



The use of organisational network analysis as a diagnostic tool during team coaching



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Orientation: Organisational network analysis (ONA) examines relationships between people and is a potential diagnostic tool to use during team coaching interventions.

Research purpose: The objective of this research was to investigate how ONA can be used during a team coaching intervention aimed at addressing business challenges.

Motivation for the study: The use of ONA as a diagnostic tool in individual coaching has been researched, but has not been applied in the emerging field of team coaching.

Research approach/design and method: An action research methodology employing both quantitative and qualitative methods was used in this research. A purposive sampling approach was used to select a leadership team of four people who received 11 team coaching sessions. Quantitative data were collected from the leadership team and their 18 direct reports, using pre- and post-test intervention ONA questionnaires. Qualitative data were collected after the coaching intervention using semi-structured interviews with the leadership team.

Main findings: Organisational network analysis helped to identify team coaching goals based on business challenges. It indicated the extent to which team coaching enhanced communication between the leadership team and their reports, enabling them to address business challenges. Organisational network analysis results taken out of context could, however, be misinterpreted.

Practical/managerial implications: Team coaches, ONA practitioners and leadership teams could use ONA as a diagnostic tool during team coaching interventions to identify team coaching goals based on business challenges, to gain insights into team dynamics and to assess the contribution of team coaching for addressing business challenges. Organisational network analysis should not be taken at face value and should ideally be triangulated with other data sources such as interviews.

Contribution/value-add: On a scholarly level, this research provides empirical evidence for the benefits of using ONA during a team coaching intervention. On a practice level, suggestions are provided for the manner in which ONA can guide team coaching interventions.

Introduction

Leaders today face many challenges: complex, uncertain and volatile environments. The usual way of doing business has changed because connections between people are becoming more important than formal organisational structures (Horney, Pasmore, & O'Shea, 2010). Leadership theory acknowledges that leaders do not lead in a social vacuum, but are embedded in systems of social networks (Mehra, Dixon, Brass, & Robertson, 2006a) and that there are significant challenges in getting diverse people to collaborate effectively (Cross, Borgatti, & Parker, 2002). New perspectives on the nature of leadership indicate that it is an inherently relational, social and collaborative process, pointing to the importance of team-based leadership (Day, 2001; George, 2010; Hoppe & Reinelt, 2010).

Despite the need for team-based leadership, the focus in the last few years has been on individual leader development, at the expense of developing collective leadership entities such as teams (Hawkins, 2014). Senge (2006) argues that team learning is vital, because when teams learn, besides producing extraordinary results, individual members grow more than they would as individuals. In addition, organisational learning takes place when teams learn. Working effectively as a team has challenges, however, and teams often struggle with silo mentality (individuals functioning autonomously), which negatively affects intra- and inter-group relations (Cilliers & Greyvenstein, 2012).

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There are several important reasons for implementing team-based working, including that teams are the best way to enact organisational strategy, enable organisations to speedily develop products and services cost effectively, enable organisations to learn (and retain learning) more effectively and promote creativity and innovation through the cross-fertilisation of ideas (Cohen & Bailey, 1996). For teams to be effective, however, certain skills are required including the social skills of active listening, communication, social perceptiveness, self-monitoring, altruism and warmth and cooperation (Woods & West, 2010). Selecting team members for these skills, or coaching them to develop these skills, could lead to a higher likelihood of team effectiveness (Hawkins, 2014, p. 36; Katzenbach & Smith, 1993, p. 45).

Coaching, in general, has emerged as an important tool for organisational learning and development (Motsoaledi & Cilliers, 2012; O'Connor & Cavanagh, 2017). The focus of coaching research has traditionally been on individual outcomes. Individual coaching has been shown to improve intrapersonal awareness and functioning, reduce workplace stress, enhance individual performance and enable dialogue and communication (Cilliers, 2011; Kauffman & Couto, 2009; Kombarakaran, Yang, Baker, & Fernandes, 2008). Very little research, however, has been conducted on the impact of team coaching on communication flow, relationships and the general wellness of others in the organisational system, and how these aspects help solve business issues (O'Connor & Cavanagh, 2013).

In response to the increasing importance of informal networks of people, a set of theories, tools and processes called organisational network analysis (ONA) has been developed to analyse and measure networks of people (Hoppe & Reinelt, 2010). Organisational network analysis has been used to measure the effect of individual coaching (O'Connor & Cavanagh, 2013; Terblanche, 2014), but no published research could be found on its application during team coaching interventions. It, therefore, appears that there is a gap in knowledge regarding the use of an analytical tool such as ONA in the context of the emerging field of team coaching. The aim of this article is to report on a study to answer the research question: *How can organisational network analysis be used as a diagnostic tool during a team coaching intervention to address business challenges?* We argue that the use of ONA can guide team coaching interventions by providing information regarding relationships between the leadership team members and their reports. This diagnostic information could lead to a more focussed coaching intervention where the correct goals are addressed and the efficacy of the team coaching intervention could be assessed.

