# Driving Product Innovation Productivity through Entrepreneurial Orientation and Quality Management Processes: A Contingency Analysis of Malaysia's Semiconductor Industry

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## ABSTRACT

Product innovation productivity (PIP) is a decisive competitive goal for manufacturing firms, yet the mechanisms that drive it remain contested. The strategy literature attributes superior innovation to entrepreneurial orientation (EO), whereas the operations literature emphasises quality management processes (QMP). This study develops and tests an integrated contingency model that examines the direct effects of EO and QMP on PIP and the moderating roles of three transition-economy conditions, market unfairness, policy support and competitive intensity. Survey data were obtained from 222 semiconductor manufacturing firms operating in Malaysia and analysed using covariance-based structural equation modelling (AMOS 29.0). The results confirm that both EO ($\beta = .49$, $p < .001$) and QMP ($\beta = .51$, $p < .001$) exert strong, positive and complementary effects on PIP, together explaining 67% of its variance. Contrary to expectations, strong policy support significantly weakened the EO–PIP relationship ($\beta = -.11$, $p < .001$), and market unfairness significantly dampened the QMP–PIP relationship ($\beta = .09$, $p < .05$); the remaining moderating hypotheses were not supported. Incorporating the two significant moderators raised the explained variance to 82%. The findings indicate that internally cultivated entrepreneurial and quality capabilities are robust drivers of innovation that are largely resilient to external contingencies, while over-reliance on institutional support may erode entrepreneurial advantage. The study contributes a novel contingency framework integrating EO and QMP and offers Malaysian semiconductor managers evidence-based guidance for building an entrepreneurial, continuously improving innovation system.

**Keywords:** entrepreneurial orientation, product innovation productivity, quality management processes, semiconductor industry, structural equation modelling

## INTRODUCTION

The semiconductor industry has been reshaped since the early 2000s by rapid technological change, globalisation and intensifying geopolitical competition. Within this landscape, Malaysia has become an indispensable node in the global value chain, accounting for a substantial share of the world's chip assembly, testing and packaging activity (Bain & Company, 2023; National Semiconductor Task Force, 2023). This position, however, is increasingly precarious. Malaysian firms remain concentrated in lower-value back-end operations, depend heavily on foreign multinationals, and face mounting competition from Vietnam, Thailand, India and a rapidly self-sufficient China (BMI Research, 2023). Sustaining competitiveness now depends on the industry's ability to move beyond contract manufacturing toward genuine product innovation.

Product innovation productivity (PIP), the speed, scope and novelty with which a firm converts effort into successful new products, has emerged as one of the most pressing challenges facing Malaysian manufacturers (Ramayah et al., 2020; Yusr et al., 2022; AlQershi et al., 2023; Mukhtar et al., 2024). Two research traditions offer competing explanations for how firms achieve high PIP. The strategy and entrepreneurship literature argues

that entrepreneurial orientation (EO), a firm's propensity toward proactiveness, innovativeness and calculated risk-taking, drives superior innovation performance (Covin & Slevin, 1989; Lumpkin & Dess, 1996; Rauch et al., 2009). The operations management literature counters that quality management processes (QMP), the systematic practices of leadership, customer focus, information analysis, people management and process control, are the true antecedents of innovation (Deming, 1986; Saraph et al., 1989; Montgomery, 2020; Prajogo et al., 2022).

Despite the maturity of both literatures, three gaps persist. First, EO and QMP have rarely been examined together, leaving their potentially complementary contribution to PIP poorly understood. Second, most studies test these relationships as context-free main effects, yet the transitional environment in which Malaysian firms operate is defined by market unfairness, discretionary policy support and fierce competition, conditions that may substantially reshape how internal capabilities translate into innovation. Third, empirical evidence from the Malaysian semiconductor sector specifically remains scarce. This study addresses these gaps by developing and testing an integrated contingency model of PIP.

Accordingly, the study pursues two objectives: (1) to examine the direct effects of EO and QMP on PIP among Malaysian semiconductor firms; and (2) to assess whether managers' perceptions of market unfairness, policy support and competitive intensity moderate these relationships. The remainder of the paper reviews the relevant literature and develops the hypotheses, describes the methodology, reports the SEM results, and discusses the theoretical and managerial implications.

