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Knowledge sharing and social networks

A case study at Energinet.dk

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Abstract

Based on a case study in the department Anlæg El & Gas at Energinet.dk, this thesis aims to uncover the connections between relational factors, knowledge types and network structures in relation to knowledge sharing. The thesis seeks to test and expand existing literature within the area, and offers a number of suggestions on how knowledge management can be improved in the department.

The analysis is based on a collection of quantitative data from the department concerning the perception of knowledge types, knowledge sharing and a number of relational factors. Furthermore, three social networks are constructed: most frequent work-related knowledge sharing, most important work-related knowledge sharing, and non work-related knowledge sharing. This is complemented with qualitative interviews to further understand and explore the analysis in the context of the department. 120 responses were obtained, resulting in a response rate of 48%.

The investigation of the whole network reveals that the relational factors all relate positively to the perceived level of knowledge sharing. Of these, the most important factor is found to be that it is fast and efficient to get access to relevant knowledge from the colleagues.

In alignment with existing literature, the analysis finds support that there is a link between the tacitness of knowledge and the degree of personalisation of communication channels that are effective to share that knowledge.

The analysis finds support that the perception of knowledge sharing between teams is positively related to structural holes, in that the more an individual is in a bridging position in the network, the better the perceived level of knowledge sharing in the department seen across the whole network.

The evaluation of the team networks reveals that the higher the degree centralization within a team and the looser the individuals in it are connected, the better the perceived level of knowledge sharing with other teams. By adding degree centralisation to Burt's model of external and internal constraint (Burt, 2001), this adaptation offers a model of the most optimal network structure for knowledge sharing within and between teams.

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1 Introduction

In 2014, Anlæg El & Gas (ANEG) of Energinet.dk introduced an IT-based knowledge database, with the aim of improving knowledge sharing among employees and thereby improving performance. Having achieved only limited success with getting employees to embrace the IT-system, the initiative was evaluated in the start of 2016, and it was decided to move away from the initial focus on increasing use of the IT-system to instead place a broader focus on improving knowledge sharing in general, still including the use of the IT-system.

The first step of the re-launch of the initiative was a two-hour workshop, "Knowledge Café", on the topic of knowledge sharing in January 2016. I was invited as an observer at the workshop, and had some informal discussions with the project manager and a number of other stakeholders in the department concerning the topic of knowledge sharing. This spurred a number of ideas and thoughts for the thesis, including:

- What type of knowledge is it that is relevant to share for this department?
- How good are they currently at sharing knowledge?
- If the IT-system is not successful, how is knowledge then shared instead?
- How do personal relations between employees influence knowledge sharing?
- What role do the social networks play for knowledge sharing?

This brought around two main aspirations of the thesis:

- To identify and test connections between relational factors, knowledge types, social network structures and knowledge sharing.
- To provide ANEG with further insight into the area of knowledge management in the department and offer suggestions for practical solutions on how knowledge management can be improved.

1.1 Introduction to Energinet.dk

Energinet.dk is an independent publicly owned company that owns and runs the Danish electricity and gas transmission system. Established as a result of the merger between four regionally based companies in 2005, the company is now headquartered outside Fredericia, with offices in seven locations across Denmark.

In total, the company has 850 employees, split across four business units. With 252 employees, ANEG is the largest of these units, and is responsible for the design and construction of new stations and power lines.

The employees in ANEG are split into 11 teams and 40+ groups working on multiple projects at the same time with varying duration and participation from other departments.

The unit ANEG is knowledge intensive and employees are generally highly educated with many engineers among its employees (Jensen, 2016).

1.2 Structure and research design

The thesis is divided into seven parts, this introduction being the first.

The second part contains a review of the theories within the relevant areas of knowledge management and Social Network Analysis. This forms the basis for the theoretical framework and hypotheses to be investigated.

The fourth part is an outline of the method used to gather and analyze the empirical research in a way that allows testing the hypotheses.

The fifth part seeks to analyze the empirical research in order to validate the hypotheses.

The sixth part will unfold a discussion of the findings in relation to theory and the seventh and final part will outline the implications of the results for the department.

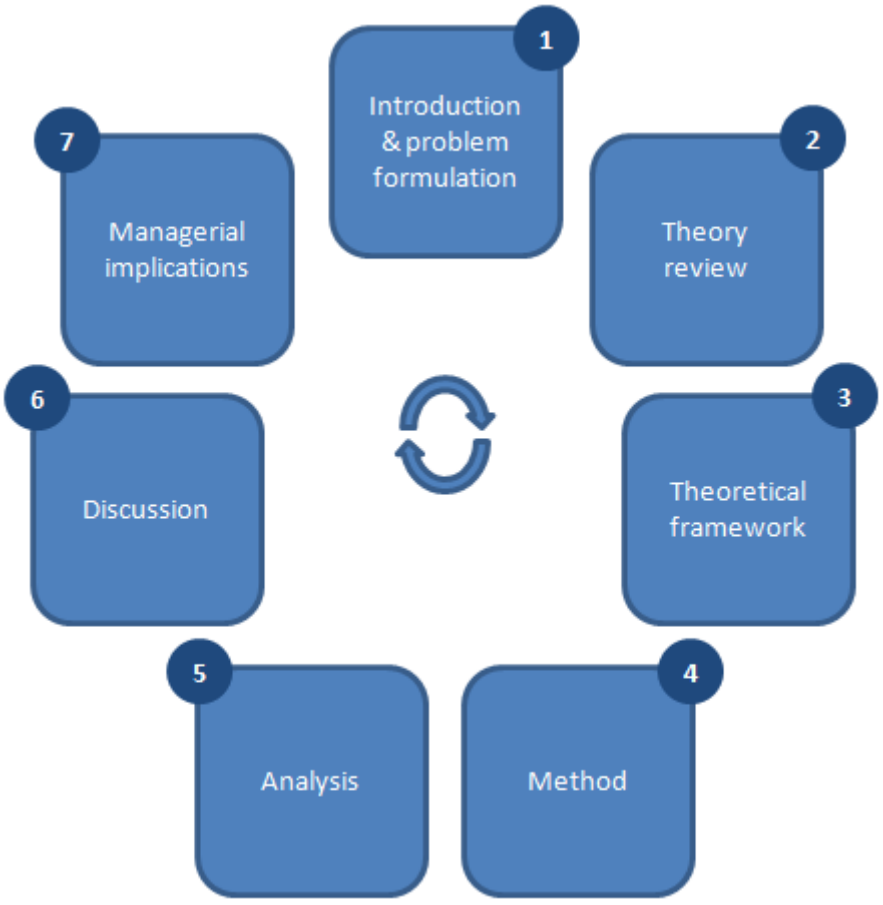

Figure 1: Research design

1.3 Research question

Having researched the theory in the area of knowledge management and social networks, it was evident that effective knowledge management is dependent on the type of knowledge required in an organization, and the social network structures. This realization led to the following research question:

What are the connections between relational factors, knowledge types and network structures in relation to knowledge sharing?

The analysis will be followed by a proposal on how the findings can be applied to improve knowledge sharing at ANEG.

1.4 Limitations

The study focuses on the issues of knowledge sharing and network structures within the department ANEG in Energinet.dk.

While knowledge management will be discussed broadly, the issue of knowledge application is considered beyond the limits of the study.

Within social networks, focus is placed on structural holes and closeness, and other theories will be touched upon only as required to shed light on those aspects.

Many studies have pointed out the importance of contextual and individual factors that have an influence on knowledge management in an organization, including e.g. industry (Rowley, Behrens, & Krackhardt, 2000), competitive situation (Teece, 1998), culture (Rong, Huang, & Shenkar, 2011), personality (Mehra, Kilduff, & Brass, 2001), motivation (Obstfeld, 2005). These will be touched upon only where they support the analytical focus of the thesis.

1.5 Source critique

The thesis has used a mix of primary and secondary sources to shed light on the research question. While the use of primary sources has ensured a high validity throughout the study, the use of secondary sources, as for example literature reviews, have assisted with getting an overview of literature and provided insight into different interpretations of primary literature. Where secondary literature has been used, alternative sources of information have been sought to ensure coherence between the findings of the different sources.

The thesis has primarily used scientific articles from renowned journals and magazines with a high number of citations in other articles. In some cases, articles that have not been frequently cited have been used where these are of recent publication date and from reliable sources, e.g. Carnabucci (Carnabuci & Diószegi, 2015).

2 Theory

2.1 Knowledge and knowledge management

Birkenshaw argued that *"A corporation's only enduring source of advantage is argued to be its knowledge - the knowledge of its employees, and the knowledge built into its structures and systems"* (Birkinshaw, 2001). Consequently, knowledge management in terms of an ability to assemble, create, share, and utilize knowledge becomes an increasingly important and necessary feature (Lagerström & Andersson, 2003).

This should put knowledge management on the top of the agenda for most organizations. However, there are indications that the area does not receive the required attention.

In 1997, an Ernest & Young survey among 431 US and European organizations found that only 13% of respondents believed that their organizations were good at transferring knowledge (Ruggles, 1998). In

another study, 74% of respondents believed that their organization's best knowledge was inaccessible and 68% thought that mistakes were reproduced several times (Alavi, 2001).

If knowledge is the only enduring source of advantage for an organization as Birkinshaw argues, this is naturally concerning.

2.2 A definition of knowledge

In order to discuss knowledge sharing in a meaningful way, it is first important to define what is meant by knowledge. There is an abundance of literature on the topic that appears to be under rapid development. Here, I will go through some of the more prominent theories and conclude with the interpretation used for this thesis.

Alavi put together a table of knowledge definitions outlining the different taxonomies in his 2001 review. He argued that while it is not necessarily important which taxonomy is used, it is important to understand the taxonomies because theoretical development is influenced by the distinction, see app. 1 (Alavi, 2001).

2.2.1 Explicit and tacit knowledge

Probably the most widely cited definition is Polaniy's distinction between 'tacit' and 'explicit' knowledge (Alavi, 2001). Polaniy argued that explicit knowledge refers to knowledge that is codifiable and transmittable in formal, systematic language, while tacit knowledge has a personal quality that makes it hard to formalize and communicate (Alavi, 2001). It covers concrete know-how, crafts, and skills that apply to specific contexts (Nonaka & von Krogh, 2009).

Nonanka elaborated on the concept in his 2009 paper, where he pointed out that knowledge is explicit and tacit along a continuum; that they are not two different kinds of mutually exclusive knowledge, but rather two forms that knowledge assumes on a continuum, mutually enhancing each other (Nonaka & von Krogh, 2009).

He further argued that tacit knowledge is a prerequisite for the application of explicit knowledge in the sense that a situation may contain hidden rules that have the potential to be articulated, and that these elements provide a basis for the explicit knowledge end of the continuum (Nonaka & von Krogh, 2009)

At the other extreme end of the continuum, tacit knowledge is not accessible through consciousness, but knowledge can move along the continuum, with some tacit knowledge eventually becoming explicit in the sense that it is codified and independent of the person. When tacit knowledge is transformed, it is also enriched when it gradually assumes an explicit form (Nonaka & von Krogh, 2009)

2.2.2 The DIKW model

The DIKW model is one of the *"fundamental, widely recognized and 'taken-for-granted' models in the information and knowledge literatures"* (Rowley J. , 2006). This model is based on the premise that there are four levels of knowledge: data, information, knowledge and wisdom, and that one level constitutes the foundation for the next, making the upper levels rarer and more demanding (Rowley J. , 2006). See app. 2.

There is a large number of texts using variations of the DIKW model, and Rowley offers a summary of the elements (Rowley J. , 2006), with the following characteristics:

- Data is discrete, objective facts or observations, which are unorganized and unprocessed, and do not convey any specific meaning. It lacks meaning and value in itself.
- Information is organized data put into context, giving meaning and understanding, relevance and purpose to data.
- Knowledge is the ability of putting multiple sources of information into action through the addition of expert opinion, skills and experience.
- Wisdom is the accumulated knowledge, allowing one to understand how to most appropriately apply concepts from one domain to new situations or problems.

Although the DIKW models do not use the explicit definitions of tacit-explicit, it approximates the distinction that data and information is explicit knowledge, whereas knowledge and wisdom is tacit.

2.2.3 Summary knowledge definition

On the basis of these theories, the interpretation of knowledge used in this thesis is that knowledge consists of information put into action and is explicit and tacit on a continuum. Explicit knowledge covers data and information, is codifiable and is independent of the individual, while tacit knowledge covers knowledge and wisdom, is not codifiable, but is dependent on the individual.

2.3 Knowledge management

Having established a definition of knowledge to use, we now turn to the topic of knowledge management. Also here, there is no shortage on literature, and I aim to collect and structure some of the recommendations from theory and research to conclude with a summary.

Although the area of knowledge management is described in various ways, four concepts are generally covered (Alavi, 2001):

- Creating knowledge
- Storing knowledge
- Transferring knowledge
- Applying knowledge

For the purpose of this thesis, I limit the theoretical investigation to the first three concepts.

2.3.1 Creating knowledge

Nonanka's 1994 paper is one of the most widely cited papers on knowledge creation, and argues that knowledge consists of information put into action and inferred by personal experience and level of engagement. He distinguished between information and knowledge, in which information is anything that can be digitized, whereas knowledge is individual to the knower, and dependent on personal justifications and experience. Despite this focus on the individual characteristics of knowledge, Nonanka highlighted that knowledge is only relevant when shared in communities of interaction (Nonaka, 1994).

Following the tradition of dividing knowledge into tacit and explicit knowledge, Nonanka argued that knowledge is created through knowledge sharing and through the conversion between explicit and tacit knowledge. This leaves four possibilities of knowledge conversion, see figure 2 (Nonaka, 1994).

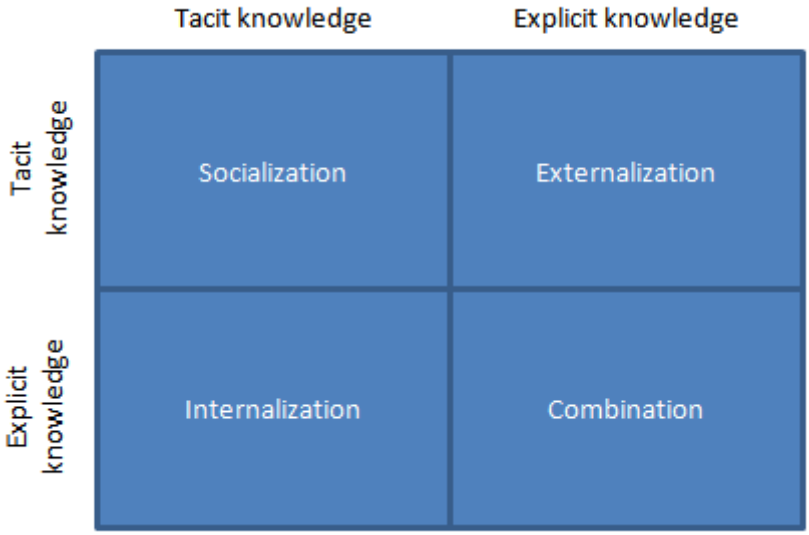

Figure 2: Modes of knowledge creation, based on Nonanka, 1994

The first mode, socialization, implies that tacit knowledge can only be transferred through some form of shared experience, e.g. by observation, imitation and practice, by which knowledge is shared and becomes part of the routine for others. This, for instance, happens when employees are 'finding their feet' in a new organization (Nonaka, 1994).

The second mode, combination, centers around the use of social processes to combine different explicit knowledge held by individuals, e.g. by meetings and phone conversations. By combining existing explicit knowledge from different individuals, new knowledge can be created in the new combinations of knowledge (Nonaka, 1994).

The third mode, internalization, deals with making explicit knowledge tacit; i.e. incorporating explicit knowledge into the routines of daily work. Nonanka found that too much emphasis is placed on this area, e.g. by Argyris' and Schön's theories on single- and double-loop learning, in that the approach advocates artificial interventions based on unrealistic assumptions about 'the right' answer, but ignores the importance of the fields of socialization and externalization (Nonaka, 1994). Nonanka argued that *"double-loop learning is not a special, difficult task but a daily activity for the organization"* that takes place continuously and undirected in the organization (Nonaka, 1994).

The fourth mode, externalization, deals with making tacit knowledge explicit, and Nonanka here pointed to the use of metaphors, analogies and images in that they enable us to experience a new behavior by making inferences from the model of another behavior (Nonaka, 1994).

Nonanka argued that while each of the four modes can create new knowledge, the dynamic interaction between the four modes is essential to organizational knowledge sharing and knowledge creation (Nonaka, 1994).

Focusing only on combining explicit-explicit knowledge becomes nothing more than a superficial interpretation of existing knowledge. On the other hand, knowledge derived from pure socialization may be difficult to apply in fields beyond the specific context in which it was created (Nonaka, 1994).

Nonanka further argued that value adding knowledge creation takes place through the shifts between the modes, for example starting with a team sharing experiences and perspectives; i.e. tacit-tacit. This is followed by dialogues, where perspectives are articulated, revealing hidden tacit knowledge; i.e. tacit-explicit. This is combined with other existing knowledge; i.e. explicit-explicit, and through interaction, that is gradually transformed into new tacit knowledge, i.e. explicit-tacit. See app. 3.

2.3.2 Storing knowledge

Just as organizations create new knowledge, they can also forget knowledge, making storing of knowledge an important aspect (Alavi, 2001). Storage of knowledge takes place in a variety of forms, including written documentation, codified information in databases, procedures and processes and tacit knowledge of individuals and their networks (Alavi, 2001).

The benefit of storing knowledge is that it helps avoid waste of resources in replicating previous work. On the flip side, it may also reinforce past inexpedient processes and habits, making it difficult for the organization to change (Alavi, 2001). While Teece highlighted the importance of sharing knowledge: *"If knowledge and experience remain personal and are not somehow shared (…) then the firm can at best expect to achieve constant return to scale"*, he also warned about some of the risks associated with codifying and storing knowledge in that while it makes replication easy, it also makes imitation easy, meaning that the more explicit the company's knowledge, the easier it is to replicate by others (Teece, 1998).

While IT-systems can be effective tools to store explicit knowledge in terms of data and information, they offer little value when it comes to storing tacit knowledge that is per definition not codifiable, but personal to the individual (Alavi, 2001) (Nonaka, 1994). Zander and Kogut highlight that while tacit knowledge is more time consuming to acquire, it also takes longer to forget; i.e. it is stored in the individual for longer than explicit knowledge is (Kogut & Zander, 1996).

Hansen et al. highlighted that there are two different strategies for knowledge management, depending on how knowledge is stored and transferred. The codification strategy involves coding and storing all knowledge in computer databases where it can be accessed by anyone in the company without having to contact the person who originally developed it. The alternative, the personalization strategy, focuses on knowledge being closely tied to the individuals, and is shared mainly through direct person-to-person contact. Here, knowledge is stored in the individual and shared through interaction between individuals (Hansen, Nohria, & Tierney, 1999).

In their analysis of the consultancy and health care businesses, the authors found that the choice of knowledge management strategy is dependent on the company's business model. Codification is useful in companies that are repeatedly dealing with similar, simple problems. Here, this approach enables growing business by achieving scale in knowledge reuse and is a cheap means of sharing information. It is, however, a pre-requisite that the information required is explicit so that it can be codified in the first place (Hansen, Nohria, & Tierney, 1999).

While the personalization approach requires a more costly way of sharing knowledge, it is more suitable in companies that create customized solutions to unique problems for their customers. This model is dependent on more personal knowledge that is not codifiable, and it is argued that *"when people use tacit knowledge most often to solve problems, the personalization approach works best"*. Here, knowledge is not stored in databases, but shared person-to-person in networks supported by the organization, e.g. by transferring people between offices, creating directories of experts, so that employees can easily find out whom to contact about a particular issue (Hansen, Nohria, & Tierney, 1999).

While it is necessary to have elements of both strategies in all companies, the authors found that the companies that tried to apply both strategies equally at the same time were less successful than the ones that focused primarily on one of them – either codification or personalization (Hansen, Nohria, & Tierney, 1999).

2.3.3 Transferring knowledge

Most literature focuses on the channels for transferring knowledge, and broadly distinguishes between formal and informal, personal and impersonal. In brief, informal mechanisms, such as coffee-meetings, are found to be effective in promoting socialization and sharing tacit knowledge, and personal mechanisms, such as personnel transfers, may be effective for transferring tacit knowledge, but they both hinder dissemination of knowledge to a wider population. Formal mechanisms, such as training sessions, and impersonal mechanisms, such as databases, may be effective for wide dissemination, but is no guarantee for understanding of knowledge (Alavi 2002). The trade-off between the different mechanisms is thus between wide dissemination and understanding, and Alavi argued that the most effective transfer mechanism depends on the type of knowledge that is being transferred (Alavi, 2001).

