

# **Social Network Analysis as a Tool for Understanding the Workforce (Project #2)**

**Final report**

**The North Superior Workforce Planning Board and HR Strategy  
Steering Committee as Mapped Social Networks**



**North Superior Workforce Planning Board**

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## **Background:**

One of the recommendations emerging from a 2012/2013 collaborative project of the North Superior Workforce Planning Board (NSWPB) was to develop strategies to better connect the supply of skills in the labour supply with local employer demand. It was recognized that getting a better picture of labour supply was needed. Combined with a growing interest in, and knowledge of, complexity theory<sup>1</sup> among members of the board, the possibility of representing the labour supply as a complex system emerged. See Appendix #1 for a brief primer on complexity theory.

In June of 2014 the group that would become the Regional Human Resource Strategy Steering Committee formed under the NSWPB. This group consisted of representatives from various organizations who were drawn to the project through NSWPB's networks as well as from among those who completed the complexity theory course and who had an interest in the workforce as a complex system. Through the early meetings of this group several ideas emerged as the group worked to see the labour supply as a complex and adaptive system of interdependent people. It was recognized that this perception of labour supply is in contrast to the typical data-driven view in which labour supply appears to be a series of disjointed and static demographics. Finding a complexity-inspired way to describe and visualize the labour supply became clearer.

At the second meeting of this group, *Social Network Analysis* was introduced as a possible tool for mapping a complex social system such as the labour supply. Contemporary software applications that generate social network maps, such as Gephi<sup>2</sup>, which is available for free online, were discussed. Tools such as Gephi can visualize or map a network of interconnected nodes. In this case, it could visualize workers in a workforce as individual agents interconnected with one another in dynamic patterns through changes in training and work experiences. It was considered whether this tool could enable us to visualize the labour supply as one holistic talent pool in the region.

At the fourth meeting of the Regional HR Strategy Steering Committee in August of 2014 the group reaffirmed its purpose of identifying a strategy through which we could access

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<sup>1</sup> The *Social Innovation and Leadership in Complexity* course was offered through Lakehead University in winter and again in fall of 2014. Along with other members of the professional community, 3 members of the NSWPB board and 2 staff participated.

<sup>2</sup> Gephi software: <http://gephi.github.io/>

information and visualize that information in a way that retains its dynamics, so as to better match labour supply and demand. Through discussion, it became clear that the group was working with 2 major projects. The first (project #1) was to build networks of labour supply stakeholders to enhance the flow of relevant information, and the second (project #2) was to begin depicting the labour supply as a complex system through social network analysis. With the addition of a developmental evaluation of the other two projects, the Regional HR Strategy Steering Committee articulated these 3 projects (see Appendix #2) for which they began seeking funding in January of 2015. In April of 2015 three Requests for Proposals were released seeking organizations or individuals to lead these projects as consultants.

No bids were received for project #2 on social network analysis. Therefore, the Regional HR Strategy Steering Committee decided to conduct this project itself on a smaller scale than was articulated in the RFP and to contract out specific aspects of the work.

In May of 2015, ongoing discussions within the Regional HR Strategy Steering Committee identified a potential sample of the workforce that would make an interesting pilot test of social network analysis. This was a group of approximately 200 workers undergoing a unique transition. A survey was developed for online administration in the summer and fall of 2015. This survey included questions to assess the respondents' networks of interaction at work (social network), and questions on satisfaction with the transition. The research team gained critical knowledge and capacity in setting up social network surveys. This project was conceived as a research project through Lakehead University and, with some modifications, passed ethics review. Stakeholders in the community also posed revisions to the survey. One recruitment letter was sent out through a contact in late September, 2015, but this generated only two respondents. Contacts within the transitioning workforce became unavailable for further recruitment efforts and the group's attention shifted to another possible sample for exploring social network analysis to understand the labour supply.

## **Current Project**

The purpose of this project is to explore the use of social network analysis as a tool for visualizing the labour supply as a complex system. In October, 2016, the HR Strategy Steering Committee identified the network consisting of the HR Strategy Steering Committee itself, the NSWPB board, and staff as a viable pilot sample with which to examine the process and potential of social network analysis. In addition to being an accessible sample, examining this network at this time is also valuable given the changes emerging in the workforce planning sector with the formation of the LEPC model. It is the intention of the group to analyze these networks periodically as the LEPC model takes shape.

## **Sampling Methods**

The survey shown in Appendix #5 was developed and distributed via a link to an online survey platform (SurveyMonkey) that was emailed to 31 potential respondents on

December 7, 2015. These respondents included 15 NSWPB board members, 3 staff, and 14 members of the HR Strategy Steering Committee. Following an instruction and welcome screen, respondents were asked to type in their own name and were then shown a list of the names of all 31 people in the network. For each name they were asked to indicate on a scale of 0 (never) to 4 (very often) how frequently they interact with this person on (a) matters relating to workforce planning, and (b) matters relating to community outreach and engagement. Following these social network questions, there were 5 additional questions in which respondents were asked to rate their satisfaction with the performance of the NSWPB on dimensions of action written to relate directly to the stated goals of the LEPC. Responses were received from 25 of the 31 people by January 24, 2016. This data is presented in the current report.

### **Data Preparation**

Data was downloaded from the online survey platform to Excel where it was transformed into a format readable by Gephi. First, participants were assigned an ID number. Two files were then prepared, the first, called a node file, contained the ID numbers linked with respondent names. The second, called the edge file, contained in columns, (a) the rater's ID number (source), the person's ID they were rating (target), and the rating itself, called weight A, which could range from 0 to 4. The rating from the other direction (the initial target person's rating of the source person), called weight B, was then placed in the column beside weight A. An average of these two weights was then calculated using Excel's average function. For those pairings in which both raters indicated a response of '0' (reflecting that they never discussed matters relating to that particular question), the pairing was deleted. Averages which ended in .5 were rounded up. The same procedure was used for the second question.

The node file and edge file for the two questions were separately uploaded into Gephi. Network layout algorithms were tested, and the Fruchterman Reingold algorithm was chosen for its ability to create an equilibrium to the network layout. With this algorithm, nodes (people) who are more connected are positioned in the centre of the network map, with people who are less connected on the periphery of the map. Nodes were first assigned a colour based on the following affiliation legend:

- a) Board – 1 (Green)
- b) HR Strategy Steering Committee – 2 (Purple)
- c) Both – 3 (Cyan/Light Blue)
- d) Staff – 4 (Orange)

Line or edge weights (the relationship between two people) were assigned a colour based on the following weight legend:

- a) Rarely – 1 (Dark Blue)
- b) Sometimes – 2 (Red)
- c) Often – 3 (Fushia/Pink)
- d) Very Often – 4 (Dark Green)

Node and line labels (with the value of the rating) were also applied. Nodes were sized according to what is called their betweenness centrality, which means that the larger the node, the more of a central role that person plays in the network.