The research question is contextualised within the underpinning theoretical fields of ONA and team coaching.

Organisational network analysis

Organisational network analysis, also referred to as social network analysis, is a methodology for collecting information

about connections among entities (usually people). This information is mathematically analysed and visualised to uncover relationship patterns and derive insights within the organisational context (Anklam, 2012; Hoppe & Reinelt, 2010, p. 600; Shaheen, 2013). In ONA, a network consists of individuals (represented by nodes) that are linked to each other through a specified set of ties. These ties indicate a form of relationship, such as an information-sharing or friendship circles (Borgatti & Halgin, 2011). The links between nodes are represented by directional arrows and is an indication of the degree of direct influence of a node in a network. Organisational network analysis distinguishes between 'in-degree' and 'out-degree' measures (Hanneman & Riddle, 2005). 'In-degree' refers to the number of people who rated an individual in a network (group perspective) and 'out-degree' refers to the number of people whom the individual rated in the network (individual perspective) (Terblanche, 2014). The terms 'group perspective' and 'individual perspective' are used in this article for the purposes of describing 'in-degree' and 'out-degree', respectively.

A hypothetical example of a simple ONA graph showing who asks whom for advice is presented in Figure 1.

Each node (indicated in the graph as a block) represents an individual and the ties are the lines between the nodes representing the advice relationship aspect. The direction of the arrow points to the individual to whom the other individuals go for advice. The node size indicates the number of ties the individual has with the other individuals in the network. The more ties the individual has, the larger the node size. The largest node is for Steve and the outward direction of the ties indicates that Steve goes to Roger, Mark, Doug and Andy for advice (individual perspective). From a group perspective, however, only Roger, Mark and Doug go to Steve for advice.

There have been several ONA studies since 2005 on aspects such as group performance and leader reputation (Mehra et al., 2006a), leadership distribution in teams (Mehra, Smith, Dixon & Robertson, 2006b), transformational leadership group interaction and climate (Zohar & Tenne-Gazit, 2008), shared leadership in work teams (Meindl, Mayo, & Pastor, 2002) and the advice and influence networks of transformational leaders (Bono & Anderson, 2005). In terms

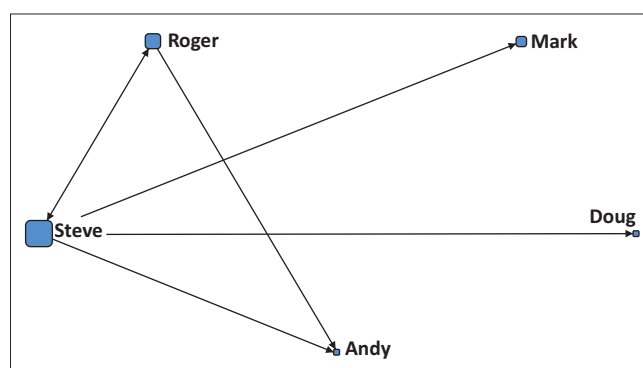


FIGURE 1: Hypothetical example of an organisational network analysis graph showing advise-seeking relationships.

of coaching, two studies using ONA were found (O'Connor & Cavanagh, 2013; Terblanche, 2014). Both these studies use ONA in the individual coaching context only, thus leaving unanswered the question about how to apply ONA in a team coaching context.

Team coaching

Coaching is a relatively new field of research, and team coaching in the workplace is an even newer subset of coaching (Carr & Peters, 2012). Team coaching has recently become more prominent as a result of the findings of organisational development researchers who observed that organisational change occurs primarily within system interactions (Hackman & Wageman, 2005).

Team coaching is defined as 'direct interaction with a team intended to help members make coordinated and task-appropriate use of their collective resources in accomplishing the team's work' (Hackman & Wageman, 2005, p. 269). Although most definitions of coaching are based on one-on-one interactions between coach and coachee, De Vries (2005, p. 75) stressed the importance of team coaching 'as the preferred tool for behavioural change'. He argues that team coaching has the highest pay-off, namely high-performance organisations, results-orientated and accountable people, boundary-less organisations and true knowledge management.

