



Prof. Dan Braha

Excelling in network research

Professors Dan Braha and Peter Vervest

Imagine that a major fire sweeps through your main suppliers production plant. Your company is threatened to shut down twenty of its plants for several weeks. General success of the business and your job are on a thin line. What do you do now and what could you have done in advance?

By Job ten Bosch & Frederik Willmes

Toyota recovered from this supply-chain disaster within only five days after such a fire. Toyota's quick recovery was attributed to their cohesive network structure of suppliers working with them for mutual success. The increasing integration of supply-chains makes profound knowledge about network dynamics more important. A discussion between RSM's Peter Vervest and Dartmouth's Dan Braha on this rapidly expanding research field provides further insight.

Networks becomes the way of getting innovations out and to reinvent them on a daily basis.

WHY SHOULD WE CARE ABOUT NETWORK RESEARCH?

Vervest: Take innovation! This is also a network related phenomenon. For instance, the technology of Voice over IP. It was already developed in the mid 90s and recently a small company named "Skype" has adopted this technology and it escapes to create a booming network. So the technology was there but took a long time to getting it ready.

Braha: Technology itself creates the infrastructure that promotes innovation. If you have a modular kind of technology you can easily connected different nodes in a very easy fashion. If the system is not connected and it is less flexible, it is much more difficult to rewire some of the interfaces and to come with new innovations. An example of this are

companies who offer free email services. They are reducing the threshold for the adoption of technology through these networks.

Vervest: If you look at technological innovation in the 70's and the 60's they all follow the classical Rogers model which was basically a diffusion model. An innovation is invented and improved at point A and then spreads all over the world. What you see today is that the network itself is the infrastructure for innovation. You put an idea on the network, other people react to it and in the process you reinvent the idea on a daily basis. Amazon.com is innovating its services constantly through all its users who react on the product and services of the company. The network becomes the way of getting the innovation out there but also helps in building it step by step.

Braha: By the way, creating a network is also a technological problem. If you want to create links to connect people then you have to use a certain technology, the right way to connect the nodes.

Vervest: What I like about your approach is that you use mathematics to discover certain network patterns that facilitate change and innovation. But, just looking at the pattern may mean nothing if you don't look at the attributes of the certain nodes and links. Nodes will try to find links that are beneficial to them, so there will be purposeful behaviour. We need to know more about this. Networks need to have a sort of efficiency. Take email for instance, a general manager

of a bank once published a commercial with an email address. They got complains that the emails did not get any replies. And he said "listen, we do not have time to answer all these emails". What you see is that this network was completely flooded and that the technology was inappropriately used. Oracle employees, for instance, have a red button on their intranet which says "social network analysis" on which you can see how you are linked in all the oracle communications of that day. Just creating a link does not help, you have got to do it with a purpose but how you build purposefulness into networks is an area still unexplored. To connect with others as and when it is needed. With the telephone you had the directory and the yellow pages. In the internet age it became the search engine, but search engines are still very rudimentary tools. There are still islands on the internet that are not findable. In theory you can connect everything to anything, but does that make the world a better place?

How you build purposefulness into networks is an area still unexplored

Braha: There also is an interesting issue related to size. There is a maximum capacity for an individual of how many links one can have and the optimal size of a community. A research on primates discovered a correlation between the amount of braincells of a species

and the size of the community. 150 is cited as the optimal size of a network and it makes sense a when you add more links to the network that it will create congestion which will negatively affect the desirability of joining the network. This suggests that there could be an optimum size for technological and social networks, but also smart business networks.

SPEAKING OF WHICH, WHAT MAKES A NETWORK SMART?

Vervest: What is smart? It is difficult to speak about smart networks but it is always so easy to criticize stupid networks. Sometimes people work together and nothing comes out. I think it is about creating something that all the network members can appreciate, we as consumers also being a member of this network. That is why creating something like Ebay or Marktplaats.nl is so smart, because you create a platform for your customers to communicate. Thereby making your consumers as well as your suppliers. The utility of such networks increases as the amount of users increases. Skype is another example of this!

Braha: I think smartness is the result of an evolutionary process, so maybe another view about being smart is that you learn from mistakes. The industry must have the ability to learn from previous experiences rather than designing everything up front. The agility of a network is thus very important it is the ability to react to uncertainties in environment. A good example for this is Napster, the free peer-to-peer network for music downloads. They had a main server, which was the centre of their network. After some legal issues Napster was forced to shut this server down. The network collapsed and was replaced by other peer-to-peer networks with different kinds of configurations. This is a good example of a network that was not flexible enough.

THESE DEVELOPMENTS ALSO CALL FOR DIFFERENT MANAGERS. WHAT WOULD THE FUTURE OF EXCELLENT UNIVERSITY EDUCATION LOOK LIKE?

Researching networks has become an uprising discipline and can be approached from many different angles as shown throughout the interview. The topics expand way further than just differentiating between formal and informal networks. The articles listed below will provide the interested reader with more detailed information about different approaches of researching networks and their structures

Some articles worth reading if you want to know more with business network theory:

- Vervest, P., van Heck, E., Preiss, K., & Pau, L.-F. (2005). *Smart Business Networks*: Springer.
- Braha, D., & Bar-Yam, Y. (2004). *Information flow structure in large-scale product development organizational networks*. *Journal of Information technology*, 19(4), 244-253.
- Barabási, A.-L. (2002). *Linked: The New Science of Networks*: Cambridge, MA: Perseus Publishing
- Newman, M. E. J. (2003). *The structure and function of complex networks*. *Siam Review*, 45(2), 167-256.
- Albert, R., & Barabasi, A. L. (2002). *Statistical mechanics of complex networks*. *Reviews of Modern Physics*, 74(1), 47-97.

VERSUS

DAN BRAHA

Dan Braha is an Associate Professor at the University of Massachusetts Dartmouth, and an affiliate of the New England Complex Systems Institute (NECSI). He was a Visiting Professor at the MIT Center for Innovation in Product Development (CIPD), a research scientist at Boston University, and a senior engineering faculty member at Ben-Gurion University. Dan Braha has advanced the formal approach in Engineering Design by introducing the Formal Design Theory (FDT). This work has also implications to the evolutionary dynamics of natural and social phenomena. His approach of networks is deeply grounded in the methods of physics and mathematics.

PETER VERVEST

Peter Vervest is a professor of business telecommunications at the RSM – Erasmus University. He teaches and researches in the fields of telecommunications and business networks. He is specifically interested in facilities for organisational performance improvement and in particular the emergence of smart business networks. Peter Vervest is also a partner of D-Age which is a company consisting of counsellors and investment managers focusing on directions for the digital age. His network research incorporates different methods and is directed towards general business success.

Braha: We should strive to educate people in a way that reflects how their networks will be. We should have an education system that is more interdisciplinary and we should strive to have managers and engineers that have a broader education so that they will be able to

connect different remote areas. **Vervest:** The focus is shifting towards networks. Towards creating systems that provide added value. This is totally different of what we train students to think, is it not? If you have a great idea, are you going to tell everyone or are you