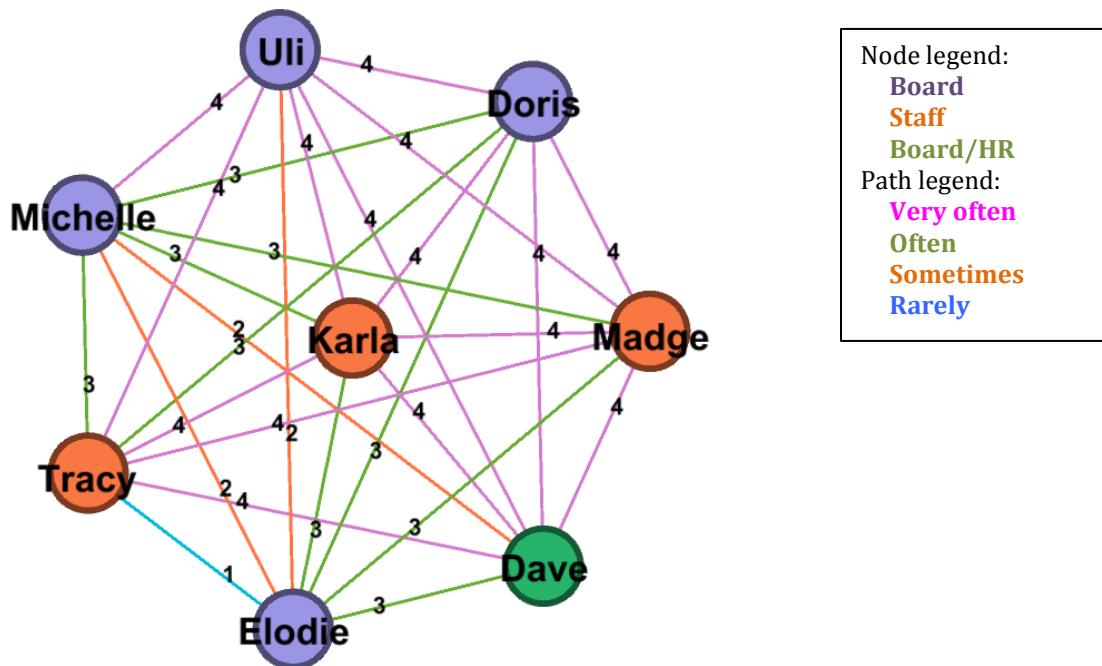
## Results

### 1. Network Mapping

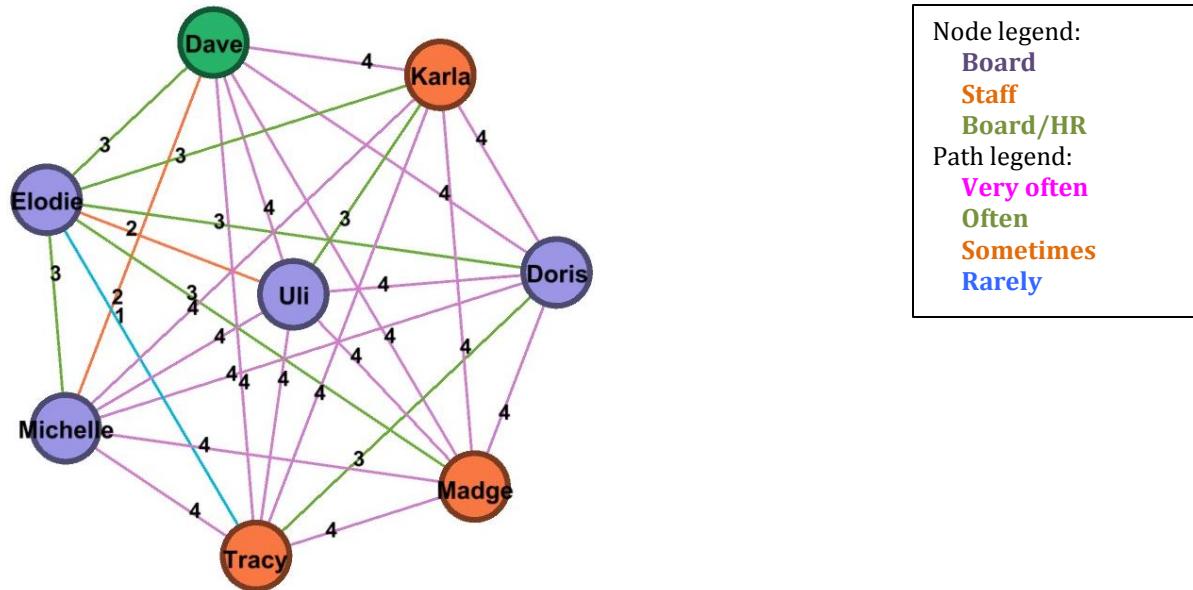
Social networks were mapped and explored using filtering to examine how the maps change when considering the sub-groups within the network (board, steering committee, executive, staff), as well as the different weights to the relationships (people connected with very often vs often, vs sometimes, vs rarely). When a given node is clicked, the network for that individual is accentuated within the overall network, making the strength and character of an individual's connections, and their positioning within the overall network more salient. These findings were explored by the research team to understand the capability of the tool and in a meeting with the NSWPB executive director on January 13, 2016. Findings were also presented on-screen and discussed with the HR Strategy Steering Committee on January 25, 2016. See Appendix #3 for a brief tutorial on Gephi.

The following images capture a series of network maps:

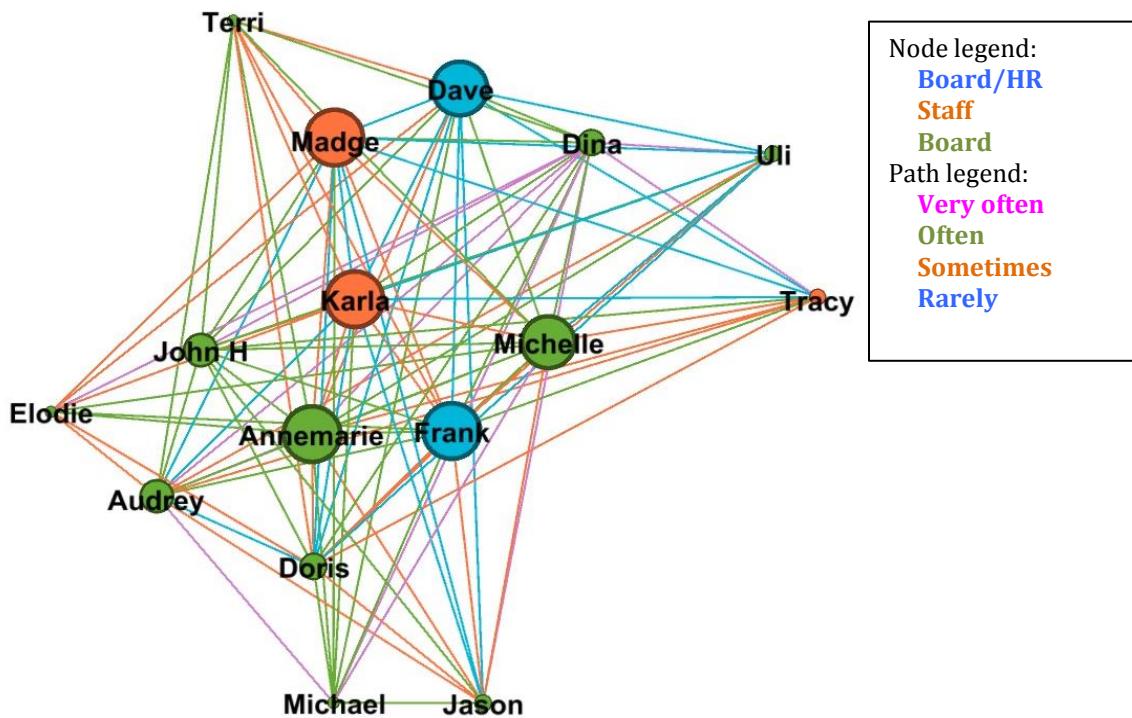
**Figure 1** NSWPB Executive Q#1: frequency of interaction on matters relating to workforce



