

Sustainable production and sourcing: the importance of integration within manufacturing networks

*Ruggero Golini (ruggero.golini@unibg.it)
Università degli Studi di Bergamo, Department of Management, Information and
Production Engineering*

*Jury Gualandris
UCD Smurfit Graduate Business School
Dublin, Ireland*

*Matteo Kalchschmidt
Università degli Studi di Bergamo, Department of Management, Information and
Production Engineering*

Summary Abstract

In this study we used survey data from 718 manufacturing plants, operating in US, Europe and Asia, to evaluate if plants embedded in global manufacturing networks adopt sustainable production and sourcing practices to larger extends than stand-alone plants or plants loosely integrated in regional manufacturing networks. Results show that the adoption of *sustainable production practices* at the plant level significantly associates with the presence and specific characteristics of a firm-wide manufacturing network. Noteworthy, the adoption of *sustainable sourcing practices* benefits only indirectly and shows to be more strongly affected by integration in the external supply chain.

Keywords: cross-sector collaboration; grounded theory; societal stakeholders

Purpose

Within manufacturing industries, green technologies and social standards evolve rapidly (Lee et al., 2014), and stakeholder groups such as investors, customers, legislators, and non-governmental organizations form diverse and changing environmental and social expectations (Jamali, 2010; Gualandris et al., 2015). Emerging anecdotal evidence suggests that productive plants operating in concert with sister facilities within global manufacturing networks can better cope with sustainability-related turbulence (Jamali, 2010) by accessing richer and more diverse stocks of procedural knowledge (Ferdows, 2006; Vereecke et al., 2006). The growing figures about foreign direct investments (UNCTAD, 2014) signals that manufacturing firms are increasing managing a network of their own production facilities, which are loosely connected and exhibit significant diversity in strategy, capabilities and market location (Cheng et al., 2015). Collaborative integration within these networks enrich a plant' individual perspectives and knowledge even when sister facilities produce different products or services (Ferdows and De Meyer, 1990; Vereecke et al., 2006; Yamin and Andersson, 2011).

Thus, pursuing a nodal level of analysis, this paper investigates if and how the geographic

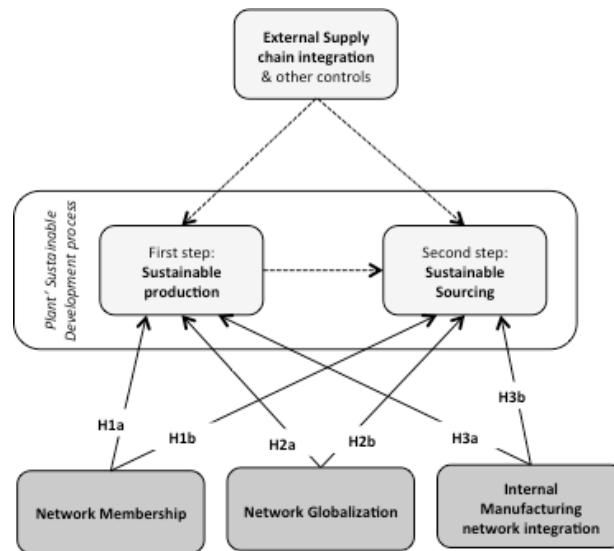
dispersion of a manufacturing network (hereafter ‘manufacturing network globalization’) and the presence of integration mechanisms between sister facilities (hereafter ‘internal manufacturing network integration’) associate with a plant’s ability to move towards more sustainable production and sourcing practices.

Although it would be reasonable to assume that plants operating in global manufacturing networks can help each other along the continuous development and adaptation of sustainable production and sustainable sourcing practices, the operations management (OM) literature devoted to environmental and social sustainability remains squarely focused on the enabling role of external integration with customers and suppliers (hereafter ‘external supply chain integration’) (Vachon and Klassen, 2006; Awaysheh and Klassen, 2010) and overlooks the existence of global manufacturing networks and the importance of knowledge flows within them (Ferdows, 2006; Vereecke et al., 2006).

