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# IMPROVING COMPANY PERFORMANCE WITH ORGANIZATIONAL NETWORK ANALYSIS (ONA)

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Humanyze

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# HUMANYZE

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HUMANYZE

## ABSTRACT FROM THE AUTHOR



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Executives at large organizations are responsible for key change initiatives to drive sustained, long-term growth. Yet, such decisions cannot be left to intuitions or “common sense”, instead they should be informed by scientific theories and methods of organizational research. Empirical organizational research actuates people data, data that carries the potential to tell us how work gets done in organizations. In this paper, we introduce a scientific framework that makes this actuation happen, i.e. organizational network analysis (ONA). ONA is the name of a broad perspective that consists of a set of organizational theories and computational methods that help understanding many important aspects of organizational collaboration and communication from raw (big) people data by primarily focusing on the connections between people and teams and the emergent structures through which organizational processes are achieved.

## NETWORKS AND ORGANIZATIONS

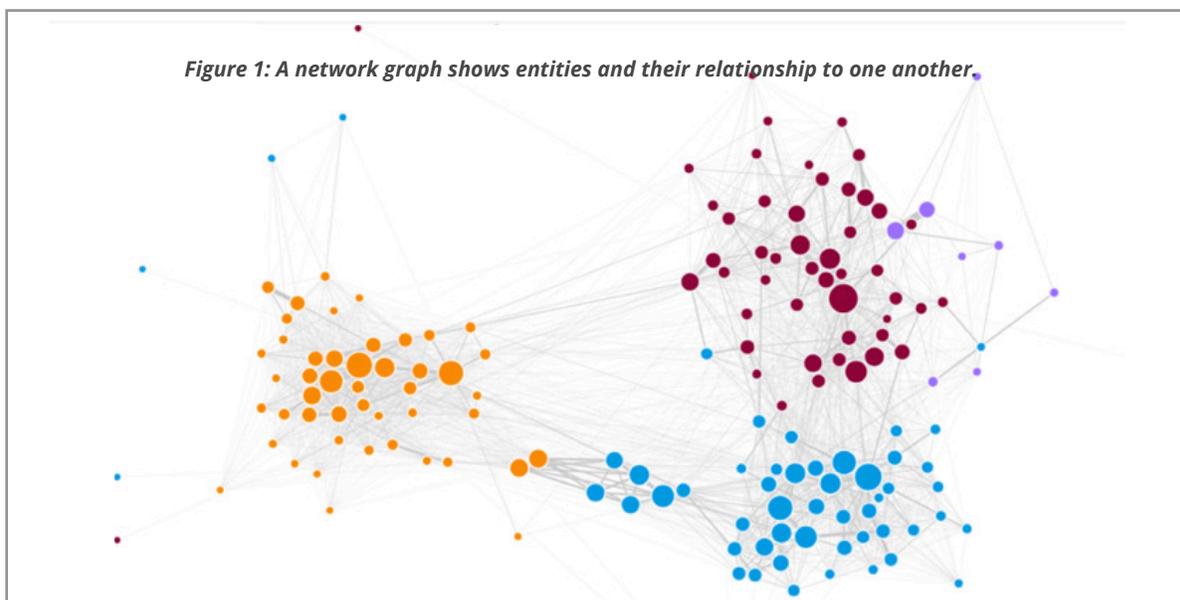
Employees do not work in a vacuum or in isolation, rather they are embedded in many overlaying (multiplex) networks. Some of the organizational networks we form are with colleagues that we see daily: face to face networks such as our friendship network, advice network, or meeting network, as well as digital networks like instant messaging (chat), phone call, or email network. Works gets done through all of these networks and it is the methods and theories of social and organizational network analysis (ONA) that allow us to synthesize and analyze these networks.<sup>1</sup>

A network consists of a set of nodes, and links (ties) connecting them, which represent actors and relationships between them. These links (relationships) can be directed (as in the case of actor A sends an email to B), or they can be undirected (as in the case of actor A and B attending the same meeting); they can also be weighted (A spent W amount of time in a week with B) or unweighted (A knows B). Although an (un)weighted (un)directed network description draws a static picture, most networks are formed over time, so their functioning and evolution can be analyzed temporally. Furthermore, multiple networks with common actors can be overlaid or combined. Then,

using the theories and methods of ONA, we can examine the effects of relationships and network structures on organizational outcomes, or reversing the direction of causality, one can measure the effects of work policies and cultures on network formation.