## LITERATURE REVIEW AND HYPOTHESES

### A. Entrepreneurial Orientation and Product Innovation Productivity

Entrepreneurial orientation captures the strategic posture through which firms pursue new opportunities via proactiveness, innovativeness and risk-taking (Miller, 1983; Covin & Slevin, 1989; Lumpkin & Dess, 1996). Firms high in EO scan the environment for emerging trends, experiment with novel solutions and commit resources ahead of demand, all of which are conducive to product innovation (Boso et al., 2012; Patel et al., 2014). Because product innovation is inherently uncertain and resource-intensive, an entrepreneurial posture that normalises calculated risk-taking is particularly valuable (Kreiser et al., 2010). In the Malaysian context, where firms often lack the political leverage to secure preferential conditions for R&D, the intrinsic entrepreneurial drive toward innovation becomes even more consequential (Loong Lee et al., 2019). We therefore hypothesise:

**H1:** A firm's level of entrepreneurial orientation has a positive and significant relationship with its product innovation productivity.

### B. Quality Management Processes and Product Innovation Productivity

Quality management processes comprise an interrelated set of practices, leadership, strategic planning, customer focus, information and analysis, people management and process management, grounded in the philosophy of continuous improvement (Saraph et al., 1989; Malhotra & Mukherjee, 2004; Montgomery, 2020). A growing body of evidence positions QMP as an antecedent of innovation: by resolving quality problems, deepening customer understanding and fostering organisational learning, QMP builds the absorptive, adaptive and innovative capabilities that underpin PIP (Prajogo & Hong, 2008; Zhang et al., 2012; El Manzani et al., 2023). QMP is widely diffused among Malaysian firms, making its innovation consequences especially relevant (Habibah Abdul Talib et al., 2014). Accordingly:

**H2:** A firm's level of quality management processes has a positive and significant relationship with its product innovation productivity.

### C. The Moderating Role of Transition-Economy Conditions

Internal capabilities do not operate in a vacuum. Malaysian semiconductor firms confront a distinctive external environment in which the returns to EO and QMP may be amplified or eroded. Three contextual factors are

salient. Market unfairness refers to ethically questionable practices, piracy, industrial espionage and intellectual-property infringement, that undermine firms that invest in legitimate innovation. Policy support denotes the industrial-support policies, licences and financial assistance extended by the state. Competitive intensity captures the ferocity of rivalry in the industry. Drawing on contingency theory, we advance six moderating hypotheses:

**H1a:** Market unfairness weakens the positive EO–PIP relationship.

**H1b:** Policy support weakens the positive EO–PIP relationship.

**H1c:** Competitive intensity strengthens the positive EO–PIP relationship.

**H2a:** Market unfairness weakens the positive QMP–PIP relationship.

**H2b:** Policy support strengthens the positive QMP–PIP relationship.

**H2c:** Competitive intensity weakens the positive QMP–PIP relationship.

Figure 1 presents the resulting conceptual model, in which EO and QMP act as direct predictors of PIP and the three contextual factors moderate these paths.