Methodology

By relying on the theory of organizational integration and process innovation (Ettlie and Reza, 1992), we theoretically examine the complex association between (i) manufacturing network globalization, (ii) internal manufacturing network integration, (iii) adoption of sustainable production practices and (iv) adoption of sustainable sourcing practices. Figure 1 depicts our conceptual model, which complements existing OM literature devoted to sustainability by acknowledging the existence of manufacturing networks and potential implications for a plant’s sustainable development process.

Figure 1 – Conceptual model



The hypotheses underlying our model are as follow:

H1. Productive plants belonging to a manufacturing network develop sustainable production practices (H1a) and sustainable sourcing practices (H1b) to higher extents relative to one-plant firms

H2. Productive plants belonging to a global manufacturing network develop their sustainable production practices (H2a) and sustainable sourcing practices (H2b) to

higher extents when compared to productive plants belonging to a regional manufacturing network.

H3. Internal manufacturing network integration positively associates to the development of sustainable production practices (H3a) and sustainable sourcing practices (H3b) within a productive plant.

To test our research hypotheses, we employed data from the sixth edition of the International Manufacturing Strategy Survey. From the original dataset consisting of 931 firms, we ended up with 718 usable cases, of which 247 are standalone plants, while the remaining 471 belong to a manufacturing network. Of these, 130 are part of a regional network and the remaining 341 are part of a global network.

We adopted four multi-item reflective constructs for external supply chain integration, internal manufacturing network integration, sustainable production and sustainable sourcing. The confirmatory factor analysis shows a good level of fit (CMIN= 242.272 DF=98 CMIN/DF = 2.183; NFI=0.945; CFI=0.969; RMSEA=0.050) and Cronbach's alpha always above 0.70 suggested satisfactory reliability.

We also created two dummy variables, the first to distinguish between one-plant firms vs plants belonging to a manufacturing network; the second to distinguish plants embedded in regional manufacturing networks from plants belonging to global manufacturing networks.

To verify our first hypothesis, we created three groups, namely (1) one-plant firms, (2) plants belonging to regional manufacturing networks and (3) plants belonging to global manufacturing networks, and we tested for differences in sustainable production and sustainable sourcing using ANOVA, non-parametric tests and Scheffé post-hoc tests. Then, we tested our baseline model that considers the effects of external supply chain integration on sustainable practices through multiple hierarchical regressions. Finally, we verified the remaining hypotheses by applying path analysis.

It is important to note that we controlled for *plant size* (logarithm of the number of employees), *industry* (ISIC Code), *country effects* (Quality of country regulations as provided by the World Bank), plant's *sustainability orientation* (Gualandris et al., 2014), and *plant responsibility* (Vereecke et al., 2006).

Findings and conclusions

Our paper builds on current OM literature to explore the effects that globalization and integration of manufacturing networks exert on a plant's ability to move towards environmentally and socially sustainable practices. Empirical results show that manufacturing network globalization does not significantly associate with the adoption of sustainable practices. Then, we found that, while external supply chain integration plays an important role, internal manufacturing network integration also significantly affects the development of sustainable practices; however, these positive effects appear to be mostly confined to sustainable production. Our findings are summarized in Table 1.

Future research avenues include (i) deepening our understanding of integration mechanisms and knowledge sharing strategies within production networks that can more effectively support the diffusion of sustainable practices across plants; (ii) investigating centrality and density of manufacturing networks with methods involving network mapping techniques (UCINET), so to explore effects we could not grasp in our investigation; (iii) analysing network configurations (vertical vs horizontal) to identify diverse diffusion patterns for sustainable practices.

Table 1 – results summary

Hypothesis	Relationships	Support?
Baseline model	External Supply Chain Integration -> Sustainable production and Sourcing	Corroborated
H1a,b	Belonging to a manufacturing network-> Sustainable production and Sourcing	Yes, only for sustainable production.
H2a,b	Belonging to a global (vs regional) manufacturing network -> Sustainable production and Sourcing	Yes; Sustainable sourcing is impacted only indirectly
H3a,b	Internal Manufacturing network Integration -> Sustainable production and sourcing	Yes; Sustainable sourcing is impacted only indirectly

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