One of the advantages of networks is their visual interpretability. Networks lend themselves to qualitative visual analysis, and one can infer invaluable information simply by viewing them. This is especially the case for small to medium size networks. Large networks might look like hairballs at first glance; however, interactive visualization environments let us overcome this problem.

In Figure 1, a digital communication network (email, chat, Skype calls, etc. combined) of participants (of four teams) in a company is depicted using the Humanyze Elements Platform. In this example, the size of a node (circle) represents the total communication each employee is involved in, the color of the node represents its team, the thickness of a tie (line) represents the amount of communication between the pair of nodes it connects. Nodes are positioned such that related employees are in closer proximity, while unrelated ones are farther apart.



<sup>1</sup> ONA is the special subfield of social network analysis, and the broader field of network science, in organizational context.

The Humanyze Elements Platform allows filtering networks by teams, media, and dates; changing the length of tie formation periods and presenting them at multiple levels (individual and team).

In ONA, beyond qualitative visual analysis, meaningful graph theoretic properties of nodes, ties, emergent local structures, teams, and entire networks are identified. Statistical descriptions and distributions of such components of networks can carry much more meaning and provide much more clear pictures of organizations than visual analysis when they are analyzed quantitatively or computationally.

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## WHY ORGANIZATIONAL NETWORK ANALYSIS (ONA)?

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What differentiates ONA from other more commonly used scientific approaches or business metrics is that by focusing on relations and interactions, rather than merely considering attributes of individuals, ONA allows for examining collaboration and communication patterns as well as the emergent structures through which organizational processes are achieved. Thus, it empowers managers and executives to uncover how individuals and teams are functioning collectively and in relation to others, how they are embedded in organizational context, and how these connections provide value.

In his comparison to isolationist approaches, Allen H. Barton, former Professor of Sociology at Columbia University, drew an analogy from biology to explain the value of an approach that accounts for the relations and the structures:

*“Using random sampling of individuals, the survey is a sociological meat-grinder, tearing the individual from his social context and guaranteeing that nobody in the study interacts with anyone else in it. It is a little like biologist putting his experimental animals through a hamburger machine and looking at every hundredth cell through a microscope; anatomy and physiology get lost; structure and function disappear, and one is left with cell biology” (Barton, 1968).*

Integration and utilization of social networks has proven to be very valuable in organizational behavior and human resource management research and practice -- see Soltis

et al. (2018) for a recent review. In particular, social network analysis has helped improve our understanding of many organizational factors including:

- How members' and leaders' social network structures help or hinder team effectiveness (Balkundi and Harrison, 2006)
- Individual and group performance (Sparrowe et al., 2001)
- Structural properties of work groups and their consequences for performance (Cummings and Cross, 2003)
- Performance implications of demographic diversity (Reagans and Zuckerman, 2001)
- Email networks in comparison to off-line social networks (Johnson et al., 2012)
- Creativity (Perry-Smith and Shalley, 2003)
- Effects of network position on innovation and team performance (Tsai, 2001)
- How network structure shapes the performance of problem-solving tasks (Shore et al., 2015)
- Short and long-term stabilities of networks (Quintane et al., 2013)
- How brokers broker (Quintane and Carnabuci, 2016)
- How to catalyze innovation (Uhl-Bien, 2017)
- Turnover (Soltis et al., 2013)
- Effective leadership (Balkundi and Kilduff, 2006)
- Effect of email overload on job satisfaction (Merten and Gloor, 2010)
- How office layouts drive social interaction (Sailer and McCulloh, 2012)
- Proximity effects on the dynamics and outcomes of collaborations (Kabo et al., 2014)
- HR practices (Kaše et al., 2013)

