 2003. Global institutional clashes: economic versus environmental regimes. International Journal of Sustainable Development and World Ecolology. 10:303-318

Mondragon AEC, Lalwani C. 2011. Measures for auditing performance and integration in closed-loop supply chains, Supply Chain Management: An International Journal. 16:(1):43-56.

Montabon F, Sroufe R, Narasimhan R. 2007. An examination of corporate reporting, environmental management practices and firm performance. Journal of Operations Management. 25(5): 998–1014.

Nidumolu R, Prahalad CK, Rangaswami MR. 2009. Why Sustainability is now the key driver of Innovation, Harward Business School Publishing Corporation.

Nunnally JC. 1978. Psychometric theory, 2nd edition. New York: McGraw-Hill.

OECD. 2009. Sustainable Manufacturing And Eco-Innovation: Framework, Practices And Measurement-synthesis report.

Ooi KB, Lin B, Teh PL, Chong AYL. 2012. Does TQM Support Innovation Performance In Malaysia's Manufacturing Industry?'. Journal of Business Economics and Management. 13(2):366–393.

Orlitzky M, Schmidt FL, Rynes SL. 2003. Corporate Social and Financial Performance: A Meta-analysis. Organization Studies. Sage publications. 24(3): 403–441.

Patel PC, Jayaram J. 2014. The antecedents and consequences of product variety in new ventures: An empirical study, Journal of Operations Management. 32: 34–50

Porter ME. 1996. What is Strategy?,Harvard Business Review.

Pugesek BH. 2003. Modeling a complex conceptual theory of population change in the Shiras Moose: History and recasting as a structural equation model. In: Structural Equation Modeling: Applications in Ecological and Evolutionary Biology Research. Cambridge University Press, Cambridge, 409 pp.

Rho BH, Park K, Yu Y. 2001. An international comparison of the select of manufacturing strategy-implementation gap on business performance. International journal Production Economics. 70: 89-97.

Sarkis J, Ni N, Zhu Q. 2011. Winds Of Change: Corporate Social Responsibility In China. Social Responsibility. Ivey Business Journal.

Schumpeter JA. 1954. Economic Doctrine and Method, New York: Oxford University Press.

Simon OR, 2008. Designing interventions for ecodesign? Business Strategy and the Environment. 17(1):77-78. (doi: 10.1002/bse.610)

Singh LP, Bhardwaj A, Sachdeva A. 2006. Quality Management Practices vs. Performance of SMEs: An Empirical Study of Indian Industries. Technology Management for the Global Future. 5: 2393-2399.

Selles H. 2013. The relative impact of countries on global natural resource consumption and ecological degradation. International Journal of Sustainable Development and World Ecology. 20(2):97-108. (http://dx.doi.org/10.1080/13504509.2013.780190)

Subramanian N, Gunasekaran A, Yu J, Cheng J, Ning K 2014. Customer satisfaction and competitiveness in the Chinese E-retailing: Structural equation modeling (SEM) approach to identify the role of quality factors. Expert Systems with Applications 41(1): 69-80

Tidd J, Bessant John Pavitt K. 2005. Managing innovation: Integrating technological, market and organizational change. 3rd ed. Wiley, West Sussex.

Triguero A, Moreno-Mondéjar L, Davia MA. 2013. Drivers of different types of eco-innovation in European SMEs. Ecological Economics. 92:25– 33

Ulusoy G. 2003. An assessment of supply chain and innovation management practices in the manufacturing industries in Turkey. International Journal of Production Economics. 86(3): 251-270.

Wilts H, Dehoust G, Jepsen D, Knappe F. 2013. Eco-innovations for waste prevention - Best practices, drivers and barriers. Science of the Total Environment. 461-462:823-829.

Wu C, Hunt N. 2000. Development of environmental policy, objectives and targets. International Journal of Sustainable Development and World Ecology. 7:357-361. - referred in isolated paragraph

Wehrmeyer W, Tyteca D. 1998. Measuring environmental performance for industry: from legitimacy to sustainability and biodiversity?, International Journal of Sustainable Development and World Ecology. 5:111-124.

Yang CJ, Chen JL. 2012. Forecasting the design of eco-products by integrating TRIZ evolution patterns with CBR and Simple LCA methods. Expert Systems with Applications. 39:2884–2892.

Yang M. 2006. Energy efficiency policy impact in India: case study of investment in industrial energy efficiency. Journal of Energy Policy. 34:3104–3114.

Yarong Z, Xin Y. 2011. Research on the sustainable development and the objective of Chinese government performance audit. Energy Procedia. 5:1230–1236.