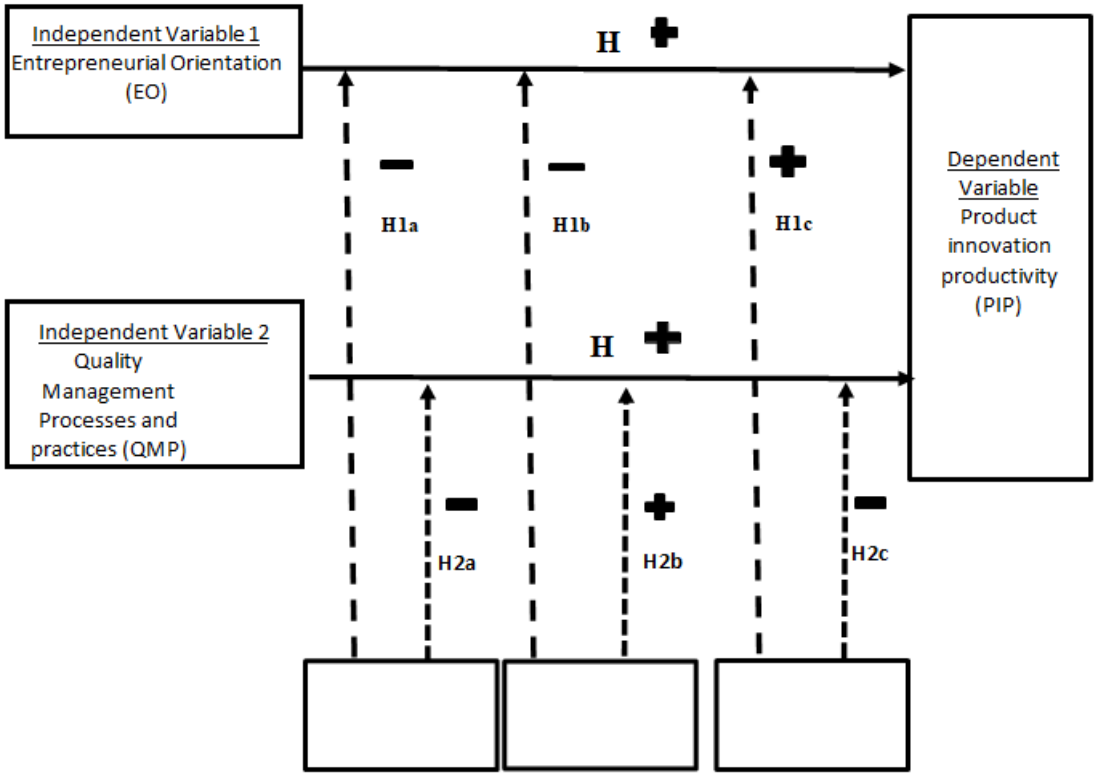


Figure 1. Conceptual contingency model of product innovation productivity.

## METHODOLOGY

### A. Research Design and Sample

A quantitative, deductive design was adopted, consistent with the study's aim of testing operationalised, quantifiable relationships (Baškarada & Koronios, 2018). A cross-sectional online survey was administered to semiconductor manufacturing firms operating in Malaysia. The sampling frame was constructed from the Malaysia Semiconductor Industry Association directory, cross-referenced with additional business directories, and restricted to firms with at least 50 employees engaged in original equipment or original design manufacturing, since such firms are most likely to contribute to new product development. Following a stratified random sampling approach, 3,000 firms were surveyed. After an initial wave and reminders, 222 usable

responses were obtained, a 7.4% response rate that is consistent with comparable industry surveys. The unit of analysis was the firm, with senior managers serving as key informants.

Independent-samples t-tests comparing early and late respondents revealed no significant differences, indicating that non-response bias was not a material concern. Firm sizes ranged widely, and just over half of the responding firms reported using advanced quality systems such as Six Sigma or Total Quality Management.

### B. Measures

All constructs were measured using validated multi-item scales drawn from prior research and rated on a seven-point Likert scale. A seven-point interval was chosen to reduce the central-tendency response bias sometimes observed among Asian respondents. Entrepreneurial orientation was operationalised through proactiveness, innovativeness and risk-taking. Quality management processes were captured as a second-order construct comprising leadership, strategic planning, customer focus, information and analysis, people management and process management. Product innovation productivity was measured in terms of the speed, scope and novelty of new-product outcomes. Market unfairness, policy support and competitive intensity were each measured with established multi-item scales. A pilot test confirmed acceptable internal consistency (Cronbach's alpha) for all constructs prior to full deployment.