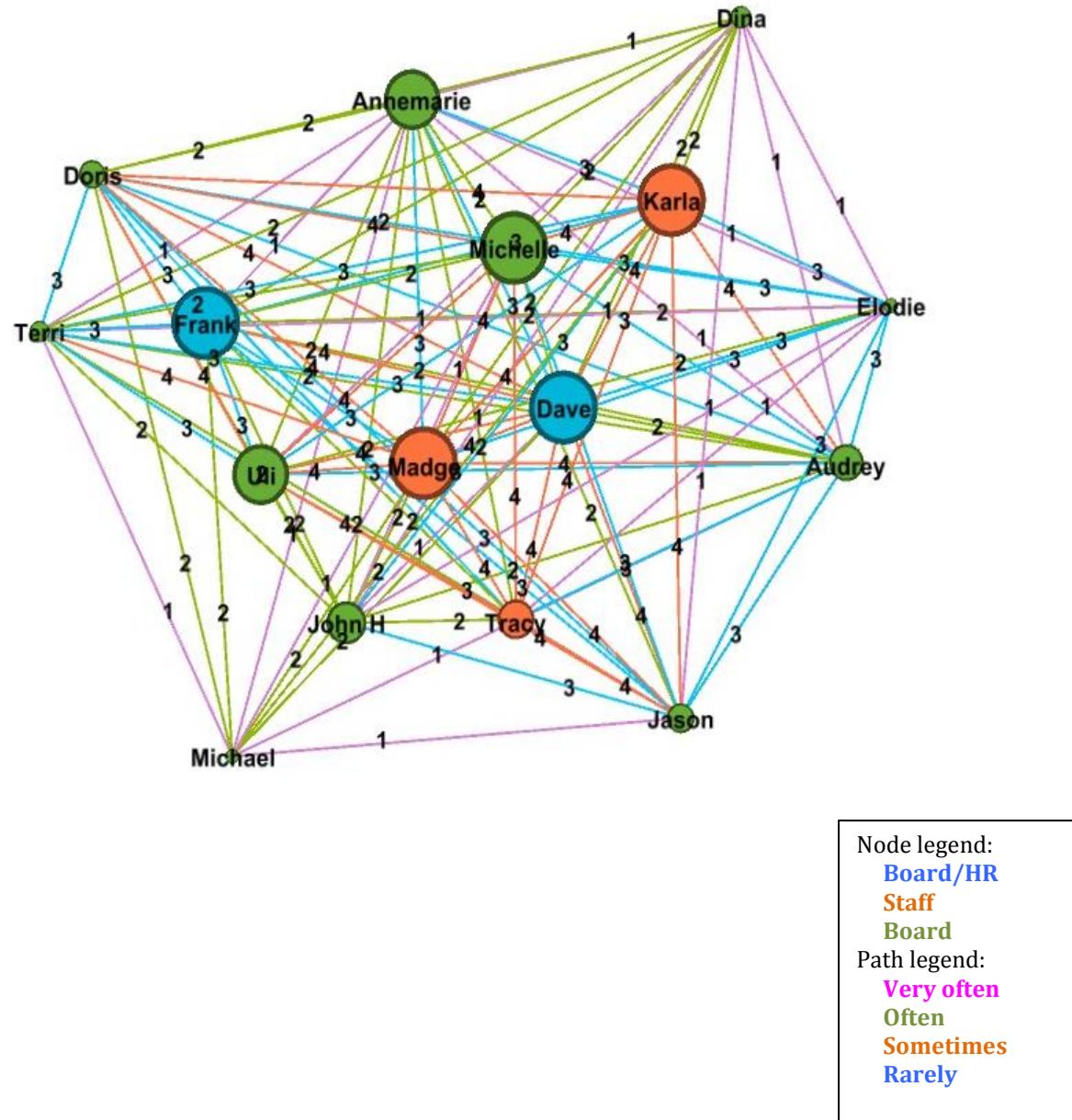
**Figure 2** NSWPB Executive Q#2: frequency of interaction on matters relating to community engagement



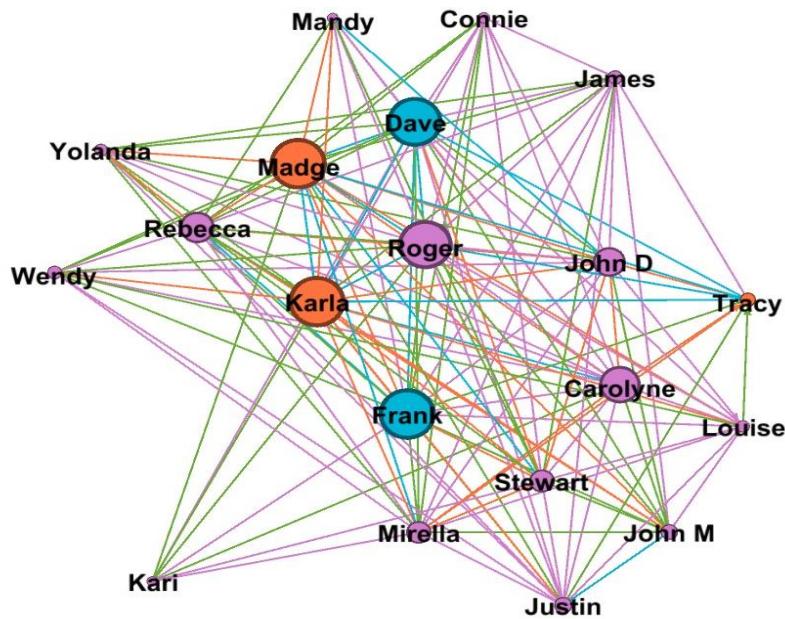
**Figure 3** NSWPB Board and staff Q#1: frequency of interaction on matters relating to workforce