## HOW IS IT DONE?

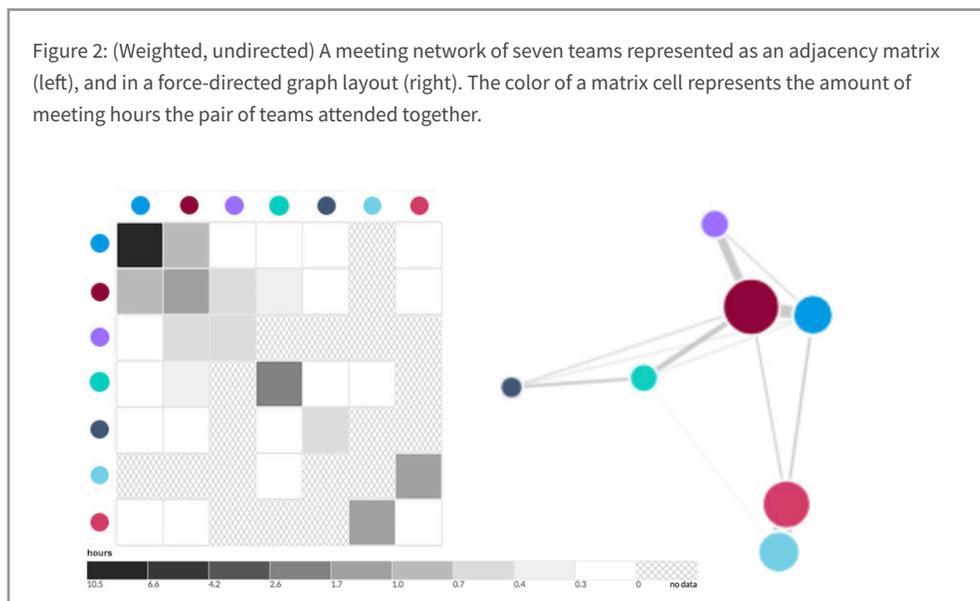
Most of the scientific research listed in the previous section employs a common set of fundamental social network theories and methods in addressing their particular question of interest. After forming their research questions and maybe a set of hypotheses to test based on their prior knowledge and observations, scientists design their research: they decide on what data to collect, how to collect and analyze them, and then how to interpret and report their findings. Similarly, executives might know that recognizing how information flows between and within teams can drive critical decision making, increase productivity and bridge process gaps, but then they need to figure out how to formulate them in their particularities, properly collect and analyze the data, and interpret the results.

**Data collection.** Not everything that counts can be counted and not everything that can be counted counts. For privacy reasons, one should only gather raw communication metadata (no content should be collected), and of only those who opted in, be it face-to-face or digital, from which networks can be inferred.<sup>2</sup> Thanks to the developments in sensor technologies and growth in APIs that allow digital data integration (especially among

communication and collaboration tools), organizational data sources are getting richer every day. Among others, we actively use these APIs and our proprietary sociometric badges (Olguín et al., 2009) to gather communication and collaboration related data.

**Data analysis.** One can form a network by creating a matrix where each element (cell) represents the strength of a pairwise relationship. In Figure 2 for example, the darker the cell, the more meeting hours the pair of teams spend together. After forming a network, we can then compute the properties of dyads (ties), actors (nodes), graphlets, emergent clusters, teams, departments, or an entire network. These properties at different levels allow us to understand organizational behaviors and processes using emergent structural (positional or topological) and relational (connectionist) perspectives. Each of these dimensions is very rich in theory and methodology (see Borgatti et al., (2009) for a brief review) and deserves a separate research report.

**Results.** Once the algorithms employing ONA are designed, implemented, and continuously run on the streaming raw data, one can then show the results in interactive



<sup>2</sup> Data privacy needs to be your first principle. You should comply with the highest standards such as EU's GDPR Privacy Standards and get certified by EU Privacy Shield Framework. You can find our data privacy policies here.

dashboards that can act as health monitors for organizations in near-real-time. Managers can see the change of metric values over time and thus diagnose active or potential problems. Beyond health monitoring, they can use such platforms to design new policies and A/B test their effectiveness.