### C. Analytical Approach

Covariance-based structural equation modelling was conducted in AMOS 29.0 using a two-stage procedure (Anderson & Gerbing, 1988). First, confirmatory factor analysis established the reliability and validity of the measurement model. Second, maximum-likelihood path analysis tested the hypothesised structural relationships. Model fit was evaluated using a combination of indices, including the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA) and standardised root mean square residual (SRMR). Because all items shared a common method and scale, Harman's single-factor test and a common latent factor were used to assess common method variance; differences in standardised loadings and explained variance between models with and without the common latent factor were negligible (below the .20 threshold), indicating that common method bias was not a significant concern (Billiet & McClendon, 2000). Moderating effects were tested through path analysis using composite interaction terms.

## RESULTS

### A. Measurement Model

The final measurement model demonstrated a good fit to the data, with all fit indices meeting conventional thresholds (CFI = .96, TLI ≥ .95, RMSEA = .05, SRMR = .05). Convergent and discriminant validity were supported: standardised factor loadings were high and average variance extracted exceeded the shared variance among constructs. These results confirmed that the constructs were reliably and validly measured, permitting structural analysis.

### B. Structural Model and Direct Effects

The structural model confirmed both direct hypotheses. Entrepreneurial orientation exerted a strong positive effect on PIP ($\beta = .49$, $p < .001$), supporting H1, and quality management processes exerted an even slightly stronger effect ($\beta = .51$, $p < .001$), supporting H2. Together, EO and QMP explained 67% of the variance in PIP ($R^2 = .67$), indicating substantial joint explanatory power. Comparisons against null, constrained and reverse-causation models confirmed that the hypothesised model provided the best fit to the data.

### C. Moderating Effects

The moderation analysis produced a more nuanced picture. Of the six moderating hypotheses, two were supported. Policy support significantly weakened the EO–PIP relationship ($\beta = -.11$, $p < .001$), supporting H1b but reversing the conventional expectation that institutional support catalyses innovation. Market unfairness

significantly dampened the QMP–PIP relationship (β = .09, p < .05), supporting H2a. The remaining four moderating effects, market unfairness on EO–PIP (H1a), competitive intensity on EO–PIP (H1c), policy support on QMP–PIP (H2b) and competitive intensity on QMP–PIP (H2c), were not statistically significant. Incorporating the two significant moderators increased the explained variance in PIP to 82% ($R^2$ = .82). Table 1 summarises the hypothesis tests.

Table 1. Summary of hypothesis testing results

| **Hypothesis** | **Path** | **β** | **Result** |
|---|---|---|---|
| H1 | EO → PIP (+) | .49*** | Supported |
| H2 | QMP → PIP (+) | .51*** | Supported |
| H1a | Market unfairness weakens EO–PIP (−) | −.06 | Rejected |
| H1b | Policy support weakens EO–PIP (−) | −.11*** | Supported |
| H1c | Competitive intensity strengthens EO–PIP (+) | .06 | Rejected |
| H2a | Market unfairness weakens QMP–PIP (−) | .09* | Supported |
| H2b | Policy support strengthens QMP–PIP (+) | .01 | Rejected |
| H2c | Competitive intensity weakens QMP–PIP (−) | −.04 | Rejected |

*Note. *p < .05; **p < .01; ***p < .001. N = 222. EO = entrepreneurial orientation; QMP = quality management processes; PIP = product innovation productivity.*

## DISCUSSION

The findings advance understanding of product innovation productivity in three ways. First, they establish that EO and QMP are not competing explanations but complementary drivers of PIP. Their combined explanatory power ($R^2$ = .67) suggests that an entrepreneurial posture and a disciplined quality system reinforce one another: EO supplies the proactive, opportunity-seeking impetus for innovation, while QMP supplies the learning infrastructure that converts experimentation, including failures, into improved outcomes (Zhang et al., 2012; Cruz et al., 2014). For a sector historically anchored in back-end manufacturing, this complementarity offers a concrete pathway toward higher-value innovation.

Second, the counter-intuitive negative moderation by policy support (H1b) is theoretically significant. Rather than amplifying entrepreneurial advantage, strong reliance on state support appears to erode it, consistent with the view that Malaysian firms derive innovation primarily from endogenous capabilities and informal knowledge networks rather than from institutional largesse (Solucis Santhapparaj et al., 2006). Excessive dependence on policy support may blunt the vigilance and resourcefulness that characterise entrepreneurial firms.

