(significant at $p<0.001$, $t$-value= 19.21) between *SP* & *PLC* while a relationship coefficient of 0.6186** (significant at $p<0.001$, $t$-value= 13.57) between *PLC* and *STP*. All of the result indices are reported in Table 3.

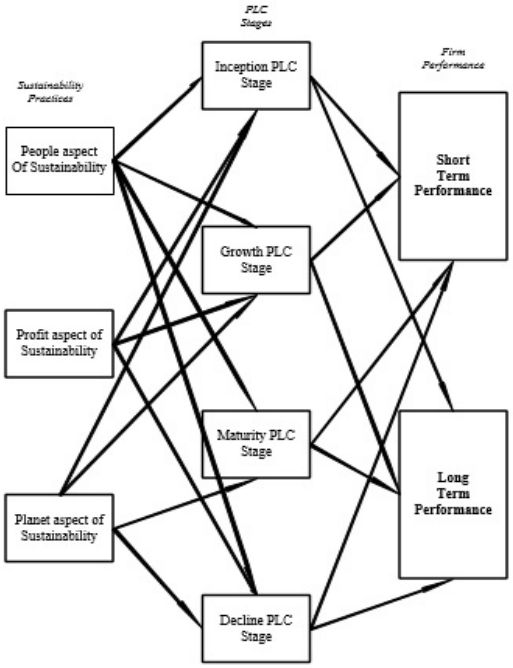
Table 3 Overall Results of the Study

| Hyp. | Dependent Variable (DV) | Independent Variable (IV) | Direct effect | In-direct Effect | $R^2$, t-value | Status of Hypothesis |
|---|---|---|---|---|---|---|
| H1 | Short term Performance | Sustainable Practices | 0.2516** | ---- | 0.3762, 17.35 | Approved at $P<0.001$ |
| H2 | Long term Performance | Sustainable Practices | 0.3342* | ---- | 0.4014, 22.19 | Approved at $P<0.05$ |
| H3 | Short term Performance | Product Life Cycle Stages | 0.5412* | ---- | 0.3242, 16.94 | Approved at $P<0.05$ |
| | | Sustainable Practices | ---- | 0.3695* | 0.4937, 19.43 | |
| H4 | Long term Performance | Product Life Cycle Stages | 0.6186** | ---- | 0.4116, 1357 | Approved at $P<0.05$ |
| | | Sustainable Practices | ---- | 0.4224* | 54.95%, 20.24 | |

## 5. Conclusion and Discussion

The relationship between sustainable practices and firm performance is mainly discussed in literature (Borland et al., 2016; Wiklund, 1999; Ortiz et al., 2016); however, little focus is provided to the role of life cycle stages in examining the relationship. An enterprise needs to align its sustainability efforts with different *PLC* stages dynamically to achieve more efficiency in the performance indices. For instance, as reported in Table 4, the total effect of sustainable practices on short term performance increases from *0.2516* ($H_1$) to *0.3695* ($H_3$) with an equivalent *11.75%* increase in $R^2$ value. It suggests that considering the mediating role of *PLC* stages in the framework enhances the relationship between *SP* and *STP* indices and also, the overall model becomes more robust. Similarly, including *PLC* in relationship framework of *SP* and *LTP* enhances the strength of relationship by *0.1* units while $R^2$ increases by *14.81%.* We can conclude that aligning the in-house sustainable practices *(People, Profit and Planet)* according to the life cycle stage of a product is rewarding not only in the short term *(returns and business growth)* but is also fruitful in long term accomplishments *(environmental footprints, reduction in emission, solid waste and social recognition).* Instead of considering product as a single unit and adopting sustainability protocols for the entire unit, it is suggested to consider the product by parts (4 *PLC* stages) and utilize the relevant sustainability approach in particular *PLC* stage in a dynamic and interactive manner. It can help an enterprise in multiple ways. *Firstly*, segregation of sustainable practices can help an enterprise in division of responsibilities according to a *PLC* stage. *Secondly*, demarcation between sustainable practices can help an enterprise to operate more efficiently, for example, more focus on profit in inception and growth stages and considering "people" aspect in maturity stage while "planet"/environment aspects in the decline stage. *Thirdly*, clustering bundles of sustainability practices according to *PLC* stages can provide an enterprise with imitable and tacit competitive edge in the market as it would be a start on new learning curve. *Lastly*, an enterprise can be more aware regarding the performance of its product and the consequences a product may cause during its service. Figure 1 contains a dynamic and interactive framework between *SP*, *PLC* stages and performance indices.