Zhao J, Liu H, Dong R. 2008. Sustainable urban development: Policy framework for sustainable consumption and production. International Journal of Sustainable Development and World Ecology. 15:318–325. (DOI 10.3843/SusDev.15.4:5)

Zhu Q, Cordeiro J, Sarkis J. 2013. Institutional Pressures, Dynamic Capabilities and Environmental Management Systems: Investigating the Iso 9000 E Environmental Management System Implementation Linkage. Journal of Environmental Management. 114:232-242.
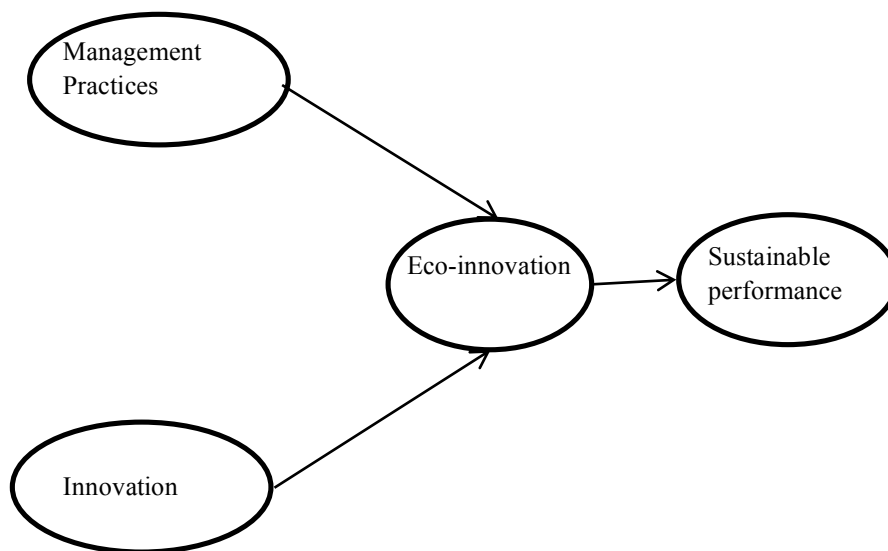
Figures

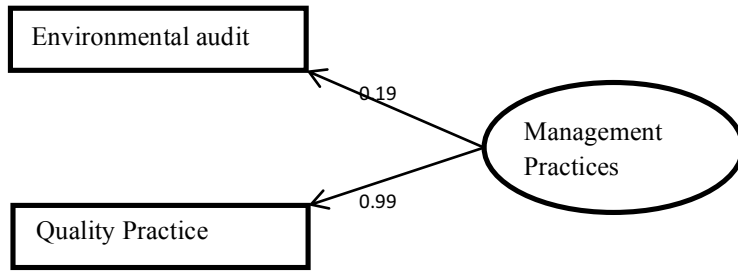Figure 1: Atecedents and consequences of eco-innovation comceptual model

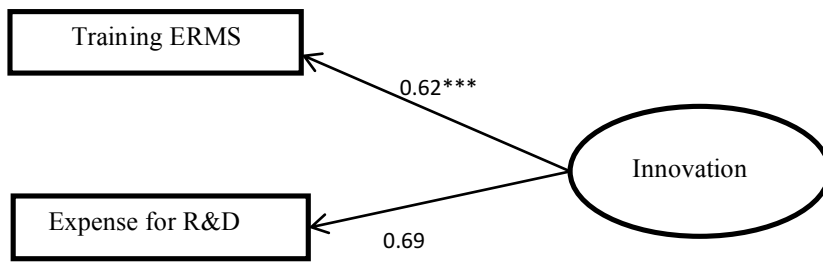Figure 2 a: Management practices measurement model