**Reading network graphs.** Concepts, models, and theories of homophily, influence (contagion), social capital, strength of weak ties, structural holes, and others help in the understanding of social networks (Borgatti and Halgin, 2011). Most organizational network theories are an adoption (or evolution) of these theories in specific organizational contexts. When we see some nodes that are more central than others or some that are close knit (such as in Figure 1), we read these patterns in the light of organizational network theories. These qualitative theories have quantified correspondences (metrics in parentheses) within ONA as well:

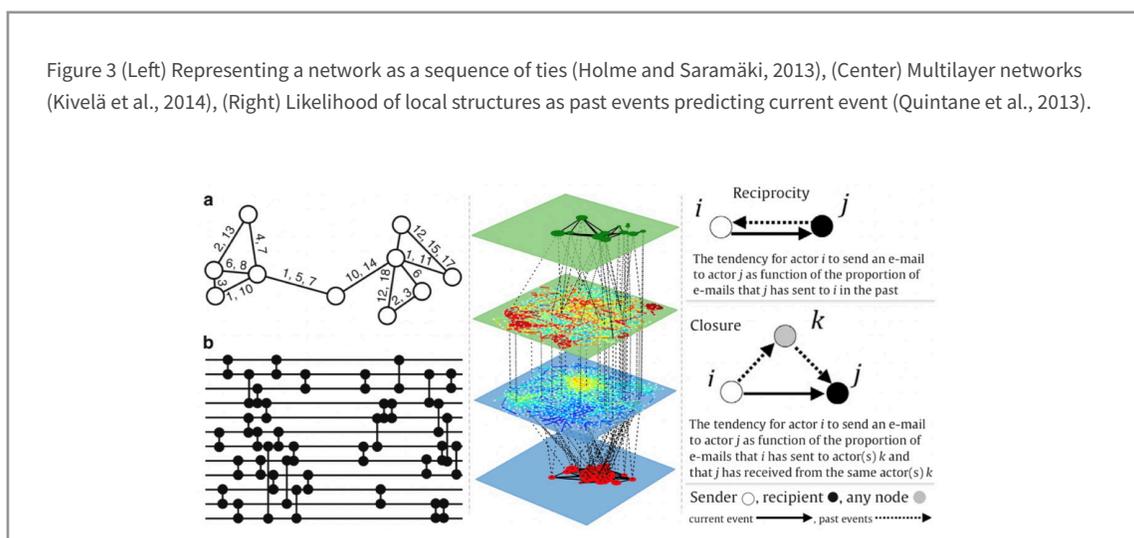
- **Central Nodes (degree):** Central nodes are the people on your team that everyone talks to. They are highly engaged employees. Information arrives to them sooner than to others.
- **Brokers (betweenness):** Knowledge brokers are employees who link poorly connected groups. For example, a knowledge broker could be a sales representative who communicates often with both the engineering team and the marketing team.
- **Clusters (clustering coefficient):** A tightly clustered team is one that frequently communicates internally. Clustering coefficient metrics reflect cohesion within an entire company

(global CC) and the number of interactions between the immediate team of an employee (local CC).

- **Quantity of Communication (link weight):** Indicates the amount of communication within a team. By knowing how much teams are interacting with each other, managers can identify potential communication gaps.
- **Homophily (assortativity):** Homophily represents the tendency of individuals to associate with others similar to themselves. By measuring the tendency of actors being connected to similar others, companies can assess the extent to which they embrace diversity and achieve inclusion.

Networks can be analyzed using such metrics, but we need to ensure construct validity. That is, different communication media and collaboration technologies are adopted differently by companies, knowing how they are used is therefore crucial; otherwise, using one channel, say email network, to assume or infer all kinds of relationships would be deceptive (Johnson et al., 2012).

There are many other, more complex metrics of network graphs which cannot be identified simply by visualizing a network (they of course can still be visualized with other types of charts). New metrics are being added as ONA's breadth is increasing thanks to the growing research and practice in this field. Some of the rather advanced topics in this field include temporal network analysis (evolution of networks and sequence analysis), multilayer network analysis, and direction of causality (antecedents and consequences of a network) (see Figure 3 for illustration).



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## BUSINESS APPLICATIONS OF ONA

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The research discussed in the previous sections helps to improve our understanding about how organizations work. But what exactly should an executive do with these findings and how can they employ ONA in their own companies to get actionable insights? Now that we've covered the basics of ONA, let's look at potential applications within organizations.

### Key Recommendations:

#### • Business Process Optimization

Are there gaps in how the information flows within teams? Which teams need to be closer aligned to improve productivity and spur innovation? Organizational network analysis helps executives identify high performing teams, process gaps, and potential communication issues. For instance, a U.S. Bank identified and remedied the cause behind one branch outperforming another by almost 200% (Humanyze, 2017a).

