List of Figures



Figure 4.1: Lean and Green practices

Figure 4.2: Number of papers in each country

Figure 4.3: Type of research

Figure 4.4: Size of the industry

Figure 4.5: Number of papers and year of publication



Figure 4.6: General overview showing the complementary and contradicting areas between LM and GM extended post Dües *et al*. (2013)

Figure 4.7: Relationships between performance criteria and Lean-Green practices.



Figure 4.8: Overlap between LM and GM for operational and environmental performance



Figure 4.9: Overlap showing the complementary and contradicting techniques between Lean and Green



Figure 4.10: Other Lean-Green themes



Figure 4.12: Results for the structural model



Figure 4.14: Structural model



Figure 4.16: SEM structural model

List of Tables

Table 4‑7: Measurement reliability and validity

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | Cronbach's Alpha | Composite Reliability | AVE | HTMT values |
| 3R | 0.847 | 0.897 | 0.686 | Does not include 1 |
| Employee Involvement | 0.751 | 0.834 | 0.502 | Does not include 1 |
| Environmental performance | 0.886 | 0.913 | 0.636 | Does not include 1 |
| GM | 0.926 | 0.936 | 0.501 | Does not include 1 |
| Green Purchasing | 0.903 | 0.922 | 0.598 | Does not include 1 |
| JIT | 0.83 | 0.876 | 0.543 | Does not include 1 |
| LM | 0.928 | 0.935 | 0.509 | Does not include 1 |
| LCA | 0.848 | 0.892 | 0.623 | Does not include 1 |
| Operational performance | 0.856 | 0.893 | 0.582 | Does not include 1 |
| TPM | 0.837 | 0.875 | 0.568 | Does not include 1 |
| TQM | 0.86 | 0.891 | 0.507 | Does not include 1 |

Table 4‑8: The *f2* values

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | 3R | EI | EVP | GM | GP | JIT | LCA |  OP | TPM | TQM |
| EVP |   |   |   |   |   |   |   | 0.396 |   |   |
| GM | 0.943 |   | 0.352 |   | 6.207 |   | 3.918 | 0.024 |   |   |
| LM |   | 1.336 | 0.152 | 0.553 |   | 2.718 |   | 0.354 | 2.883 | 2.767 |

Table 4‑9: The Stone-Geisser’s Q2 values

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Endogenous variable | TPM | JIT | TQM | EI | LCA | 3R | GP | GM | EVP | OP |
| *Q*2 | 0.340 | 0.390 | 0.364 | 0.282 | 0.490 | 0.320 | 0.509 | 0.161 | 0.224 | 0.288 |

Table 4‑10: *t* statistics and *p* values and decision on the hypotheses

|  |  |  |  |
| --- | --- | --- | --- |
|  | *t* statistics  | *p* values | Decision |
| Environmental performance Operational performance | 8.924 | 0.000 | supported |
| GM Environmental performance | 6.777 | 0.000 | supported |
| GM Operational performance | 0.973 | 0.331 | Not supported\* |
| LM Environmental performance | 2.042 | 0.042 | supported |
| LM GM | 11.955 | 0.000 | supported |
| LM Operational performance | 5.377 | 0.000 | supported |

Table 4‑11: R2, AVE, Cronbach's alpha and composite reliability values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Cronbach's Alpha | Composite Reliability | AVE | R2 |
| 3R | 0.873 | 0.902 | 0.569 | 0.636 |
| Economic performance | 0.914 | 0.932 | 0.663 | 0.603 |
| HRM | 0.727 | 0.830 | 0.550 | 0.294 |
| Environmental performance | 0.889 | 0.916 | 0.645 | 0.371 |
| Green Manufacturing | 0.925 | 0.934 | 0.508 | 0.366 |
| Green purchasing | 0.912 | 0.930 | 0.626 | 0.809 |
| JIT | 0.851 | 0.890 | 0.575 | 0.812 |
| LCA | 0.786 | 0.853 | 0.540 | 0.639 |
| Lean Manufacturing | 0.912 | 0.924 | 0.518 |  |
| Social performance | 0.910 | 0.929 | 0.652 | 0.465 |
| TPM | 0.769 | 0.837 | 0.563 | 0.563 |
| TQM | 0.849 | 0.889 | 0.573 | 0.773 |

Table 4‑12: Fornell-Larcker criterion-discriminant validity

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 3R | EP | EVP | GM | GP | HRM | JIT | LCA | LM | SP | TPM | TQM |
| 3R | **0.754** |  |  |  |  |  |  |  |  |  |  |  |
| EP | 0.590 | **0.814** |  |  |  |  |  |  |  |  |  |  |
| EVP | 0.638 | 0.675 | **0.803** |  |  | 0 |  |  |  |  |  |  |
| GM | 0.708 | 0.486 | 0.595 | **0.713** |  |  |  |  |  |  |  |  |
| GP | 0.515 | 0.262 | 0.402 | 0.699 | **0.791** |  |  |  |  |  |  |  |
| HRM | 0.187 | 0.266 |  0.163 |  0.329 |  0.271 | **0.742** |  |  |  |  |  |  |
| JIT | 0.393 | 0.496 | 0.415 | 0.548 | 0.454 | 0.512 | **0.758** |  |  |  |  |  |
| LCA | 0.446 | 0.374 | 0.434 | 0.599 | 0.692 | 0.411 | 0.560 | **0.735** |  |  |  |  |
| LM | 0.416 | 0.478 | 0.466 | 0.605 | 0.527 | 0.543 | 0.601 | 0.594 | **0.720** |  |  |  |
| SP | 0.625 | 0.697 | 0.630 | 0.585 | 0.429 | 0.120 | 0.328 | 0.425 | 0.346 | **0.807** |  |  |
| TPM | 0.299 | 0.217 | 0.329 | 0.462 | 0.438 | 0.538 | 0.64 | 0.401 | 0.641 | 0.197 | **0.750** |  |
| TQM | 0.364 | 0.447 | 0.435 | 0.560 | 0.502 | 0.382 | 0.55 | 0.560 | 0.679 | 0.340 | 0.598 | **0.757** |