**Figure 4** NSWPB Board and staff Q#2 frequency of interaction on matters relating to community engagement

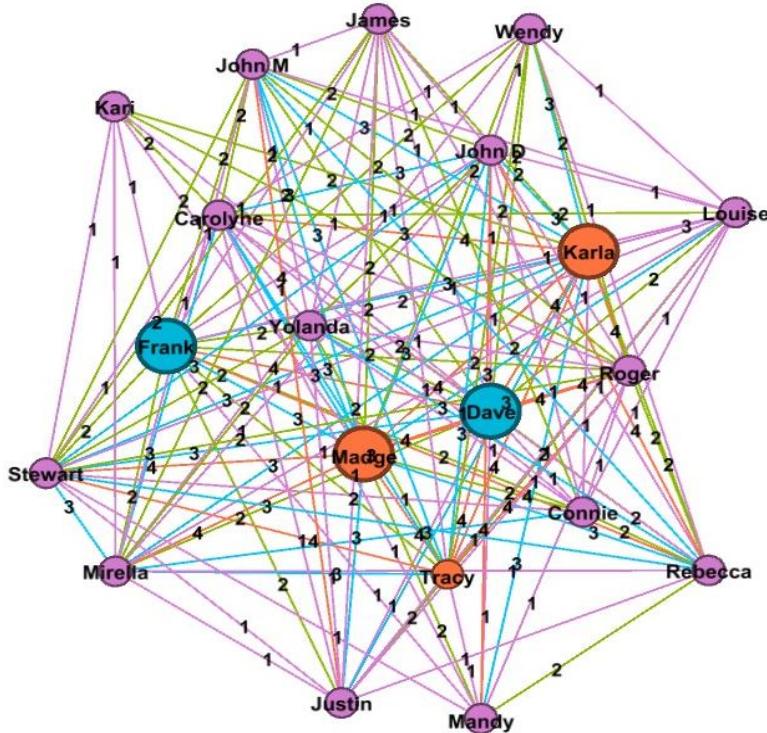


**Figure 5** HR Strategy Steering Committee and staff Q#1: frequency of interaction on matters relating to workforce



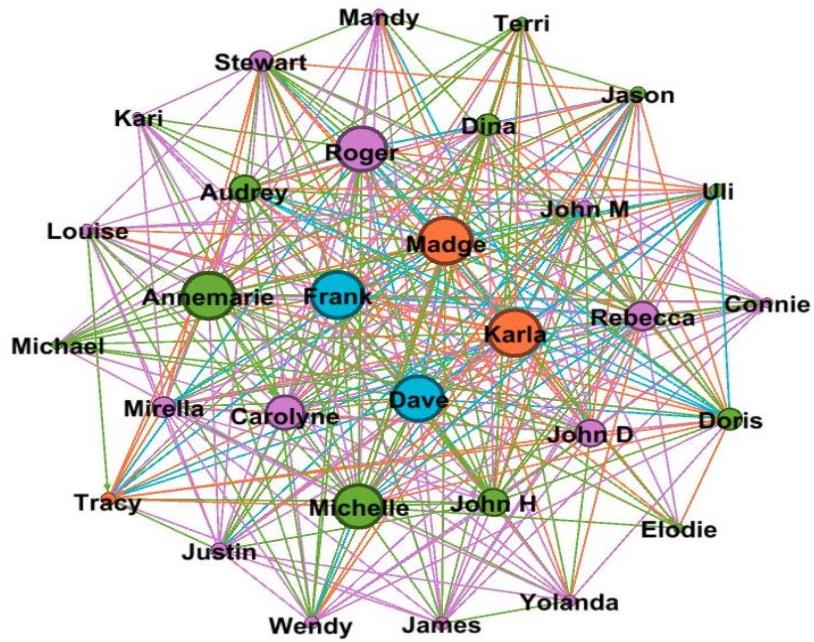
Node legend:
HR Committee
Staff
Board/HR
Path legend:
Very often
Often
Sometimes
Rarely

**Figure 6** HR Strategy Steering Committee and staff Q#2: frequency of interaction on matters relating to community engagement

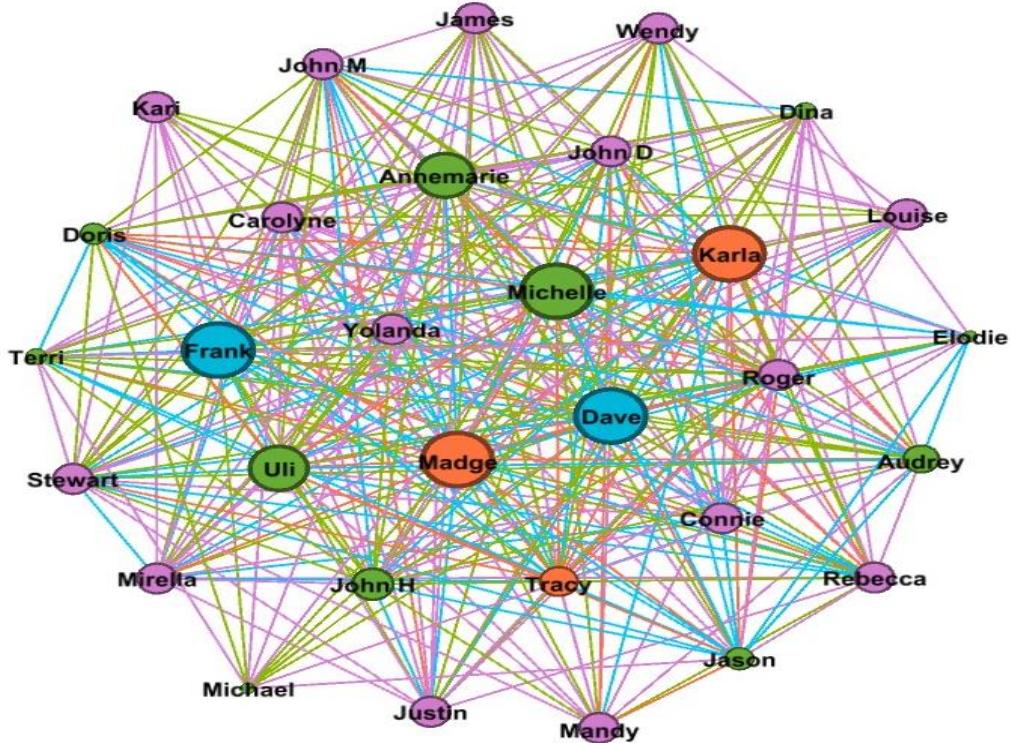


Node legend:
HR Committee
Staff
Board/HR
Path legend:
Very often
Often
Sometimes
Rarely

**Figure 7** Whole network Q#1: frequency of interaction on matters relating to workforce



**Figure 8** Whole network Q#2: frequency of interaction on matters relating to community engagement



## 2. Network Statistics

The network mapping software produces a number of potentially meaningful network statistics as well. These were examined in relation to the whole network shown in Figures #7 and #8 above, and are described below:

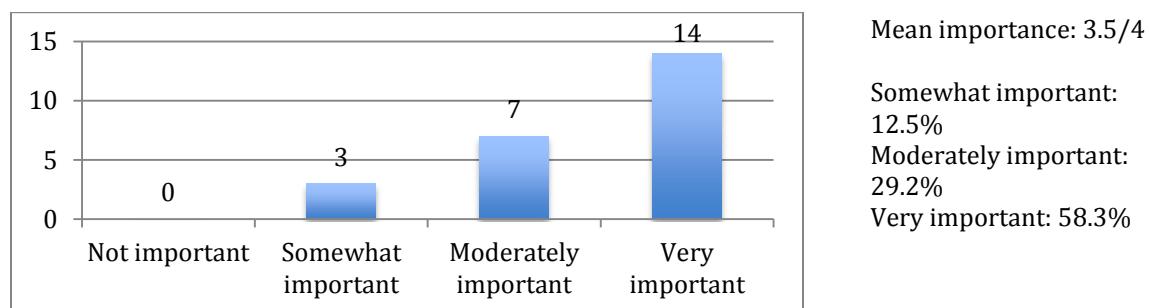
**Table 1** Network Statistics, explanation and results

Statistic	Explanation	Results and Interpretation
Average Path Length	Tells us how far apart the two most distant nodes are in the network. The distance between two nodes that are connected is counted as 1.	For Q1 was 1.30 and for Q2 was 1.25
Betweenness Centrality	Tells us how often a node is on the shortest path between two nodes in a network. This statistic also helps to identify nodes that are connectors.	The nodes in Weight 1 and Weight 2 were sized according to their betweenness centrality in order to distinguish those nodes that played important roles in connecting the network.
Graph Density	Measures how close a network is to complete. It is a ratio of the number of <i>actual</i> edges (connecting lines) to the number of <i>possible</i> edges. When all possible connections are in place, graph density is equal to 1.	Q#1: 70% Q#2: 75%  Note that the higher the density of the network the more rigid the network is considered to be. Therefore, a density of approximately 70-75% is good.
Average Degree	Tells how many edges are connected to each node. This tells you how connected an individual is within the network	Node degrees for both questions ranged from 11 to 30. In a network of 31 nodes, 30 is the highest number of connections (edges) possible. Q#1 had an Average Degree of 20.8; Q#2 had an Average Degree of 22.4. It was meaningful to note which respondents had the highest (30) and lowest (11) numbers of connections. This distribution was interpretable.
Clustering Coefficient	Measures how complete the neighbourhood of an individual node is. For example, the neighbourhood of Julie is all of the people (nodes) connected to Julie. If all of the people in her neighbourhood are also connected to each other, then the clustering coefficient is equal to '1'. If the people Julie is connected with have no connections with each other, then the coefficient is '0'.	The <b>Average Clustering Coefficient</b> statistic is the average of all clustering coefficients in the entire network. The Average Clustering Coefficient for Q#1 was .82 and for Q#2 was .85.