#### • Workspace design

Research has shown that where you sit in the office matters; close proximity leads to collaboration (Lee, 2017). Distances as little as 10 feet can impact communication between team members. By understanding how teammates are interacting, executives can ensure that critical teams are placed near each other to optimize productivity and office design decisions. Communication data can be used to measure the impact of an office redesign or expansion. For instance, what is the impact of moving one team offsite on company performance? A major oil company was able to save millions of dollars in

#### • Organizational Health

Happy employees are productive employees that promote desired company culture. Teams that collaborate are more engaged, innovative and equipped to solve problems (Olguín and Pentland, 2010). ONA gives executives insight into which teams are the most collaborative and inclusive. ONA can also measure the efficacy of diversity and inclusion initiatives by identifying when employees are included in meetings and how often employees are getting face time with management. Are employees working 70+ hours a week? How does this impact employee retention? With ONA, executives and managers

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## CONCLUSION

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Traditional research explained the outcome of an individual, a team, or a company as a function of behavioral attributes or an aggregate of characteristics. Network analysis adds social structure into the equation by considering processes, influence, and social capital in the larger construct of how work gets done. ONA produces meaningful graph theoretic properties of nodes, ties, emergent local structures, teams, and entire networks for quantitative and computational analysis. Examining communication and collaboration patterns within and across teams helps organizations optimize business processes, improve workplace design, and measure organizational health. Beyond these benefits, managers can leverage ONA-based platforms to design new policies and test their effectiveness.

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## REFERENCES

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Balkundi, P., Harrison, D.A., 2006. Ties, Leaders, And Time In Teams: Strong Inference About Network Structure's Effects On Team Viability And Performance. *Acad. Manage. J.* 49, 49–68. <https://doi.org/10.5465/amj.2006.20785500>

Balkundi, P., Kilduff, M., 2006. The ties that lead: A social network approach to leadership. *Leadersh. Q.* 17, 419–439. <https://doi.org/10.1016/j.leaqua.2006.01.001>

Barton, A.H., 1968. Survey research and macro-methodology. *Am. Behav. Sci.* 12, 1–9. Borgatti, S.P., Halgin, D.S., 2011. On Network Theory. *Organ. Sci.* 22, 1168–1181. <https://doi.org/10.1287/orsc.1100.0641>

Borgatti, S.P., Mehra, A., Brass, D.J., Labianca, G., 2009. Network Analysis in the Social Sciences. *Science* 323, 892–895. <https://doi.org/10.1126/science.1165821>

Cummings, J., Cross, R., 2003. Structural properties of work groups and their consequences for performance. *Soc. Netw.* 25, 197–210. [https://doi.org/10.1016/S0378-8733\(02\)00049-7](https://doi.org/10.1016/S0378-8733(02)00049-7)

Halgin, D.S., Gopalakrishnan, G.M., Borgatti, S.P., 2015. Structure and agency in networked, distributed work: The role of work engagement. *Am. Behav. Sci.* 59, 457–474.

Holme, P., Saramäki, J., 2013. Temporal Networks as a Modeling Framework, in: *Temporal Networks, Understanding Complex Systems*. Springer, Berlin, Heidelberg, pp. 1–14. [https://doi.org/10.1007/978-3-642-36461-7\\_1](https://doi.org/10.1007/978-3-642-36461-7_1)

Humanyze, 2017a. Humanyze - A U.S. Bank Improves Call Center Productivity and Employee Retention [WWW Document]. Humanyze. URL <https://www.humanyze.com/casestudies-major-us-bank/> (accessed 5.2.18).

Humanyze, 2017b. A Major Oil and Gas Company Faces Expansion [WWW Document]. Humanyze. URL <https://www.humanyze.com/case-studies-oil-and-gas/> (accessed 5.2.18).

Johnson, R., Kovács, B., Vicsek, A., 2012. A comparison of email networks and off-line social networks: A study of a medium-sized bank. *Soc. Netw.* 34, 462–469. <https://doi.org/10.1016/j.socnet.2012.02.004>

Kabo, F.W., Cotton-Nessler, N., Hwang, Y., Levenstein, M.C., Owen-Smith, J., 2014. Proximity effects on the dynamics and outcomes of scientific collaborations. *Res. Policy* 43, 1469–1485.