Team coaching has a number of benefits: self-regulation of acceptable group behaviours, development of trust and support within the group, improved listening and communication, greater commitment and accountability, improved systemic awareness of the organisation, prevention of organisational silo formation, knowledge transfer and management and improved organisational results (Anderson, Anderson, & Mayo, 2008; De Vries, 2005; Ward, 2008). There is, however, still a lack of evidence addressing the sequence of team coaching intervention, team process and team performance (Hackman & Wageman, 2005, p. 271). Organisational network analysis offers the ability to analyse and graphically represent relationship patterns between team members. This diagnostic information could assist in identifying relationship problems within a team and could also be used to measure the change in relationships, both important aspects of a team coaching process (Anklam, 2012; Hackman & Wageman, 2005).

From the literature, it appears that team coaching holds potential to improve team dynamics and the resultant business performance. The use of ONA to guide a team coaching intervention is an unexplored field of research, which is addressed in this article.

Research design

Research approach

An iterative action research approach was employed with the aim of taking action (team coaching) to solve a problem

(addressing business challenges) and contribute to science (researching ONA's use in team coaching) (Coughlan & Coghlan, 2002; Gummesson, 2000). Action research is appropriate when the research question relates to describing an unfolding series of actions over time and understanding the process of change or improvement in order to learn from it, as is the case with this study (Coughlan & Brannick, 2001). Action research has been used successfully in a number of coaching-related research projects (Cox, 2013; McLaughlin, 2013; Terblanche, 2014).

In line with the research methods associated with action research, both qualitative and quantitative data were used (Greenwood & Levin, 2007; James, Slater, & Bucknam, 2011). Quantitative data consisted of pre- and post-test coaching intervention ONA data sets, while qualitative data consisted of one-on-one interviews with the leadership team members after the team coaching intervention.

Research strategy

Guided by the need to empirically investigate the phenomenon of using ONA as a diagnostic tool in team coaching, the research followed a case study strategy that was conducted in a single organisation (Babbie & Mouton, 2014). This allowed for insights into a particular case to serve the interest of both the researcher and the organisation (Denzin & Lincoln, 2005).

A six-step iterative action research process was followed as shown in Table 1 (Coughlan & Coghlan, 2002, p. 230; Terblanche, 2014, p. 149).

Research method

Research setting

The researcher conducted the team coaching with a leadership team of four managers at one single company. The team identified for coaching was self-managed and had the specific goal of implementing and monitoring a continuous improvement (CI) programme, which focuses on improving productivity and efficiencies in the company. The CI programme was considered by the chief executive officer (CEO) of the organisation to be of critical importance for business success. The CEO was concerned that the programme was not delivering as expected and requested that the team coaching specifically should focus on this critical business issue.

TABLE 1: Action research steps and application.

Action research step	Application to coaching
1. Gathering data	Extract the ONA data from the questionnaire.
2. Feedback	Understanding the meaning of the ONA data for the team.
3. Analysing data	Understanding the meaning for the team of the ONA data.
4. Action planning	Assist the team with new strategies, based on insights from the ONA data.
5. Action taking	Allow the team to execute their strategies between coaching sessions.
6. Evaluation	Reflect on the outcomes of the strategies at the next coaching session.

ONA, organisational network analysis.

The CID-CLEAR team coaching model was used (Hawkins, 2014) to conduct 11 team coaching sessions of 2 h each. Organisational network analysis data were used throughout the coaching intervention in various ways as reported in this article.

Sampling

The research included two sets of participants. An existing leadership team of four managers, who were responsible for implementing the business-critical CI programme, was selected for the team coaching exercise. In addition, the four team members had to identify employees who report directly to them to participate in the pre- and post-test coaching ONA questionnaires. The team members identified 18 such employees. In total, therefore, 22 employees participated in the pre- and post-coaching ONA questionnaire feedback.

Entrée and establishing researcher

The researcher was both a researcher and coach. As a coach, she conducted team coaching with a team of four managers. As a researcher, she facilitated the ONA questionnaire and analysis process. She also conducted one-on-one interviews with the four team members after the coaching and, kept field notes. The researcher obtained permission from the CEO of a company to conduct the research. The research was explained to the four team members after which written permission was obtained from the team to conduct team coaching. A meeting was held with the 18 direct reports to explain and request their participation in the pre- and post-test coaching ONA questionnaires. Each participant agreed and signed a consent form.

The researcher was aware of her role as insider researcher (Corbin Dwyer & Buckle, 2009, p. 58). She took active steps to remain objective through practising reflexivity. This involved keeping a research diary (Lincoln & Guba, 1985) and consulting with an ONA and coaching expert on a regular basis to reflect on the research process. The potential subjectivity that accompanies the insider researcher role was negated to an extent by the objective, quantitative nature of the ONA process.

Data collection methods

Three sets of data were collected. The pre- and post-test ONA questionnaires (Table 2) were completed by the four team members and their 18 direct reports; one-on-one interviews were held with each of the four team members after the team coaching sessions had ended; and field notes were kept by the researcher during the coaching sessions (Holloway & Wheeler, 2010).