Gupta and Govindarajan identified five factors that enhance the transfer of tacit knowledge between departments (Gupta & Govindarajan, 2000):

(i) Value of the source unit's knowledge stock.
(ii) Motivational disposition of the source unit.
(iii) Existence and richness of transmission channels.
(iv) Motivational disposition of the target unit.
(v) Absorptive capacity of the target unit. Absorptive capacity is the *"ability to recognize the value of new information, assimilate it, and apply it to commercial ends"* (Cohen & Levinthal, 1990), and that will differ between units and individuals in an organization.

Zander and Kogut argued that companies are *"social communities which use their relational structure and shared coding schemes to enhance the transfer and communication of new skills and capabilities"* (Kogut & Zander, 1996). They make a distinction between codified information and know-how, which equates the distinction between explicit and tacit knowledge, and find that the more codified, the faster the transfer of knowledge, which on the one hand can be an advantage in terms time to market of a product, but also have a greater risk of fast imitation by others.

They make a second point in that the accumulation of experience in an activity makes it easier and faster to communicate and understand relevant knowledge, reducing the time and cost of knowledge transfer. This is in line with Cohen and Levinthal's absorptive capacity, and it should be expected that the longer an

employee works with a given activity, the easier is the transfer of knowledge within the same activity (Kogut & Zander, 1996).

Carlile argued that a particular complication in knowledge transfer is that which takes place across boundaries, e.g. between departments with different areas of expertise (Carlile, 2002). Carlile pointed out that knowledge has the characteristics of being localized (specific to a set of problems), embedded (tacit to the individual) and invested in practice (applying known measures to known problems), which makes it difficult to accommodate the knowledge developed in another practice.

Carlile described three levels in the approaches to overcoming the problem:

The syntactic approach focuses on the establishment of a shared and stable syntax across a boundary through e.g. more information, communication and team strategies. While Carlile recognized that this eases the transfer of knowledge across boundaries in a stable environment, he also pointed out that this will be insufficient in areas with new knowledge emerging (Carlile, 2002).

The semantic approach outlines that even though a shared syntax is present, interpretations are often different, complicating the effective transfer of knowledge. The solution draws on Nonankas' creation of 'mutual understanding', created through communities of interactions where individuals can work through semantic differences by making tacit knowledge explicit across a boundary (Nonaka, 1994). Carlile argued, however, that the semantic approach ignores the potential consequences to the individuals of sharing knowledge, i.e. that it may not be in the interest of an individual to share knowledge (Carlile, 2002).

The pragmatic approach focuses on the potential consequences, and outlines that not only do individuals need to be able and willing to share knowledge, they need also be willing to alter their own knowledge, acknowledging that there can be conflicting interests, and that people can be strategic about what they chose to share (Carlile, 2002).

In his research, Carlile focused on the use of boundary objects; objects that are shared across different problem solving contexts, and work to establish a shared context that 'sits in the middle'. Calile worked with four categories of boundary objects:

- Repositories, e.g. databases, which supply a common reference point
- Standardized forms and methods, e.g. formalized processes, which makes categorizing differences less problematic across settings
- Objects or models, e.g. sketches, drawings, mock-ups, prototypes, which demonstrate current form and function
- Map of boundaries, e.g. Gantt-charts, process maps, which clarify the dependencies between departments

Carlile found that boundary objects – particularly objects, models and maps - are useful in transferring knowledge both from a practical and political perspective; it assists with establishing a shared syntax, and it facilitates the process of transferring knowledge that is localized, embedded and invested in practice so that new knowledge can be created, resolving the negative consequences identified (Carlile, 2002).

2.3.4 Summary Knowledge management

Based on this, there are indications that a company needs to have an effective transfer of both explicit and tacit knowledge to succeed (Nonaka, 1994), but knowledge management efforts need to be focused primarily on one or another, dependent on the business model (Hansen, 1999).

While explicit knowledge is found to be effectively transferred through codification and wide dissemination, independent of the individual, the transfer of tacit knowledge is more complex.

There is wide agreement that the effective transfer of knowledge is dependent on a number of factors concerning how employees relate to each other including trust, access/accomodation, motivation, shared goals, and a common understanding.

This is found to be best nurtured through some form of shared experience through which knowledge is shared and becomes part of the routine for others through the creation of a common syntax and understanding. Effective facilitators for this include socialization, person-to-person interaction, the use of boundary objects and metaphors.

This leads to the following four hypotheses based on the relational factors between employees:

- H1: The better individuals know whom to contact for information, the higher the perceived level of knowledge sharing
- H2: The better the perceived access to colleagues, the higher the perceived level of knowledge sharing
- H3: The more accommodating colleagues are perceived to be to share knowledge, the higher the perceived level of knowledge sharing
- H4: The higher the level of perceived trust, the higher the perceived level of knowledge sharing

And the following hypotheses, based on the different knowledge types and communication channels:

- H5: Individuals who perceive tacit knowledge to be more valuable prefer personal contact as channel for knowledge sharing
- H6: Individuals who perceive explicit knowledge to be more valuable prefer documents as channel for knowledge sharing

2.4 Social Network Analysis

Social Network Analysis (SNA) is based on the premise that the social world is based on interactions rather than in the aggregation of individuals; that social life is created primarily by the relations and patterns they form (Marin & Wellman, 2011). SNA is a method to analyzing and visualizing relations and has developed into being a frequently used tool in a wide range of disciplines, including organizational development.

In this context, SNA can be used to analyze and visualize informal relationships between people. These relationships can often shed more light on the way work happens in an organization than the formal organizational structures. The informal relations are, however, often invisible to managers, who do not have an overview of the relations between employees in the organization (Cross, Borgatti, & Parker, 2002). Research has shown that while managers can diagram the links of the five or six people closest to them, the

understanding of the relations and networks beyond this are usually incorrect (Krackhardt & Hanson, 1993).

Using SNA to visualize these otherwise invisible relations, communication networks and patterns of interaction enables managers to work with groups to facilitate effective collaboration and improve information sharing where strategically important (Cross, Borgatti, & Parker, 2002). It is important to note that people have a finite amount of time to invest in developing and maintaining relationships, and it is often not possible or desirable to have strong relationships between all employees or departments in an organization. SNA can offer insights that allow managers to evaluate which relationships are important to develop and maintain, and support the development of these (Cross, Borgatti, & Parker, 2002).

In relation to the present challenge, SNA is useful because it recognizes that employees do not work or share knowledge in isolation, but are embedded in social networks (Wang & Noe, 2010).

While social relationships cannot be mandated by management, they are heavily influenced by factors under management control, including hierarchical levels, office location, project staffing etc. In this way, managers have a way to influence the social relationships and networks in the way that is most beneficial to the organization (Wang & Noe, 2010). In order to do so, it is, however, important that management has an indication of the existing and desired relationships and networks.

2.4.1 SNA and performance

A great deal of research has been conducted in the past 30-40 years on the connection between the structures and positions in social networks and performance. Here, I aim to outline some of the most prominent research that is relevant for the focus of this thesis.

2.4.1.1 Structural holes

Burt's work on structural holes introduced the concept that social capital is created by a network in which individuals broker connections between otherwise disconnected groups. The underlying idea is that an important reason why some individuals outperform their peers is because of differences in the networks to which they belong, and the position they take in it. Burt argued that forming a large network can be less important than having a structurally advantageous position within a network (Burt, 2001).

Burt found that individuals whose ties are limited to only a few groups are less likely to receive diverse information than individuals whose ties span many groups because information that circulates within a group of highly connected individuals is likely to be redundant, in that people over time will come to know the same things (Burt, 2001).

Individuals whose ties span many different groups, on the other hand, obtain a lot of non-redundant information concerning projects, resources etc, and thereby gain a competitive advantage as they are in a position to gain information and control benefits, which can be used to their own advantage (Burt, 2001).

According to Burt, there are two main advantages of the broker position:

- As information first circulates within one group before it is exchanged between groups, the broker is able to control the information flow between groups, which gives him a significant power over the information that is shared.

- Access to different groups gives the broker access to different information and perspectives from each group, which increases the diversity of information that the broker has access to.

Consequently, the broker has access to more opportunities, which can be used for his personal advantage (Burt, 2001).

Similarly, Baer finds that brokerage has a very strong positive relation with innovation as a broker is in a position to access diverse information and has access to less redundant information compared to closed networks (Baer, Evans, Oldham, & Boasso, 2015).

In their analysis of network centrality and personality, Mehra et al. found while occupying a structural hole position in the friendship network is positively related to performance, having a large work network is negatively related to performance, suggesting that the advantages of occupying a structural hole position may be off-set by the disadvantages of having to maintain a large network (Mehra, Kilduff, & Brass, 2001).

The evidence, however, is inconclusive, as other researchers have found opposing results, e.g. Brass, who found that employees occupying structural hole positions were no more likely than others to be high performers (Brass, 1981).

While Burt argued that there are advantages to the individual who occupies a structural hole position, the control of certain information can also lead to consolidation of power and influence with key persons (risk of becoming a broker). If a key employee leaves an organization, other employees will lose their link and connection with each other, resulting in fragmented networks. The structure also entails a risk that it is not necessarily the most appropriate information that is shared; or that information is not shared correctly, as it requires that the broker understands the different information of multiple groups in depth. Moreover, a broker can become a bottleneck and needs to align different interests, which may lead to inefficiencies in coordination.

Bizzi found that while it may be beneficial for an individual to occupy a structural hole position, in accordance with Burt's findings, there are potentially negative consequences when brokers are present in groups where group dynamics are important for the outcomes (Bizzi, 2013). First of all, there is a risk that the information will not be shared, as brokers may be reluctant to share the information with the group, wanting to maintain a personal advantage, which leads to group tensions rather than better solutions. Secondly, the presence of brokers in a group may lead to other team members experiencing lower autonomy, seeing as they are dependent on the broker for information. This leads to lower job satisfaction and less effective performance (Bizzi, 2013).

Bizzi found that having few individuals utilizing brokerage created tension in the group, leaving the other members with a lower sense of autonomy, job satisfaction, trust and ultimately performance. In this light, brokerage can be detrimental to the realization of group or organizational level goals (Bizzi, 2013).

2.4.1.2 Closeness

In contrast to Burt, Coleman argued that that there are a number of benefits from networks with a high degree of closeness, in the extreme where everyone is connected to everyone. Not only is there a better foundation for effective communication in that there is a shared language, culture and norms within a closed network, communication is furthermore improved as information does not have to go through

multiple parties, thus deteriorating the quality of information. A closed network also facilitates better cooperation and a high level of trust due to the control mechanism that no one can escape the notice of others, thereby making it less risky to trust others (Coleman, 1988).

Finding that Burt and Coleman represent contradicting views on which type of structural embeddedness is most beneficial, Rowley et al. set out to investigate under which conditions closed networks are positively related to firm performance (Rowley, Behrens, & Krackhardt, 2000). In their analysis of the semi-conductor and steel industries, they found that firms operating in stable environments perform better when having closed networks with strong ties because the strong ties enabled the firms to establish relational trust and transfer high quality information and tacit knowledge across organizational boundaries, while at the same time building a mechanism of social control to govern the partnership relationships (Rowley, Behrens, & Krackhardt, 2000).

On the other hand, firms in a rapidly changing environment with high levels of uncertainty are better served by structural holes and weak ties, because this structure grants effective access to novel information and control benefits, which is important when success is dependent on exploring new opportunities, rather than the exploitation of existing technology (Rowley, Behrens, & Krackhardt, 2000).

Rowley et al. further described how different kinds of structure may be beneficial at different stages for a firm; e.g. when exploring new options, firms can tolerate more information noise in order to access a wider pool of knowledge, and sparse networks with structural holes will be beneficial. When the firm moves from exploration to exploitation, however, the information requirements are more specific, the firm is less tolerant for information noise, and closed networks will be more beneficial in that enable a deeper understanding of information through redundant sources. This does, however, come with the risk that this may limit the firm's openness to new ways of doing things with potential disastrous implications (Rowley, Behrens, & Krackhardt, 2000).

Burt offered a different approach to integrating the two viewpoints (Burt, 2001). Acknowledging the validity of the arguments speaking in favor of closeness as put forward by Coleman, Burt developed a theory where he differentiated between external and internal constraint in groups, and found support that the best performance is achieved when groups are characterized by a high degree of closeness within the group, and by structural holes beyond the group, based on a viewpoint that that structural holes are the source of added value in terms of new, diverse input and resources, while closeness is critical to realizing the value of the new input in a setting that is characterized by trust and close cooperation (Burt, 2001), see figure 3.

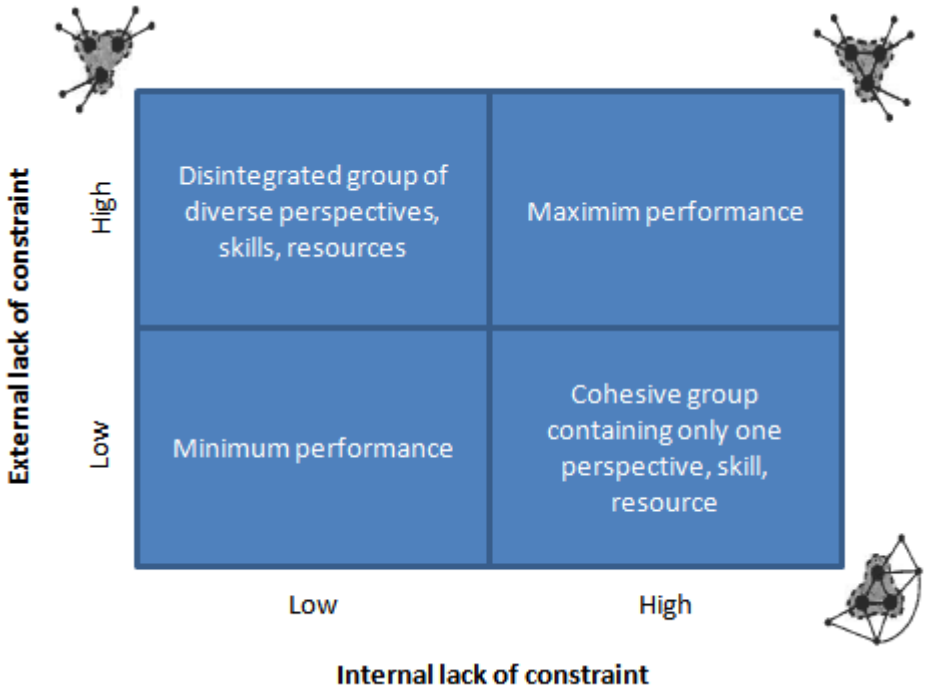

Figure 3: External and Internal Constraint, based on Burt, 2001

Despite the integrative theories, the discussion of whether structural holes or closeness provide the best structure for performance, hereunder knowledge sharing, to a large extent still represent two opposing theories. To evaluate which of the two theories best fit the context at ANEG, the following hypotheses were formulated:

- H7: Individuals in structural hole positions perceive information sharing to be better than individuals in closed networks
- H8: Individuals in closed networks perceive information sharing to be better than individuals in structural hole positions

To investigate the influence of network structures within the teams on the perceived level of knowledge sharing within and between teams, the following hypothesis was formulated:

- H9: The perceived level of knowledge sharing within and between teams depends on the network structure in the teams

2.4.1.3 Knowledge transfer and knowledge types

Extending on Granovetter's theory of the strength of weak ties (Granovetter, 1973), Hansen investigated the link between strength of ties and transfer of different types of knowledge (Hansen, 1999).

He found that weak links hold search benefits over strong ties, independent of whether knowledge is codified (explicit) or non-codified (tacit). However, he also found that strong links had an advantage over weak ties in the transfer of non-codified knowledge (Hansen, 1999).

Hansen found a number of reasons for the search benefit of weak ties, most prominently that having many weak ties gives access to new, diverse and non-redundant knowledge, making it more effective to search

for new knowledge. Strong ties in a closed network, on the other hand, has a lot of overlap in knowledge, and is more resource demanding to maintain than weak ties.

Extending this with the theory in knowledge management, one could expect that where explicit knowledge is perceived to be most valuable, people in structural hole positions find knowledge sharing to be better than those in closed networks. On the other hand, where tacit knowledge is perceived to be most valuable, people in closed networks find knowledge sharing to be better than those in structural hole positions.

This leads to the following hypotheses:

- H10: Where explicit knowledge is perceived to be most valuable, individuals in structural hole positions find knowledge sharing to be better than those in closed networks.
- H11: Where tacit knowledge is perceived to be most valuable, individuals in closed networks find knowledge sharing to be better than those in structural hole positions.

3 Theoretical framework

Based on the review of theory in the field, a theoretical framework of the area was developed, see figure 4.

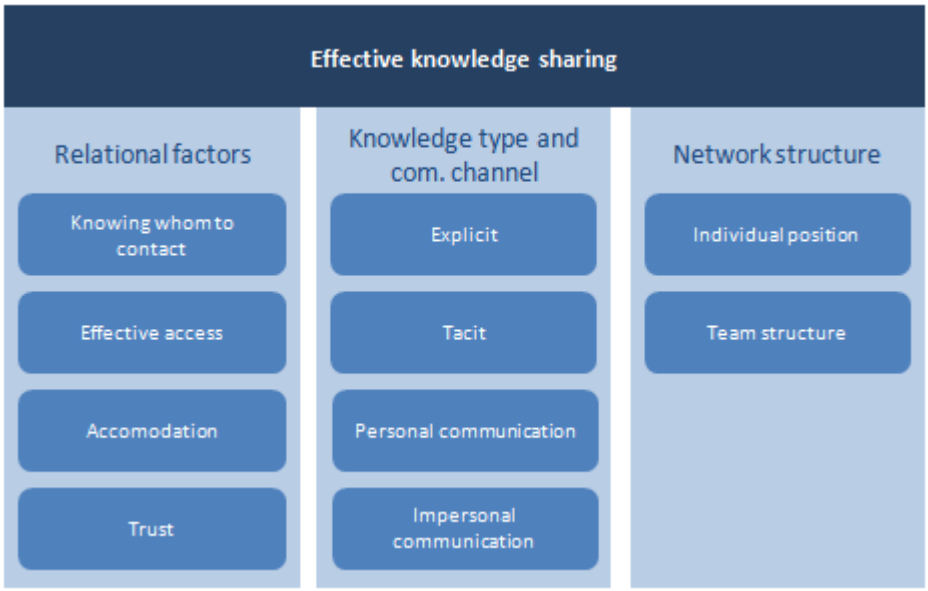

Figure 4: Theoretical framework

Essentially, the theoretical framework proposes that the effectiveness of knowledge sharing is dependent on relational factors between the employees, the type of knowledge that is most valuable to a particular organization and the communication channels that are used, as well as the network positions of the individual employees and the network structures in the teams.

4 Method

To test these hypotheses, input was required in five main categories:

1. Most valuable type of knowledge
2. Effectiveness of current knowledge sharing
3. Relational factors
4. Effectiveness of communication channels for knowledge sharing
5. Informal knowledge sharing networks

The first round of data collection was based on a questionnaire asking the respondents questions within the above categories, along with basic demographic data. See app. 4.

4.1 Sample and network boundaries

Defining the boundaries of the networks poses a number of challenges in SNA. The underlying premise of SNA is that people have relations across the formal boundaries of organizations, departments, and teams; and that these relationships influence the behavior of the individuals (Marin & Wellman, 2011). Thus, treating the group memberships as boundaries is a simplification of the different levels of group memberships, affiliations with in multiple groups, and cross-cutting ties between groups (Marin & Wellman, 2011).

In Energinet.dk, the subject of analysis was the employees of the department ANEG, and the relationships between these employees.

While it would have been interesting to map the full networks of all employees in the department, including the relationships bridging the boundaries to other departments and external partners, it was decided to focus on the intra-departmental relations, and the boundaries of the networks were limited to this department alone.

While the approach sought to investigate the relationships between employees in the same department, this also allowed analyzing relationships between employees in different teams within the department. This enabled taking into consideration some degree of membership in multiple groups and cross-cutting ties between employees in different teams. It also allowed examining variations in the networks within different teams.

Setting these boundaries was necessary due to the duration and practical effectuation of the analysis, although it did put some limitations to the analysis, which are important to keep in mind when making conclusions on the basis of the analysis, e.g. the ego networks may be represented differently in this analysis than if the network included also individuals outside of the department.

4.2 Determining the questions

The questionnaire was developed as a range of closed questions. Open questions were considered as this could have increased the liability and validity of the data, but it would on the other hand have posed a risk of not collecting sufficient coherent data to perform quantitative analysis (Krosnick, 1999).

The questions and constructs were based on the review of relevant literature within the areas of knowledge management and SNA.

