Nexus Nonsense or is it?

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Abstract

Recent popular literature has posited a new view of reality or has it? Best-selling books such as Nexus (Buchanan, 2002), Linked (Barabasi, 2002) and Tipping Point (Gladwell, 2000) have discussed in detail the idea of little things making a difference. They also look at networks and their impact on society.

"… we view the economy as a complex network, whose nodes are companies and whose links represent the various economic and financial ties connecting them." (Barabasi, p2002). Authors exploring complex systems have titled their work "The Science of Networks". Their topology of nodes and links is consistent with that long adopted by IMP researchers.

Their "science of networks" allows for the inclusion of "hubs" - those nodes with many more links. Network properties include exponential growth, power-law pattern and "continents". Networks can be scale–free or random and possess directed or non-directed links. While their empiricism is eclectic ranging from basic geometry to phase transition to nuclear physics much of the experimentation has been computer or internet based.

Just what aspects of this science are consistent with the IMP Group concepts developed over the past 20 years will be the focus of this paper. Interestingly it will also investigate how these concepts may further IMP research.

Introduction

Recent popular literature has posited a new view of reality or has it? Best-selling books such as Nexus, Linked and Tipping Point have discussed in detail the idea of little things making a difference. They also look at networks and their impact on society. Tipping Point (Gladwell, 2000) in particular looks at the diversity of roles in communication in networks.

While all these popular science books are being published there is simultaneously much talk within IMP circles (or should we say networks) as to the future of IMP research. *Quo Vadis* IMP? On research issues, especially on methodology, IMP Group contributors on a number of occasions have raised this question. For example, Easton (1995) has argued that case research is particularly appropriate to industrial network research so as to get to the underlying "reality". With others (Easton, Wilkinson & Georgieva, 1997) he also suggests that " in the limit, this is an impossible task…". In pointing the way for future IMP research he goes on to suggest the use of (then) current developments in the modeling of complex systems such as NK Models, Chaos and SWARM as possible paths forward.

Can these recent publications (Barabasi, 2002; Buchanan, 2002, Gladwell, 2000) in the popular science area which lay claim to a domain of "the science of networks" provide some ways forward for IMP or have all options been exhausted. While neither tome could be described as a compendium of complex system modeling, both do provide a collection of examples/case studies in networks from very diverse disciplines. All three publications could prove to be useful supplements for future IMP researchers.

Superficially there are some distinct parallels between research findings in this "science of networks" and those of IMP researchers. This paper will attempt to examine those parallels and discover if indeed this idea of small worlds, Tipping point and nexus is nonsense in terms of IMP research or is it something we can use to enhance our research in the complex area of network theory. Other IMP authors (Morlacchi,Young & Wilkinson, 2000) have referred to the Barabasi findings and, probably wisely, appear to have elected not to pursue the topic further, given that it may be at odds with long accepted views within IMP. Including these topics for debate in an IMP forum is at least consistent with the conditions for inclusion in the IMP group – " a well developed sense of scepticism and an anarchistic streak" (Easton, Zolkiewski & Bettany, 2002)

Network Structure

IMP researchers have long been fascinated with network structures. The graphing of complex "ball and stick" models features still in IMP publications. Easton et al, posit that the intricate ball and stick model "opened a new and exciting world to those more used to the atomistic, homogenous world of traditional research in marketing" ((1997, p.273). The original IMP2 research instrument featured a "diagram" of such a generalised model. This model has some similarity with a branch of mathematics known as graph theory – a graph (or network) being a bunch of nodes connected by links (Barabasi, p16). Barabasi describes how Erdos and Renyi proposed the explanation that nodes are connected randomly. However this model's fundamental tenet that all nodes are created equal is not reflected in IMP research reality. Random graph theory seems to have little to offer in explaining the directed nature of connectedness in business networks. As Easton *et al* (ibid, 1997) stated, "…what they (structural network studies) fail to do is to go below the surface and attempt to research and/or model the mechanism, deep structures and fundamental processes that drive such (evolutionary) changes.

Albert, Jeong and Barabasi, (1999) attempt to "map" the World Wide Web, "We found the separation (between the nodes) to be proportional to the logarithm of the number of nodes in the network. That is, if we denote ***d*** to be the average separation between the nodes on a Web of ***N*** WebPages, then this separation followed the equation:

$$d = 0.35 + 2\log N$$

where ***log N*** denotes the base 10 – logarithm of ***N***" (Albert *et al*, 1999).