Ka e, R., King, Z., Minbaeva, D., 2013. Using Social Network Research in HRM: Scratching the Surface of a Fundamental Basis of HRM. *Hum. Resour. Manage.* 52, 473–483. <https://doi.org/10.1002/hrm.21546>

Kivelä, M., Arenas, A., Barthelemy, M., Gleeson, J.P., Moreno, Y., Porter, M.A., 2014. Multilayer Networks. *J. Complex Netw.* 2, 203–271. <https://doi.org/10.1093/comnet/cnu016>

Lee, S., 2017. Can Reconfiguring Spatial Proximity between Organizational Members Promote Individual-Level Exploration? Evidence from a Natural Experiment (SSRN Scholarly Paper No. ID 3094639). *Social Science Research Network*, Rochester, NY.

Merten, F., Gloor, P., 2010. Too Much E-Mail Decreases Job Satisfaction. *Procedia - Soc. Behav. Sci.* 2, 6457–6465. <https://doi.org/10.1016/j.sbspro.2010.04.055>

## REFERENCES

---

Olguín, D.O., Pentland, A., 2010. Assessing group performance from collective behavior, in: Proc. of the CSCW. Citeseer.

Olguín, D.O., Waber, B.N., Kim, T., Mohan, A., Ara, K., Pentland, A., 2009. Sensible organizations: Technology and methodology for automatically measuring organizational behavior. *IEEE Trans. Syst. Man Cybern. Part B Cybern.* 39, 43–55.

Perry-Smith, J.E., Shalley, C.E., 2003. The social side of creativity: A static and dynamic social network perspective. *Acad. Manage. Rev.* 28, 89–106.

Quintane, E., Carnabuci, G., 2016. How Do Brokers Broker? Tertius Gaudens, Tertius Iungens, and the Temporality of Structural Holes. *Organ. Sci.* 27, 1343–1360. <https://doi.org/10.1287/orsc.2016.1091>

Quintane, E., Pattison, P.E., Robins, G.L., Mol, J.M., 2013. Short - and long-term stability in organizational networks: Temporal structures of project teams. *Soc. Netw.* 35, 528–540. <https://doi.org/10.1016/j.socnet.2013.07.001>

Reagans, R., Zuckerman, E.W., 2001. Networks, diversity, and productivity: The social capital of corporate R&D teams. *Organ. Sci.* 12, 502–517.

Sailer, K., McCulloh, I., 2012. Social networks and spatial configuration—How office layouts drive social interaction. *Soc. Netw., Capturing Context: Integrating Spatial and Social Network Analyses* 34, 47–58. <https://doi.org/10.1016/j.socnet.2011.05.005>

Shore, J., Bernstein, E., Lazer, D., 2015. Facts and Figuring: An Experimental Investigation of Network Structure and Performance in Information and Solution Spaces. *Organ. Sci.* 26, 1432–1446. <https://doi.org/10.1287/orsc.2015.0980>

Soltis, S., Brass, D., Lepak, D., 2018. Social Resource Management: Integrating Social Network Theory and Human Resource Management. *Acad. Manag. Ann.* <https://doi.org/10.5465/annals.2016.0094>

Soltis, S.M., Agneessens, F., Sasovova, Z., Labianca, G. (Joe), 2013. A Social Network Perspective on Turnover Intentions: The Role of Distributive Justice and Social Support. *Hum. Resour. Manage.* 52, 561–584. <https://doi.org/10.1002/hrm.21542>

Sparrowe, R.T., Liden, R.C., Wayne, S.J., Kraimer, M.L., 2001. Social networks and the performance of individuals and groups. *Acad. Manage. J.* 44, 316–325. Tsai, W., 2001. Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. *Acad. Manage. J.* 44, 996–1004.

Uhl-Bien, M.A., Rob Cross, Jonathan Sims, and Mary, 2017. How to Catalyze Innovation in Your Organization. *MIT Sloan Manag. Rev.*

## **APPENDIX A: SUPPLEMENTAL MATERIALS**

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Waber, Ben. (2013) People Analytics. Upper Saddle River, NJ. FT Press.