Third, the significant dampening of the QMP–PIP relationship by market unfairness (H2a) indicates that ethically questionable competitive practices, piracy and intellectual-property infringement, undercut the innovation returns to quality investments. When imitation is cheap and protections weak, the payoff from disciplined quality-driven innovation is diminished. Notably, the EO–PIP relationship remained robust to market unfairness, suggesting that entrepreneurial firms are comparatively resilient to dysfunctional competition.

The non-significance of the remaining moderators, particularly competitive intensity, echoes the inconclusive findings of prior research and points to the multidimensional, context-dependent nature of these interactions (Kraus et al., 2012; Kim et al., 2012). Overall, the results portray EO and QMP as durable internal drivers whose value is only marginally contingent on the external environment.

### A. Managerial Implications

Three recommendations follow for managers of Malaysian semiconductor firms. First, firms should upgrade the sophistication of their quality systems and implement QMP in an explorative, learning-oriented manner that actively seeks innovation ideas from customers, suppliers and partners. Second, managers should institutionalise the three components of EO, proactiveness, innovativeness and calculated risk-taking, and rebalance product portfolios toward technology-driven as well as market-driven innovation, with top management championing new ideas and allocating resources accordingly. Third, firms should build endogenous innovation capabilities rather than over-relying on policy support, and should protect innovation returns against market unfairness through legal channels and sustained long-term focus. The resilience of EO- and QMP-driven innovation to most external contingencies means that developing an entrepreneurial, continuously improving quality system should be the strategic priority.

### B. Limitations and Future Research

Several limitations qualify these findings and suggest avenues for future work. The model treats EO and QMP as composite constructs; decomposing them into their constituent dimensions may reveal more granular interactions with PIP. The study also focuses on EO to the exclusion of other strategic orientations, such as market and learning orientation, whose joint effects merit investigation. The set of contextual moderators, while theoretically motivated, omits factors such as environmental turbulence and firm ownership. Finally, the single-source, cross-sectional sample drawn from Malaysia's principal electronics hubs constrains generalisability; longitudinal, multi-source designs spanning more diverse regions would strengthen causal inference.

## CONCLUSION

This study developed and tested an integrated contingency model of product innovation productivity in Malaysia's semiconductor industry. Using structural equation modelling on data from 222 firms, it demonstrated that entrepreneurial orientation and quality management processes are strong, complementary drivers of PIP, jointly explaining two-thirds of its variance. It further showed that the value of these internal capabilities is largely robust to external contingencies, with two notable exceptions: strong policy support weakened the entrepreneurial pathway, and market unfairness weakened the quality pathway. The central message for managers and policymakers is that sustainable innovation in transitional industries is built primarily from within, through an entrepreneurial culture and a disciplined, explorative quality system, rather than conferred from without. By integrating the strategy and operations perspectives into a single contingency framework, the study offers both a theoretical contribution and a practical roadmap for elevating the innovation performance of Malaysia's semiconductor firms.

## REFERENCES

1. AlQershi, N. A., Ali, G. A., Al-Rejal, H. A., Al-Ganad, A., Farhan Busenan, E., & Ahmed, A. (2023). The power of strategic knowledge management in the relationship between innovation and the performance of large manufacturing firms in Malaysia. International Journal of Innovation Science, 15(1), 19–41.
2. Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. Psychological Bulletin, 103(3), 411–423.
3. Bain & Company. (2023). Southeast Asia's semiconductor opportunity. Bain & Company.
4. Baškarada, S., & Koronios, A. (2018). A philosophical discussion of qualitative, quantitative, and mixed methods research in social science. Qualitative Research Journal, 18(1), 2–21.
5. Billiet, J. B., & McClendon, M. J. (2000). Modeling acquiescence in measurement models for two balanced sets of items. Structural Equation Modeling, 7(4), 608–628.
6. BMI Research. (2023). Malaysia semiconductors report. Fitch Solutions.
7. Boso, N., Cadogan, J. W., & Story, V. M. (2012). Complementary effect of entrepreneurial and market orientations on export new product success. International Business Review, 21(4), 667–681.