IMP researchers' concept of 'distance' (Hallen, & Wiedersheim-Paul, 1982; Johanson & Wiedersheim-Paul, 1975) between companies in business relationships is defined in terms of four aspects – social, cultural, technological and time. Separation between nodes and distance between actors do not appear to be greatly different conceptually.

There could be some merit examining "distance" between actors within a specific business network over time as the number of actors change. In fact this brings to mind the whole concept made popular by the movie of the early 90's entitled "6 Degrees of Separation". Where the concept based on Stanley Milgram's 1960s research was applied to show how anyone can know or be connected to another by as few as 6 other people or connectors. Gladwell (2000) takes the concept further by explaining that connectors are important for more than simply the number of people they know but also their importance is a function of the kinds of people they know and their proximity "we associate with the people who occupy the same small, physical spaces that we do". He concludes that

> *Six degrees of separation doesn't mean that everyone is linked to everyone else in just six steps. It means that a very small number of people are linked to everyone else in a few steps, and the rest of us are linked to the world through those special few.* (Gladwell, 2000, pp.36-37)

There is some evidence of this train of thought within IMP research "Networks are thus the medium and outcome of connectedness effects in a world of interdependent economic actors" (Easton & Araujo, 1994). Easton (1995) suggests that research on networks should concentrate on just four key, general characteristics: connectedness, complexity, the sociality problem and time.

For IMP researchers the connections between entities are generally, but not exclusively, defined in terms of economic exchange relationships. An extreme view is that by tracing economic exchange links it could be shown that any organisation is linked with any other. Most IMP researchers have concentrated on dyads, focal groups or small nets as the research unit. However the very essence of the network is its connectedness which the narrow focus on small units does not capture.

In follow up research to his work on Web mapping Barabasi (2002) uncovered a high degree of unevenness in the Web's topology. He discovered that 90 % of all Web documents had fewer than 10 links yet about 3 are referenced to nearly a million other documents. A few highly connected nodes, defined as hubs by Barabasi (2002), dominate the WWW network. Compared to these hubs the rest of the Web is invisible. Hubs, it is claimed, appear in most large complex networks studied so far. This raises the issue – do business networks have hubs? Certainly it is generally accepted that Pareto's Principle applies to business markets. Are the dominant players accounting for 80% of the total business effectively the equivalent of hubs?

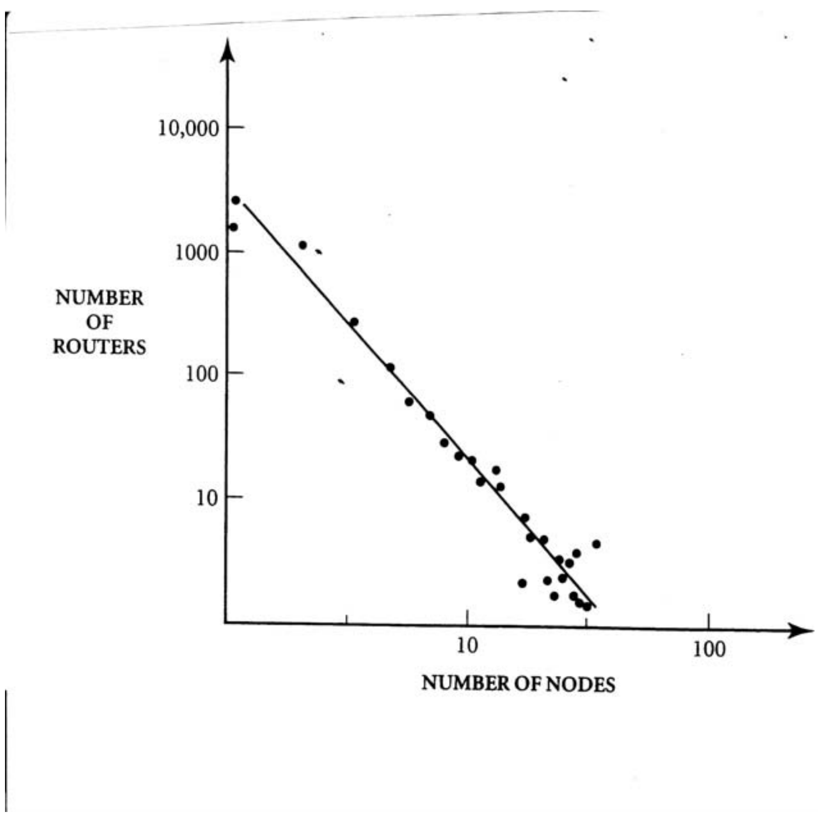

Figure 1: Distribution of Internet nodes according to how many links they possess. (Buchanan 2002)