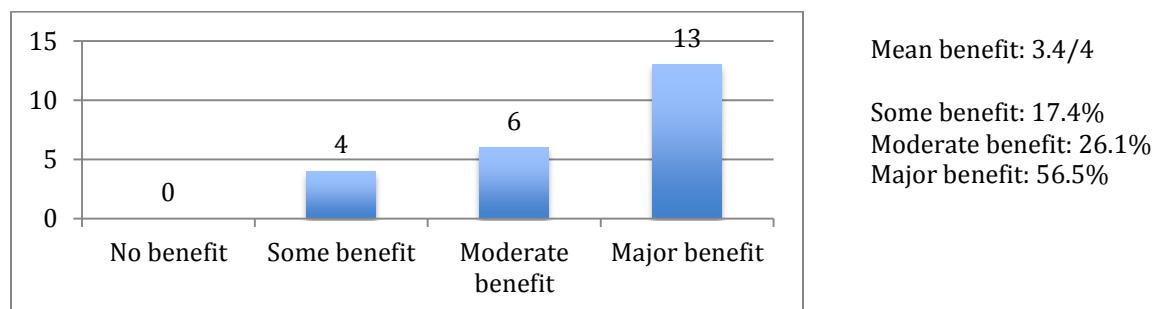
### 3. Analysis of Non-Network Questions

In addition to the social network questions, respondents were asked questions regarding their involvement with the NSWPB and/or HR Strategy Steering Committee. These questions with their mean responses and frequencies are shown below. For each of these questions, participants indicated their response on a scale from 1 to 4.

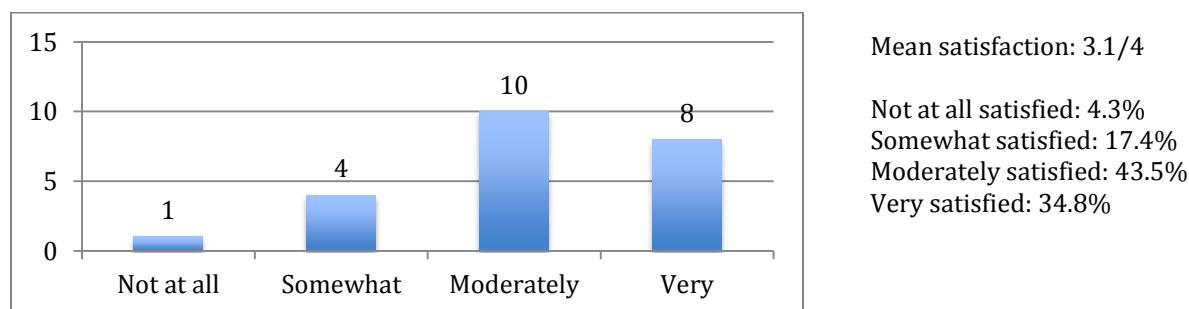
1. How important is your involvement with the HR Strategy Steering Committee or the North Superior Workforce Planning Board to your broader organizational or professional mandate?



2. How much do you feel that you benefit from your involvement with the HR Strategy Steering Committee or the North Superior Workforce Planning Board?



3. How satisfied are you with your contributions to the work of the HR Strategy Steering Committee or the North Superior Workforce Planning Board?



The remaining questions used the same scale of the degree to which NSWPB meets expectations in the following areas:

**Table 2** Degree to which NSWPB meets expectations: means and frequencies (%)

Question	Mean	Does not meet expectations (1)	Somewhat meets expectations (2)	Mostly meets expectations (3)	Meets expectations (4)	Exceeds expectations (5)
Develop partnerships with local stakeholders	4.3	0	0	4 (16%)	10 (40%)	11 (44%)
Mobilize the community to identify and address labour market issues and opportunities, and workforce development needs	4	0	0	7(28%)	10 (40%)	8 (32%)
Engage local stakeholders in improving employment and training service coordination and integrated planning	4	0	1 (4%)	5 (20%)	11 (44%)	8 (32%)
Conduct research to gain better understanding of local labour market and employment policies, programs or initiatives operating in the community	4	0	1 (4%)	4 (16%)	14 (56%)	6 (24%)
Develop recommendations as to how local labour market and employment policies, programs, or initiatives might more effectively work together	3.8	0	2 (8%)	5 (20%)	14 (56%)	4 (16%)
Lead workforce development planning	4	0	3 (12%)	4 (16%)	8 (32%)	10 (40%)
Research and forecast human resource needs in high growth and dominant industries	3.7	1 (4%)	1 (4%)	6 (24%)	13 (52%)	4 (16)
Contribute to local economic planning and community development	3.8	0	1 (4%)	7 (28%)	11 (44%)	6 (24%)
Improving local labour market conditions	3.4	1 (4%)	5 (20%)	5 (20%)	12 (47%)	2 (8%)
Collaborate with stakeholders to design and develop projects that research and test innovative approaches	4.2	0	2 (8%)	2 (8%)	11 (44%)	10 (40%)

Respondents were also given the opportunity to provide any additional comments on the survey. Seven responses were received and these are shown in Appendix #4.

#### 4. Relationships between Network Statistics and Responses to Non-network Questions

As each of the statistics in Table 1 is run in Gephi, it is recorded in a table format in the Data Laboratory area under the Nodes tab. This information can then be exported from Gephi as a .csv file for further analysis. Therefore, to further explore the data we entered each person's network statistics (e.g., betweenness and average degree values) into SPSS alongside his or her responses to the above non-network questions (importance of involvement, benefit, satisfaction, meets expectations). Using SPSS, we then examined possible correlations between these network statistics and non-network responses. The following correlations were found to be significant (which means there is less than 5% or 1% chance that the identified relationship is a random finding).

- Average weighted degree was found to be significantly positively correlated with Q12: Is NSWPB improving local labour market conditions?
  - $r = .41, p < .05$
  - *Those who have more connections within the network report that NSWPB is more strongly meeting their expectations in improving local labour market conditions*
- Betweenness was found to be significantly positively correlated with Q2: How much do you feel you benefit from your involvement with the HR Strategy Steering Committee or NSWPB?
  - $r = .46, p < .05$
  - *Those who are more connected in the network feel they benefit more from their involvement.*
- Betweenness was found to be significantly positively correlated with Q3: How satisfied are you with your contributions to the work of the HR Strategy Steering Committee or NSWPB?
  - $r = .52, p < .01$
  - *Those who are more connected in the network are more satisfied with their contributions to the work of the NSWPB.*
- Betweenness was found to be significantly positively correlated with Q11: How effectively does NSWPB contribute to local economic planning and community development?
  - $r = .55, p < .01$
  - *Those who are more connected in the network report that the NSWPB is more strongly meeting their expectations in contributing to local economic planning and community development.*

Note that the sample size, of 25, is relatively small for considering correlational findings. We can be more confident in the significance and stability of such findings with a larger sample size. In general however, being more connected in the network is associated with reporting greater benefit from involvement with NSWPB, greater satisfaction with one's own contributions to the work of NSWPB, and feeling that NSWPB is meeting one's expectations in the area of local economic planning and community development.

## Discussion

Applying complex adaptive systems theory to understanding the workforce has not, to our knowledge, been done before in published research. This intersection has proven fruitful, in (a) revealing the potential inherent in a knowledge network approach to better capturing and mobilizing existing workforce information, and (b) revealing a potential tool with which to visualize the workforce as a complex adaptive system. The results reported herein describe the findings of Phase 1, an initial exploratory pilot study, of this second (b) part of the overall project.