Figure 1 Interactive Framework between SP, PLC and Firm Performance




The purpose of sustainability is to use resources more efficiently in order to preserve them for the generations to come (Saltiel *el al*., 1994). A discussion is made on the importance of utilizing sustainability efforts according to *PLC* stages. Managers can utilize this framework by listing capabilities of production system and making clusters of them according to different *PLC* stages. The capabilities include but are not restricted to production efficiency for profit generation, human potential and environmental initiatives. As a demonstration, a follow-up content analysis of literature was performed to identify the most cited factors of sustainable practices. The list of factors was administered to the selected respondents and they were requested to examine the categorization of sustainable practices in different *PLC* stage. Literature based list of sustainable factors is provided in Appendix A. Exploratory Factor Analysis *(EFA)* was performed on the collected data to assign sustainable practices to different *PLC* stages (Kim *et al*., 2015). *EFA* was conducted using Principal Component Analysis *(PCA)* and orthogonal rotation was selected as different *PLC* stages are not correlated (Costello *et al*., 2005). The results of *EFA* are listed in Appendix B and categorization of sustainable practices according to life cycle stages is provided in Table 4.

Table 4 Assignment of Sustainable Practices to *PLC* Stages

| Sustainable Practices | Adoption of Sustainable Practices in *PLC* Stages | | | |
|---|---|---|---|---|
| | Introduction Stage | Growth Stage | Maturity Stage | Decline Stage |
| 1 | ✓ | | | |
| 2 | | ✓ | | |
| 3 | ✓ | | | |
| 4 | ✓ | | | |
| 5 | | | | ✓ |
| 6 | | | ✓ | |
| 7 | | | ✓ | |
| 8 | | | | ✓ |
| 9 | | ✓ | | |
| 10 | | ✓ | | |
| 11 | | | ✓ | |

| | | | | |
|---|---|---|---|---|
| 12 | ✓ | | | |
| 13 | | | ✓ | |
| 14 | | | | ✓ |
| 15 | | ✓ | | |
| 16 | | | ✓ | |
| 17 | ✓ | | | |
| 18 | | | | ✓ |
| 19 | | ✓ | | |
| 20 | | ✓ | | |

Data for *EFA* analysis was collected from the same sample as the respondents were aware of the objectives and study design. A framework as a result of *EFA* analysis is provided in Figure 2 which clusters the sustainable practices according to *PLC* stages. Managers can use it as a decision-making tool to segregate the *SP* factors for utilizing their efforts optimally. For instance, the inception stage of *PLC* comprises of R&D, prototyping, raw material procurement, product development and finally, launching the product. As per the acquired results, relevant *SP* practices in this stage are optimal use of natural resources, eco-friendly design, eco-friendly process and green purchasing. Similarly, cluster of practices can be used for other *PLC* stages.

Figure 2 Decision Matrixes for Sustainable Practices Bundle

| | *Bundle of Sustainable Practices* | |
|---|---|---|
| *Product Life Cycle Stages* | Inception Stage | *Sustainable use of natural resources, Eco-design, Green procurement, Eco-friendliness, Green purchasing* |
| | Growth Stage | *Adoption of the best available techniques, Training, Empowering personnel, Environmental regulation, Investment recovery, Profit margins* |
| | Maturity Stage | *Social welfare services, community awareness, pollution control, product life cycle analysis, cost of environmental friendliness* |
| | Decline Stage | *Environmental compliance, product responsibility, stewardship, cooperation with customers* |

As a case example, the proposed framework was applied to two (2) enterprises for assessment of sustainable practices according to *PLC* stages. One of the selected enterprises was fabrication based while another was involved in bottle manufacturing practices. Archival data was analyzed for list of sustainable practices relevant to their context and a detailed analysis was performed according to the guidelines provided in Figure 2. The findings of case-based analysis are provided in Table 5.