TABLE 2: List of organisational network analysis questions.

Number	Question
1.	How often do you give information about the CI programme?
2.	How often do you discuss a challenging problem regarding production?
3.	How often do you discuss a new or innovative idea?

Source: Adapted from Cross, Walsh and Borgatti (2000, p. 38)
CI, continuous improvement.

The ONA questionnaire consisted of three relationship questions focused on specific aspects within the context of the team's responsibility for the implementation of the CI programme in the company. The notion of 'giving information about the CI programme', 'discussing production problems' and 'discussing new or innovative ideas' was highlighted by the CEO as areas of business concern that were not showing significant signs of improvement since the launch of the CI programme.

During the ONA process, each of the 22 participants were asked to rate their relationship with every other participant for each of the three ONA questions using an itemised rating scale with seven levels: (1) never, (2) less than once every 2 months, (3) once every 2 months, (4) once or twice a month, (5) once or twice a week, (6) about once a day, (7) more than once a day. In total, there were 462 possible relationship ties (22 participants × 21 ratings per participant).

The responses from all the ONA questionnaires were collated and formatted to conform to the input requirements of the free ONA software, Netdraw (Borgatti, 2002). This software allowed the researcher to produce ONA graphs illustrating the relationships patterns between the participants.

One-on-one face-to-face semi-structured interviews were recorded using a digital recorder that enabled the researcher to triangulate interview data with ONA findings (Babbie & Mouton, 2012). The interview consisted of questions that explore the team members' experience of the coaching process and their interpretation of the ONA results. The team members were aware of the context of the research, namely to determine the use of ONA in a team coaching context.

Data analysis

The data analysis consisted of two parts: ONA pre- and post-test analysis (quantitative) and the thematic analysis of the one-on-one interviews with the four team members after coaching (qualitative). Degree centrality was used for ONA analysis. This refers to the number of ties a person has with the other participants for a given relation question. With directed data, the analysis distinguished between 'in-degree' centrality (group perspective) and 'out-degree' centrality (individual perspective) (Hanneman & Riddle, 2005). For the purpose of analysis, a 'high-frequency' and 'low-frequency' filter was selected for each question. High-frequency indicates the selection of either 5, 6 or 7 (at least once a week or more) and low-frequency refers to responses selecting 1 (never) for each ONA question, as indicated in Table 3. A number of ONA graphs indicating ties between

TABLE 3: Organisational network analysis measurements per organisational network analysis question used to generate organisational network analysis graphs.

ONA question	ONA measurements
Group perspective and high-frequency filter	5–7: at least once a week or more
Individual perspective and high-frequency filter	5–7: at least once a week or more
Group perspective and low-frequency filter	1: never
Individual perspective and low-frequency filter	1: never

ONA, organisational network analysis.

all the participants were created and used during the team coaching intervention.

The interview questions were analysed using content analysis (Hsieh & Shannon, 2005) to provide triangulated data for assessing how useful ONA was as a diagnostic tool during the team coaching intervention.

Findings

There were two sets of ONA results (one pre- and one post-test) and interview findings. The pre-test results consisted of 12 ONA result sets consisting of low- and high frequency responses for each of the three ONA questions and from both the group and individual perspectives. These results were shared with the leadership team before and during the team coaching intervention. In a similar manner, 12 post-test coaching ONA results were compiled using the same criteria as the pre-coaching results to ensure comparability. A comparison of the pre- and post-coaching results was provided to the team to review and discuss after the team coaching intervention. Interview data were used after the coaching intervention to triangulate the post-test ONA results.

Findings before coaching

The pre-test ONA results were used in the first team coaching session as an input for a reflective exercise to provide the team an opportunity to discuss their current team dynamics in relation to the business challenges articulated by the CEO. From a group perspective, the low frequency responses to the first ONA question referring to the frequency of sharing

information about the CI programme, provided significant insights. Out of a possible 462 relationship ties (22 participants \times 21 ratings per participant), 70% selected the interaction frequency of 'never' giving information about the CI programme (Question 1) as illustrated in the denseness of the relationships ties in Figure 2.

Similarly, the results for Question 3 indicated that 65% of the participants selected 'never' when answering 'How often do you discuss a new or innovative idea' with the other participants (Question 3). Question 2 considered the frequency with which production problems were discussed between participants. The group perspective and low-frequency results were similar to the other two ONA questions, showing that a high number of participants never discussed a production problem with each other. There was, therefore, evidence of lack of communication regarding the business challenges identified by the CEO from the majority of participants.