The purpose of this pilot study was to explore the use of social network analysis as a tool for visualizing the workforce as a complex adaptive system. At first we attempted to combine this analysis with a survey on satisfaction with a workforce transition in the community. We hope to be able to pick up this study again once this transition is more fully completed, the situation is more stable, and we are able to work with our sector contacts again to revisit the study. Nevertheless, the time spent developing that study was worthwhile as our team learned about the process of setting up social network surveys with large samples using specialized online survey tools (Network Genie), and worked through emerging issues unique to this research relating to the naming of nodes in the network. Significant capacity was built as a result of this effort.

We then identified the HR Strategy Steering Committee and NSWPB Board and Staff as a network with which to explore social network analysis as a tool. Being a smaller network with no concerns about anonymity we were able to use a more standard online survey tool (SurveyMonkey) to collect network data and ask a small number of non-network questions. This effort resulted in 25 of 31 respondents. With this data we were able to generate social network maps as depicted in the results above, and interact with these maps in the company of the HR Strategy Steering Committee (January 25) and NSWPB Executive Director (January 13) to explore possible insights and interpretations. We find that the maps are most meaningful when interacted with dynamically. Still images of the maps, as shown in this report, do not fully capture the potential of this tool to conceptualize the meaning of the various patterns of connection. Along with revealing insights about the nature, shape, density, and patterns of the networks, we also built considerable further capacity through this study in how to prepare and analyze social network data using Gephi.

The non-network questions included in the survey provided an important baseline in terms of these respondents' perceptions of the NSWPB and their own contributions to its work as of January, 2016. On a whole, participants report that the NSWPB is moderately to very important to their work, and they report experiencing a moderate to major benefit from their involvement. They also report a moderate level of satisfaction with their own contributions to the current work of the NSWPB. Participants reported that the NSWPB mostly meets their expectations in each of the identified areas of work. Variations in participants' responses to these items will be most informative when compared over time.

The project team also built considerable capacity in understanding and generating the network statistics described in Table 1. These findings reveal important information about the properties of the network that is the NSWPB and the HR Strategy Steering Committee.

From this pilot sample we have learned many things and built considerable capacity. The next question is **to what extent can this tool be used to understand the workforce as a complex adaptive system**. If social network mapping were done with individual members of the workforce, perhaps everyone in a given occupation in a certain region (e.g., all professional geologists in Northern Ontario), one would be able to map and discern the patterns of connection among these individuals. Given that the individuals in the network can be grouped and colour coded on the basis of meaningful characteristics (e.g., being on the board, HR Strategy or staff in the current study), one could observe the degree to which people in groups based on employment status, workplace, or gender cluster in their social networks. Who knows whom? Who exchanges information with whom? Who is being left out of these networks and who are the most connected? As we intend to do with the current sample, one could also collect the social network information again periodically over time (e.g., every 6 months) and then observe changes in these maps and patterns over time, revealing the “churn” or dynamic movement that occurs within the workforce as people change positions. The network statistics could be also calculated to reveal, for example, changes in overall connectedness over time, or differences between certain sub-networks or groups (e.g., different occupations, genders, employment status) in their connectedness.

One valuable insight from this project is that the question you ask people on the social network survey is critical to the meaning of the resulting maps. In the case of this pilot study we asked two questions: frequency of interaction with each person on matters relating to the workforce and on matters relating to community engagement. If conducting a social network analysis on the workforce, one would want to choose this question or these questions carefully. Perhaps it is the degree to which you work with each person (currently or in the past), or know each person, or the degree to which you exchange professional information with each person. The larger the social network being analyzed, the longer it takes respondents to fill out the social network survey, as they must answer the question for each other person. Given that it is thus quite labour intensive, one would want to ask only one or two questions per relationship. So again, it is important to choose the question(s) very carefully.

In sum, social network analysis could prove highly valuable in understanding the workforce as a complex adaptive system. One key limitation to this is how cumbersome it is for respondents to complete the initial survey, and there may be concerns regarding anonymity if a list of names is provided. The larger the network being analyzed, the more names one must answer each question for. Alternatively, one could ask respondents to list the names of the people they know or work with, and ask them to respond for each of these

names. This is the approach we were taking with the initial sample of transitioning workers. The advantage is anonymity and a user-generated list may be more efficient for respondents. The disadvantage is that the resulting network may not be complete or accurate, and researchers would have to manually construct or check the links among people based on names that may be spelled differently by different respondents. Social network survey tools, such as Network Genie, can in part handle some of these issues. Furthermore, with a larger network, the individual names associated with each node become less important compared to the overall patterns revealed in the network.

With the current small sample of 31 possible relationships, this pilot study has only scratched the surface of what is possible with social network analysis. Further research will be needed to explore what becomes possible when larger segments of the actual workforce are mapped.

## **Deliverables**

The primary deliverables of this pilot study are as follows:

- The capacity to set up social network surveys in several ways, with awareness of different options and associated advantages and disadvantages
- Awareness of unique challenges of social network surveys and possible solutions
- The capacity to use Gephi as a social network analysis tool to generate maps and network statistics
- Insights relating to the network properties of the NSWPB, staff, and HR Strategy Steering Committee, including the relative connectedness of various individual members and stakeholders
- Insights relating to the non-network questions in the survey
- Awareness that network connectedness is related to respondents' satisfaction with their contributions to the work of the NSWPB and the degree to which they feel they benefit.
- Baseline information to which we can compare the evolving social networks of the NSWPB / LEPC members in relation to their satisfaction with the work of the network
- Insights into how social network analysis may be usable in examining larger segments of the actual workforce.

## Into the Future

This pilot study was a process of exploring social network analysis as a tool and building capacity in its execution. There appears to be some considerable potential in the use of social network analysis to understand and analyze the dynamics of the workforce. Further research is recommended and the following are possible next steps.

- To conduct a set of follow-up analyses with the same group of people, plus the members of the emerging LEPC steering committee and working groups. If the same social network and non-network questions are asked of this expanding group, perhaps every 3 months, we will be able to observe changes in network patterning over time and determine if changes in the performance of the group is associated with changes in the underlying social networks. This will also give us experience with both larger networks and network maps analyzed over time.
- Continue to monitor the possibility of conducting social network analysis with the transitioning community group. As this situation stabilizes, the potential benefit of analyzing changing workplace culture and the absorption of the transitioning group of staff into the new organization may become more sellable. There are also some potential new contacts within the research team that may be leveraged.
- Look for opportunities to conduct social network analysis within a given organization. One use for this tool is to map how information flows around an organization. Another possibility is to reveal patterns of connectedness within and across departments or functions within an organization.
- Look for opportunities to conduct social network analysis within a segment of the workforce, perhaps everyone with a certain professional designation within a defined geographic region. Consider respondents' access to and comfort with computer-based survey tools and whether and how respondents could be provided with the names of others within the network.
- Given that the completion of the survey itself is one of the barriers to scaling up the size of an analyzed social network (time required and tedium of responding to one or two questions relating to all the people in one's known network), it would be valuable to develop a user-friendly interface for the survey. The HR Strategy Steering Committee has discussed various possibilities, including an interactive app through which respondents could maintain a profile and set of connections, and be able to observe and interact with their map. The development or identification of such an interface is critical to expanding social network analysis to larger samples of the workforce.