4.2.1 Type of knowledge

Hansen's 1999 paper pioneered the work on the effect of different knowledge types in SNA. In his study, he determined whether knowledge was simple or complex based on whether information was codified (Hansen, 1999). This definition was considered, but discarded after the pre-test (see chapter 4.4), and instead it was decided to replace this question with three more elaborately explained definitions of knowledge based on the definition of knowledge used in the study, where knowledge is seen as explicit and tacit on a continuum, see chapter 2.2.3. This led to the following questions:

This type of knowledge is most valuable for me to solve my most important tasks:

- *General knowledge and data, as contained in documents, reports, manuals, procedures etc.*
- *Information received in writing as response to a specific question, supported by further explanation*
- *Personal knowledge, know-how and personal experience from others, which is hard to replicate in writing*

4.2.2 Effectiveness of knowledge sharing

To have an indication of the current level of knowledge sharing, respondents were asked to rate their level of agreement to two statements:

- *We are good at sharing knowledge in the department*
- *We are good at sharing knowledge in my team*

While the responses on these questions do not necessarily give a conclusive answer to how good knowledge sharing is, it does provide a measure of the respondents' perception of the level of knowledge sharing, which is taken as an approximation of the actual level of knowledge sharing.

4.2.3 Relational factors

To test if there were measurable relational factors that could influence the perceived level of knowledge sharing, respondents were asked to rate their level of agreement to three statements:

- *I know who to contact for input on a work related problem*
- *It is fast and efficient to get access to relevant knowledge from my colleagues*
- *My colleagues are accommodating to share relevant knowledge*

Furthermore, the level of trust needed to be measured. Research has shown that trust is difficult to measure accurately using surveys in that people often display a different trusting behavior than they indicate in surveys when asked directly. Glaeser et al. showed that to determine whether someone is trusting, it is important to ask about trusting behavior, rather than merely asking whether the respondent trusts someone else (Glaeser, Laibson, Scheinkman, & Soutter, 2000).

To determine the level of trust reliably, accounting for this challenge, three questions were asked:

- *Generally, I believe that I can trust the colleagues in my team*
- *I share information unreservedly with the colleagues in my department*
- *The colleagues in my department share information unreservedly with me*

After data was collected, it was validated through a Chronbach's alpha test whether the rating on the three questions could be combined into one measure of trust.

4.2.4 Communication channels

In selecting the communication channels to enquire about, a number of people from Energinet.dk were asked which communication channels were used within the organization, resulting in a list of six possibilities:

- *Documents, manuals, procedures etc.*
- *E-mail*
- *GETS-better*
- *Lync (instant messanging)*
- *Personal contact (face-to-face)*
- *Telephone*

These channels are suitable for transferring different kinds of knowledge and cover a range from impersonal to personal in the following order: Documents, GETS-better, E-mail, Lync, Telephone, Personal contact. However, in order not to invoke a question order bias, it was decided to list the options in alphabetical order.

4.2.5 Scale points

The scale questions were using a unipolar 5-point Likert scale with each point labelled with words rather than numbers (Schaeffer & Presser, 2003). The decision to label each point rather than just the end points was to improve the reliability and validity of the data (Krosnick, 1999). An uneven scale with a neutral, middle alternative was used to reduce the amount of random measurement error without affecting the validity (Schaeffer & Presser, 2003). No 'don't know' option was included as the neutral, middle alternative was deemed sufficient to decrease the risk of random data error (Schaeffer & Presser, 2003).

4.2.6 Social network questions

The approach to obtaining data for the SNA was based on a free-recall method, asking the participants to name five people from their recollection without being presented with a list of employees. Compared to the roster method, where participants choose from a list of candidates in their potential network, the free-recall approach is sometimes found to provide less accurate information and have a bias towards most recent contacts (Carnabuci & Diószegi, 2015). The roaster method, however, results in longer questionnaires and can be more time consuming when mapping large networks, as in this case (Carnabuci & Diószegi, 2015). The fact that the network boundaries were defined to be within the department mitigates the risk of respondents forgetting people they share relations with (Marin & Wellman, 2011).

Burt found that five names was the most cost-effective number of names to ask to be able to accurately map a social network. He found that *"the additional names can be expected to be 60–70% redundant with the first five, which makes the additional burden on respondents of asking for more names questionable"* (Burt & Merluzzia, 2013). Leaving room for only five names, the participants were only able to include their strongest links, and it was not possible subsequently to analyze the strength of ties, as the data did not contain this variation.

The data on knowledge sharing was collected on directed ties, meaning that it was investigated whom an individual approaches to seek advice, whereas the social network of non-work related relations was performed on undirected ties.

The network questions were phrased as follows:

- *Please list the 5 persons in ANEG that you have **most often** sought work related knowledge from within the past 3 months, as well as the most important communication channel, you have used.*

The assumption was that this would result in a list of strong ties for seeking knowledge. However, a risk was recognized that some participants might not interpret this as valuable knowledge, so to validate this, a second question was posed:

- *Please list the 5 persons in ANEG that you obtained the **most valuable** work related knowledge from within the past 3 months, as well as the most important communication channel, you have used.*

These were followed by options to mark one of five possible communication channels: E-mail, Lync, Face-to-face, Telephone, and Other (followed by a free-text field).

Research has shown that an employee's friendship network is an important source of knowledge-sharing and support (Carnabuci & Diószegi, 2015), which led to the third network question:

- *Please list the 5 persons in ANEG that you have spoken the most with about topics that are not work related (hobbies, interests, spare time activities etc.) within the past 3 months.*

A specific time frame of three months was set to ensure that the respondents answered on a similar duration, making the data comparable across respondents. By setting this to three months respondents, the risk of respondents having to recall a distant past was avoided, improving the reliability of the study (Schaeffer & Presser, 2003).

4.3 Control variables

Seniority in the department was included to validate if this factor outside the theoretical framework had a significant influence on the evaluation of knowledge sharing. Seniority was chosen as it can have an impact on the place in the networks and on the evaluation of knowledge sharing in that people with a high seniority are more likely to take a central position in the network (Yamkovenko & Hatala, 2015).

4.4 Pre-testing

The survey was pre-tested on three people within Energinet.dk and three people outside of the company to check whether the questions were ambiguous, if the questions were understood in the same way that they were intended, and if they were likely to meet resistance (Krackhardt & Hanson, 1993). Using cognitive pre-testing, people were asked to think out loud while reading the questions (Krosnick, 1999).

A number of changes were made following the pre-tests. For example, the original intention was the use the same question as Hansen to determine whether the most valuable knowledge was simple or complex: *"How well documented is the type of knowledge that you usually need to solve your tasks"* (Hansen, 1999), but this was interpreted by several people to indicate how good the company was at documenting knowledge that was possible and supposed to be documented. It was therefore decided to replace this

question with three more elaborately explained definitions of knowledge, which the respondents should evaluate. See chapter 4.2.1 for the chosen approach, which was interpreted according to the intention.

4.5 Distribution method

It was decided to let the respondents complete the survey online in their own time, rather than asking the respondents the questions in person. Partly because of the high number of participants and the time it would take to ask the questions in person, partly as the self-administered approach allows people more time to think through their response, which is particularly important for the SNA part of the questionnaire, and also increase the likelihood of the respondents using the full scale (Schaeffer & Presser, 2003). On the down side, this approach did not allow clarifying the questions in case of potential misunderstandings, increasing the importance of the pre-test, and can have had a negative impact on the response rate (Krosnick, 1999).

A number of tools were investigated before deciding on the online survey tool, SurveyExact. This is not ideal for SNA as it lacks specific layout capabilities and analytical tools that others contain, e.g. Socilyzer, but it is more stable and contains strong data extract capabilities for later statistical analysis. It was considered to use SurveyExact for the scale questions and Socilyzer for the SNA questions, but it was deemed to incur a risk of low response rate if the participants were required to use two different tools.

A link was sent to the employees by the team leaders in an e-mail explaining the background and purpose of the study. Here, it was highlighted that the results would be anonymous, and that participation was voluntary, but encouraged by the company. See app. 5.

The respondents were given three weeks to complete the survey, which took approximately 8-10 minutes to complete.

4.6 Validity and risks

4.6.1 Anonymity

One of the most valuable ways to use SNA for installing change in an organization is to engage employees in discussions on the basis of visualizations of the networks with people's names on the nodes, so that people can see themselves and their colleagues in the networks (Cross, Borgatti, & Parker, 2002). The associated HR consultant in Energinet.dk, however, voiced some concern that a lack of anonymity might lead to a low response rate and entail a risk of misleading information in that people would have an interest in inflating their network or representing themselves as more connected to certain people than they are in reality (Utoft, 2016). Yamkovenko draws attention to this risk of social desirability and points out that this can be eliminated by asking for a limited number of ties (Yamkovenko & Hatala, 2015). The risk of inflation was thus mitigated by anonymizing the results, removing any personal motivation to be strategic about the answers.

Therefore, it was decided to make the results anonymous for the entire organization. Respondents were still required to input their own name in order to generate the SNA, but they were made aware of the anonymity principle both in the e-mail invitation and in the introduction to the survey online.

4.6.2 Ambiguity

Despite the efforts to ensure that the questions were unambiguous and understandable in their own right without further explanation, one respondent sent a message after having completed the survey, saying that *"I was in doubt what the questions actually referred to and tried to read between the lines"* (Jensen, PMO manager, 2016). It was considered to follow up with that respondent and clarify what the questions were, allow her to change her submission if needed, and add further explanatory comments in the survey for the rest of the respondents. However, as more than 50 people had already responded to the survey at that time, it was deemed most accurate to leave the questions as they were in order not to risk that the remaining respondents would be answering questions with a different meaning, ultimately disturbing the validity of the survey.

To minimize the risk that the survey results were misaligned with reality, a number of interviews were held with team leaders after the survey data was collected and analyzed. See chapter 4.6.6.

4.6.3 Time

For SNA in particular, it can be an issue that the network reflects a particular point in time. It depends on the current structure and dynamics in the organization, and the answers may be influenced by certain events and moods with the respondents, and the network might look different if the survey is repeated only a short time after (Yamkovenko & Hatala, 2015).

4.6.4 Response rate

Lastly, in SNA, missing data can significantly affect the representations of the network, and the removal of a single centrally located node can have significant implications for the structure of the network (Yamkovenko & Hatala, 2015) (Carnabuci & Diószegi, 2015).

One week in to the survey 26% had responded, and the PMO Manager at Energinet.dk sent a reminder to the team leaders with a status of the response rates in their teams, see app. 6. While this worked effectively to increase the response rates over the next days, it was unfortunately not well received by all recipients, some of whom felt *"that they were exposed"* (Jensen, PMO manager, 2016). One week before deadline, another reminder was sent to the 127 people who had not yet responded to the survey, see app. 7.

On the deadline, 120 responses were collected in total, resulting in a response rate of 48%. An additional 34 people had started answering the survey, but closed the survey before completion. Seeing as the respondents had been promised that participation was voluntary and that they could leave the survey at any time if they did not wish to participate, it was decided not to include the partial answers.

4.6.5 Data cleaning

After collecting the data for the SNA, all entries were matched up against a main list of employees provided by the contact in ANEG. This was done to identify any data entry errors in terms of wrong spelling and individuals outside the department.

As the questionnaire asked for both full names and initials of the contacts, wrong spelling could be easily identified and corrected.

A list of contacts entered in the questionnaire, but not found in the main list, was sent to the contact in ANEG, who provided the missing details. 15 individuals from the department were added to the list. Four contacts were not possible to identify, and 40 contacts were found to be people outside the department.

In total, 213 manual corrections were made to the SNA data for all three networks, thus 12% of all entries were manually corrected.

In a number of cases, respondents chose to enter fewer than five contacts, especially under the non-work related contacts, where also five respondents chose to enter only dummy data, which was excluded, leaving only 115 responses to that data set.

As the questionnaire had specifically asked the respondents to name their contacts within the department, it was decided not to include the contacts outside the department. On the one hand, it meant that a number of respondents had fewer than five contacts listed, but on the other, it ensured that only networks within the department were mapped as per the initial limitations.

Last, all nodes were coded with a unique combination of the department prefix and a random digit. This ensured consistency across the three network analyses, while at the same time ensuring anonymity.

4.6.6 Interviews

To complement the findings of the analysis, interviews were held with three of the team leaders in the department. The purpose of was both to validate the findings of the quantitative data through clarification, and at the same time to elaborate and expand the interpretation of the results by getting further insights into the characteristics of the teams and their work with knowledge management - trying to understand the background for the results - thereby increasing the validity of the study (Greene, Caracelli, & Graham, 1989).

After the completion of the data analysis, the team leaders were invited to a one hour meeting, where they were presented with the overall findings of the analysis and a more in-depth presentation of the results pertaining to their specific team. This was followed by a semi-structured interview about the interpretation of the results and knowledge sharing within their team and the department in general.

The team leaders of Projekter, Indkøb and QHSE reverted positively, the others were not available.

4.6.7 Reflection on data collection

Using a questionnaire for data collection always entails issues of validity, i.e. whether the questionnaire actually measures what it is intended to measure. While steps such as the definition of the constructs and pre-testing can improve the validity, one is always faced with the risks that the respondents perceive certain questions or words differently than the intention of the author. Furthermore, the perception of each of the respondents can be influenced by a number of events that are impossible for the author to foresee and mitigate for (Miles, 2014).

While qualitative data collection holds a number of advantages in terms of being able to ask into the specific perception of the respondent and record a more accurate reflection of the perception, the issue of validity is not entirely eliminated in that a number of other factors can play a role in determining the answer that the respondent provides, e.g. social desirability issues, strategic considerations in answering

the questions etc. (Miles, 2014). Also here, the response is influenced by a number of factors that it is impossible for the researcher to take into account.

Therefore, all conclusions based on data, whether collected quantitatively or qualitatively, should be taken as an indication for further exploration rather than conclusive evidence.

A different approach might have further improved the validity of the study, e.g. observations at the department over a longer period of time coupled with informal and unstructured interviews with employees in the different teams around the topic of knowledge sharing. This might have provided more reliable information about both the actual and perceived levels of knowledge sharing as well as a possibility to capture the social networks by mapping the personal communication between employees. The insight into the corporate culture that such an exercise would have provided, might also have assisted with uncovering different reasons for the level of knowledge sharing and use of different communication channels. Similarly, access to electronic communication data would have provided more accurate information about the use of communication channels between different individuals.

This was, however, beyond the scope of the project.

5 Analysis

This chapter will present the analysis of the quantitative data with the aim of verifying the hypotheses. After an introduction to the overall descriptive statistics, an analysis of the scale questions will be presented, where hypotheses 1-6 will be tested through a series of linear regression models.

Hereafter, the social networks will be presented with a number of observations to each of the networks and a comparison between the networks, followed by a number of linear regression analyses to verify hypotheses 7-11 using the input on the scale questions from the questionnaire in combination with the network measures from the SNA.

5.1 Descriptive statistics

5.1.1 Sample size

The sample used consists of the department ANEG, including team leaders and the head of department, amounting to 251 persons in total. A total of 120 employees completed the survey. In addition to this, 34 responses were incomplete, and had to be discarded. 5 respondents entered dummy data under their non-work related contacts, and the data was excluded, leaving only 115 respondents in that analysis. While a sample of this size is appropriate for network studies using survey data, missing data is problematic in that it may cause wrong conclusions, especially in a network survey (Carnabuci & Diószegi, 2015). Not only is there a risk that the network visualizations display a misleading picture due to missing input from potentially prominent network members, there is a risk that the network measures, including degree, density, constraint etc. are not displaying a correct picture as the addition of a few more individuals might change the picture significantly, and a group that has a high level of measured closeness, might in reality be one that is low on closeness (Carnabuci & Diószegi, 2015). Consequently, these measures need to be taken with some precaution, as do the linear regression analyses that include these measures.

There were unfortunately no possibility of extending the deadline of the survey to increase the response rate, and it was necessary to proceed with the collected data despite the negative consequences for the reliability of the data. A sample size of 48% is however larger than some of the other respected research in the area, e.g. Obstfeldt (Obstfeld, 2005).

5.1.2 Averages and distribution

The descriptive statistics and averages of the variables provide an overview of the collected data. The individual variables were coded to provide an easier overview of the results (see app. 8 and app. 9). To check for skewness in the measured variables, charts of the distributions were created, see app. 10. Here, it is evident that some of the data is left skew, which is also reflected in the mean values of some of the variables.

It is noticeable that the mean of the variables for knowledge types display a higher rating, the more tacit the knowledge, compare the mean of VID TAC of 4.43, VID T-E of 4.11 and VID EXP of 3.82. This indicates that the department in general finds tacit knowledge to be more valuable than explicit knowledge.

In relation to communication channels, personal communication (KAN PER) stands out with a mean of 4.78, while GETS-better (KAN GET) on the other end scores a mean of a mere 2.13 in terms of how useful it is perceived to provide access to useful and valuable information.

The overall assessment of how good the organization is at sharing knowledge reveals that there is general agreement that knowledge sharing works well within the teams (VID TEA) with a mean of 4.18, while the score for knowledge sharing within the department (VID AFD) is noticeable lower with a mean of 3.74.

Within the relational factors, means of 4.25 and 4.56 indicate that employees know whom to contact to solve a work-related problem (VED KON), and that colleagues are accommodating to share knowledge (KOL IMØ). Overall, the results indicate that there is a large degree of trust in the organization with the overall trust variable (TIL GEN), scoring a mean of 4.77. A score of 3.94 reveals that there may be room for improvement on how fast and efficient it is to get access to relevant knowledge from colleagues (HUR KON).

5.1.3 Observations on full data set correlations

To identify any potential correlations between the variables, a matrix of the correlation coefficients was produced between all variables, see app. 11. The purpose of this was to get a quick overview of links and correlations to be tested through regression models at a later stage. At this point, the correlations were not tested for significance.

Interestingly, the only correlation with seniority that is noticeable is between seniority in the department and perceived level of knowledge sharing in the team at 0.25 with all other correlations with seniority lower and seemingly insignificant.

It is not surprising to find correlations between the perceived levels of knowledge in the department and the perceived levels in the teams (VID AFD and VID TEA). The positive correlations between the relational factors of knowing whom to contact (VED KON), the perceived efficiency of access to knowledge (HUR KON), the perceived approachability of colleagues (KOL IMØ) and trust (TIL GEN, TIL IN, TIL OUT) with the

perceived levels of knowledge sharing in the department and in the teams is likely to be explained by the fact that these variables are prerequisites for a high level of knowledge sharing.

5.2 Analytical methods

5.2.1 Combination of variables

For some of the hypotheses, the topic of interest was the perceived level of knowledge sharing - regardless of whether it is within the department or in the team, and it was therefore decided to combine the two variables VID AFD and VID TEA into one variable. To evaluate whether the two are sufficiently similar to justify that they are measuring the same thing, and consequently can be combined into one variable, the reliability of the variables was calculated using Chronbach's Alpha, where a value above 0.6 indicates a level of similarity that is generally seen to be sufficient to combine the values into one (Lance, Butts, & Michels, 2006). For VID AFD and VID TEA, this revealed a measure of 0.74, and they were combined in to VID COM.

Also, the three variables covering trust were evaluated for reliability with the intention to combine them into one. The Chronbach's Alpha revealed a measure of 0.69, which is taken to indicate an accepted level (Lance, Butts, & Michels, 2006), and it was decided to combine the variables into TIL COM. See app. 12.

5.2.2 Linear regression

Linear regression models are used to establish the explanatory power of the variables to the dependent variable. A model with a significance level of < 0.05 is generally considered to be significant. To conduct a reliable linear regression model, a number of conditions should to be met to be sure that the model displays the correct picture (Su, Yan, & Chih-Ling, 2012):

Measurement: All variables are measured on an interval scale without error. For this to be met, the variables of seniority were converted to a scale of 1-4. For the social network measures, the low response rate is likely to have a negative impact on the accuracy of the measurements, and the results of the linear regression models including these variables should be interpreted with caution.

Specification: All relevant indicators are included in the analysis. During a multiple linear regression analysis, variables with limited influence on the dependent variable are removed from the analysis, and the analysis is run again without the variable(s) that have a limited explanatory power.

Multicollinarity: There can be no high level of multicollinarity between the independent variables as this might cover the same explanatory factors. For trust, the combination of the three variables ensured that this condition was met. Where relevant in the hypothesis tests, both individual and multiple linear regression models were conducted to test for overlap in the independent variables.

Linear relationship between variables: This was checked by creating scatter plots between the dependent and independent variables for each analysis.

Normality: The variables are assumed to be normally distributed. See app. 10. This is approximately the case for most variables, with some exceptions, e.g. VID TAC , KOL IMØ, KAN DOK, KAN PER and TIL that are left skew. When variables are not normally distributed, e.g. when data is skew to one of the sides, it does not necessarily undermine the findings of the analysis, but may cause problems with extracting significant findings. To overcome this, data can be converted into binary data to better examine the variation.