Figure 2 b: Innovation practices measurement model
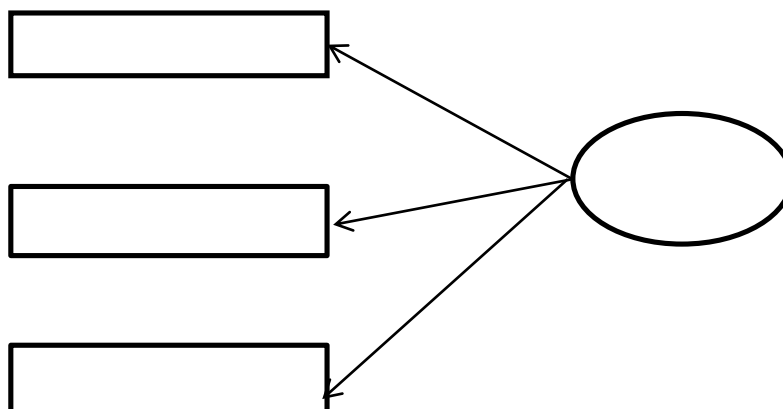
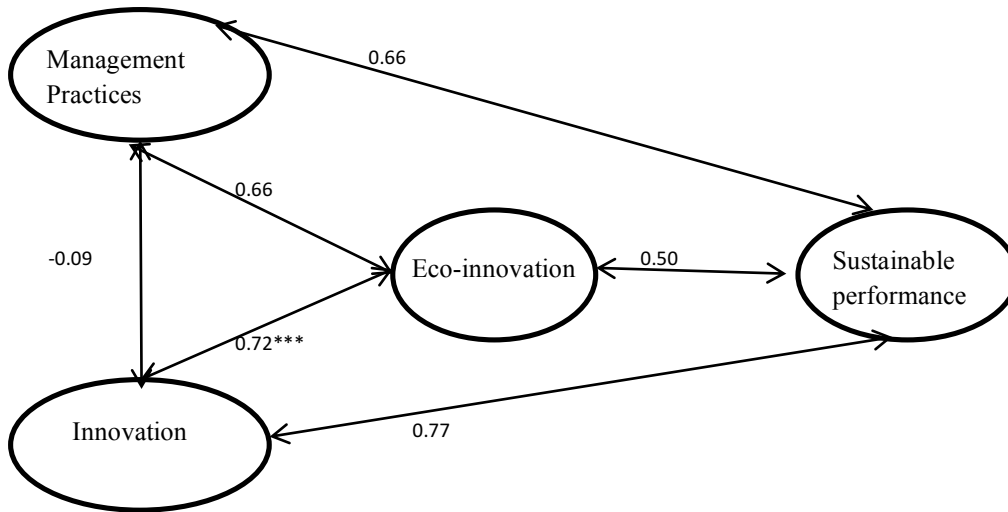Figure 2 c: Sustainable performance measurement model

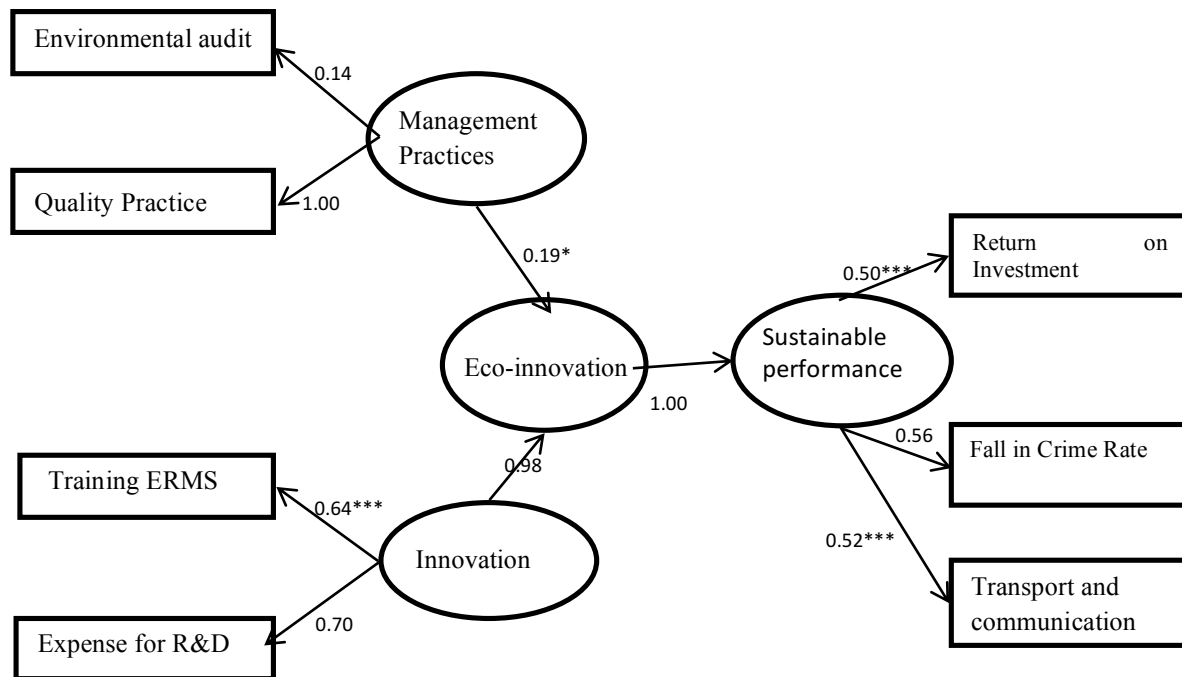Figure 3: Confirmatory factor analysis model