## Appendices

### Appendix #1 - Complexity Theory: A Brief Primer

#### ***Complexity Theory***

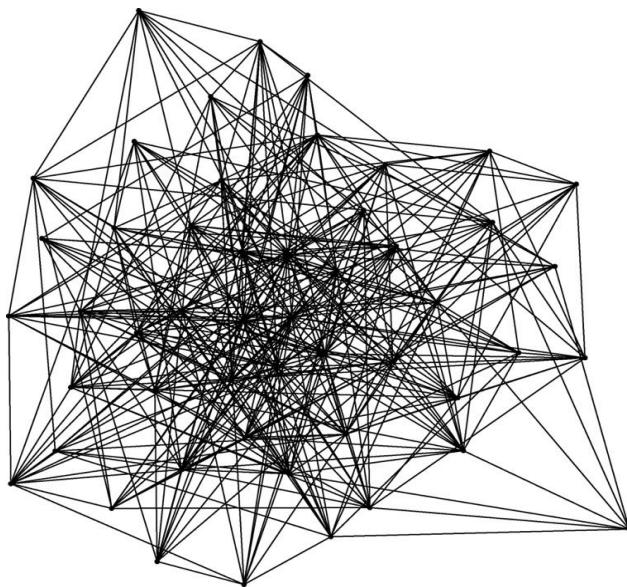
Complexity theory, or complexity science as some are beginning to refer it (Mitchell, 2009; Johnson, 2007), is the *study of phenomena which emerge from a collection of interacting objects*. It is an emerging area of theory and research that spans disciplines such as mathematics, physics, biology, cognitive science, and economics. Because there are such diverse perspectives involved, the phenomena being studied are variously called complex systems, dynamical systems, non-linear systems, and complex adaptive systems, each with slightly different connotations.

#### ***Interdependent connections and emergence:***

Collectively, these are systems that become what they are through the interactions of many independent components. The components in a system, which could be individual people in an organization or computers in a network or neurons in a brain, are independent in that they are free to act as they like but also interdependent in a network, such that the actions of each one affects the experience of all the other components in the network; and they in turn affect the experience of the original component. Figure 1 displays an interconnected system or network.

This interdependency leads to *emergence*, which is that the behaviour of the whole system has its own reality that is not predictable from the behaviour of the individual components themselves. In other words, through continual interactions among the components, the system as a whole develops characteristics one could not have anticipated from looking only at the behaviour of the components. These characteristics emerge through interactions. For example, as individuals in a workplace interact with one another, exchanging information, resources, and values, both formally and informally, they create the culture and operations of the organization as a whole, an entity that is something greater than any of the individuals themselves.

**Figure 1** Interconnectedness in a complex system



***Complex Adaptive Systems Theory:***

The theory within complexity science that has most relevance to this project is *complex adaptive systems theory*, as it is associated with the study of living systems such as ecologies, economies, and other human systems (Holland, 1992). In complex adaptive systems, the individual components in the system display the capacity to adapt and learn. They constantly vary the “rules” of interaction that they have with other components in the system so as to seek the best possible outcomes. Of course because all the other components in the system are also constantly adapting and varying their rules of interaction, the emergent whole is constantly shifting, it is dynamic. One consequence of this is that the emergent behaviour of the whole system is usually far from optimal. Indeed, there is no “optimal” end state because complex adaptive systems are always exhibiting new collective behaviour as they evolve (Holland, 1992).

## Appendix #2 - Project Descriptions January, 2015

### Box 1: Projects of the Regional HR Strategy

#### **1. *Building a Labour Supply Knowledge Network:***

Through a process of building trust and collaboration, the North Superior Workforce Planning Board (NSWPB) will nurture the formation of a living knowledge network of people and organizations who are stakeholders in labour supply. Processes will be developed through which to query this network, and to manage, consolidate, and regularly share knowledge with the network. Thus, the project will enhance the exchange and use of the full diversity of labour supply information that is already available.

#### **2. *Mapping the Labour Supply as a Social Network:***

Through a professionally developed website and mobile application, we will be able to gather information from a pilot sample of approximately 200 people that will be analyzed using network analysis and mapping. This will provide a new category of labour supply data. Being able to visualize the workforce as a dynamic and patterned whole that is formed through the connections among people is a marked alternative to the static, broad, group-level statistics that are currently available. This is also a research project out of Lakehead University for which federal funds are being sought.

#### **3. *Developmental Evaluation:***

Developmental evaluation is an approach to program evaluation that involves documenting decisions and formalizing the learning and the knowledge bases that drive decisions. It provides real-time data and feedback that enhances the development, testing, refinement and quality of potential solutions.

## Appendix #3 - Gephi Tutorial

### Data Preparation

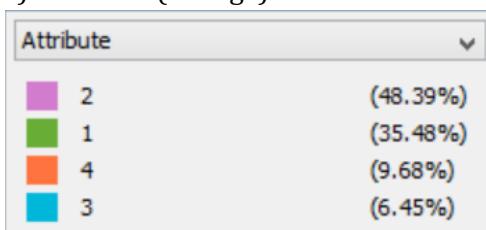
1. Data was downloaded from the survey platform (SurveyMonkey) into an Excel file.
2. Responses for the two questions on level of communication were recoded with Never = 0, Rarely = 1, Sometimes = 2, Often = 3, Very Often = 4.
3. In preparation for Gephi upload, participants were assigned an ID number with their group affiliation (**node file**), and had their responses arranged by who was rating the other person (*source*), to person being rated (*target*), and the rating itself (*weight*; creating the **edge file**).
4. Where two respondents rated the other on how frequently they communicated (e.g., Person A rated their level of communication with Person B based on question 1 and 2 **below**, and Person B did the same for Person A), an average was calculated. For pairs where respondents both indicated they never talked on these matters (0), the pairing was deleted.
5. Averages ending in .5 were rounded up.

**Question 1:** How frequently do you interact with this person on matters relating to the workforce, employment, or the labour market?

**Question 2:** How frequently do you interact with this person on matters relating to community development, mobilization, outreach, or engagement?

### Gephi Upload

1. Edge files for the two questions were created into two separate social network maps.
2. Individuals (*nodes*) were assigned a colour based on their group affiliation:
  - a) Board – 1 (Green)
  - b) HR Strategy Steering Committee – 2 (Purple)
  - c) Both (Board and HR) – 3 (Cyan/Light Blue)
  - d) Staff – 4 (Orange)



**DO:** Appearance → Nodes → Attribute → [Drop Down Menu] Attribute → Apply

3. The lines between nodes (*edges*) were assigned a colour based on their level of communication (*weight*):
  - a) Rarely – 1 (Purple)
  - b) Sometimes – 2 (Green)
  - c) Often – 3 (Orange)
  - d) Very Often – 4 (Cyan/Light Blue)

Labels were applied to the nodes to identify them, and edges to see the numerical number of the weights.



**DO:** Edges → Attribute → [Drop Down Menu] Weight (select one with distinct colours) → Apply

**DO:** [Bring up Bottom Bar by clicking tab on right] → [Tab] Edges → [Deselect] Use node color → [Tab] Labels → [Select box] Node → [Select box] Edge → [On left] Configure → [Tab] Edge → [Select] Weight (deselect label) → OK

4. Nodes were sized according to their ***betweenness centrality***. The larger the node is, the more important they are as a network connector; without that node, certain parts of the network would not communicate and the network more fragmented.  
**DO:** [Select] Statistics → (Under Edge Overview) Average Path Length → Run  
**DO:** [Select] Appearance → Nodes → [Tab] Attribute → Size (image with three rings beside painting pallet) → [Drop Down Menu] Betweenness Centrality (set to 10 and 50, respectively) → Apply
5. The social network map is then presented in a more digestible and neater format using the Fruchterman Reingold layout.  
**DO:** Layout → [Drop Down Menu] Fruchterman Reingold → Run

### Filtering

1. Open filter tab.
2. Partition folder, then drag Partition (Attribute) to the bottom workspace (Queries).
3. Clicking one of the groups and Applying will filter so you only see those within that group.
4. To filter by the level of communication, open Equal folder, and drag the Weight item down to be a sub filter.  
To do this, click on the Partition (Attribute) you have in the workspace to open it, then where the image of a target is, drag it there.
5. Click back and forth to filter by group as well as level of communication.