When presented with the pre-test ONA results, the leadership team members were surprised. They acknowledged that the ONA results could be an indication of the overall lack of understanding of what was meant by the term 'continuous improvement' in the company. The team members' insights from the pre-test ONA data were aligned with the researcher's own journal, indicating that the CEO had expressed concern about the current state of the CI programme. A discussion with the team resulted in the identification of an overarching coaching goal: 'improved communication' both within the team and their direct reports. The leadership team felt that if communication could be improved, the business challenge identified by the CEO would be addressed.

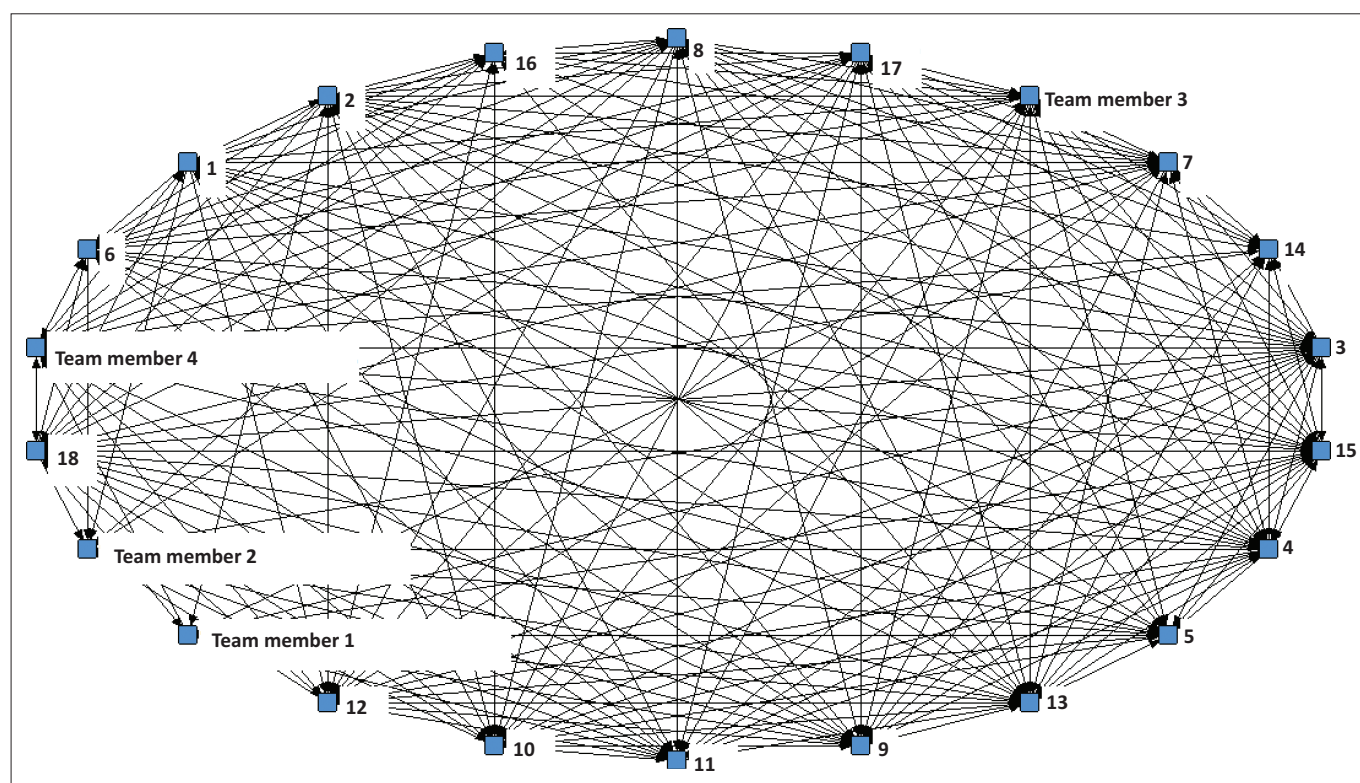


FIGURE 2: Organisational network analysis pre-test graph for frequency of giving information, low frequency response.

Findings after coaching

After the team coaching intervention was completed, 12 more ONA results were generated and compared to the pre-test results. Three classifications were made for each of the ONA questions, reflecting both the group perspective and the individual perspective:

- Positive change (+): The team member had more positive relationships after the coaching than before the coaching with all the participants.
- Negative change (-): The team member had fewer positive relationships after coaching than before coaching with all the participants.
- No change (0): The team member did not increase or decrease the number of ties after coaching.

The cumulative effect on the number of relationship ties per ONA questions is summarised in Table 4.

It is important to note that when there was a decrease in the number of ties indicating 'never' (applicable to all low-frequency filters), this was regarded as a positive result (an improvement) and is, therefore, regarded as '+' in Table 4. The results summarised in Table 4 are discussed next with reference to the 'Result' in the far left column.