Homoscedasticity: The residuals should display an equal distribution across the line, as otherwise there is a risk of overestimating the correlation. This is checked by scatter plots where relevant in the models.

5.3 Control variables

A number of control variables were considered for the analysis, including gender, educational level, and certain personality traits such as e.g. extrovertness/introvertness, as these might have an influence on the approach to knowledge sharing, but it was decided to leave it at seniority in the department as this was deemed to be the most obvious control variable to knowledge sharing. This was included in the multiple linear regression models where relevant.

5.4 Hypotheses 1-4

The first four hypotheses were intended to uncover the link between the perceived level of knowledge sharing and the relational factors with the following expectations:

H1: The better individuals know who to contact for information, the higher the perceived level of knowledge sharing

H2: The better the perceived access to colleagues, the higher the perceived level of knowledge sharing

H3: The more accommodating colleagues are perceived to be to share knowledge, the higher the perceived level of knowledge sharing

H4: The higher the level of perceived trust, the higher the perceived level of knowledge sharing

In order to test these, a series of individual simple linear regression models were created with the perceived level of knowledge sharing (VID COM) as dependent variable to establish whether the individual relational variables have a significant explanatory power to the dependent variable. A summarized table of the results in table 1. See app. 13. for scatter plots and app. 14 for the full analysis output.

	VED KON	HUR KON	KOL IMØ	TIL COM
R Square	0,19	0,35	0,13	0,12
Coefficient	0,41	0,54	0,41	0,51
Significance	6,24271E-07	1,01608E-12	5,41252E-05	0,000145

Table 1: Results linear regression model, H1-H4. Perceived level of knowledge sharing and relational factors

The R Square is a measure of how close the data is to the fitted regression line, explaining how much of the variability that is explained by the linear model. This reveals that while all of the variables explain some of the variability within the dependent variable, HUR KON is the variable that explains the most of the variability in isolation.

The coefficient measures the explanatory power of the variable, meaning that for each additional scale point in the independent variable, the dependent variable is expected to increase by the coefficient. Also here, HUR KON has the highest score, meaning that a change in this variable has the highest impact on the score of the dependent variable.

The significance is a measure of whether the null-hypothesis of no effect can be rejected. In all cases, the significance is below 0.05, meaning that the null-hypothesis can be rejected in all cases, and the results considered significant.

Evaluating the hypotheses in isolation, each of them can therefore be confirmed.

As these variables are unlikely to work in isolation, it was decided to run a multiple linear regression model to establish the combined explanatory power of the variables and adjust for potential multicollinearity. This model included also seniority in the department as control variable.

This revealed that the overall model was significant, and with an R Square of 0.42, higher than any of the individual variables in the previous models. The variables of ANC AFD, KOL IMØ and TIL COM, however, had a P-value of above 0.05, and were removed from the analysis before it was re-run, see app. 15.

This resulted in a drastically improved overall significance with P-values well below 0.05 for both remaining variables, and R Square slightly reduced to 0.38. Of the two, HUR KON reveals both the highest significance, and the highest coefficient of 0.45, see app. 16.

In conclusion, hypotheses 1-4 are all confirmed, however with the notion that HUR KON displays the strongest results, followed by VED KON then TIL COM and finally KOL IMØ.

In other words, the variable that has the largest influence on how well employees perceive knowledge sharing is that it is fast and efficient to get access to relevant knowledge from the colleagues. Also knowing whom to contact and being able to trust one's colleagues play a role. That colleagues are accommodating plays a noticably smaller role than the other factors.

5.5 Hypothesis 5

Hypotheses 5 and 6 were intended to uncover the link between the perceived value of different knowledge types and preferred communication channels based on an expectation that there would be a correlation between the degree of tacitness of knowledge and personal communication.

H5: Individuals who perceive tacit knowledge to be more valuable prefer personal contact as channel for knowledge sharing

To test hypothesis 5, the dependent variable was VID TAC, the perception of tacit knowledge being the most important type of knowledge, and the perception of the effectiveness of the communication channels were used as independent variables in a multiple linear regression analysis. To check for linearity, scatter plots were created with VID TAC and the communication channels, where no non-linear relationships were found, see app. 17.

The multiple linear regression analysis showed an R Square of 0.23 and overall significance. Of all the communication channels, only KAN PER showed a significant coefficient and a significance of less than 0.05. See app. 18. Therefore, a simple linear regression was run with only this variable. This resulted in a slightly reduced R-square at 0.20, an improved significance and a coefficient of 0.71, see app. 19.

On this basis, hypothesis 5 was confirmed - the more important tacit knowledge is perceived to be, the more effective personal communication is perceived to be as a communication channel.

5.6 Hypothesis 6

H6: Individuals who perceive explicit knowledge to be more valuable prefer documents as the preferred channel for knowledge sharing

To test hypothesis 6, the dependent variable was VID EXP, the perception of explicit knowledge being the most important type of knowledge, and the perception of the effectiveness of the communication channels were used as independent variables in a multiple linear regression analysis. To check for linearity, scatter plots were created with VID EXP and the communication channels, where no non-linear relationships were found, see app. 20.

The multiple linear regression analysis showed an R Square of 0.38 and overall significance. Of all the communication channels, only KAN DOK showed a significant coefficient and a significance of less than 0.05. See app. 21. Therefore, a simple linear regression was run with only this variable. This resulted in a slightly reduced R-square at 0.36, an improved significance and a coefficient of 0.61, see app. 22.

On this basis, hypothesis 6 was confirmed - the more important explicit knowledge is perceived to be, the more effective documents are perceived to be as a communication channel.

5.7 Social Network Analysis

The network analysis was performed using UCINet creating three separate networks with attributes indicating which department the respondents belong to. See app. 23-25 for visualizations.

The intention of the first social network, VIDEN OFTE, was to map, whom employees most often engage with for knowledge sharing, based on the question "*Please list the 5 persons in ANEG that you have **most often** sought work related knowledge from within the past 3 months, as well as the most important communication channel, you have used"*. This is based on the commonly used approach that strong ties are based on frequency of interaction.

As described in chapter 4.2.6, this entails a risk that employees would not interpret this as the most valuable knowledge, and e.g. a secretary would be on a lot of lists due to frequent interaction, despite that the information shared is not necessarily valuable knowledge, but e.g. travel reports, invoices etc. Therefore, the intention of the second social network, VIDEN VIGTIG, was to map whom employees engage with to get the most valuable knowledge, based on the question: *"Please list the 5 persons in ANEG that you obtained the **most valuable** work related knowledge from within the past 3 months, as well as the most important communication channel, you have used"*.

As friends are known to be a source of knowledge sharing, the intention of the third network, SOCIAL, was to map with the circle of friends of the employees in the workplace based on the question*: "Please list the 5 persons in ANEG that you have spoken the most with about topics that are not work related (hobbies, interests, spare time activities etc.)"*.

5.7.1 Comparative description of the networks

5.7.1.1 Whole network measures

To investigate differences and similarities between the three networks, a number of measures were used to compare the three overall networks:

Density measures the overall level of connectivity in a network and is the proportion of ties that are actually present, and can serve as an indicator of how fast information can flow in the network directly between actors. A network with 100% density is one where all nodes are connected to each other. The larger the density, the faster information can travel within the team.

Closeness measures the distance between the actors in a network, i.e. how many other nodes an actor must go through to connect with the other members of the network. The higher the closeness measure, the shorter the distance between the members of the network. The closer the network, the faster information travels between the individuals in it. In addition to the direct connections between individuals, the closeness measure takes into account the distance between the individuals in a network.

Degree centrality is a measure of the number of direct ties between the members of a network, and is taken as an indication of the networking activity of the members within a network. A high degree centrality in a group means that the connections are centered around only a few individuals, whereas in a group with a low degree centrality, the activity is more evenly spread across the individuals in the network.

Furthermore, the ego degree measures were used to make a comparison of the number of connections of each ego network, i.e. a count of how many connections the individual nodes have. This was used to get an indication of how widely spread the networks were. All the individuals, who responded to the questionnaire as instructed would have an out-degree of 5, however, those, who either entered less than 5 contacts, or entered contacts outside of the department, would have an out-degree of less than 5. In this context, the in-degree was deemed to be the most interesting measure, where - if everything was distributed evenly – all individuals would have an in-degree of 5. Therefore, it is interesting to note how many of the individuals have an in-degree higher than 5 as this is an indication of the extent to which the network is centered around only a few individuals.

Also, the number of connections within the same team of the respondent were counted and used as an indication of how well connected the network was within and between teams.

Last, the count of preferred communication channels was established on the basis of what channel the respondent had chosen for each of the contacts in the questionnaire for the VIDEN OFTE and VIDEN VIGTIG networks.

The networks showed a number of similarities and differences in their structure, see table 2.

	VIGTIG	OFTE	SOCIAL
Respondents	120	120	115
Network size	213	210	215
Density	0,013	0,012	0,011
Closure	0,192	0,182	0,204
Deg Centralization	0,011	0,011	0,012
In-degree >5	13%	12%	9%
Out-team contacts	34%	32%	23%
In-team contacts	66%	68%	77%
Channel frequency			
PER	83%	84%	N/A
TEL	6%	6%	N/A
EMA	8%	7%	N/A
LYN	0%	0%	N/A
AND	3%	3%	N/A

Table 2: Comparison of networks

120 people responded to the VIDEN VIGTIG and VIDEN OFTE network questions, while five abstained from answering the SOCIAL questions. The total networks include 210-215 individuals, meaning that apart from the individuals, who responded to the survey, up to an additional 100 individuals within the department, who did not respond to the survey, were mentioned once or more as a contact of one of the respondents.

The density, closeness and degree centralization measures for VIDEN VIGTIG and VIDEN OFTE networks indicate that the structures of the two networks are very similar in terms of how closely connected the individuals are. SOCIAL has a slightly higher degree of closeness, indicating that there is a shorter distance between the members of the network in general.

In the VIDEN OFTE and VIDEN VIGTIG networks, 12-13% of the network members have an in-degree higher than 5, meaning that these individuals have more people listing them as contacts than they have contacts listed. For SOCIAL, this is only 9%, which explains why the number of people in the network is higher, despite fewer respondents. See app. 26-28.

While this is a measure to be taken with some caution as the survey contained a limitation of five contacts, it does provide an indication that VIDEN OFTE and VIDEN VIGTIG are relatively similar in this respect.

Testing to which extent individuals selected the same contacts in the three different networks revealed that in 40% of all cases, a contact that an individual had selected in SOCIAL was selected by the same individual in VIDEN OFTE. For SOCIAL and VIDEN VIGTIG the number was 39%. The comparison of VIDEN OFTE and VIDEN VIGTIG revealed an overlap of 65%.

Supporting the similarity on the individual in-degree across the networks, a correlation matrix revealed that the correlation of in-degree between the individuals in VIDEN OFTE and VIDEN VIGTIG was as high as 0.89, while the correlation between SOCIAL and the work related networks was 0.47. See app. 29. To validate this indication, two simple linear regression models were made with the in-degree measures from VIDEN OFTE and VIDEN VIGTIG as the dependent variable and in-degree from SOCIAL as the independent variable.

Both showed a high degree of significance and coefficients of 0.55 and 0.57 respectively, indicating that there is a noticeable correlation between the work-related knowledge sharing networks and the social networks. See app. 30 and 31.

Similarly, a linear regression model was made with in-degree from VIDEN VIGTIG as the dependent variable and in-degree from VIDEN OFTE as the independent variable, showing a high level of significance and a coefficient of 0.93, which indicates a strong overlap in the people most often mentioned as contacts under VIDEN OFTE and VIDEN VIGTIG, see app. 32.

To get an indication of the extent to which the teams shared knowledge primarily within their own team, a table was produced, outlining the number of contacts the respondents within each team had listed from within and outside their own team, see app. 33-35. On the overall networks, VIDEN OFTE and VIDEN VIGTIG have a similar percentage of in-team contacts with 68% and 66% respectively.

Not surprisingly, SOCIAL revealed a significantly higher degree of in-team contacts overall, see app. 35. It makes logic sense that people socialize most with people from their own team. This is also evident when comparing the visualizations of three networks, where you find that the individuals in SOCIAL are grouped more together in their own teams than in the other two networks.

For VIDEN VIGTIG and VIDEN OFTE, the preferred communication channel with each of the nominated contacts revealed a similar picture. With 120 respondents each providing a preferred communication channel to each of their five contacts, this gives a total of 600 possible communication channels. In VIDEN OFTE, there were five cases where no preferred contact was indicated, leaving a total of 595 possible preferred communication channels. For VIDEN VIGTIG, the total number of possible channels was 583.

Evaluating the number of times each of the four communication channels were indicated shows a clear preference for personal communication: This was chosen in 84% of all cases in VIDEN OFTE and 83% in VIDEN VIGTIG, see app. 36 and 37.

5.7.1.2 Summary comparative description of three networks

It was established that there is very little difference between VIDEN VIGTIG and VIDEN OFTE across all the measures. Although the linear regression model showed a significant and relatively large correlation between the in-degree scores of the work related knowledge sharing networks and SOCIAL, there were significant differences in the percentage of in-team contacts, which is also evident from the visualization of the network. This is taken as an indication that the two work related knowledge sharing networks to a large degree reflect a similar picture of knowledge sharing between individuals in the department.

Having described and compared the three networks, we can proceed to test hypotheses 7 and 8.

5.8 Hypothesis 7 and 8

These two contradicting hypotheses were intended to evaluate which of the theories of structural holes and closeness best fit the current structure at ANEG.

H7: Individuals in structural hole positions perceive information sharing to be better than individuals in closed networks

H8: Individuals in closed networks perceive information sharing to be better than individuals in structural hole positions

To measure closeness vs. structural holes, the ego level constraint measure developed by Burt (Burt, 2001) was chosen as the main independent variable for analysis. This variable is a function of size, density and hierarchy, and measures the extent to which an individual's connections are redundant. As such, it provides a measure of both structural holes (by a low score) and closeness (by a high score) in one and the same measure.

To test the hypothesis, four simple linear regression models were created; two with the perceived level of knowledge sharing within the team (VID TEA) as the dependent variable, and two with the perceived level of knowledge sharing within the department (VID AFD) as the dependent variable. The independent variables were the constraint measure from the VIDEN VIGTIG and VIDEN OFTE networks respectively, see app. 38-41, summarized below in table 3.

VID AFD	VIGTIG	OFTE
R sq	0,04	0,05
Coeff.	-1,36	-1,48
Sig	0,037	0,015

VID TEA	VIGTIG	OFTE
R sq	0,01	0,01
Coeff.	-0,66	-0,43
Sig	0,250	0,421

Table 3: Results linear regression models H7-H8. Perceived level of knowledge sharing and constraint

With significance levels above 0.05, and an R Square of 0.01, it can be concluded that the constraint measure has very little explanatory power on VID TEA as the dependent variable, and the null-hypothesis of zero correlation cannot be rejected. In other words, no significant correlation is found between network positions in the entire network and perceived knowledge sharing within the team, and on this basis, it cannot be concluded whether structural holes or closeness are most suitable for knowledge sharing *within the team.*

With VID AFD as the dependent variable, however, the significance levels are below 0.05 for both networks, and there is a noticeable negative coefficient, indicating that there is in fact a correlation between the constraint measure and the dependent variable. The negative coefficient means that the more constrained the networks, the lower the score on VID AFD, and reversely, the less constrained – or the more an individual finds himself in a brokerage position in the entire network - the better the perceived level of knowledge sharing *in the department*. Although an R Square of only 4-5% means that the independent variable only explains a little part of the variation, hypothesis 7 can be confirmed for perceived knowledge sharing in the department, but not for the perceived knowledge sharing in the team.

There are no indications that higher constraint leads to higher perceived levels of knowledge sharing, and hypothesis 8 can be rejected.

5.8.1 Team networks

To further investigate similarities and differences between the teams, individual networks for all teams were created where only the respondents from each of the teams were included. As chapter 5.7.1 had revealed that VIDEN VIGTIG and VIDEN OFTE were similar on most counts, this was made on the basis of the VIDEN VIGTIG network. See app. 42 for visualizations of the individual networks.

The same measures as used for the three overall networks were used to compare the team networks as well, see summary in table 4.

	AUT	DAT	IND	KON	LED	NET	PLA	PRM	PRO	QHS	STA
Respondents	12	5	17	7	7	9	17	4	24	9	9
Network size	22	17	36	26	20	34	51	17	72	31	29
Density	0,092	0,088	0,059	0,046	0,092	0,037	0,033	0,070	0,021	0,039	0,054
Closure	0,283	0,361	0,250	0,412	0,406	0,037	0,171	0,200	0,164	0,128	0,250
Deg Centralization	0,127	0,254	0,089	0,167	0,190	0,121	0,070	0,275	0,051	0,137	0,134
In-degree >5	23%	6%	11%	0%	15%	3%	8%	6%	4%	0%	17%
Out-team contacts	13%	25%	21%	57%	23%	40%	20%	58%	51%	50%	34%
In-team contacts	87%	75%	79%	43%	77%	60%	80%	42%	49%	50%	66%
Channel frequency											
PER	88%	76%	85%	71%	77%	69%	78%	94%	87%	68%	98%
TEL	8%	20%	0%	0%	11%	2%	7%	3%	7%	20%	0%
EMA	3%	4%	6%	18%	9%	18%	12%	3%	7%	13%	2%
LYN	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%
AND	0%	0%	9%	11%	0%	11%	4%	0%	0%	0%	0%

Table 4: Comparison of team networks

Within the network measures, it is evident that there is a correlation between density, the number of people with >5 in-degree and the number of in-team contacts, although the latter is not statistically significant at an alpha level of 0.05, see app. 43 and 44. This does serve as an indication that the larger the number of contacts within the team, the higher the density.

While the average in-team contacts for the whole network is 66%, at the one end of the scale, Automation stands out with 87% in-team contacts, and at the other end of the scale, Projektmodning and Konstruktioner stand out at the other end with 42% and 43% respectively - meaning that they more frequently mentioned contacts outside their own team as the ones they communicate with on important work related items. This picture is confirmed by the visualization in app. 23, clearly showing that while Automation is closely linked in the lower left corner, the nodes from Konstruktioner are scattered around the network, and Projektmodning finds themselves in the middle, connected to other groups.

In terms of the selected communication channels, nine of the 11 teams had chosen personal communication in more than 70% of all cases. In the networks Netplanlægning and Indkøb, 'other' was selected a number of times. Here, the comment field noted that either all communication modes were used, or personal contact was used to establish contact, later to be followed up by a different channel, supporting the importance of personal communication as the preferred channel.

Four departments had chosen e-mail in more than 10% of the cases, and there seems to be a trend that the teams with the most out-team contacts favor e-mail to a larger extent that the teams with fewer out-team contacts, which makes logical sense.

Having described and looked into the specifics of the teams, we can proceed to test hypothesis 9.

5.9 Hypothesis 9

The intention of this hypothesis was to establish which factors influence the perceived level of knowledge sharing within and between teams.

H9: The perceived level of knowledge sharing within and across teams depends on the network structure in the teams

To test the hypothesis, VID TEA and VID AFD were used as dependent variables, and the three team based network measures were used as independent variables in two multiple linear regression models, see app. 45 and 46.

The model for VID TEA had a very low significance, and the scatter plots showed no clear linear relationship. The correlation between VID TEA and density approximated the form of a reversed U-shape, which could indicate that density has a positive impact on the perceived level of knowledge sharing up until a point, after which there are negative returns when the density becomes too high, see app. 45. With only 11 teams in the study, however, this indication should be taken with some caution.

The multiple linear regression model for VID AFD reveals a more prominent significance of 0.1, and a noticeable R square of 0.56. As density had a high P-value, this was removed from the model before it was rerun. The reduced model showed overall significance of 0.04 with an R square of 0.53, see app.47.

We here see that the two remaining network measures, closeness and degree centralization have opposite working coefficients. Where there is a positive coefficient between degree centralization and VID AFD of 3.82, the relation between VID AFD and closeness has a negative coefficient of -2.10. For sake of completeness, two individual simple linear regression models were run, see app. 48 and 49, but none of them were found to be significant in isolation.

Meaning that the higher the degree centralization - the more connections in a team are centred around a few individuals - and the looser they are connected, the better the perceived level of knowledge sharing with other teams.

To understand this better, we need to turn to the individual teams. App. 50 shows a matrix of the team averages on all variables.

Here we find that the two teams with the highest degree centralization, DAT and PRM both rate VID AFD well above average, and average on closeness. Both also only have a single individual with an in-degree above 5, indicating that while the individuals in the teams are generally not closely connected, there are a few individuals with a high centrality, who have the potential to be a broker. This is also evident from the visualizations in app. 42.

The teams with the lowest degree centralization are PLA and PRO, who both score below average on closeness and below average on VID AFD. Here, it is also evident from the visualizations that the connections are spread out on a large number of individuals, without any one particularly central actor.