Table 5 Application of proposed framework

| Industry Type | List of Sustainable Practices (SP) | SP related to Inception PLC | SP related to Growth PLC | SP related to Maturity PLC | SP related to Decline PLC |
|---|---|---|---|---|---|
| Fabrication | Lean manufacturing, Total Quality Management, Research and Development, New learning curve, Energy consumption, Incentives for employees, Life cycle analysis, Health hazards, Community awareness, Profit driven production, Industrial safety, Environmental compliance, Product termination, Business leadership, Eco-friendly design, Solid waste reduction, Improving practices | Total Quality Management, Energy consumption, Industrial Safety, Eco-friendly design | Lean manufacturing, Research & development, New learning curve, Profit driven production | Incentives for employees, Life cycle analysis, Community awareness, Product termination, Improving practices | Health hazards, Environmental compliance, Business leadership, Solid waste reduction |
| Bottle Manufacturing | Green purchasing, Product recycling, Alternate techniques, Corporate social responsibility, Empowering personnel, Social welfare, Waste reduction, Stewardship, Feedback from clients, Product recovery, Improving practices, Pollution control, Quality standards, Benefits for workers, Sustainable process adoption | Green purchasing, Quality standards, Sustainable process adoption. | Alternate techniques, Empowering personnel, Improving practices | Corporate social responsibility, Social welfare, Product recovery, Pollution control, Benefits for workers. | Product recycling, Feedback from clients, Waste reduction, Stewardship. |

## 6. Future Directions

The results reported in this study provide meaningful insights. In a resource constraint environment, optimal allocation of sustainable resources can enhance the productivity of an enterprise. The framework recommended in this study can be applied to an industrial context using a case study approach (Yin, 2009) to not only further generalize the findings but also to assist the practitioners in practical decision making. Another area of exploration is to consider the mediating effect of individual *PLC* stage in the relationship model of *SP* and firm performance. This practice can provide researchers with interactive insights such as the identification of sustainable efforts in different *PLC* stages for short-term and long-term performance. Practitioners can thus aim on sustainability actions needed for short term and long-term results, separately. A methodological recommendation for future research is to adopt longitudinal study design, unlike the current study which is cross-sectional. As discussed earlier, time span for the short-term accomplishments is 3-5 years while it is 7-10 years for long term goals. A longitudinal study conducted in multiple time spans can result in more robust and practical findings.

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## Appendix

Exhibit A Factors of Sustainable Practices for Cluster Analysis

| Sustainable Practice | Reference |
|---|---|
| Sustainable use of natural resources | Park et al., 2014 |
| Adoption of the best available technique | Michelson et al., 2006 |
| Eco-design | Bogue, 2007 |
| Green procurement | Union, 2014 |
| Environmental compliance | Taddeo et al., 2012 |
| Social welfare services | Khodakarani et al., 2014 |
| Community awareness | Shi et al., 2010 |
| Product responsibility | Hussen, 2012 |
| Training of employees | Robert, 2004 |
| Empowering personnel | |

| | |
|---|---|
| Pollution control | Sanjay et al., 2005 |
| Eco-friendliness | |
| Product life cycle analysis | |
| Stewardship | |
| Environmental regulations | Qinghua et al., 2004 |
| Cost of environmental friendliness | |
| Green purchasing | |
| Cooperation with customers | Zhu et al., 2008 |
| Investment recovery | |
| Profit margins. | |

Appendix – B EFA Analysis of *PLC* Stages for *SP* Bundles

| | Factors | | | | |
|---|---|---|---|---|---|
| Item | Introduction | Growth | Maturity | Decline | Communality |
| 1 | 0.784 | | | | 0.766 |
| 3 | 0.725 | | | | 0.740 |
| 4 | 0.692 | | | | 0.705 |
| 12 | 0.633 | | | | 0.652 |
| 17 | 0.587 | | | | 0.601 |
| 2 | | 0.891 | | | 0.872 |
| 9 | | 0.864 | | | 0.861 |
| 10 | | 0.778 | | | 0.824 |
| 15 | | 0.742 | | | 0.761 |
| 19 | | 0.656 | | | 0.687 |
| 20 | | 0.618 | | | 0.634 |
| 6 | | | 0.824 | | 0.812 |
| 7 | | | 0.802 | | 0.764 |
| 11 | | | 0.719 | | 0.717 |
| 13 | | | 0.644 | | 0.680 |
| 16 | | | 0.637 | | 0.639 |
| 5 | | | | 0.818 | 0.802 |
| 8 | | | | 0.634 | 0.735 |
| 14 | | | | 0.602 | 0.669 |
| 18 | | | | 0.576 | 0.591 |
| Eigenvalue | 12.45 | 6.82 | 4.37 | 2.08 | |
| Total Variance Explained | 61.86 | | | | |

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