8. Covin, J. G., & Slevin, D. P. (1989). Strategic management of small firms in hostile and benign environments. Strategic Management Journal, 10(1), 75–87.
9. Cruz, C., Justo, R., & De Castro, J. O. (2014). Does family employment enhance MSEs performance? Journal of Business Venturing, 27(1), 62–76.
10. Deming, W. E. (1986). Out of the crisis. MIT Press.
11. El Manzani, Y., Sidmou, M. L., & Cegarra, J. J. (2023). Does total quality management enhance innovation? Total Quality Management & Business Excellence, 34(1–2), 1–32.
12. Habibah Abdul Talib, Kamarudin Abu Bakar, & Awaluddin Mohamed Shaharoun. (2014). Case study of TQM implementation in a food-processing SME in Malaysia. TQM Journal, 26(5), 501–513.
13. Kim, D. Y., Kumar, V., & Kumar, U. (2012). Relationship between quality management practices and innovation. Journal of Operations Management, 30(4), 295–315.
14. Kraus, S., Rigtering, J. P. C., Hughes, M., & Hosman, V. (2012). Entrepreneurial orientation and the business performance of SMEs. Review of Managerial Science, 6(2), 161–182.
15. Kreiser, P. M., Marino, L. D., Kuratko, D. F., & Weaver, K. M. (2010). Disaggregating entrepreneurial orientation. Small Business Economics, 40(2), 273–291.
16. Loong Lee, S., et al. (2019). Entrepreneurial orientation and firm performance in Malaysia. Journal of Entrepreneurship in Emerging Economies, 11(3), 394–410.
17. Lumpkin, G. T., & Dess, G. G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. Academy of Management Review, 21(1), 135–172.
18. Malhotra, N., & Mukherjee, A. (2004). The relative influence of organisational commitment and job satisfaction on service quality. Journal of Services Marketing, 18(3), 162–174.
19. Miller, D. (1983). The correlates of entrepreneurship in three types of firms. Management Science, 29(7), 770–791.
20. Montgomery, D. C. (2020). Introduction to statistical quality control (8th ed.). Wiley.
21. Mukhtar, S., et al. (2024). Quality management and innovation performance in emerging economies. International Journal of Quality & Reliability Management, 41(3), 789–810.
22. National Semiconductor Task Force. (2023). National semiconductor strategy. Ministry of Investment, Trade and Industry, Malaysia.
23. Patel, P. C., Kohtamäki, M., Parida, V., & Wincent, J. (2014). Entrepreneurial orientation-as-experimentation and firm performance. Strategic Management Journal, 36(11), 1739–1749.
24. Prajogo, D. I., & Hong, S. W. (2008). The effect of TQM on performance in R&D environments. Technovation, 28(12), 855–863.
25. Prajogo, D. I., et al. (2022). The relationship between quality management and innovation revisited. International Journal of Production Economics, 245, 108402.
26. Ramayah, T., Yusr, M. M., Othman, A. R., & Abdul-Halim, H. (2020). Quality management practices and product innovation. Benchmarking: An International Journal, 27(4), 1305–1328.
27. Rauch, A., Wiklund, J., Lumpkin, G. T., & Frese, M. (2009). Entrepreneurial orientation and business performance. Entrepreneurship Theory and Practice, 33(3), 761–787.
28. Saraph, J. V., Benson, P. G., & Schroeder, R. G. (1989). An instrument for measuring the critical factors of quality management. Decision Sciences, 20(4), 810–829.
29. Solucis Santhapparaj, A., Sreenivasan, J., & Loong, J. C. K. (2006). Competitive factors of semiconductor industry in Malaysia. Technovation, 26(9), 1061–1072.
30. Yusr, M. M., Salimon, M. G., Mokhtar, S. S. M., et al. (2022). Green innovation performance and quality management. Journal of Cleaner Production, 330, 129909.
31. Zhang, D., Linderman, K., & Schroeder, R. G. (2012). The moderating role of contextual factors on quality management practices. Journal of Operations Management, 30(1–2), 12–23.