Overall, there is an indication that the combination of low closeness and high degree centralization within a team has a positive impact on knowledge sharing across teams.

Further to Burt's structural hole argument (Burt, 2001), Bizzi argued that although a structural hole position is beneficial to the individual, as supported by hypothesis 7, there can be potentially negative consequences when brokers are present in groups (Bizzi, 2013), see also chapter 2.4.1.1.

To validate whether the structural hole position of individuals within the team had an influence on the perceived level of knowledge sharing for the remaining team members, the constraint of all individuals was calculated within their own team. The individuals with the 10% lowest constraint scores across all teams were categorized as being in structural hole positions, and the average scores on VID TEA and VID AFD were calculated both including and excluding these individuals. Subsequently, the difference in scores was highlighted, meaning that if the difference was positive, the individuals in structural hole positions scored higher than the remaining individuals in the team, and vice-versa if negative.

As demonstrated in table 5, this shows that three teams have individuals in structural hole positions within their own teams. In all cases, the average scores on the perceived level of knowledge sharing was notably lower for the remaining individuals in the team, which indicates that although there is a positive correlation between being in a structural hole position and the perceived level of knowledge sharing in the department, there may be an undesired impact on the remaining team members in that they perceive the level of knowledge sharing to be lower, if there are individuals in structural hole positions in their team.

Team	# low const	% low const	AVG VID AFD	AVG VID TEA	Diff AVG VID AFD	Diff AVG VID TEA
AUT	0	0%	3,67	4,17	N/A	N/A
DAT	0	0%	4,00	4,20	N/A	N/A
IND	0	0%	3,65	4,29	N/A	N/A
KON	0	0%	3,43	4,29	N/A	N/A
LED	0	0%	3,71	4,00	N/A	N/A
NET	1	11%	4,33	4,33	0,75	0,75
PLA	0	0%	3,71	4,24	N/A	N/A
PRM	0	0%	4,25	4,25	N/A	N/A
PRO	3	13%	3,25	3,83	1,24	0,57
QHS	0	0%	4,00	4,33	N/A	N/A
STA	2	22%	4,44	4,56	0,63	1,13

Tabel 5: Individual constraint and team level perception of knowledge sharing

Having already established a possible connection between perceived level of knowledge sharing in the department and closeness and degree centrality, we now turn to other possible explanation factors in the data set, and test if the relational factors also have a significant influence on team level. To evaluate whether it was possible to combine the trust variables on a team level as well, Chronbach's Alpha was calculated on the three variables, revealing score of 0.75, meaning that the variables are sufficiently similar to combine the values into one: TIL COM.

The multiple linear regression model with VID AFD as the dependent variable and the relational factors as independent variables show a prominent R Square of 0.86 and a significance of 0.009, revealing that these variables have a lot of explanatory power on the perception of knowledge sharing in the department, see app. 51. As VED KON and KOL IMØ have a high P-value and low coefficients, these were removed before re-running the model, se app. 52. This further improved the significance and only slightly reduced the R

Square to 0.85, leaving an interpretation that HUR KON and TIL COM have a significant and positive correlation with VID AFD, with HUR KON having the highest influence of the two.

The model for VID TEA was not significant at an alpha 0.05 level when including all relations variables, see app. 53. Also here, VED KON and KOL IMØ were removed before rerunning the model, see app 54. This shows an R Square of 0.61 with a significance of 0.02 for HUR KON and TIL COM. Here, however, TIL COM is the most significant variable with the highest coefficient.

This indicates that for the perception of knowledge sharing both inside teams and between teams, a high level of trust as well as the ability to quickly and efficiently gain access to colleagues play a significant role. It is interesting to note that while trust is the most important factor when it comes to knowledge sharing within the team, fast and effective access plays the larger role or knowledge sharing between teams.

To further investigate the matter, three multiple linear regression models were set up with the network measures as dependent variables and the relational variables as independent variables. These were reduced until the models were significant, see app. 55-60.

This revealed that while there was a slightly positive correlation between team density and trust, it was however not statistically significant at an alpha 0.05 level.

A negative correlation between closeness and HUR KON was found, however, at 0.10, this was also not statistically significant at the chosen level.

Degree centralization on the other hand, showed a statistically significant, positive correlation of 0.25 with TIL COM at an R Square of 0.39 with a significance of 0.03, see app. 60. As a correlation was also found between trust and the perceived level of knowledge sharing both within and between teams, this indicates that there can be an indirect influence of degree centralization on the level of knowledge sharing.

In summary, the analysis of the team networks provided indications that:

- The combination of low closeness and high degree centralization within a team has a positive impact on knowledge sharing between teams
- The relational factors of fast and efficient access to colleagues and trust have an influence on the perceived level of knowledge sharing between teams with access playing the largest role
- The relational factors of fast and efficient access to colleagues and trust have an influence on the perceived level of knowledge sharing within the teams with trust playing the largest role
- There is a positive correlation between trust and degree centralization, meaning the higher the degree centralization, the higher the level of trust in the team.

Although no direct correlation between the network structure measures and knowledge sharing within the teams was found, hypothesis 9 is partially confirmed on the basis of the correlations between knowledge sharing between teams and degree centralization and closeness as well as the correlation between degree centralization and trust.

5.10 Hypothesis 10 and 11

The intention of these hypotheses was to evaluate whether there is a difference between the network position of individuals and the perceived level of knowledge sharing - depending on the type of knowledge

that is perceived to be most valuable. The hypotheses are based on Hansen's findings that weak ties are better suited in search for explicit knowledge, whereas strong ties are better suited for transferring tacit knowledge (Hansen, 1999).

It was not possible to create an exact replication of Hansen's study, as the respondents in this study were only asked to list their top five contacts, which are assumed to be the strongest ties. Instead of the differentiation between strong and weak ties, constraint was used to measure structural holes vs. closeness, and the analysis subsequently investigates whether there is a benefit of having a low / high constraint to how efficient knowledge sharing is perceived to be - depending on the type of knowledge that is perceived to be most valuable.

H10: Where explicit knowledge is perceived to be most valuable, individuals in structural hole positions find knowledge sharing to be better than those in closed networks

H11: Where tacit knowledge is perceived to be most valuable, individuals in closed networks find knowledge sharing to be better than those in structural hole positions

To test hypotheses 10 and 11, the respondents were split up into groups who find explicit and tacit knowledge to be most valuable respectively. This was done on the basis of the variables VID TAC, VID EXP and VID T-E with the individuals scoring VID TAC higher than VID EXP placed in the group who perceive tacit knowledge to be most important (group tacit), and the individuals who scored VID EXP or VID T-E higher than VID TAC in the other group (group explicit). Group explicit contains 20 individuals, and group tacit 61 individuals. 39 individuals had scored the variables VID TAC and VID EXP equally and were not included in this test.

To test hypothesis 10, linear regression models were made with VID TEA and VID AFD as dependent variables and constraint for individuals in group explicit as the independent variable. To confirm the hypothesis, there should be a negative correlation between the dependent and independent variables, meaning the less constrained your network, the better you perceive knowledge sharing to be. These models were made for both the VIDEN VIGTIG and VIDEN OFTE networks, see app. 61-64.

As summarized in below table, although the correlation is negative, supporting the hypothesis, none of the models showed any significant correlation, and on this basis, hypothesis 10 cannot be confirmed.

VID AFD	VIGTIG	OFTE
R sq	0,01	0,00
Coeff.	-1,09	0,44
Sig	0,611	0,832

VID TEA	VIGTIG	OFTE
R sq	0,05	0,00
Coeff.	-1,93	-0,34
Sig	0,367	0,871

Table 6: Results linear regression models H10. Perceived level of knowledge sharing and constraint, group explicit

For hypothesis 11, the same models were run for the group tacit, see app. 65-68. To confirm the hypothesis, there should be a positive correlation between the dependent and independent variables.

VID AFD	VIGTIG	OFTE
R sq	0,05	0,06
Coeff.	-1,28	-1,59
Sig	0,096	0,050

VID TEA	VIGTIG	OFTE
R sq	0,01	0,02
Coeff.	-0,41	-0,73
Sig	0,558	0,328

Table 7: Results linear regression models H11. Perceived level of knowledge sharing and constraint, group tacit

Contrary to expectations, all correlations are negative, meaning that where tacit knowledge is valued higher than explicit knowledge, the correlation is that the less constrained an individual's network, the better the perceived levels of knowledge sharing.

While the linear regression model for VID TEA is not significant for this group either, it is somewhat surprising that the model for VID AFD is more significant for this group than for group explicit, indicating that there is a more significant correlation between structural hole position and perceived knowledge sharing levels in the group where tacit knowledge is valued higher than explicit knowledge.

5.11 Overview of analytical findings

The analysis revealed a number of findings that can assist with casting light on the research question of the connections between relational factors, knowledge types and network structures in relation to knowledge sharing. See table 7 for an overview of the main analytical findings.

Hypothesis	Indep.var.	Coefficient	Sig.	R-square	Dep. var.
1	VED KON	0,41	6,24E-07	0,19	VID COM
2	HUR KON	0,54	1,01E-12	0,35	VID COM
3	KOL IMØ	0,41	5,41E-05	0,13	VID COM
4	TIL COM	0,51	1,45E-04	0,12	VID COM
1-4	HUR KON VED KON	0,45 0,18	9,28E-13	0,38	VID COM
5	KAN PER	0,71	2,16E-07	0,20	VID TAC
6	KAN DOK	0,61	3,84E-13	0,36	VID EXP
7	Constraint	-1,36	3,70E-02	0,04	VID AFD VIGTIG
7	Constraint	-1,48	1,50E-02	0,05	VID AFD OFTE
9	Closure Deg. central	-2,10 3,82	4,77E-02	0,53	VID AFD VIGTIG
9	HUR KON TIL COM	1,26 0,79	5,60E-04	0,85	VID AFD VIGTIG
9	HUR KON TIL COM	0,37 0,61	2,33E-02	0,61	VID TEA VIGTIG
9	TIL COM	0,25	3,88E-02	0,39	Deg. central VIGTIG
9	Density	0,08	7,18E-02	0,32	TIL COM
9	Closure	-0,25	1,03E-01	0,27	HUR KON
9	Deg. central	0,25	3,88E-02	0,39	TIL COM
11	Constraint	-1,28	9,60E-02	0,05	Group tacit VID AFD VIGTIG
11	Constraint	-1,59	5,00E-02	0,06	Group tacit VID AFD OFTE

Table 8: Main analytical findings

6 Discussion

6.1 Knowledge sharing at department and team level

One of the first findings of the analysis was that while the employees overall rate knowledge sharing within their own team to be good with an average of 4.18 across the department, the level of knowledge sharing within the entire department is rated significantly lower with an average of 3.74. Not a single team rates knowledge sharing at the department level to be higher than that of the team.

This was discussed in the interviews with the team leaders (Rasmussen, Sørensen, & Larsen, 2016), where it became evident that a lot of focus is being placed on knowledge sharing and social interaction within the individual teams, e.g. in the form of semi-weekly team meetings and ERFA meetings (Rasmussen, Sørensen, & Larsen, 2016). In relation to Nonanka's model of knowledge creation (Nonaka, 1994), these activities focus primarily on the combination of explicit knowledge.

Furthermore, some teams have structures in place to support the transfer of tacit - tacit knowledge in form of physical co-location, team building activities and mentorship arrangements, where inexperienced employees follow more senior employees to learn how things are done (Rasmussen, Sørensen, & Larsen, 2016). This is in alignment with the socialization mode in Nonanka's model (Nonaka, 1994).

During the knowledge café, the conversion of explicit - tacit knowledge was emphasized as something that needs to be part of the daily routine as employees apply explicit knowledge in their daily work, as also pointed out by Nonanka (Nonaka, 1994). Conversion of tacit - explicit knowledge will be discussed further in chapter 6.3.

Overall, it appears that there are many measures in place to support effective knowledge sharing within the teams that are in alignment with theory, and the quantitative data supports that this is working successfully.

Turning to knowledge sharing on a department level, a number of factors come into play.

Part of the explanation why knowledge sharing is not perceived to be good on a department level can be attributed to the fact that the organization was merged from four smaller organizations in 2005, where the employees had a wider interface across the individual organizations, and as such were accustomed to being 'in the loop' of what was happening in the organization, also outside of their own team and department (Rasmussen, Sørensen, & Larsen, 2016). This created a culture that is brought forward to this day, where the employees expect a high level of knowledge sharing on the department level. After the merger, the organization is much larger and has a significantly larger number of on-going activities, meaning that this level of knowledge sharing is no longer practically possible.

However, the organization still places a focus on keeping employees informed about company strategy and direction, departmental strategies and initiatives, and regularly hosts 'knowledge cafés' where employees can participate to learn about a large variety of topics, regardless of the direct relevance to their job (Rasmussen, Sørensen, & Larsen, 2016).

As a result, there is so much information available to the employees that no one can be fully informed about everything, although they may expect to be, which may explain why knowledge sharing is perceived to be inadequate at the department level.

Lastly, in ANEG, there is a great variety in the tasks of the different teams and for some teams, knowledge sharing within the team will be more important than between teams and vice-versa. For example, for around half of the employees of the team Indkøb, connections with colleagues in other teams in ANEG are not relevant for their daily work (Rasmussen, Sørensen, & Larsen, 2016). Here, a high score on the perceived level of knowledge sharing with other teams in the department would be a cause for concern. A quick separation of the two groups revealed that with an average score of 3.42, the perceived level of knowledge sharing in the department was indeed lower for the employees who had no work related reason to maintain a network outside their own team within the department. The group who had work related reasons to maintain a network within the department scored an average of 3.80. Although not a drastic difference, this still serves as an indication that the ones to whom it is most important to share knowledge within the department are also those, who perceive knowledge sharing to be working best, at least in this particular team. Investigating this area further would require a more in-depth analysis that is beyond scope for this project.

6.2 Hypothesis 1-4 – relational factors

The test of the first four hypotheses revealed that there is support for the expected relationship between the perceived level of knowledge sharing and the relational factors identified in existing theory, and that the most important relational factor to influence the perceived level of knowledge sharing in general is that it is fast and efficient to get access to relevant knowledge from the colleagues with an R square of 0.35. This variable, however, does not score particularly high overall in ANEG compared to the other relational variables.

During the interviews, a number of possible explanations were offered for this. In all of the teams, many employees are working off-site much of the time. This is most predominant for senior employees, which naturally does not make it fast and efficient to get access to knowledge from the people it may be most relevant to get access to.

At the same time, the department has a culture of meeting in person – to an extent that it can sometimes take weeks to find a vacant slot in the calendar to arrange a meeting (Rasmussen, Sørensen, & Larsen, 2016). This means that people become inaccessible, and it may not be the most important or pressuring items that time is allocated for (Rasmussen, Sørensen, & Larsen, 2016). This relates to the point made by Cross et al. (Cross, Borgatti, & Parker, 2002) that people have a finite amount of time to invest in developing and maintaining relationships, and it is often not possible or desirable to have strong relationships between all employees or departments in an organization.

A third possible explanation was that many of the employees have a technical background, and although it may not be difficult to meet, knowledge transfer could be difficult in that they 'speak a different language' (Rasmussen, Sørensen, & Larsen, 2016). This relates to both Cohen and Levinthal's work on absorptive capacity (Cohen & Levinthal, 1990) and Carlile's work on boundary spanning (Carlile, 2002), where the lack of a common syntax and understanding may complicate the transfer of knowledge.

6.3 Hypothesis 5-6 - knowledge types and communication channel

The test of the correlation between the perception of the value of knowledge types and preferred communication channel supported the hypotheses that the more important tacit knowledge is perceived to be, the more effective personal communication is perceived to be as a communication channel. This was supported with an R Square of 0.20 and a coefficient as high as 0.71. The test also supported the hypothesis that the more important explicit knowledge is perceived to be, the more effective documents are perceived to be as a communication channel. Here, the coefficient was as 0.61 with an R Square of 0.36.

This supports the theory that the most effective channel for transferring knowledge is dependent on the type of knowledge that is being transferred (Alavi, 2001).

The data reveals a widespread perception that tacit knowledge is more valuable than explicit knowledge with an average rating of 4.43 versus 3.82 for explicit knowledge. At the same time, however, all interviewees describe the department as being documentation driven to large extent, where procedures, processes, communication and decisions are documented to a very large degree in IT systems. This is partly attributed to the fact that the company is partly publically owned, which sets high requirements for documentation, but also to a zero mistake culture, where it becomes important to document one's actions to avoid any potential later repercussions (Rasmussen, Sørensen, & Larsen, 2016).

A part of the explanation why explicit knowledge is still perceived to be less valuable than tacit knowledge in general may be that the organization is so deeply rooted in documented knowledge that it is taken for granted, and therefore not perceived to be value adding by the employees (Rasmussen, Sørensen, & Larsen, 2016). At the same time, the department places a lot of focus on sharing of tacit knowledge, see also chapter 6.1.

In relation to the strategies for knowledge management (Hansen, Nohria, & Tierney, 1999), it seems that the organization is trying to adapt both the personalization and the codification strategy at the same time, where Hansen et al. argue that the most successful organizations are those that focus primarily on one of them (Hansen, Nohria, & Tierney, 1999).

In an attempt to support the conversion of tacit - explicit knowledge (Nonaka, 1994) on a departmental level, and store knowledge to minimize the risk of losing knowledge when employees leave the company, the GETS-Better database was introduced in 2014 for employees to log their experiences, however, with limited success (Rasmussen, Sørensen, & Larsen, 2016). In reference to the literature on knowledge transfer, there is widespread agreement that while explicit knowledge is effectively transferred through the use of written documentation, this is not possible for tacit knowledge (Alavi, 2001) (Nonaka, 1994). This may assist with explaining the limited success of the GETS-Better initiative, and supports the need to align communication channel with the type of knowledge that needs to be transferred.

6.4 Hypothesis 7-8 – knowledge sharing and whole network structure

Hypothesis 7 and 8 indicated that the structural hole theory applies also to knowledge sharing between teams in that the more an individual is in a bridging position in the network, the better the perceived level of knowledge sharing in the department seen across the whole network. Although the effect is not overwhelming with an R Square of 0.04, there is a sizable coefficient of -1.36. This is aligned with Burt's structural hole theory on performance (Burt, 2001), and also supports Gupta and Govindarajan's finding of the presense of transmission channels as a prerequisite for transfer of knowledge (Gupta & Govindarajan, 2000).

No support was found for neither structural hole or closeness on a whole network level when it comes to the perceived level of knowledge sharing within the team.

6.5 Hypothesis 9 – knowledge sharing and team network structure

With a notable R Square of 0.53, hypothesis 9 revealed that the higher the degree centralization within a team and the looser team members are connected, the better the perceived level of knowledge sharing with other teams. This means that the average perceived level of knowledge sharing on department basis is higher in teams, where connections are centralized around a few individuals with many connections, and where the closeness is low. No support was found that the network structure had any direct influence on the perceived level of knowledge sharing within the team.

This indicates that Burt's theory on structural holes (Burt, 2001) is supported not only on a whole network level as indicated by hypothesis 7, but here also on a team level.

This is contrary to Coleman's argument that closeness enhances performance in a team (Coleman, 1988), and also contrary to Burt's integrated theory of external and internal constraint (Burt, 2001), where

closeness within a team is seen to be an advantage to realizing the value of the new input in a setting that is characterized by trust and close cooperation.

A part of the explanation for this results may be found in the fact that the teams in ANEG are divided into groups with each their group leader (Rasmussen, Sørensen, & Larsen, 2016), and that the presence of a group leader, who is well-connected, enhances the perception of knowledge sharing in the department as that group leader may act as a go-to person for the members of the group. This effect is enhanced by a low degree of closeness within the group, by which the importance of the group leader as a focal point for information is increased.

The test of Bizzi's argument of potentially negative consequences when brokers are present in groups (Bizzi, 2013), indicated that although there is a positive correlation between being in a structural hole position and the perceived level of knowledge sharing in the department, there may be an undesired impact on the remaining team members in that they perceive the level of knowledge sharing to be lower, if there are individuals in structural hole positions in their team.

Taken in combination, this indicates that while loosely coupled groups with well-connected group leaders on average perceive knowledge sharing in the department to be better than the groups, who are less centralized and closer connected, the flip side of the coin is that the presence of brokers in a team can have a negative influence on the perceived level of knowledge sharing of the remaining team members, supporting Bizzi's theory (Bizzi, 2013).

The findings within the teams themselves revealed that the most important factor to influence the perceived level of knowledge sharing within the team was trust, with a coefficient of 0.61. It is surprising that there is no correlation between closeness and trust as otherwise stipulated in the theories of Burt (Burt, 2001), Coleman (Coleman, 1988), and Bizzi (Bizzi, 2013). Instead, trust was furthermore found to be significantly correlated with degree centralization with an R Square of 0.39, indicating that there can be an indirect influence of degree centralization on the perceived level of knowledge sharing within the team.