In terms of overall change in relationship ties, Table 4, Result 4 (total change), indicates that all team members except for TM2 showed improvement. TM3 showed the most improvement in the number of positive ties (+79), followed by TM4 (+23). TM1's tie count remained relatively stable at +2.

TM2's result, a decrease of 36 relationship ties, seems to deviate from the results of the other three team member's (TMs) and warrants discussion. TM2 indicated in the interview after the coaching that, during the team coaching intervention, structural changes were made at the company. TM2 had to move to a new department with different employees reporting to her. This structural change had a

negative impact on all her ONA results after the coaching and explains the reduced relationship tie counts. TM2 will, therefore, be excluded from the rest of the discussion.

The increase in the number of positive ties in the post-test ONA results for TM1, TM3 and TM4 points to an improvement in their relationship ties to each other and their direct reports. A closer look at the ONA question-specific results (Results 1.1–3.4) provides insight into the change in team dynamics as a result of the team coaching.

Giving more information

Result 1.1 indicates an increase in the number of participants giving information about the CI programme to TM1, TM3 and TM4 after coaching. Result 1.4 indicates that there were fewer participants to whom TM1, TM3 and TM4 never gave information about the CI programme after coaching. These results suggest that there were improvements in engagement between the leadership team and their 18 direct reports through an increase in the bilateral communication. These ONA findings were supported by the interviews where team members referred to improvements in how they engaged with others after receiving team coaching:

'I have made an effort for people to see more of who I am and not just this person who is enforcing rules. I don't want to be the person who is only on the factory floor when something bad is happening.' (TM3, female, production planning manager)

'I am trying to soften how I communicate with people.' (TM1, male, client services manager)

'The listening exercises ... made us aware when someone talks, are you giving them your full attention, are you hearing what they are saying, are you jumping to your own conclusions, assumptions in your head, are you actually understanding what they are saying?' (TM4, female, production manager)

Discussing new or innovative ideas

Result 3.3, the group perspective or low-frequency for Question 3 (discussion of innovative ideas), showed positive changes from before coaching started to after coaching. The results for

TABLE 4: Change in number of overall relationship ties after coaching per team member.

Result number	ONA measurements	Team member 1 (TM1)	Team member 2 (TM2)	Team member 3 (TM3)	Team member 4 (TM4)
1	Question 1: Give information				
1.1	Group perspective and high-frequency	+4	0	+3	+2
1.2	Individual perspective and high-frequency	-6	-1	+19	+5
1.3	Group perspective and low-frequency	+3	-2	0	+1
1.4	Individual perspective and low-frequency	+3	-1	+10	+6
2	Question 2: Discuss challenging production problems				
2.1	Group perspective and high-frequency	-3	0	+1	0
2.2	Individual perspective and high-frequency	-7	-7	+15	-1
2.3	Group perspective and low-frequency	-1	-2	-3	-1
2.4	Individual perspective and low-frequency	+3	-1	+5	-3
3	Question 3: Discuss new or innovative idea				
3.1	Group perspective and high-frequency	-2	0	-1	0
3.2	Individual perspective and high-frequency	0	-5	+9	+1
3.3	Group perspective and low-frequency	+3	0	+4	+9
3.4	Individual perspective and low-frequency	+5	-18	+17	+4
4	Total change between pre- and post-testing occasion	+2	-36	+79	+23

ONA, organisational network analysis.

TM1, TM3 and TM4 indicate more ties from the group perspective regarding sharing new or innovative ideas. This implies that more participants discussed innovative ideas with the leadership team. Result 3.4, individual perspective or low-frequency, also showed improvement. This implies that the team members had more contact with the wider group and discussed new or innovative ideas with more of the participants after receiving coaching. This ONA result was again corroborated by the interview data:

'When you try to give ideas on how you see things from outside their departments ... me as well, I accept a lot more advice from them because previously people tended to have this wall up – Don't tell me what to do in my department'. (TM4, female, production manager)

Now we actually ask:

'What do you think? What would you guys do?' (TM4, female, production manager)

'When we were in coaching we also benefitted from sitting together and learning and hearing other people's experiences.' (TM3, female, production planning manager)

This finding, therefore, supports the notion that team coaching may promote the sharing of new or innovative ideas in an organisation and that ONA analysis could be used to identify this change.