Testing for the fit of distribution of links on various Web sites Barabasi (2002) discovered that these follow precisely a mathematical expression called a *power law.* Figure 1, a log – log graph, illustrates the characteristics of a power law distribution. This work builds on the research done by Faloutos, Faloutos, and Faloutos (1999). The continuous downward sloping line evidences that numerous small events coexist with a few large events. Barabasi (ibid, p68) asserts; "This implies that the number of WebPages with exactly ***k*** incoming links, denoted by ***N (k)***, follows $N(k) \sim k^{-y}$, where the parameter ***y*** is the degree exponent. Barabasi (ibid, P69) claims "…. in numerous large networks that we and many other scientists have had a chance to investigate, an amazingly simple and consistent pattern has emerged: The number of nodes with exactly ***k*** links follows a power law, each with a unique degree exponent that for most systems varies between two and three."

The investigations provided by Barabasi (2002) ranged from links between actors, webs within cells to citations in physics journals. IMP researchers have also attempted to look at such a network analysis, although not necessarily using the same method. Morlacchi et al, (2000) looked at network evolution using the personal research networks among IMP researchers. Buchanan's examples include proteins in yeast (p116), North Atlantic Ocean food web (p142) and river networks (p98). This area of research is clearly one that could aid the investigation of networks and to date is evidently underutilized by most IMP researchers.

The similarities in terminology are also evident in Figure 2. As previously mentioned IMP research investigates such things as focal groups, dyads, triads and small nets. They discuss networks in terms of the relationships between actors, activities and resources (Hakansson & Snehota, 1995) and discuss the idea of no business being an island. (Hakansson & Snehota, 1982). In Figure2 Barabasi (2002) discusses the network in similar terms, i.e. for central core one could read focal relationship, also interestingly we see the concept of the islands emerging. This concept is something, which could be further, investigated within IMP research

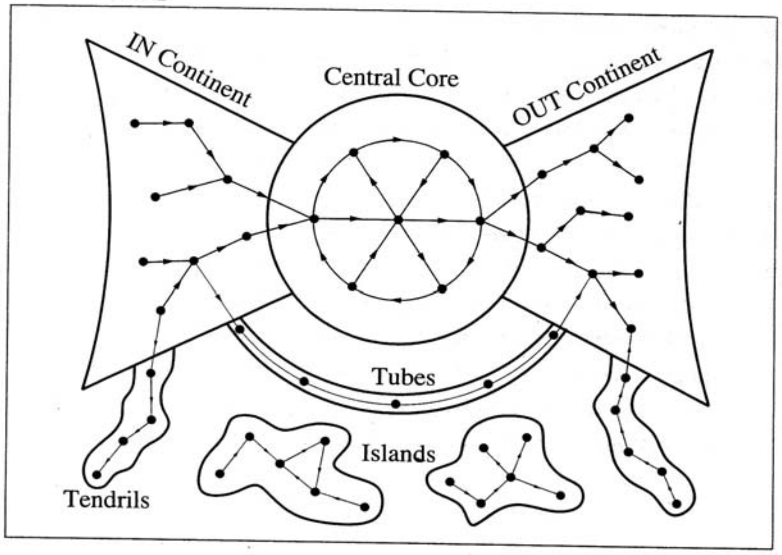

Figure 2: The Continents of a directed network (Barabasi, 2002)

Network Evolution

The previous discussion brings us to the area of network evolution. One perspective proposed by the IMP group is that "….evolution of industrial networks is neither a deterministic, timeless process subject to invariant principles nor a series of disconnected random events subject only to local rules. The traditional way in which industrial networks theory has dealt with this dilemma is to posit that network evolution is a dialectical process, the continuous struggle of opposite tendencies: the tendency to increasing order vs. the tendency to increasing heterogeneity and disorder, the tendency towards decentralisation and simpler, flatter structures" (Hakansson, 1992).