The reason why trust is positively related to the degree of centralization can again be connected to the structure of group leaders within the teams, where a well-connected group leader can increase the feeling of trust within the team by having a trustworthy and reliable source of information and connections.

Combining these findings of the internal team structure with the findings on the overall network from hypotheses 7 and 8 provides an indication that the optimal structure for knowledge sharing is one that is characterized by a high degree centralization within the group, which enhances trust, and improves knowledge sharing within the team, and by structural holes beyond the group, which gives access to new information and improves knowledge sharing between teams.

In relation to Burt's integrated model (Burt, 2001), this indicates that maximum performance for knowledge sharing is not characterized by a high degree of closeness internally, and a low constraint externally as per Burt's model, but by adding degree centralisation to the model, the optimal level of knowledge sharing is instead characterised by a high degree of centralisation and low closeness internally, and low constraint externally, see top left quadrant of figure 5, where the red node represents the internal central actor.

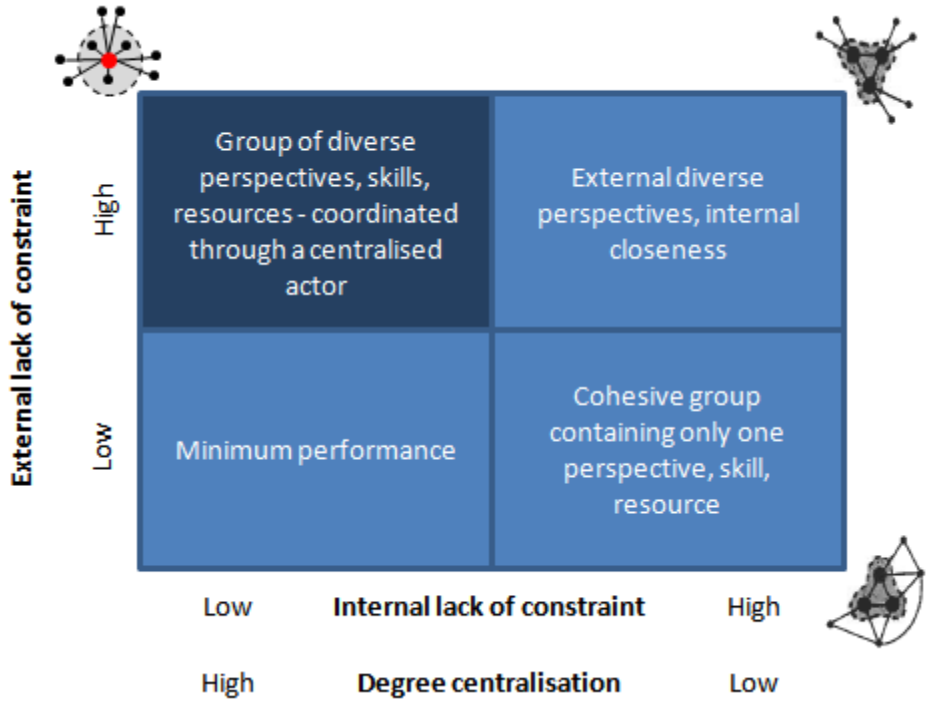

Figure 5: Own adaptation of Burt's model, Burt, 2001

6.6 Hypotheses 10-11

Although with a relatively small R Square of 0.05, hypothesis 11 indicated that structural hole position is positively related to knowledge sharing in the department when tacit knowledge is perceived to be most valuable. This is contrary to the expected result based on Hansen's theory (Hansen, 1999).

It is, however, important to keep in mind that this analysis was effectively measuring if the constraint within a network of only strong ties had an effect on perceived level of knowledge sharing, dependent on the type of knowledge that was perceived to be most valuable. In that light, the finding may not be so surprising in that it indicates that there is a stronger correlation between structural holes and perceived level of knowledge sharing than of closeness and perceived level of knowledge sharing. This is in line with the findings in hypotheses 7 and 8, and is consistent with the finding that the department in general perceived tacit knowledge to be more valuable than explicit knowledge, and that the individuals that find themselves in broker positions overall perceive knowledge sharing in the department to be better than those in more constrained network positions.

7 Managerial implications

In relation to the context at ANEG, the analysis and discussion reveals a number of areas that could be beneficial for the department to consider.

First of all, the current dual focus on sharing both explicit and tacit knowledge may have unintended consequences for the department. Hansen's recommendation that a company should decide which of the two strategies for knowledge transfer to follow - personalization or codification - is based on the premise that if you try to focus on both at the same time, neither will be implemented successfully (Hansen, Nohria,

& Tierney, 1999). A company that is based on personalized solutions risk under-delivering to their customers if increasing focus on the codification strategy, and a company that is based on codification risks wasting resources and re-inventing solutions if increasing focus on the personalization strategy.

Being as reliant on documented knowledge as ANEG is, it would appear that the department is best served with predominantly following the codification strategy, and evaluating where sharing of tacit knowledge by personal contact is required, and where it is a non-value adding resource drain. This is something that could improve the accessibility of employees, and subsequently improve knowledge sharing where it adds most value to the organization.

Secondly, it is evident that the use of GETS-Better for capturing personal experiences is misaligned with the theory of aligning the communication channel to the type of knowledge that is sought transferred (Alavi, 2001). Tacit knowledge such as personal experience is most efficiently shared either tacit - tacit through socialization (Nonaka, 1994), as some of the teams already have successful experience with, or by conversion from tacit - explicit through externalization (Nonaka, 1994). In the case of the latter, however, this is not achievable through an IT-system, but requires personal interaction and the use of e.g. metaphors, analogies and images (Nonaka, 1994).

Thirdly, there are indications that knowledge sharing between teams is not necessarily working as well as desired, and it might be worth for the team managers to consider, who the most important partners for knowledge sharing are outside their own team, and evaluate if it would be beneficial to enhance absorptive capacity or apply methods of boundary spanning (Carlile, 2002) to foster more efficient communication between teams - where knowledge sharing is of strategic importance.

Lastly, the network analysis revealed that brokers in the whole network and central actors in the teams play an important role in sharing knowledge. It is important to ensure that the risks of having such central actors in a network are mitigated, for example by ensuring that all connections between teams are not eliminated if a single employee leaves the department, by ensuring that the brokers and central actors do not become bottlenecks and by being aware of potential strategic interests of the brokers that might influence the knowledge that is shared.

8 Limitations and further research

The results and mechanisms identified in this study are specific to ANEG, and neither the collected data nor the results are exhaustive for the what influences knowledge sharing in an organization. Furthermore, despite the fact that 11 different teams have been analyzed, the data relates only to a single department in a single organisation.

The social network analysis is bound by a number of limitations. First of all, the analysis is based on data collected at a given point in time, and as such only displays a static picture of the situation. As social networks are under constant development, it would be interesting to repeat the study at a later point in time to test whether the same mechanisms are at play. This would enhance the validity of the findings.

Secondly, the response rate of 48% presents a considerable risk that the network measures are not reflecting an accurate picture of the structures and positions in the networks. Similarly, as structural hole

positions are likely to be found in weak ties (Granovetter, 1973), it is likely that this study has not uncovered all aspects of the network structures as it only included strong ties.

Thirdly, having confined the network boundaries to include only individuals within the department may have resulted in important relations being excluded from the analysis, which would potentially have resulted in other network measures, had they been included. Previous research has shown that ties reaching into other departments and other organisations are often important channels for knowledge sharing (Carnabuci & Diószegi, 2015).

These aspects can have critical consequences for the findings and conslusions of the analyses and may challenge the finding that the optimal structure for knowledge sharing is to be found in networks that are characterised by a high degree of centralisation and low closeness internally, and low constraint externally.

Therefore, it would be interesting to see future studies testing the model on the basis of more complete data. Where other organisations are involved, it is important to keep in mind that a number of other factors also play a role, see also chapter 1.4.

The managerial implications are applicable only to ANEG and only within the scope of this study. While these are aspects that would be beneficial for the department to look into, the different elements may be influenced by factors outside the scope of this study, for example political and cultural considerations. Consequently, the managerial implications do not represent an exhaustive set of recommendations on how to improve knowledge sharing in the department.

9 Conclusion

Following a review of existing literature within the topics of knowledge management and social networks, the study analyzed the connections between relational factors, knowledge types and network structures in relation to knowledge sharing through 11 hypotheses.

It was found that the relational factors of a) knowing whom to contact, b) that colleagues are accomodating, c) that it is fast and efficient to access knowledge, and d) trust between colleagues all relate positively to the perceived level of knowledge sharing. Of these, the most important factor was found to be that it is fast and efficient to get access to relevant knowledge from the colleagues.

The analysis found support that the more important tacit knowledge is perceived to be, the more effective personal communication is perceived to be as a communication channel, and the more important explicit knowledge is perceived to be, the more effective documents are perceived to be as a communication channel. This is in alignment with the findings of existing literature.

The analysis of the knowledge sharing networks revealed that the structural hole theory applies also to knowledge sharing between teams in that the more an individual is in a bridging position in the network, the better the perceived level of knowledge sharing in the department seen across the whole network.

On a team level, it was found that the higher the degree centralization within a team and the looser it is connected, the better the perceived level of knowledge sharing with other teams. This can be explained by the presence of a group leader within the team, who is well-connected, which enhances the perception of

knowledge sharing as that group leader may act as a go-to person for the members of the group. This effect is enhanced by a low degree of closeness within the group, by which the importance of the group leader as a focal point for information is increased. There are indications, however, that the presence of brokers in a team can have a negative impact on the perceived level of knowledge sharing of the remaining team members.

Furthermore, trust was found to be significantly correlated with degree centralization, indicating that there can be an indirect influence of degree centralization on the perceived level of knowledge sharing within the team.

These findings led to an adaptation of Burt's integrated theory of internal and external constraint (Burt, 2001), where the optimal level of knowledge sharing is characterised by a high degree of centralisation and low closeness internally, and low constraint externally. This can be used as a frame of reference for future research.

Altogether, the findings resulted in a set of concrete recommendations to ANEG on areas to consider for improving knowledge sharing within the department.

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11 Appendices

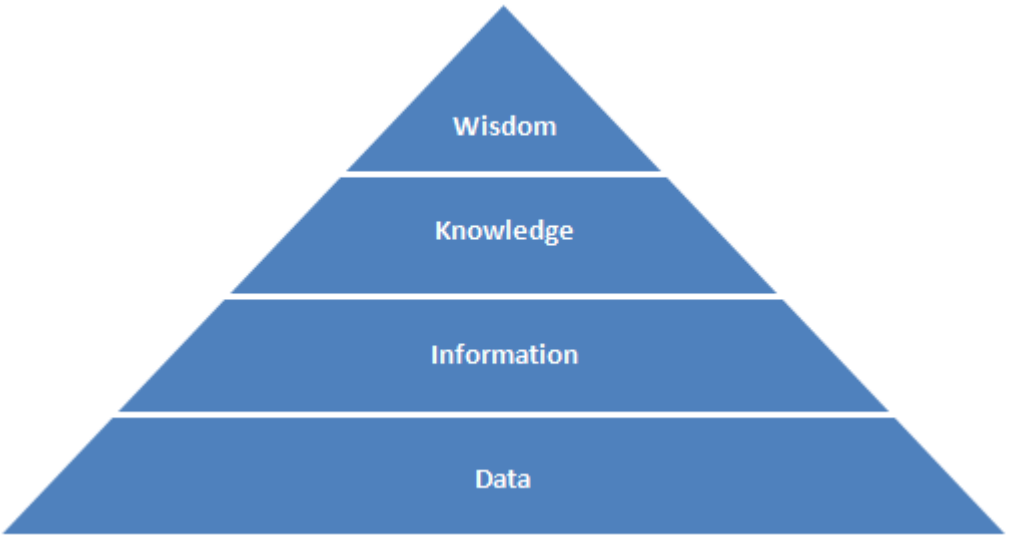
Contents

1. Chapter 2.2 – Taxonomy of knowledge types

Knowledge Types	Definitions	Examples
Tacit	Knowfledge is rooted in actions, experience, and involvement in specific context	Best means of dealing with specific customer
Cognitive tacit:	Mental models	Individual's belief on cause-effect relationships
Technical tacit:	Know-how applicable to specific work	Surgery skills
Explicit	Articulated, generalized knowledge	Knowledge of major customers in a region
Individual	Created by and inherent in the individual	Insights gained from completed project
Social	Created by and inherent in collective actions of a group	Norms for inter-group communication
Declarative	Know-about	What drug is appropriate for an illness
Procedural	Know-how	How to administer a particular drug
Causal	Know-why	Understanding why the drug works
Conditional	Know-when	Understanding when to prescribe the drug
Relational	Know-with	Understanding how the drug interacts with other drugs
Pragmatic	Useful knowledge for an organization	Best practices, business frameworks, project experiences. engineering drawings, market reports

Source: Alavi, 2001

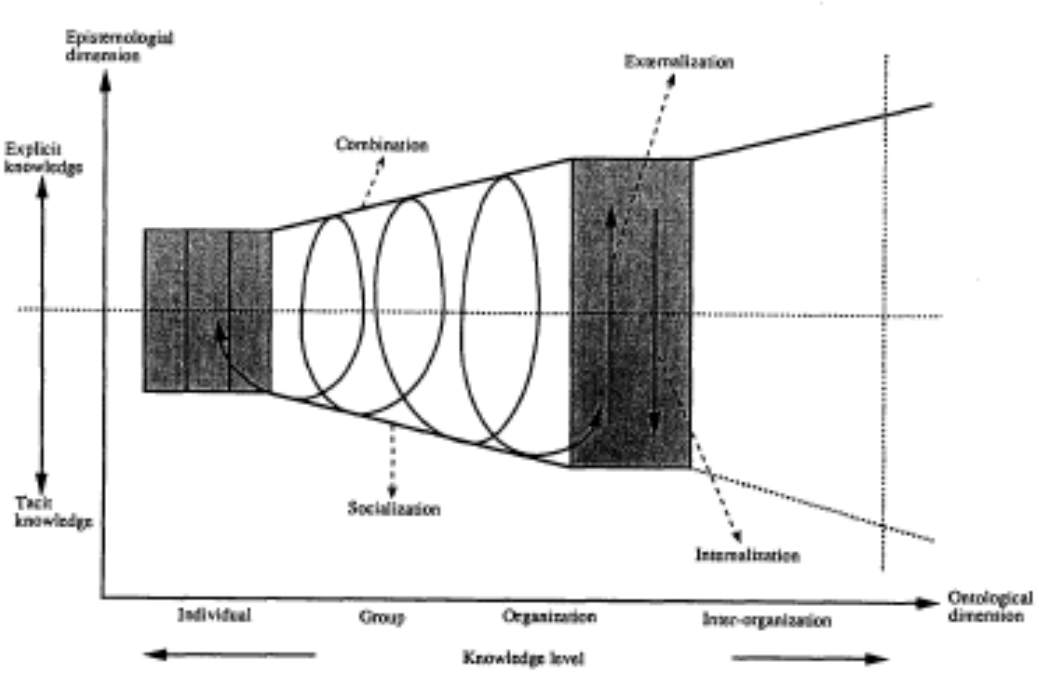
2. Chapter 2.2.2 – DIKW model



Source: Rowley, 2006

3. Chapter 2.3.1 – Spiral of organizational knowledge creation

Figure 2 Spiral of Organizational Knowledge Creation



Source: Nonanka, 1994

4. Chapter 4 – Questionnaire

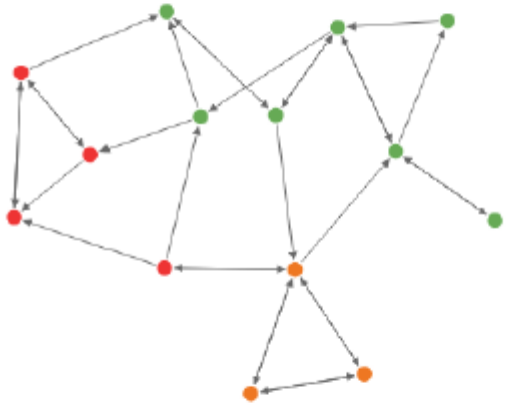
Velkommen til undersøgelse om vidensdeling i ANEG

Introduktion
Denne spørgeskemaundersøgelse har til formål at indsamle data til en undersøgelse af, hvordan vidensdeling kan forbedres i ANEG og indgår i et speciale på cand.merc. ved Aarhus Universitet.

Undersøgelsen består af to dele:
- Et traditionelt spørgeskema, der indeholder en række spørgsmål omhandlende viden, kommunikationskanaler og tillid.
- En netværksanalyse, hvor du skal angive, hvem du kommunikerer med om forskellige emner.

Det tager ca. 8-10 minutter at udfylde.

Når dataen er blevet indsamlet, vil den bruges til at danne kort over sociale netværk lignende denne:



Inputtet omkring viden, kommunikationskanaler og tillid vil blive brugt som variable i analysen, og derudover vil en række netværksindikatorer blive udregnet.

Anonymitet
For at kunne udføre netværksanalysen er det nødvendigt, at du opgiver dit navn i besvarelsen af spørgeskemaet. Al data vil dog blive anonymiseret i analysen og vil ikke blive vist til nogen i eller uden for ANEG.

Frivillighed
For at kunne lave den mest retvisende analyse og effektuere de mest relevante forbedringstiltag er det vigtigt at samtlige respondenter deltager i undersøgelsen. Det er frivilligt at deltage i undersøgelsen og

du kan vælge at afbryde din deltagelse i undersøgelsen på ethvert givet tidspunkt. Hvis du vælger dette, vil netværksanalysen ekskludere al data der involverer dig.

Demografiske spørgsmål

Først kommer en række demografiske spørgsmål som bruges til statistisk analyse. Dataen anonymiseres efterfølgende.

Navn og initialer

Dit navn _____

Dine initialer _____

Køn

- ☐ Mand
- ☐ Kvinde

Afdeling

- ☐ Automation
- ☐ Data og Modeller
- ☐ Indkøb
- ☐ Konstruktioner
- ☐ Ledningsanlæg
- ☐ Netplanlægning
- ☐ Planlægning
- ☐ Teknik
- ☐ Plan og Miljø
- ☐ Projekter
- ☐ Projektmodning
- ☐ QHSE
- ☐ Stationer
- ☐ Teknisk direktør

Faggruppe

Din faggruppe

Hvor længe har du arbejdet i Energinet.dk?

- ☐ < 1 år
- ☐ 1 - 4 år
- ☐ 5- 10 år

❑ > 10 år

Hvor længe har du arbejdet i din nuværende afdeling?

❑ < 1 år
❑ 1 - 4 år
❑ 5- 10 år
❑ > 10 år

Videnstype og vidensdeling

Herefter følger 2 spørgsmål omhandlende videnstyper og vidensdeling, hvor du skal angive, hvor enig du er i udsagnene.

Denne type viden er mest værdifuld, for at jeg kan løse min vigtigste opgave:

	Meget uenig	Uenig	Neutral	Enig	Meget enig
Personlig viden, know-how og personlige erfaringer fra andre, som er svære at gengive på skrift	❑	❑	❑	❑	❑
Information modtaget på skrift som respons på et specifikt spørgsmål, understøttet af yderligere forklaringer	❑	❑	❑	❑	❑
Generel viden og data, som indeholdes i dokumenter, rapporter, manualer, procedurer etc.	❑	❑	❑	❑	❑

Hvor enig er du i følgende udsagn?

	Meget uenig	Uenig	Neutral	Enig	Meget enig
Vi er gode til at dele viden i afdelingen	❑	❑	❑	❑	❑
Vi er gode til at dele viden i mit team	❑	❑	❑	❑	❑
Jeg ved, hvem jeg skal kontakte for at få input til at løse et arbejdsrelateret problem	❑	❑	❑	❑	❑
Det er hurtigt og effektivt at få adgang til relevant viden hos mine kollegaer	❑	❑	❑	❑	❑
Mine kollegaer er imødekommende med at dele relevant viden	❑	❑	❑	❑	❑

Kommunikationskanaler

Herefter følger et spørgsmål om vigtigheden af kommunikationskanaler, hvor du skal angive, hvor enig du er i udsagnene.

Denne kommunikationskanal giver mig adgang til den mest værdifulde og relevante arbejdsrelaterede viden for at kunne løse min vigtigste opgave:

	Meget uenig	Uenig	Neutral	Enig	Meget enig
Dokumenter, manualer, procedurer etc.	❑	❑	❑	❑	❑
E-mail med kollegaer	❑	❑	❑	❑	❑
GETS-better	❑	❑	❑	❑	❑
Lync/videokonference med kollegaer	❑	❑	❑	❑	❑

Personlig kontakt (face-to-face) med kollegaer	❑	❑	❑	❑	❑
Telefonsamtale med kollegaer	❑	❑	❑	❑	❑

Tillid

Herefter følger 3 spørgsmål om tillidsniveauet i din afdeling, hvor du skal angive, hvor enig du er i udsagnene.