Perception mismatch

Results 1.1, 2.1 and 3.1 (group perspective or high-frequency) indicate low to negative increase in number of ties across all three ONA questions. This implies that the participants reported that they had less high frequency interaction with the leadership team after coaching than before. This could be interpreted as team coaching having a negative effect on relationships. This finding is similar to a study conducted by O'Connor and Cavanagh (2013, p. 15). Their research indicated that although the coaching intervention appeared to improve the quality of communication from the coachee's (individual) perspective, as was the case for this research, there is a difference between the coachee's experiences of their interactions with the other participants, and how those participants (group perspective) experienced these interactions. O'Connor and Cavanagh's explanation is that the coaching process encourages the coachees to find new ways of interacting through a deliberate process of change aimed at assisting them in dealing with difficult and challenging issues. Any changes experienced are more likely to be judged more positively by the coachee, and therefore the individual perspective results are likely to show a higher increase in ties. The participants' (group perspective) responses to the ONA questions, therefore, could be different to those of the coachees because the participants were not part of the coaching intervention (O'Connor & Cavanagh, 2013, p. 17).

The importance of context

Results 2.1, 2.2, 2.3 and 2.4 indicate that with the exception of TM3, all ties whether high- or low-frequency decreased after coaching with regard to the discussion of production

problems. During the review of the post-test ONA results with the team members, a possible explanation was provided: there was less production urgency during the coaching period, which led to fewer production problems. In addition, because of restructuring, there were changes to the reporting hierarchy in the participant group during the coaching process. The consequence was that production problems were discussed with other employees outside the research group of 22 participants. The results and reasons provided by the team members pointed to the importance of soliciting feedback from the participants where anomalies are present in ONA results and not to accept ONA results at face value.

Discussion

The objective of this research was to investigate how ONA can be used as a diagnostic tool during a team coaching intervention aimed at addressing business challenges. The researcher met with the CEO of the organisation who articulated business challenges centred around the ability of the leadership team, consisting of four members to promote the CI programme, discuss problems their teams experience and share innovative ideas. The researcher embarked on a team coaching intervention with the leadership team aimed at addressing the CEO's concerns. The findings revealed that:

- By incorporating business challenges in an ONA questionnaire, the team was able to identify a coaching goal to address the business challenges.
- After the team coaching intervention, the comparison between ONA pre- and post-test results provided an indication of the progress towards addressing the business challenges through fulfilling the coaching goal (improved communication).
- Even though ONA can be useful as a diagnostic tool during team coaching, it is important to triangulate the ONA data with other sources such as interviews to contextualise network results.

These findings can be linked back to previous research. In terms of coaching goal identification, ONA has been shown to be effective in pinpointing areas of breakdown in networks as a result of lack of collaboration in an organisation (Cross et al., 2002, p. 31). Cross et al. (2002) discovered that using network diagrams as prompts can help teams to identify issues hindering their performance. Performance impediments include behavioural and organisational design elements that need improvement in order to promote the team's efficiency and effectiveness. They state:

Rich discussions will often evolve simply by showing network diagrams to the members of a group and asking them to diagnose the patterns they see ... Often this process simultaneously creates common awareness of problems, helps define solutions, and gains agreement on actions, all critical steps to effecting organisational change. (Cross et al., 2002, p. 39)

This was certainly the case in this research. When presented with the ONA results before the coaching, the team reflected

and acknowledged that there is a problem in communication both between the leadership team and their reports. These findings are corroborated by Terblanche's (2014, p. 157) research on using ONA in individual coaching sessions. He founds that the ONA results serve 'as a reality check for coachees' and after the sharing of the ONA results, it was difficult for coachees to remain in denial.

The identification of the need to improve communication helped the leadership team to detect an underlying problem that they judged to be at the root of the business challenges identified by the CEO. The ability to identify root-cause problems helped the team coaching process to focus on an area where it could make the greatest impact. Goal setting is a central aspect of coaching research and a number of scholars have investigated the importance of setting coaching goals and their effect on the coaching process (Grant, 2012; O'Connor & Cavanagh, 2013; Spence, 2007). Grant defines coaching goals as 'internal representations of desired states or outcomes' (Grant, 2012, p. 148), while Locke and Latham (2009, p. 19) define goals as 'a regulatory mechanism for mentoring evaluation and adjusting one's behaviour'. Clutterbuck and Spence (2016); however, assert that there is still an open question as to how context influence the setting of coaching goals. The findings discussed here indicate that ONA could help a team to identify coaching goals that are context-sensitive. Contexts were included through the fact that the business challenges were incorporated in the ONA questions and then used to define coaching goals. This mechanism to some extent answers Clutterbuck and Spence's question of how to include context in coaching goal setting.

Organisational network analysis assisted the leadership team to identify lack of communication as the root cause of the CEO's concerns about business challenges. Findings from the post-test ONA questionnaire and supported by interviews conducted after coaching pointed to an improvement in communication between the leadership team and their direct reports. This improvement was observed as the increase in relationship ties between the leadership team and their direct reports.