### Statistics

1. Statistics can be viewed by opening the Data Table and examining Node information.
2. Click the light bulb at the upper right of the screen to configure the columns you see.

#### **Appendix #4 - Open-ended additional comments on the survey**

1. I think the board and team of NSWPB do an exceptional job considering the size of the management and front line team.
2. Would like to note that from my perspective, even the number of positive responses (meets and/or exceeds expectations), still provide an opportunity for improvement or expansion in board initiatives.
3. I am not that aware of how NSWPB is performing in relation to expectations. These are my best guesses.
4. We need to get more aggressive in our approach and execution. Numbers update more frequently also with personal visits! We are good in starting new projects
5. well positioned for upcoming challenges of both market and funders
6. These are not easy questions to answer as individual expectations vary, as does ones definition of rarely, sometimes or often. , i.e. meeting with people 5 - 6 times a year will be considered "sometimes" to one person and "often" to another.
7. Well organized organization.

## **Appendix #5 – Survey**

### **Excerpts for the Survey**

#### *Introduction Letter*

Thank you for your interest and participation!

This survey is presented by Dr. Mirella Stroink and the North Superior Workforce Planning Board. It is part of a project in which we are looking at workforce dynamics through the lens of Complex Adaptive Systems (CAS) Theory. Through a CAS lens, social network maps of the workforce can be created by analyzing how individual people interact with one another.

Social network mapping and analysis is a visualization and statistical tool. Traditional methods of studying the workforce rely on broad group-level statistics and do not show us how people move around within the workforce. Network mapping and analysis enables us to observe the patterns of relationship people have as they work with and exchange information with people in various positions around them.

The objective of this survey is to map the frequency of interactions between members of the NSWPB. This survey will help evaluate social networking research tools, with the intention of extending their use towards better understanding of the workforce dynamics in Northwestern Ontario. Secondly, this survey aims to evaluate your experiences with the NSWPB (or HR Strategy Steering Committee), and the efficacy of the NSWPB in a number of initiatives.

#### **Instructions**

The survey should take less than 15 minutes to complete. You will first be asked to identify yourself by typing in your name. Then, you will be asked two questions for each other person within the NSWPB. For each person, you will be asked to reflect on how frequently you, a) interact with them on matters relating to the workforce, employment, or labour market, and b) interact with them on matters relating to community development, mobilization, outreach, or engagement using the scale provided. Please leave those questions for your own name blank.

You will then be asked to evaluate your experiences with either the NSWPB or the HR Strategy Steering Committee, and finally, you will be asked to evaluate the efficacy of the NSWPB in a number of initiatives. This survey is not anonymous, though the information will be kept confidential. You may leave blank any questions that you feel uncomfortable answering. Please complete this survey by Monday January 18, 2016. If you have any questions about the survey or results, please contact Dr. Mirella Stroink using the information below. Your participation is greatly appreciated!

Dr. Mirella Stroink  
Lead Researcher for the Thunder Bay Regional Human Resource Strategy, North Superior Workforce Planning Board  
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## **Survey Distribution**

This survey was distributed to the 31 participants including Staff and Directors from the North Superior Workforce Planning Board and the members of the HR Strategy Steering Committee.

## **Survey Questions**

Each participant was asked to look at the individual name of all participants (31 names listed) and answer the following 2 questions selecting the appropriate response from the scale:

**How frequently do you interact with this person on matters relating to the workforce, employment or the labour market?**

Never	Rarely	Sometimes	Often	Very Often
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**How frequently do you interact with this person on matters relation to community development, mobilization, outreach, or engagement?**

Never	Rarely	Sometimes	Often	Very Often
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Additional survey questions included:

**Are you on the NSWPB Board or the HR Strategy Steering Committee?**

**How important is your involvement with the HR Strategy Steering Committee and/or the North Superior Workforce Planning Board?**

Not Important	Somewhat Important	Important	Moderately Important	Very Important
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**How much do you feel that you benefit from your involvement with the HR Strategy Steering Committee and/or the North Superior Workforce Planning Board?**

Not Important	Somewhat Important	Important	Moderately Important	Very Important
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**How satisfied are you with your contributions to the work of the HR Strategy Steering Committee and/or the North Superior Workforce Planning Board?**

Not Important	Somewhat Important	Important	Moderately Important	Very Important
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Instructions: Using the scale below, please evaluate the efficacy of the NSWPB.

**Please think about the work the North Superior Workforce Planning Board is currently conducting and those projects they have worked on in the last 12 months.**

Does not meet expectations	Somewhat meets expectations	Mostly meets expectations	Meets Expectations	Exceeds expectations
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**How effectively does the NSWPB develop partnerships with local stakeholders?**

Does not meet expectations	Somewhat meets expectations	Mostly meets expectations	Meets Expectations	Exceeds expectations
----------------------------	-----------------------------	---------------------------	--------------------	----------------------

**How effectively does the NSWPB mobilize the community to identify and address labour market issues and opportunities, and workforce development needs?**

Does not meet expectations	Somewhat meets expectations	Mostly meets expectations	Meets Expectations	Exceeds expectations
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**How effectively does the NSWPB engage local stakeholders in improving employment and training service coordination and integrated planning?**

Does not meet expectations	Somewhat meets expectations	Mostly meets expectations	Meets Expectations	Exceeds expectations
----------------------------	-----------------------------	---------------------------	--------------------	----------------------

**How effectively does the NSWPB conduct research to gain better understanding of local labour market and employment policies, programs or initiatives operating in the community?**

Does not meet expectations	Somewhat meets expectations	Mostly meets expectations	Meets Expectations	Exceeds expectations
----------------------------	-----------------------------	---------------------------	--------------------	----------------------

**How effectively does the NSWPB develop recommendations as to how local labour market and employment policies, programs, or initiatives might more effectively work together?**

Does not meet expectations	Somewhat meets expectations	Mostly meets expectations	Meets Expectations	Exceeds expectations
----------------------------	-----------------------------	---------------------------	--------------------	----------------------

**How effectively does the NSWPB lead workforce development planning?**

Does not meet expectations	Somewhat meets expectations	Mostly meets expectations	Meets Expectations	Exceeds expectations
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**How effectively does the NSWPB research and forecast human resource needs in high growth and dominant industries?**

Does not meet expectations	Somewhat meets expectations	Mostly meets expectations	Meets Expectations	Exceeds expectations
----------------------------	-----------------------------	---------------------------	--------------------	----------------------

**How effectively does NSWPB contribute to local economic planning and community development?**

Does not meet expectations	Somewhat meets expectations	Mostly meets expectations	Meets Expectations	Exceeds expectations
----------------------------	-----------------------------	---------------------------	--------------------	----------------------

**Is NSWPB improving local labour market conditions?**

Does not meet expectations	Somewhat meets expectations	Mostly meets expectations	Meets Expectations	Exceeds expectations
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**How effectively does NSWPB collaborate with stakeholders to design and develop projects that research and test innovative approaches?**

Does not meet expectations	Somewhat meets expectations	Mostly meets expectations	Meets Expectations	Exceeds expectations
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**Please share any additional thoughts or comments you may have at this time.**

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Thank you for participating!

Your responses will help us understand the workforce as a complex adaptive system by examining the frequency of which people interact with each other and the topic of interaction. Social network mapping will allow us to observe relationship patterns between people within the NSWPB and HR Strategy Steering Committee.

This survey will help evaluate social networking research tools, with the intention of extending their use towards better understanding of the workforce dynamics in Northwestern Ontario, as well as the general efficacy of the NSWPB.

If you have any questions or are interested in a summary of the results, please contact Dr. Mirella Stroink with the information given below.

Dr. Mirella Stroink

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# North Superior

Workforce Planning Board

***“Connecting community partners to improve the quality of life in our communities through workforce development.”***