Hvor enig er du i følgende udsagn vedrørende tillid?

	Meget uenig	Uenig	Neutral	Enig	Meget enig
Generelt vil jeg sige, at jeg kan stole på de kollegaer, der arbejder i mit team	❑	❑	❑	❑	❑
Jeg deler uforbeholdent information med kollegaerne i min afdeling	❑	❑	❑	❑	❑
Mine kollegaer i afdelingen deler uforbeholdent information med mig	❑	❑	❑	❑	❑

Netværk

Herefter følger tre spørgsmål vedrørende dine netværk.

Angiv venligst de 5 personer i ANEG, du **oftest** har søgt arbejdsrelateret viden hos inden for de sidste 3 måneder, samt den vigtigste kommunikationskanal, du har benyttet til det formål.
Skriv venligst fornavn, efternavn og initialer, f.eks.: Jens Jensen / JJE

		E-mail	Lync/Videokonference	Personlig kontakt (face-to-face)	Telefonsamtale	Andet
Person 1	_____	❑	❑	❑	❑	❑ _____
Person 2	_____	❑	❑	❑	❑	❑ _____
Person 3	_____	❑	❑	❑	❑	❑ _____
Person 4	_____	❑	❑	❑	❑	❑ _____
Person 5	_____	❑	❑	❑	❑	❑ _____

Angiv venligst de 5 personer i ANEG, du har fået den **mest værdifulde** arbejdsrelaterede viden hos inden for de sidste 3 måneder, samt den vigtigste kommunikationskanal, du har benyttet til det formål.
Skriv venligst fornavn, efternavn og initialer, f.eks.: Jens Jensen / JJE

		E-mail	Lync/Videokonference	Personlig kontakt (face-to-face)	Telefonsamtale	Andet
Person 1	_____	❑	❑	❑	❑	❑ _____
Person 2	_____	❑	❑	❑	❑	❑ _____
Person 3	_____	❑	❑	❑	❑	❑ _____
Person						

Angiv venligst de 5 personer i ANEG, du har talt mest med om emner, der ikke er arbejdsrelaterede (hobbyer, interesser, fritidsaktiviteter osv) inden for de sidste 3 måneder.
Skriv venligst fornavn, efternavn og initialer, f.eks.: Jens Jensen / JJE

Person 1 _____
Person 2 _____
Person 3 _____
Person 4 _____
Person 5 _____

Besvarelsen er nu afsluttet.

Mange tak for din hjælp!

Har du nogle spørgsmål til processen er du velkommen til at kontakte Jacob Simonsen på jacob@simonsen.dk

5. Chapter 4.5 – E-mail invitation to participate in survey

Subject: Undersøgelse om vidensdeling i ANEG -SU 11/3
To: a-ANEG-Anlæg El og Gas <a-ANEG-Anlaeg_El_og_Gas@energinet.dk>

Kære alle,

I forbindelse med vores fokus på vidensdeling i ANEG har vi indgået et samarbejde med Jacob Simonsen som er cand. merc. specialestuderende ved Aarhus Universitet. Han undersøger, hvordan vidensdeling kan forbedres, og i den forbindelse er der brug for, at medarbejderne i ANEG besvarer et online spørgeskema. For at kunne lave den mest retvisende analyse og effektuere de mest relevante forbedringstiltag er det vigtigt at du deltager i undersøgelsen.

Data vil danne grundlag for en dybdegående analyse af vores nuværende vidensdeling, de sociale netværk og de kommunikationskanaler der benyttes til vidensdeling. Vi håber at kunne bruge konklusionerne fra specialet til at forbedre den måde, vi deler viden på i afdelingen. Denne type analyse er afhængig af en høj svarprocent, og vi opfordrer derfor kraftigt til din deltagelse.

Spørgeskemaet findes her: https://www.survey-xact.dk/LinkCollector?key=CNELD4WM1K96

Det tager ca. 8-10 minutter at udfylde. Seneste frist for besvarelse er 11. marts.

Process
Undersøgelsen består af to dele:
- Et traditionelt spørgeskema, der indeholder en række spørgsmål omhandlende viden, kommunikationskanaler og tillid.
- En netværksanalyse, hvor du skal angive, hvem du kommunikerer med om forskellige emner.
Når data er blevet indsamlet, vil den bruges til at danne kort over sociale netværk lignende denne:

Inputtet omkring viden, kommunikationskanaler og tillid vil blive brugt som variable i analysen, og derudover vil en række netværksindikatorer blive udregnet.

Anonymitet
For at kunne udføre netværksanalysen er det nødvendigt, at du opgiver dit navn i besvarelsen af spørgeskemaet. Al data vil dog blive anonymiseret i analysen og vil ikke blive vist til nogen i eller uden for ANEG.

Frivillighed
For at kunne lave den mest retvisende analyse og effektuere de mest relevante forbedringstiltag er det vigtigt at samtlige respondenter deltager i undersøgelsen. Det er frivilligt at deltage i undersøgelsen og du kan vælge at afbryde din deltagelse i undersøgelsen på ethvert givet tidspunkt. Hvis du vælger dette, vil netværksanalysen ekskludere al data der involverer dig.

Venlig hilsen

Trine Holm Jensen
Gruppeleder
Projekter
+4523338948
THJ@energinet.dk

Tonne Kjærsvej 65
7000 Fredericia
+4570102244
www.energinet.dk

6. Chapter 4.6.4 - Reminder

---------- Forwarded message ----------
From: Trine Holm Jensen <THJ@energinet.dk>
Date: 2016-03-01 12:57 GMT+01:00
Subject: VS: Undersøgelse om vidensdeling i ANEG -SU 11/3
To: Torben Glar Nielsen <TGN@energinet.dk>, Kasper Vestergaard Larsen <kvl@energinet.dk>, Jannie Rasmussen <JRS@energinet.dk>, Henrik Riis <HRI@energinet.dk>, Marian Petrea Kaagh <mpk@energinet.dk>, Aksel Gruelund Sørensen <AGS@energinet.dk>, Bjarne Christian Gellert <BCG@energinet.dk>, Per Balle Holst <PHT@energinet.dk>, Steen Beck Nielsen <sbn@energinet.dk>, Martin Høegh Jensen <MHJ@energinet.dk>, Sebastian Dollerup <SDO@energinet.dk>, Henrik Egetoft Pedersen <hpd@energinet.dk>, Kim Søgaard <ksq@energinet.dk>, Anders Dan Boisen <abn@energinet.dk>
Cc: Jacob Simonsen <jacob.simonsen.dk@gmail.com>

Kære ledere,

Den 19. februar udsendte vi en mail med link til en undersøgelse af videndelingen i ANEG**. Seneste frist for besvarelse er 11. marts.**

Vi har brug for, at I opfordrer jeres medarbejdere (og jer selv) til at svare, da vi på denne måde får det bedste overblik over hvordan viden bliver delt på tværs. Pt har følgende afdelinger svaret:

Afdelinger	Gennemført	Ikke besvaret	Nogen svar	Grand Total	% gennemført
Automation	3	17	1	21	14%
Data og Modeller	2	10	1	13	15%
Indkøb	7	17		24	29%
Konstruktioner	4	16	1	21	19%
Leder -Automation			1	1	0%
Leder -Data og Modeller	1			1	100%
Leder -Indkøb		1		1	0%
Leder -Konstruktioner		1		1	0%
Leder -Ledningsanlæg		1		1	0%
Leder -Netplanlægning		1		1	0%
Leder -Plan og Miljø		1		1	0%
Leder -Projekter			1	1	0%
Leder -Projektmodning		1		1	0%
Leder -QHSE	1			1	100%
Leder -Stationer	1			1	100%
Ledningsanlæg	6	12		18	33%
Netplanlægning	3	18	1	22	14%
Områdeleder -Planlægning		1		1	0%
Områdeleder -Teknik		1		1	0%
Plan og Miljø	11	22	2	35	31%
Projekter	12	14	3	29	41%
Projektmodning	2	9	1	12	17%
QHSE	3	8	2	13	23%
Stab		1		1	0%

Stationer	6	7	2	15	40%
Teknisk direktør		1		1	0%
Grand Total	**62**	**160**	**16**	**238**	**26%**

Venlig hilsen

Trine Holm Jensen
Projekter
+4523338948
THJ@energinet.dk

7. Chapter 4.6.4 – Second reminder

---------- Forwarded message ----------
From: **Jacob Simonsen** <jacob@simonsen.dk>
Date: 2016-03-07 15:18 GMT+01:00
Subject: Undersøgelse om vidensdeling i ANEG -SU 11/3
To: jacob@simonsen.dk

Kære medarbejder i ANEG!

Trine Holm Jensen sendte den 9. februar en mail til samtlige medarbejdere i ANEG med et link til et spørgeskema, som skal bruges til mit speciale ved Aarhus Universitet om vidensdeling og sociale netværk.

Formålet er at analysere sammenhængen mellem sociale netværk, vidensdeling og kommunikationskanaler, og det er mit mål at kunne komme med konkrete og brugbare forslag til, hvordan vidensdeling kan forbedres yderligere i ANEG.

Indtil videre har 38% svaret på spørgeskemaet. Det har givet mig en god basis for mine analyser, men for at kunne få større sikkerhed i konklusionerne er det nødvendigt at indsamle mere data.

Jeg må understrege, at det er frivilligt at deltage, dataen vil blive anonymiseret, og hvis der er nogle af netværksspørgsmålene, du ikke ønsker at besvare, kan du anføre 'ønsker ikke besvare' i tekstfeltet.

Derfor håber jeg, at du vil bruge 8-10 minutter på at udfylde spørgeskemaet på: https://www.survey-xact.dk/LinkCollector?key=CNELD4WM1K96

Sidste frist er 11. marts.

På forhånd tak for hjælpen!

Mvh.

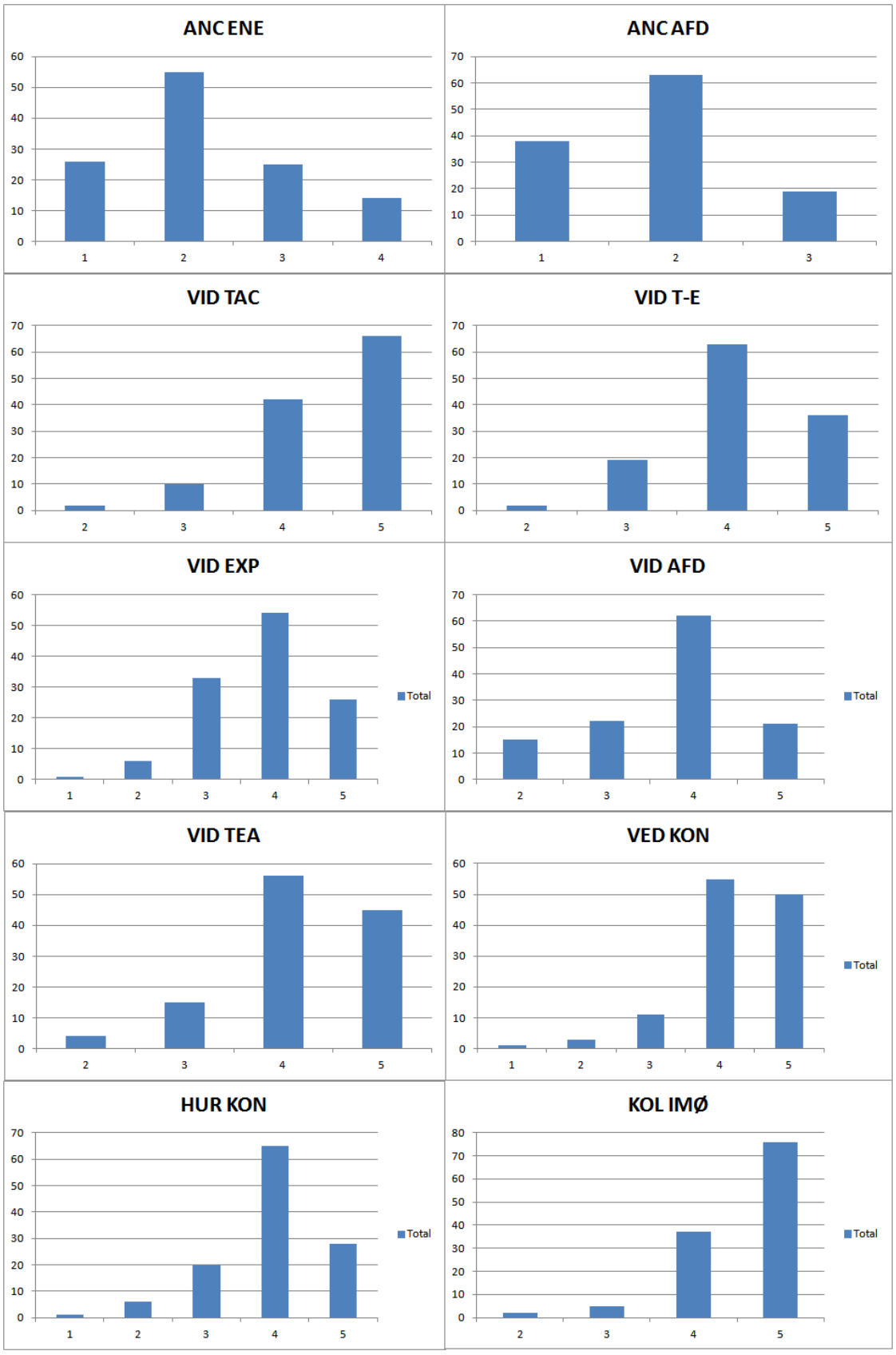
8. Chapter 5.1.2 – Code of variables

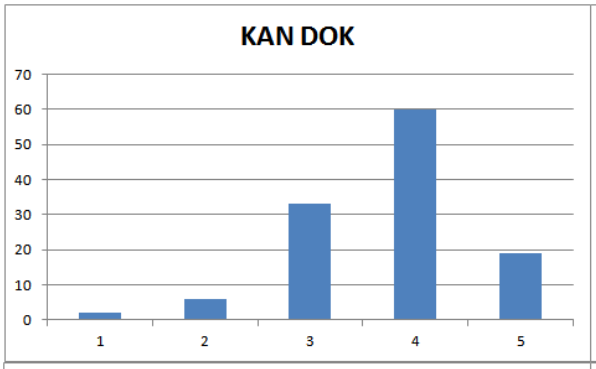
Code	Question
ANC ENE	Hvor længe har du arbejdet i Energinet.dk?
ANC AFD	Hvor længe har du arbejdet i din nuværende afdeling?
VID TAC	Denne type viden er mest værdifuld, for at jeg kan løse min vigtigste opgave: - Personlig viden, know-how og personlige erfaringer fra andre, som er svære at gengive på skrift
VID T-E	Denne type viden er mest værdifuld, for at jeg kan løse min vigtigste opgave: - Information modtaget på skrift som respons på et specifikt spørgsmål, understøttet af yderligere forklaringer
VID EXP	Denne type viden er mest værdifuld, for at jeg kan løse min vigtigste opgave: - Generel viden og data, som indeholdes i dokumenter, rapporter, manualer, procedurer etc.
VID AFD	Hvor enig er du i følgende udsagn? - Vi er gode til at dele viden i afdelingen
VID TEA	Hvor enig er du i følgende udsagn? - Vi er gode til at dele viden i mit team
VED KON	Hvor enig er du i følgende udsagn? - Jeg ved, hvem jeg skal kontakte for at få input til at løse et arbejdsrelateret problem
HUR KON	Hvor enig er du i følgende udsagn? - Det er hurtigt og effektivt at få adgang til relevant viden hos mine kollegaer
KOL IMØ	Hvor enig er du i følgende udsagn? - Mine kollegaer er imødekommende med at dele relevant viden
KAN DOK	Denne kommunikationskanal giver mig adgang til den mest værdifulde og relevante arbejdsrelaterede viden for at kunne løse min vigtigste opgave: - Dokumenter, manualer, procedurer etc.
KAN EMA	Denne kommunikationskanal giver mig adgang til den mest værdifulde og relevante arbejdsrelaterede viden for at kunne løse min vigtigste opgave: - E-mail med kollegaer
KAN GET	Denne kommunikationskanal giver mig adgang til den mest værdifulde og relevante arbejdsrelaterede viden for at kunne løse min vigtigste opgave: - GETS-better
KAN LYN	Denne kommunikationskanal giver mig adgang til den mest værdifulde og relevante arbejdsrelaterede viden for at kunne løse min vigtigste opgave: - Lync/videokonference med kollegaer
KAN PER	Denne kommunikationskanal giver mig adgang til den mest værdifulde og relevante arbejdsrelaterede viden for at kunne løse min vigtigste opgave: - Personlig kontakt (face-to-face) med kollegaer
KAN TEL	Denne kommunikationskanal giver mig adgang til den mest værdifulde og relevante arbejdsrelaterede viden for at kunne løse min vigtigste opgave: - Telefonsamtale med kollegaer
TIL GEN	Hvor enig er du i følgende udsagn vedrørende tillid? - Generelt vil jeg sige, at jeg kan stole på de kollegaer, der arbejder i mit team
TIL OUT	Hvor enig er du i følgende udsagn vedrørende tillid? - Jeg deler uforbeholdent information med kollegaerne i min afdeling
TIL IN	Hvor enig er du i følgende udsagn vedrørende tillid? - Mine kollegaer i afdelingen deler uforbeholdent information med mig

9. Chapter 5.1.2 – Descriptive statistics

	ANC ENE	ANC AFD	VID TAC	VID T-E	VID EXP	VID AFD	VID TEA	VED KON	HUR KON	KOL IMØ	KAN DOK	KAN EMA	KAN GET	KAN LYN	KAN PER	KAN TEL	TIL GEN	TIL OUT	TIL IN
Mean	2,23	1,84	4,43	4,11	3,82	3,74	4,18	4,25	3,94	4,56	3,73	4,03	2,13	3,09	4,78	4,14	4,77	4,57	4,28
Standard Error	0,08	0,06	0,07	0,07	0,08	0,08	0,07	0,07	0,08	0,06	0,08	0,06	0,08	0,09	0,04	0,07	0,04	0,06	0,07
Median	2,00	2,00	5,00	4,00	4,00	4,00	4,00	4,00	4,00	5,00	4,00	4,00	2,00	3,00	5,00	4,00	5,00	5,00	4,00
Mode	2,00	2,00	5,00	4,00	4,00	4,00	4,00	4,00	4,00	5,00	4,00	4,00	3,00	3,00	5,00	4,00	5,00	5,00	5,00
Standard Deviation	0,92	0,67	0,72	0,72	0,86	0,89	0,78	0,79	0,82	0,66	0,85	0,67	0,93	0,95	0,46	0,71	0,48	0,62	0,78
Sample Variance	0,85	0,45	0,52	0,52	0,74	0,80	0,60	0,63	0,68	0,43	0,72	0,44	0,86	0,91	0,21	0,51	0,23	0,38	0,61
Kurtosis	-0,54	-0,79	0,92	-0,08	0,06	-0,34	0,32	2,14	0,99	2,64	0,77	-0,15	-1,05	0,01	2,64	0,57	3,08	1,78	0,20
Skewness	0,45	0,20	-1,14	-0,44	-0,44	-0,54	-0,77	-1,20	-0,81	-1,57	-0,64	-0,20	0,18	-0,42	-1,86	-0,64	-1,95	-1,34	-0,87
Range	3,00	2,00	3,00	3,00	4,00	3,00	3,00	4,00	4,00	3,00	4,00	3,00	3,00	4,00	2,00	3,00	2,00	3,00	3,00
Minimum	1,00	1,00	2,00	2,00	1,00	2,00	2,00	1,00	1,00	2,00	1,00	2,00	1,00	1,00	3,00	2,00	3,00	2,00	2,00
Maximum	4,00	3,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	4,00	5,00	5,00	5,00	5,00	5,00	5,00
Sum	267	221	532	493	458	449	502	510	473	547	448	483	256	371	573	497	572	548	514
Count	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120

10. Chapter 5.1.2 – Distribution of data




KAN DOK
70
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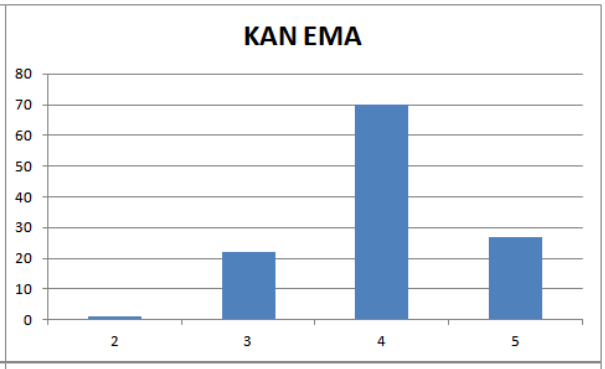
4
5


