December 2013

“Big data” in workplace research: Using high technology to assess workplace collaboration

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Many leading organizations now consider workplace design an important strategic investment to drive organizational effectiveness and business success. One consequence of this shift from cost-centered to human-centered design involves defining success for workspaces in terms of the quality of human experience rather than traditional knowledge worker productivity.

Much remains to be understood in terms of what constitutes workplace environments that foster human experience: how are experiences shaped in today’s workplaces? What factors play a role? Can current methods provide any design guidance beyond sociofugal spaces for communication? In particular, can workplace design support or hinder interactions crucial for collaboration and ultimately, for driving innovation?

This is where high technology can come in handy. Social Network Analysis (SNA) is an interdisciplinary field of social psychology, sociology and mathematics (matrix algebra). While it has been around since the 1950s and has been used even in esoteric ways, such as in intelligence, counter-intelligence and law enforcement, it is recently gaining importance in workplace research trying to inform workplace design.

SNA quantifies and visualizes connections (ties) between and among individuals (nodes or egos), such as friendship, trust, or face-to-face communication. By evaluating the ratio between intra-group and inter-group ties, we can provide “bottom-up,” data-driven reasons for adjacency recommendations using adjacency diagrams (also called “bubble diagrams”). Briefly, members of highly interactive groups (e.g., cliques) should share dedicated space (such as project or war rooms), and any two groups with strong inter-group ties should ideally be co-located or adjacent.

With respect to these empirical adjacency analyses, it’s interesting to speculate about a design dilemma, a “chicken or egg” conundrum: Do social networks reflect the influence of place on collaboration or do they represent communication patterns to which place design should respond? In this regard, our research suggests that propinquity (spatial proximity influences interaction) is an important outcome, meaning that for most groups, stronger connections should ideally be co-located or adjacent.

The research literature on SNA primarily provides analyses at the individual level or across entire networks; however, for workplace research and strategy, group-level evaluations provide the most meaningful insights as workplaces are almost always designed on the group (such as departments) level—or at least we feel they should be.

Objective assessment of interaction patterns within office environments (Olguín-Olguín & Pentland, 2010) can yield important insights about organizational performance, which in turn can be supported with appropriate space design. “Social capital” assumes that unique value exists within the interactions between and among people and groups of people, independent of employees’ individual contributions. If these interactions can be measured and made visible, implications for collaboration can ultimately be derived. There are some assumptions that creating highly dense and open work environments will help workers collaborate more. While it might be true for some organizations, it is important to understand the social settings first and social network analysis can help researchers and workplace designers test these assumptions.

If social networks ultimately link organizational performance to collaboration and innovation (Pentland, 2012), workplace strategy may be subordinate to organizational design, at least in terms of its role in supporting collaboration. However, strategic alignment between workplace and organizational design can provide unique advantages for driving business success compared to alternatives.

**AN EXAMPLE FROM HAWORTH**

Ideation is a global team of scientists, researchers, and strategists focused on workplace performance at Haworth, a global leader in the design and manufacture of office interiors and adaptive work environments. Ideation has been using technology that involves wearable badges and space-anchored antennas to provide this type of objective measurement of interactions, including where they occurred, who was involved, their frequency and duration, and certain of their attributes (e.g., speaker/listener; active/passive - measured with accelerometers). This new technology requires participants to wear a badge similar to an employee ID card that transmits and receives infrared signals approximately every second.

While participation in such measurements is completely voluntary, in our recent two research projects we observed over 90% participation rate. This is perhaps due to the fact that this technology is brand new and participants are very interested and curious. It is a passive way to collect data (versus for example surveys). While in the beginning participants are aware of wearing these sensors, showing them to colleagues, chatting about them – which could impact results – this diminishes in about two days and we can exclude the first set of data from the analysis. Antennas can be placed in any space or area to “anchor” the data – this diminishes in about two days and we can exclude the first set of data from the analysis.

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the interactions between/among badges as well as to anchor the location of individual badges. The ultimate goal of such an assessment is to visualize (search for patterns) and quantify interactions (“connectedness”).

After data have been collected for at least ten business days, we use software (UCINET) to visualize and evaluate the interactions among the participants. As far as possible, we adhere to informed consent “best practices” for voluntary participation in research, so to a certain extent, final participant groups tend to be convenience samples from departments whose interactions our clients want to understand and visualize. We often measure employees from multiple departments on more than one floor, but our samples rarely reflect entire companies. The broader and more complete the participation (groups of 150-250 are ideal to capture “Big Data”), the better the estimates of the social networks based on interaction patterns will be.

Interaction duration thresholds (e.g., 1-minute, 3-minutes, 10-minutes) can be used to focus on meaningful communication. Empirical reasons have been established for accepting a three-minute threshold as the minimum for eliminating “chit chat,” although there may be important cultural differences in this regard. For example, in New York City, people tend to focus “on topic” much faster than in West Michigan; thus, thresholds for filtering “socializing” could be shorter there, perhaps only one or two minutes.

At this point, these interaction data can be evaluated similarly to any other social network analysis. Individual actors within such networks are represented as dots, called nodes, in network diagrams; the connections between nodes, called ties, are represented by lines (see Figure 1). Individual (ego level) analyses evaluate connections among individuals within and between teams, identifying speakers, listeners, hubs (individuals central to their group/team), outliers (individuals on the periphery of interaction within their group), bridges or liaisons (individuals linking two groups; these can serve as “connectors” or “bottlenecks”) and other functional roles.

Group level analyses can identify:

- **Cliqus**, a group of individuals where everyone interacts with everyone else—this situation also represents 100% density, where every possible connection between any two individuals in a group exists empirically.
- **Fragmentation**, higher interaction within than between groups.
- **Isolates**, groups with no ties to other groups.
- **Propinquity**, the tendency for spatially proximal nodes to be connected.
- **Cohesion and centrality**, which convey the nature of intra-group and inter-group connections.

The authors have also developed an exploratory algorithm to predict “innovation potential,” where relatively large, highly interactive groups are characterized by high density, low centrality, and high cohesion, which suggest egalitarianism and trust among group members. Investigation to verify is ongoing.

To conclude, several important design implications can be derived from these social network analyses and diagrams:

- Longer interactions (60 minutes or more) tend to involve only two to three people, suggesting that most spaces for interaction can be relatively small; although triads may be important for collaboration, they can make space planning difficult!
- Ties between floors even within highly connected groups are weaker than those among group members sharing space on the same floor (propinquity). To optimize interaction, it’s best for team members to be on the same floor.
- Empirically derived group adjacencies can be an excellent starting point for architectural planning (i.e., blocking & stacking).
- Ideally, space planning should support the dynamic nature of interactions within and between groups.
- The goal is not always to be well connected; “outliers” are just as important in a well-functioning organization as central figures (cf. Cain, 2012).

As team work continues to define the workplace of the future, understanding how teams form and the role design plays in supporting their formation and ongoing interaction will be crucial to both the financial stability of organizations and the well-being of employees. In particular, the behavioral scaffolding that links interaction to communication and finally to collaboration and innovation will be an increasingly important sequence for leaders in and out of business to understand throughout this decade and beyond.

Endnotes:
1  Sociofugal spaces are group spaces arranged in a way that each person in the group can maintain some privacy from the others.
2  Sociopetal spaces are group spaces arranged in a way that each person in the group can see and interact with the others.

References:

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