The importance of communication in teams was highlighted by a number of studies. One study showed the importance of gaining 'socially verifiable interpretations of specific situations' to assist a team in managing uncertainty (Burt, 1987, as cited in Zohar & Tenne-Gazit, 2008, p. 746). Cross et al. (2002) found that 85% of managers interviewed claimed that they received knowledge that is critical to project completion from other people in their network, underscoring the need for communication beyond the manager's default network. Information relating to production problems is more likely to be shared throughout a network and lead to a common understanding of a production problem, if there is a wider set of communication partners (Zohar & Tene-Gazit, 2008). The increase in communication helped the leadership

team to address the CEO's concern about the lack of innovation in the organisation. This finding is in line with a study by Rousseau, Aubé and Tremblay (2013), who found that team coaching had a direct effect on support for innovation in an organisation.

The research reported on here indicates that by using ONA, it is possible to provide an indication of the level of discussion about innovation as observed through the change in the team dynamics. This is in line with an observation by Ehrlich and Carboni (2005) who made a link between the likelihood of information sharing and the creation of new ideas. In general, ONA has been shown to help indicate the manner in which information flows in an organisation and can therefore allow for customised interventions such as communication training (Cross et al., 2000) or as in the case of this research, team coaching. The findings of this research are aligned with the research conducted by Borgatti and Molina (2003) who found that the structure revealed by the ONA process created new communication forums that allowed individuals to be more aware of the activities of all members of the group.

Comparative pre- and post-test ONA results indicated that TM1, TM3 and TM4 showed improved relationship ties, but TM2's tie count reduced. This apparent ONA anomaly was explained during her interview after coaching by the fact that during the team coaching process, she was moved to a different team, which affected her interaction dynamics with the research group. The insight gained from this finding is that it is important to not interpret the ONA findings in isolation. Organisational network analysis results must be interpreted within the context of the participants and this context can be gained through, for example, follow-up interviews with the participants as suggested by Cross et al. (2002). Organisational network analysis results could be influenced by factors outside of the coaching process. Cross et al. (2002, p. 31) acknowledge that different factors that fragment a network demand a different set of interventions. However, they argue that the use of ONA, when combined with interviews, 'makes these interactions visible, allowing for a diagnosis and an appropriate solution'. In a similar manner, Foster, Borgatti and Jones (2011) used interviews as an integral part of their ONA analysis research.

Practical implications

This research provides guidelines to team coaches, ONA practitioners and leadership teams on the value of using ONA as a diagnostic tool during team coaching interventions aimed at addressing business challenges. Companies and organisational development practitioners implementing change management programmes may benefit from using ONA as a diagnostic tool during team coaching interventions to determine the informal networks within a company, and how to most effectively use these networks to address business challenges. This research may also benefit the coaching academic research community by providing

insights into the application of ONA to team coaching, both as a novel coaching diagnostic tool, and to guide a team coaching intervention.

Limitations and recommendations

This research used only one type of ONA analysis measurement, namely, degree centrality. The addition of other analysis measurements, such as closeness or betweenness, could have provided additional data and insights. Only one network (entire research group) was analysed. Using subnetworks, for example, a network for each team member and their direct reports could have provided additional data that could have influenced the findings.

The small sample size of four team members in this research limits the applicability of the results to a wider population. Further research with larger teams or extended networks outside the team could build on the results of this study. It must also be acknowledged that the team and their reports did not work in isolation and interacted with other people in the organisation. The improved communication indicated by the post-test Social Network Analysis (SNA) results could, therefore, have been influenced by factors outside the team coaching.

The relatively short period for the team coaching process prevented the researcher from assessing the sustained impact of improved communication on addressing the business challenges. Follow-up with the team members three to six months after receiving team coaching could provide a more objective view of the impact of team coaching on the effectiveness of the team.

Conclusion

Team coaching is a relatively new and under-researched field. Organisational network analysis is a well-defined methodology for analysing relationships between people. The use of ONA in individual coaching has been researched, but no research could be found on using ONA during team coaching interventions. This research explored the use of ONA during a team coaching intervention and found that:

- Organisational network analysis can be used to identify team coaching goals by explicitly incorporating the business challenges in the ONA questionnaire.
- Organisational network analysis can be used to provide a measure of team coaching efficacy relative to the goal identified (improved communication in this instance).
- Organisational network analysis results should be triangulated with other data sources (such as interviews) to contextualise the coaching outcomes.

Team coaching holds potential to facilitate systemic changes in organisations to address business challenges. This research indicated the potential of using ONA as a novel diagnostic approach to support a team coaching intervention.

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Competing interests

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Authors' contributions

E.D.E. conducted the research and co-authored this article. N.H.D.T. supervised the research and co-authored the article.

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