Table 4‑13: *Q*2 and *f*2 values

|  |  |  |
| --- | --- | --- |
|  | *f*2 | *Q*2 |
|  | EP | EVP | GM | SP |  |
| Social performance | 0.385 |  |  |  | 0.293 |
| Lean Manufacturing | 0.164 | 0.152 | 0.578 |  |  |
| Green Manufacturing |  | 0.356 |  |  0.229 | 0.139 |
| Environmental performance | 0.236 |  |  | 0.350 | 0.216 |

Table 4‑14: Hypothesis testing results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | t-statistic | p-values | Hypothesis | Decision |
| EVP EP | 3.714 | 0.000 | H6 | Accepted |
| EVP SP | 4.799 | 0.000 | H7 | Accepted |
| GM EVP | 4.729 | 0.000 | H4 | Accepted |
| LM EVP | 1.984 | 0.031 | H2 | Accepted |
| LM GM | 8.208 | 0.000 | H1 | Accepted |
| SP EP | 5.942 | 0.000 | H8 | Accepted |
| LM EP | 2.194 | 0.029 | H3 | Accepted |
| GM SP | 3.612 | 0.000 | H5 | Accepted |

Table 4‑15: Indirect impacts results

|  |  |  |  |
| --- | --- | --- | --- |
|  | t-statistic | p-Values | Decision |
| LM EVP EP | 1.967 | 0.04 2 | Significant |
| LM EVP SP | 1.994 | 0.033 | Significant |
| GM EVP EP | 2.822 | 0.005 | Significant |
| GM EVP SP | 2.980 | 0.003 | Significant |

Table 4‑16: Cronbach's alpha, Composite reliability, AVE and HTMT values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | Cronbach's alpha>0.7 | Composite reliability>0.7 | (AVE)>0.5 | HTMT |
| Economic performance | 0.885 | 0.913 | 0.636 | Does not include 1 |
| Environmental performance | 0.88 | 0.908 | 0.623 | Does not include 1 |
| External barriers\_ | 0.866 | 0.908 | 0.712 | Does not include 1 |
| Green Manufacturing | 0.888 | 0.909 | 0.529 | Does not include 1 |
| Internal barriers | 0.841 | 0.88 | 0.513 | Does not include 1 |
| Lean Manufacturing | 0.897 | 0.916 | 0.521 | Does not include 1 |
| Lean-Green Manufacturing | 0.725 | 0.82 | 0.536 | Does not include 1 |
| Social performance | 0.915 | 0.933 | 0.667 | Does not include 1 |

Table 4‑17: R2 and *Q*2 values

|  |  |  |
| --- | --- | --- |
| Variables | R2 | *Q*2 |
| Economic Performance | 0.81 | 0.493 |
| Environmental Performance | 0.309 | 0.172 |
| Green Manufacturing | 0.832 | 0.421 |
| Lean Manufacturing | 0.836 | 0.418 |
| Lean-Green Manufacturing | 0.285 | 0.114 |
| Social Performance | 0.6 | 0.372 |

Table 4‑18: *f*2 values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Environmental performance | Economic performance | Social performance | Lean-Green Manufacturing |
| Environmental performance |  | 0.788 | 0.767 |  |
| Social performance |  | 0.263 |  |  |
| Lean-Green Manufacturing | 0.448 | 0.159 | 0.189 |  |
| External barriers |  |  |  | 0.208 |
| Internal barriers  |  |  |  | 0.212 |

Table 4‑19: path coefficient, t-statistics, *p*-value and decision

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Hypotheses | Effect of | On | Path coefficient | t-statistics | p values | Decision  |
| H7 | Environmental performance | Economic performance | 0.619 | 9.883 | 0 | Accepted |
| H6 | Environmental performance | Social performance | 0.667 | 9.635 | 0 | Accepted |
| H1 | External barriers | Lean-Green Manufacturing | -0.274 | 2.71 | 0.009 | Accepted |
| H2 | Internal barriers | Lean-Green Manufacturing | -2.78 | 2.76 | 0.007 | Accepted |
| H4 | Lean-Green Manufacturing | Economic performance | 0.163 | 2.857 | 0.004 | Accepted |
| H3 | Lean-Green Manufacturing | Environmental performance | 0.556 | 6.983 | 0 | Accepted |
| H5 | Lean-Green Manufacturing | Social performance | 0.170 | 2.377 | 0.018 | Accepted |
| H8 | Social performance | Economic performance | 0.217 | 2.519 | 0.012 | Accepted |