# Social Network Analysis:
## Design choices for structuring supply chains

It may come as a surprise but there is no commonly agreed way or method for measuring supply chain complexity. However, a recent research paper by Adami, Verschoore & Sellitto [1] in July 2020 centred on the Brazilian wind turbine industry set out to use a real world example illustrating the benefits of Social Network analysis (SNA) to Supply Chain Management (SCM). In essence the recognition that the structural configuration and complexity as mechanisms for competitive advantage is of critical interest to practitioners and academics alike.

Experience has shown that Supply chains (SCs) are structured in a multitude of forms with each one reflecting the purchasing strategy formulated by the purchasing organisation, ranging from vertically integrated to single outsourcing or multi-sourcing and with multiple tiers. All of which serve to illustrate the plethora of possibilities in terms of structural configurations results and in distinct degrees of complexity. Supply chain mapping first appeared in the automotive industry and from which early metrics were derived. However, to date the complete possibilities that SNA offers to SCM are as yet unknown and under researched.

**Some of the key interests will lie in the areas of;**

| | |
|---|---|
| Competitive advantage | Supply chain resilience |
| Risk in relation to costs | Sustainability attributes |

In constructing what researchers' term sociograms (See table 1 below) we can see the impact of egos, interdependence between buyers and suppliers, quantum of people involved, missing social (or stakeholder) connections, critical suppliers, overloaded pivotal roles, etc. See table 2 below) As this then builds to show the level of complexity it identifies the increased transaction costs as a result and how this impacts competitive advantage. Further, this can indicate a higher risk of disruption and hence and indicator of resilience within that supply chain. A factor that has been pulled into sharp focus by the recent pandemic Covid-19. By inference this also shows where the pinch points or constraints are and seek to identify where mitigation actions/plans are needed. Equally, the knock on effect from suppliers that were dependent on a single supplier to the principal organisation too.

Table 1: Sociogram: Betweenness centrality in the Brazilian wind turbine industry

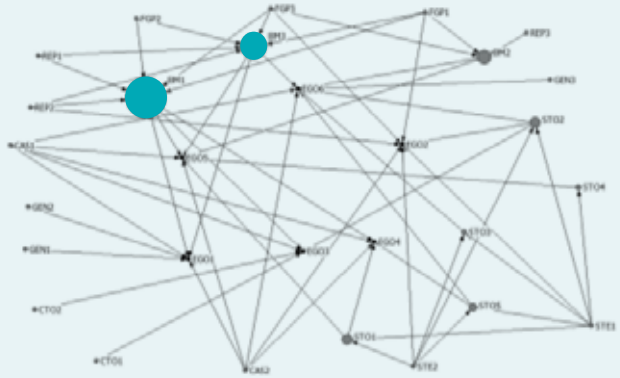



Table 2: Ego networks structural properties

| Property | Metric | EGO1 | EGO2 | EGO3 | EGO4 | EGO5 | EGO6 |
|---|---|---|---|---|---|---|---|
| Network size | Number of actors | 12 | 8 | 13 | 16 | 16 | 17 |
| Cohesion (density overall) | Average degree | 1.333 | 1.125 | 0.923 | 1.375 | 1.438 | 1.294 |
| Centralization | In-degree | 0.4628 | 0.9592 | 0.3681 | 0.2578 | 0.3956 | 0.4453 |
| Core-periphery | Size of core group | 3 | 2 | 3 | 6 | 5 | 7 |
| Structural holes | Constraint | 0.167 | 0.236 | 0.2 | 0.2 | 0.143 | 0.125 |
| Betweenness centrality | Critical actors | BM1; BM3 | - | BM1 | BM1 | BM1; BM3 | BM3 |
| Network output | Number of units sold attenuated by capacity | 255 | 61 | 237 | 288 | 427 | 430 |



In essence the industry is so competitive that the real differentiator for organisations is the way companies design and control their supply chains, recognising price and dependability as prime drivers for selection. This sector like many others that are capital intensive have contracts that are predicated on high penalties for failure to deliver. Accordingly, this has seen the more successful players adopt a balance between vertical integration (in-house manufacturing) and fully outsourced components. The cautionary aspect here remains the increased risk of adopting single source suppliers, recognising the advantages of lower investment and access to advanced technology and techniques at the same time.

Comparing the SNA metrics for the principal organisation (or OEM) with the network output metric (market share), the results indicate that, within the context of the Brazilian wind turbine SC, the more complex SC configuration produced better results in terms of order-winning. The subset [EGO4, EGO5, EGO6] accounts for 67% (attenuated index) of the market. Thus, the most successful design choices seem to be those that minimize the disruption risk by increasing structural complexity and creating redundancies (Chopra and Sodhi, 2014; Yan et al., 2015 [2]). Further, increasing complexity to minimise the disruption risk is preferred even when the transactions cost increases. The disruption risk can also be related directly to the network size too. Similarly, a large core size indicates a larger base of first-tier suppliers, which helps to reduce dependencies.

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[1] Adami, V.S., Verschoore, J.R. and Sellitto, M.A., 2020. Structure and complexity in six supply chains of the Brazilian wind turbine industry. The International Journal of Logistics Management.

[2] Chopra, S. and Sodhi, M.S. (2014), "Reducing the risk of supply chain disruptions", MIT Sloan Management Review, Vol. 55 No. 3, pp. 73-80.