Figure 4: Path model

Table I Performance criteria

Sustainable Criteria		Author	Area of Study
Sustainable practices leading Sustainable Performance	Economy (Management)	Leitham et al. 2000, Ulusoy 2003, Yang 2006	Industrial performance studies
		Dangayach and Deshmukh, 2000 and 2003	per capita Gross National Product (GNP), Gross Domestic Product (GDP), Manufacturing (% of GDP), per Capita Research and Development (GDR) Expenditure and Exports
		Rho et al. 2001, Singh et al. 2006	Manufacturing Innovation Practices BPR (Business Process Reengineering), ERP (Enterprise Resource Planning), TQM (Total Quality Management), JIT (Just-In-Time), TPM (Total Productive Maintenance), CIM (Computer Integrated Manufacturing), QFD (Quality Function Deployment), DFM (Design For

			Manufacturer), PDM (Product Data Management), FMS (Flexible Manufacturing System), CAD (Computer-Aided Manufacturing) and CAE (Computer-Aided Engineering).
		Fang and Cote (2005)	Cleaner Production towards sustainability
		Meyer, 2002	Market valuation, financial measures, Non-financial measures and Cost measures
	Environment (Eco Innovation)	Fredericks (2012)	Environmental Performance Index (EPI), Sustainable Development Indicators (SDIs)
		Liu et al. 2002, Yang 2006, Jayal et al. 2010	Environmental studies
		Klassen and McLaughlin's 1996	Environmental Collaboration
		Montabon et al, 2007	Environment Management
	Socio-Economic (Innovation)	Curkovic 2003	Environmental Responsible Manufacturing
		Despeisse et al., 2012[b]	Sustainable Manufacturing practices such as lean manufacturing, Environmentally Conscious Manufacturing (ECM) and '4-Rs' (reduction, remanufacturing, recycling and reuse)
		Herrmann et al. 2008, Yarong and Xin, 2011 and Gimenez et al. 2012	Economic, ecological/ environmental and social
		Foronda-Robles and Galindo-Pérez-de-Azpillaga (2012)	socio-economic development and the strategies for protected natural areas
		Jayal et al. (2010)	functionality, manufacturability, recyclability, re-manufacturability, resource utilization/economy and societal impact
		Orlitzky et al. 2003, Esty and Winston 2006 and Gimenez et al. 2012	Environmental, Social and Corporate Governance
		Malarvizhi and Sangeeta (2008)	Social, Economic and Socio-economic

Table 2: Construct test statistics

Constructs	Variables code	Variables	Cronbach's Alpha	Composite reliability	AVE
Innovation	C1	Training on ERMS to employees	0.625	0.5596	0.3901
	C2	Proportion of Expenses from turn over for			

		R&D activities			
Management Practices	C3	Frequency of environmental practices Audit	0.629	0.5696	0.5082
	C4	Quality/ Management Practices			
Sustainable Performance	D2	Return on Investment	0.605	0.6618	0.3476
	E2	Fall in Crime Rate			
	F1	Transport and communication facilities has improved			

Table 3: Fit indices of the confirmatory factor analysis model

x^2(df)	Normed x^2	CFI	RMSEA(% CI)	IFI
15.6(14)	1.11	0.854	0.060	0.910

Table 4: Fit indices of the path model

x^2(df)	Normed x^2	CFI	RMSEA(% CI)	IFI
21.3(15)	1.42	0.920	0.065	0.925

Table 5: Description of Fit indices (Source: Shah and Goldstein, 2006)

Fit index	Description	Suggested cut-off
x^2/df	Normed chi-square: chi-square divided by degree of freedom	(0.002,4.80)
CFI	Comparative fix index: compares the model fit with a baseline model	(0.88,1.00)
IFI	Incremental fit index: group of goodness of fit indices that assesses how well a specified model fits relative to some alternative baseline model	(0.88,0.98)
RMSEA	Root mean square error of approximation	(0.00,0.13)

Appendix 1: General characteristics of respondents and their organization

S.No	Characteristics	Details
1.	Preferred Designation	Middle level managers to General manager
2.	Experience	8 – 25 years

3.	Organization strength	In existence for more than 5 years
4.	Employees (Size of the company)	50 to 500
5.	Location of firms	Tamilnadu a state in southern India
6.	Type of Sector	Manufacturing
7.	Practices followed	• Management – ISO 9001, EMS, Environmental Audit, Quality Practices • Environmental – ISO 14000, R&D investment, Training on ERMS • CSR activities