The power law characteristic, discovered as being identifiable across a wide range of networks, suggests a deterministic model of network formation. As Buchanan (ibid, p105) states "…despite all the manifold differences in what makes these networks grow and evolve, they may share some common core process of growth". Barabasi (ibid, p91) is less ambiguous. "Networks are not en route from a random to an ordered state. Neither are they at the edge of randomness and chaos. Rather, the scale-free topology is evidence of organizing principles acting at each stage of the network formation process". This idea is somewhat at odds with Easton et al (1997) who argue that the edge of chaos does appear to have characteristics similar to that of industrial networks. In support Hakansson and Snehota (1995) quite clearly state that "the network of business relationship can thus never be seen as a stable structure. It is a structure with inherent dynamic features characterised by a continuous organising process. Obviously this is an area that would require further research. How we can apply the popular science methodology/ view to the idea of Network evolution is perhaps the greatest challenge?

Network Dissolution/Extinction

There has been a only a limited amount of research within the IMP group on network decline/dissolution/ending with emphasis being on the relationship ending process "…we lack a good overall picture of the (relationship) weakening processes." (Tahtinen & Snehota, 2002). The more recent contributions have come from Tahtinen 2002, Tahtinen & Snehota 2002, and Wendelin, 2002). There was some earlier case based research including one on the Australian Soft Drink Industry (Donnan, 1995).

Likewise in the "science of networks" tomes network extinction does not account for many paragraphs. Barabasi's focus (p223) is on extinction of al Qaeda. This "science" he sees as providing an understanding of terrorist organisations: "In reality, terrorist networks obey rigid laws that determine their topology, structure, and therefore their ability to function. ……the battle against al Qaeda can and will be won by crippling the network, either by removing enough of its hubs to reach the critical point for fragmentation or by draining its resources, preparing the groundwork for cascading internal failures" (Barabasi, p223). This debate also revolves around the concept that many webs do not have a spider, this concept of a spiderless web is clearly in contrast to the IMP notion of the focal relationship at the centre of the network and something that clearly deserves further research.

Buchanan is more circumspect. He relates to network extinction experiments conducted by Barabasi's colleagues. "Random networks, despite their redundancy, fall apart quite quickly in the face of an uncoordinated attack. Networks of the aristocrat kind fell apart gracefully under the attack, and never suffered a catastrophic disintegration" (Buchanan, p 131). He asserts that "It is the highly connected hubs that account for the difference". This idea is something Gladwell discusses in terms of Tipping Points. If we look at a recent example we could note the disintegration of the Iraqi Regime during the recent Gulf War. What is perhaps of greatest interest here is what drives the network to the tipping point, what combinations of factors are required to basically tip it over the edge. Again there are interesting concepts posited by Gladwell (2000) which attempt to explain this - connectors, stickiness, the power of context and rumours. Again this is an area where IMP research does have some parallels and in fact could probably draw on these concepts to enhance network research.

Concluding Thoughts

Barabasi (2002), Buchanan (20002) and Faloutsos et al (1999) assert that their findings are applicable to economic/business systems. "In reality, the market is nothing but a directed network. Companies, firms, corporations, financial institutions, governments, and all potential economic players are the nodes. Links quantify various interactions between these institutions, involving purchases and sales, joint research and marketing projects and so forth. The ***weight*** of the links captures the value of the transaction, and the direction point from the provider to the receiver. The structure and evolution of this weighted and directed network determine the outcome of all macroeconomic processes" (Barabasi, p208 – 209).

Barabasi appears to equate networks with "markets" here rather than adopt the "between markets and hierarchies" perspective. Unlike his Web focused research it offers no experimental evidence to support his "the market as directed network" assertion. Perhaps there is a challenge here. Maybe further research to test Barabasi's claims.

Overall in all three popular science books Nexus,(Buchanan, 2002) Linked (Barabasi, 2002) and Tipping Point (Gladwell, 2000) we see opportunities to enhance IMP research and indeed take it even further in some cases. This work-in-progress paper has hopefully opened up some new areas where IMP research could go especially in the area of methodology and come some way towards answering the oft asked question of where next for IMP?

There are as previously pointed out many similarities between the concepts and ideas put forward in the popular science domain and much of the work already done in IMP as detailed in Table 1. However if we only take one thing from all of this perhaps it is the idea that we must remove the wrapping (Barabasi p.225). The goal as Barabasi so rightly points out is to understand the complexity. "to achieve that we must move beyond structure and topology and start focusing on the dynamics that take place along the links." Although IMP researchers have being attempting to do that for many years by borrowing from other disciplines in a long established tradition, borrowing from physicists is perhaps another way forward.

Table 1: A comparative framework of IMP and Science of Networks (SON) theory

	IMP Approach	SON Approach
Research Focus	Networks and relationships in Business Markets	An eclectic range of Networks
Central Concepts	Connectedness Economic Exchange	Connectedness Degrees of separation
Terminology	Focal relationships, dyads, triads, small nets, actors, activities, resources	Central core, tubes, tendrils, islands, continents, routers, nodes
Preferred Research Methodology	Predominantly Qualitative	Quantitative models
Unit of research	Dyads, triads, focal groups, small nets, gaps	hubs, nodes,
Representation	"Ball and stick" models	Graph Theory
Network Evolution	Phased Models	Random or power series model
Time Perspective	Short to Long-term	Short-term

References.

Albert, R., Jeong, H. and Barabasi, A-L, "Diameter of the World Wide Web", *Nature,* 401 (1999): 130-131.

Barabasi, A-B, (2002), Linked, the New Science of Networks, Perseus Publishing, Massachusetts.

Buchanan, M., (2002), Nexus, Small Worlds and the groundbreaking Science of Networks, Norton, New York.

Donnan, M., (1995), "Does the Weakening of Strong Ties mean Network Necrosis", Working Paper, 11th Annual IMP Conference.

Easton, G. & Araujo, L. (1994), "Discontinuity in Networks: Initiators, Issues and Initiatives", 10th IMP Annual Conference proceedings, p 381 – 397.

Easton, G. (1995), "Methodology and Industrial Networks", in K. Moller and D. T. Wilson (Eds.) *Business Networks*, Kluwer Academic Publishers, Norwell, Mass.

Easton, G., Wilkinson, I. & Georgieva, C., (1997), "Towards Evolutionary Models of Industrial Networks – A Research Programme", in Gemunden, Ritter & Walter, Ch 17.

Easton, G. Zolkiewski J. & Bettany, S. (2002) "An exploratory taxonomic study of IMP Group conference paper" 18th IMP Conference, Dijon, France.

Faloutos, M., Faloutos, P. & Faloutos C. (1999), "On Power-Law Relationships of the Internet Topology", Comput. Commun. Rev. 29, 251.

Ford, D., (1998), Managing Business Relationships, John Wiley, Sussex.

Germunden, H., Ritter, T. and Walter, A., (1997), Relationships and Networks in International Markets, Elsevier, Oxford.

Gladwell, M., (2000), The Tipping Point, Abacus, London.

Hakansson, H. (1992), Evolution Processes in Industrial Networks", in Industrial Networks: a New View of Reality, edited by B. Axelsson and G. Easton, Routledge.

Hakansson, H. & Snehota, I (1989), "No Business is an Island: The Network Concept of Business Strategy", Scandinavian Journal of Management, Vol 4, No. 3, 187-200.

Hakansson, H. & Snehota, I (1995), Developing Relationships in Business Networks. London, Routledge.

Hallen, L. & Wiedersheim-Paul, F. (1982) "Psychic Distance in International Marketing – An Interaction Approach' CIF Working Paper, Centre for International Business Studies, Uppsala University.

Milgram, S. (1967), "The Small World Problem", Psychology Today, Vol 1, pp.60-67, cited in Gladwell, M., (2000), The Tipping Point, Abacus, London.

Moller, K and Wilson, D., (1995), Business Marketing: An Interaction and Network Perspective. Kluwer, Massachusetts.

Morlacchi, P., Young, L. & Wilkinson, I. (2002) "A Network analysis of the personal research networks of IMP researchers" paper presented at 16th IMP Conference, Bath UK.

Tahtinen, J. & Snehota, I., (2002) “Weakening processes in business relationships” in Proceedings of the 18th Annual IMP Conference, p139.

Wendelin, R., “The effect of Bonds on Relationship Termination – Cases from the Truck Producing Industry” in Proceedings of the 18th Annual IMP Conference, p151.