KAN EMA
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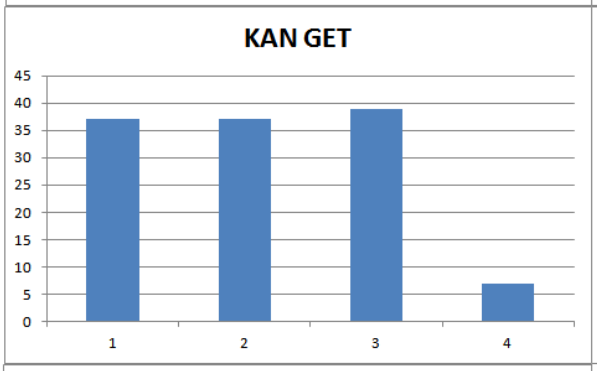
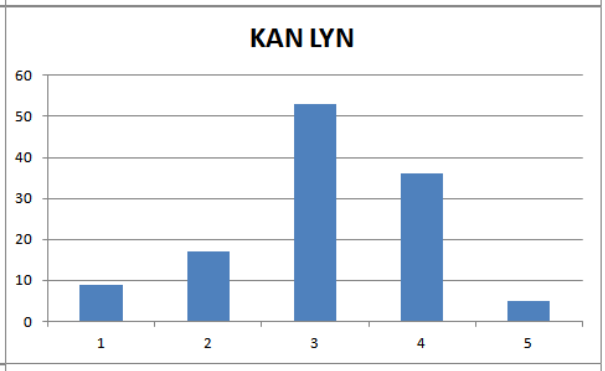
3
4
5


KAN GET
45
40
35
30
25
20
15
10
5
0
1
2
3
4


KAN LYN
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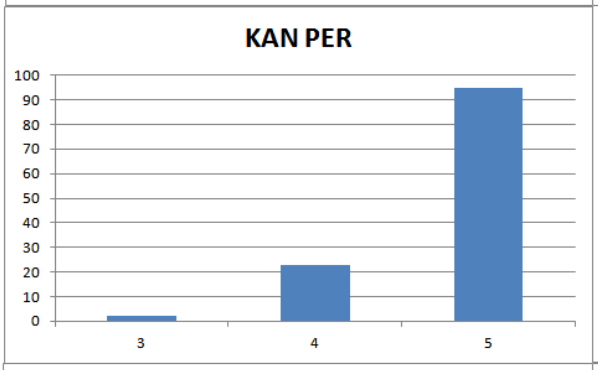
50
40
30
20
10
0
1
2
3
4
5


KAN PER
100
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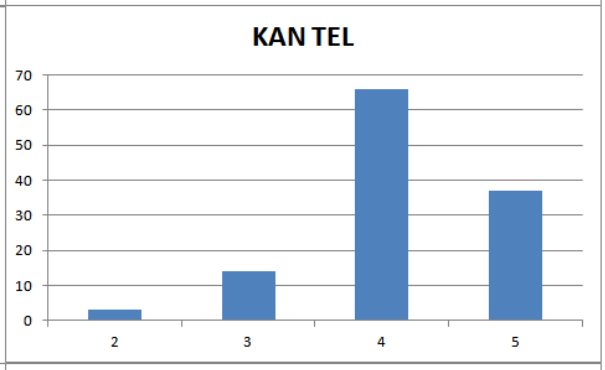
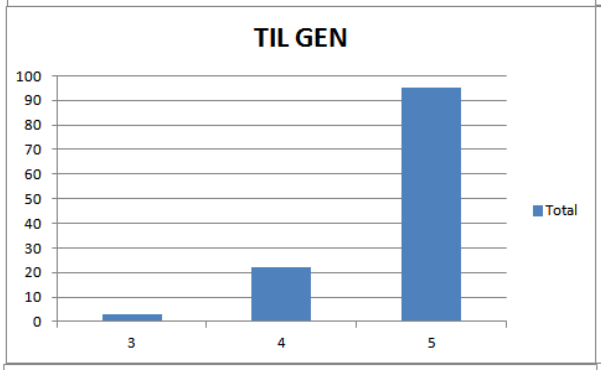
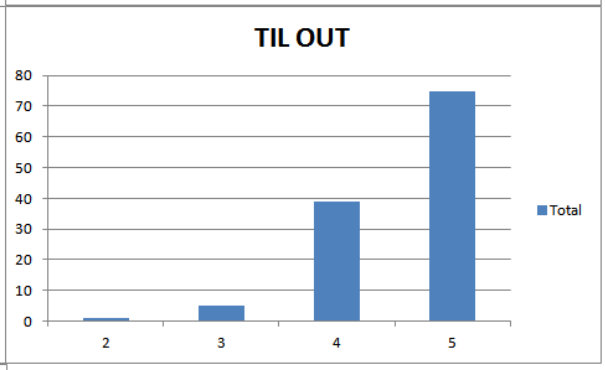
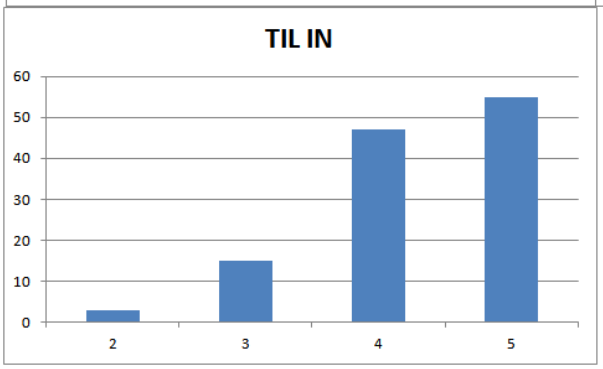
80
70
60
50
40
30
20
10
0
3
4
5

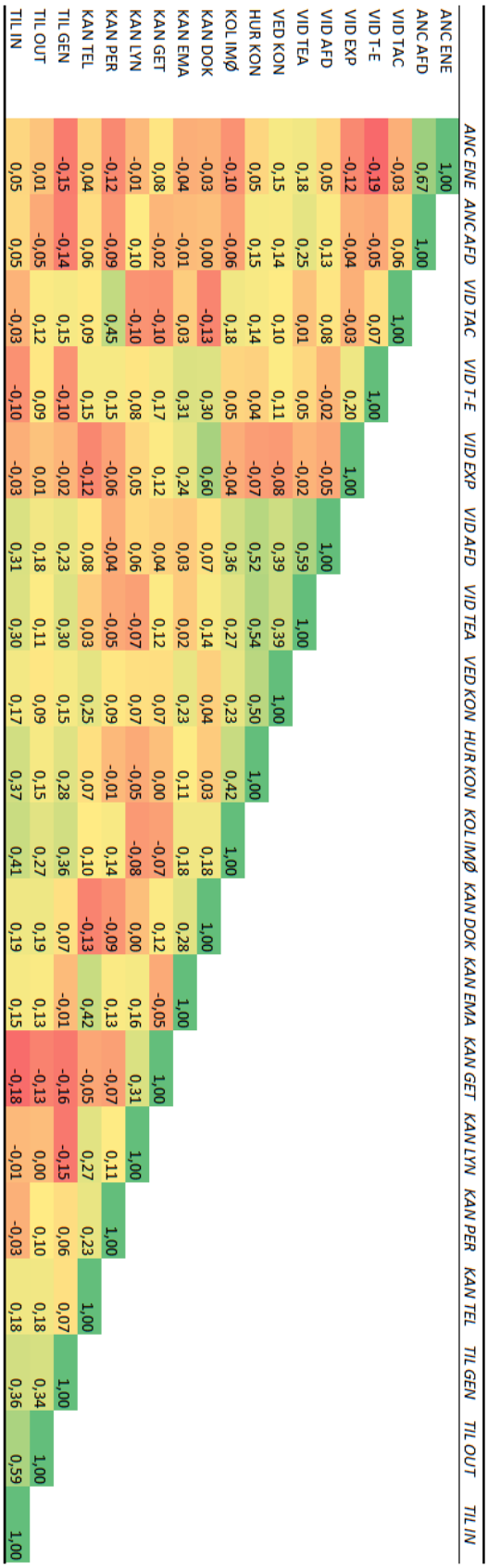

KAN TEL
70
60
50
40
30
20
10
0
2
3
4
5


TIL GEN
100
90
80
70
60
50
40
30
20
10
0
3
4
5
Total


TIL OUT
80
70
60
50
40
30
20
10
0
2
3
4
5
Total


TIL IN
60
50
40
30
20
10
0
2
3
4
5

11. Chapter 5.1.2 – Correlation analysis



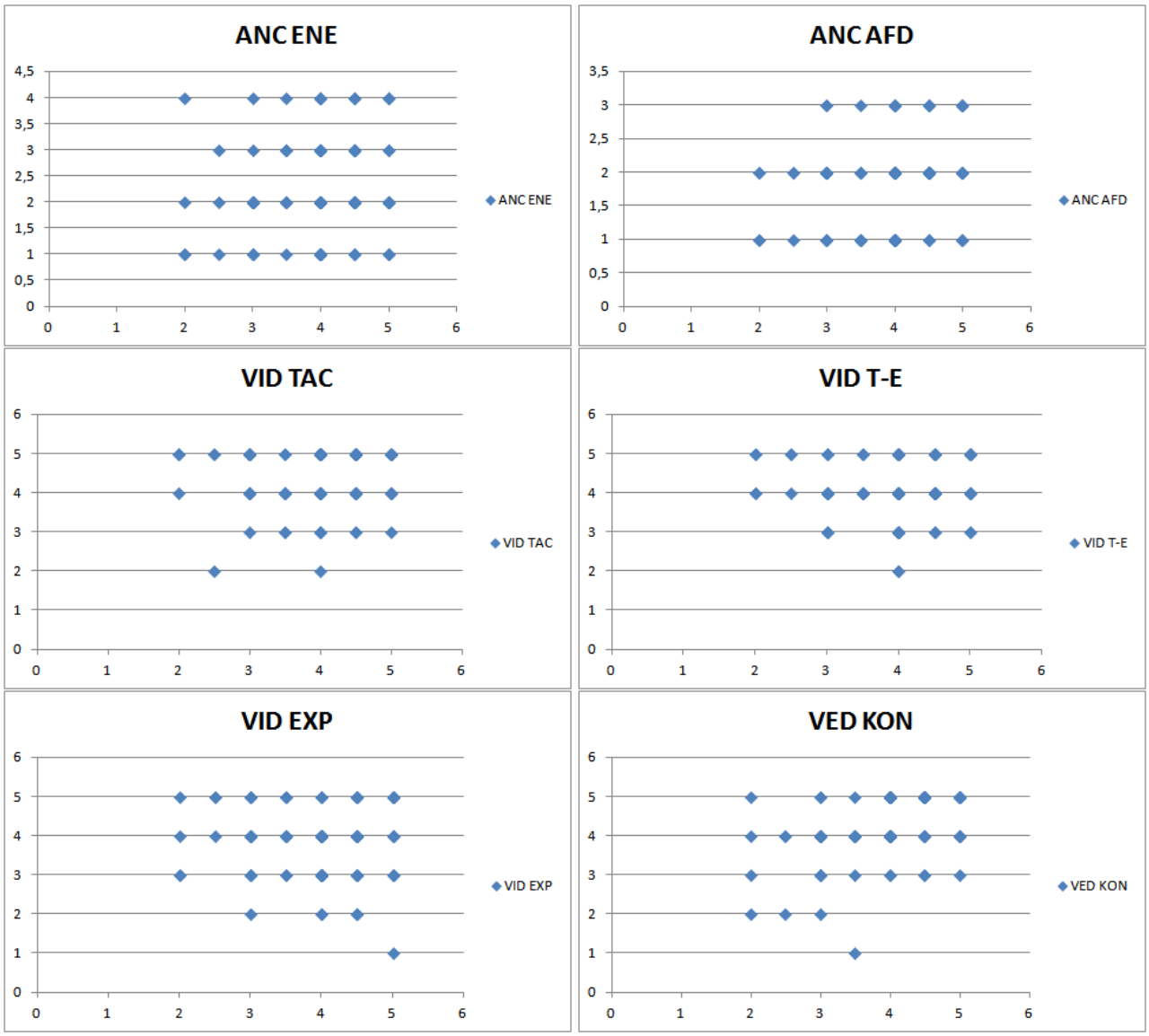
	ANC ENE	ANC AFD	VID TAC	VID T-E	VID EXP	VID AFD	VID TEA	VED KON	HUR KON	KOL IMØ	KAN DOK	KAN EMA	KAN GET	KAN LYN	KAN PER	KAN TEL	TIL GEN	TIL OUT	TIL IN
ANC ENE	1,00																		
ANC AFD	0,67	1,00																	
VID TAC	-0,03	0,06	1,00																
VID T-E	-0,19	-0,05	0,07	1,00															
VID EXP	-0,12	-0,04	-0,03	0,20	1,00														
VID AFD	0,05	0,13	0,08	-0,02	-0,05	1,00													
VID TEA	0,18	0,25	0,01	0,05	-0,02	0,59	1,00												
VED KON	0,15	0,14	0,10	0,11	-0,08	0,39	0,39	1,00											
HUR KON	0,05	0,15	0,14	0,04	-0,07	0,52	0,54	0,50	1,00										
KOL IMØ	-0,10	-0,06	0,18	0,05	-0,04	0,36	0,27	0,23	0,42	1,00									
KAN DOK	-0,03	0,00	-0,13	0,30	0,60	0,07	0,14	0,04	0,03	0,18	1,00								
KAN EMA	-0,04	-0,01	0,03	0,31	0,24	0,03	0,02	0,23	0,11	0,18	0,28	1,00							
KAN GET	0,08	-0,02	-0,10	0,17	0,12	0,04	0,12	0,07	0,00	-0,07	0,12	-0,05	1,00						
KAN LYN	-0,01	0,10	-0,10	0,08	0,05	0,06	-0,07	0,07	-0,05	-0,08	0,00	0,16	0,31	1,00					
KAN PER	-0,12	-0,09	0,45	0,15	-0,06	-0,04	-0,05	0,09	-0,01	0,14	-0,09	0,13	-0,07	0,11	1,00				
KAN TEL	0,04	0,06	0,09	0,15	-0,12	0,08	0,03	0,25	0,07	0,10	-0,13	0,42	-0,05	0,27	0,23	1,00			
TIL GEN	-0,15	-0,14	0,15	-0,10	-0,02	0,23	0,30	0,15	0,28	0,36	0,07	-0,01	-0,16	-0,15	0,06	0,07	1,00		
TIL OUT	0,01	-0,05	0,12	0,09	0,01	0,18	0,11	0,09	0,15	0,27	0,19	0,13	-0,13	0,00	0,10	0,18	0,34	1,00	
TIL IN	0,05	0,05	-0,03	-0,10	-0,03	0,31	0,30	0,17	0,37	0,41	0,19	0,15	-0,18	-0,01	-0,03	0,18	0,36	0,59	1,00

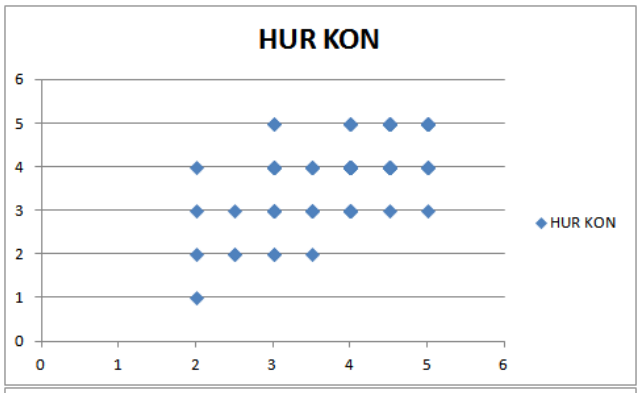
12. Chapter 5.2.1 – Chronbach's alpha

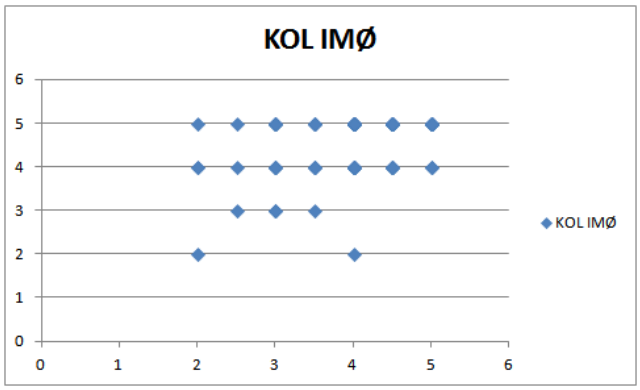
Test results	
VID TEA, VID AFD	
Mean is...	7,925
SD is...	1,4841524
alpha is...	0,73671932
SEM is...	0,76153172
# of items is	2

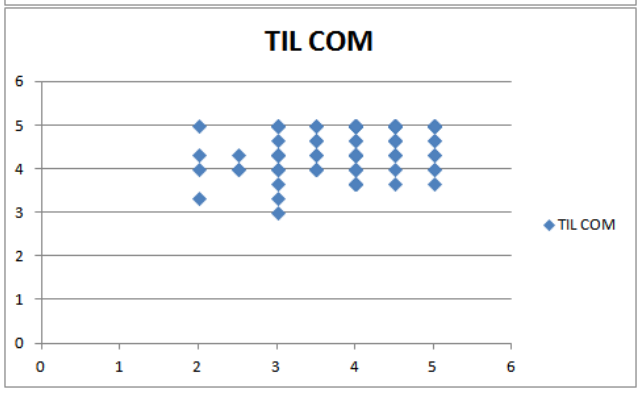
Test results	
TIL GEN, TIL OUT, TIL IN	
Mean is...	13,6166667
SD is...	1,49545608
alpha is...	0,68786486
SEM is...	0,83549719
# of items is	3

13. Chapter 5.4 – Scatter plots independent variables relation and VID COM









14. Chapter 5.4 – Simple linear regression models VID COM and relation variables

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,44
R Square	0,19
Adjusted R Square	0,18
Standard Error	0,67
Observations	120

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	12,59	12,59	27,77	6,24271E-07
Residual	118	53,49	0,45		
Total	119	66,08			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	2,22	0,34	6,57	1,42074E-09	1,55	2,88	1,55	2,88
VED KON	0,41	0,08	5,27	6,24271E-07	0,26	0,57	0,26	0,57

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,59
R Square	0,35
Adjusted R Square	0,35
Standard Error	0,60
Observations	120

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	23,20	23,20	63,83	1,01608E-12
Residual	118	42,88	0,36		
Total	119	66,08			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	1,85	0,27	6,83	3,83739E-10	1,31	2,38	1,31	2,38
HUR KON	0,54	0,07	7,99	1,01608E-12	0,40	0,67	0,40	0,67

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,36
R Square	0,13
Adjusted R Square	0,12
Standard Error	0,70
Observations	120

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	8,56	8,56	17,56	5,41252E-05
Residual	118	57,52	0,49		
Total	119	66,08			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	2,11	0,45	4,70	6,9777E-06	1,22	2,99	1,22	2,99
KOL IMØ	0,41	0,10	4,19	5,41252E-05	0,21	0,60	0,21	0,60

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,34
R Square	0,12
Adjusted R Square	0,11
Standard Error	0,70
Observations	120

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	7,64	7,64	15,42	0,0001452
Residual	118	58,44	0,50		
Total	119	66,08			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	1,67	0,59	2,83	0,005476011	0,50	2,83	0,50	2,83
TIL COM	0,51	0,13	3,93	0,0001452	0,25	0,76	0,25	0,76

15. Chapter 5.4 - Multiple linear regression model VID COM and relation variables

SUMMARY OUTPUT VID COM

Regression Statistics	
Multiple F	0,65
R Square	0,42
Adjusted I	0,40
Standard I	0,58
Observati	120

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regressio	5	27,81	5,56	16,57	2,83626E-12
Residual	114	38,27	0,34		
Total	119	66,08			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,14	0,57	0,25	0,800660052	-0,98	1,27	-0,98	1,27
ANC AFD	0,15	0,08	1,83	0,069746001	-0,01	0,31	-0,01	0,31
VED KON	0,16	0,08	2,09	0,039131598	0,01	0,32	0,01	0,32
HUR KON	0,36	0,08	4,38	2,61056E-05	0,20	0,52	0,20	0,52
KOL IMØ	0,12	0,10	1,24	0,21629659	-0,07	0,31	-0,07	0,31
TIL COM	0,20	0,12	1,64	0,103130841	-0,04	0,44	-0,04	0,44

16. Chapter 5.4 - Multiple linear regression model VID COM and relation variables - reduced

SUMMARY OUTPUT

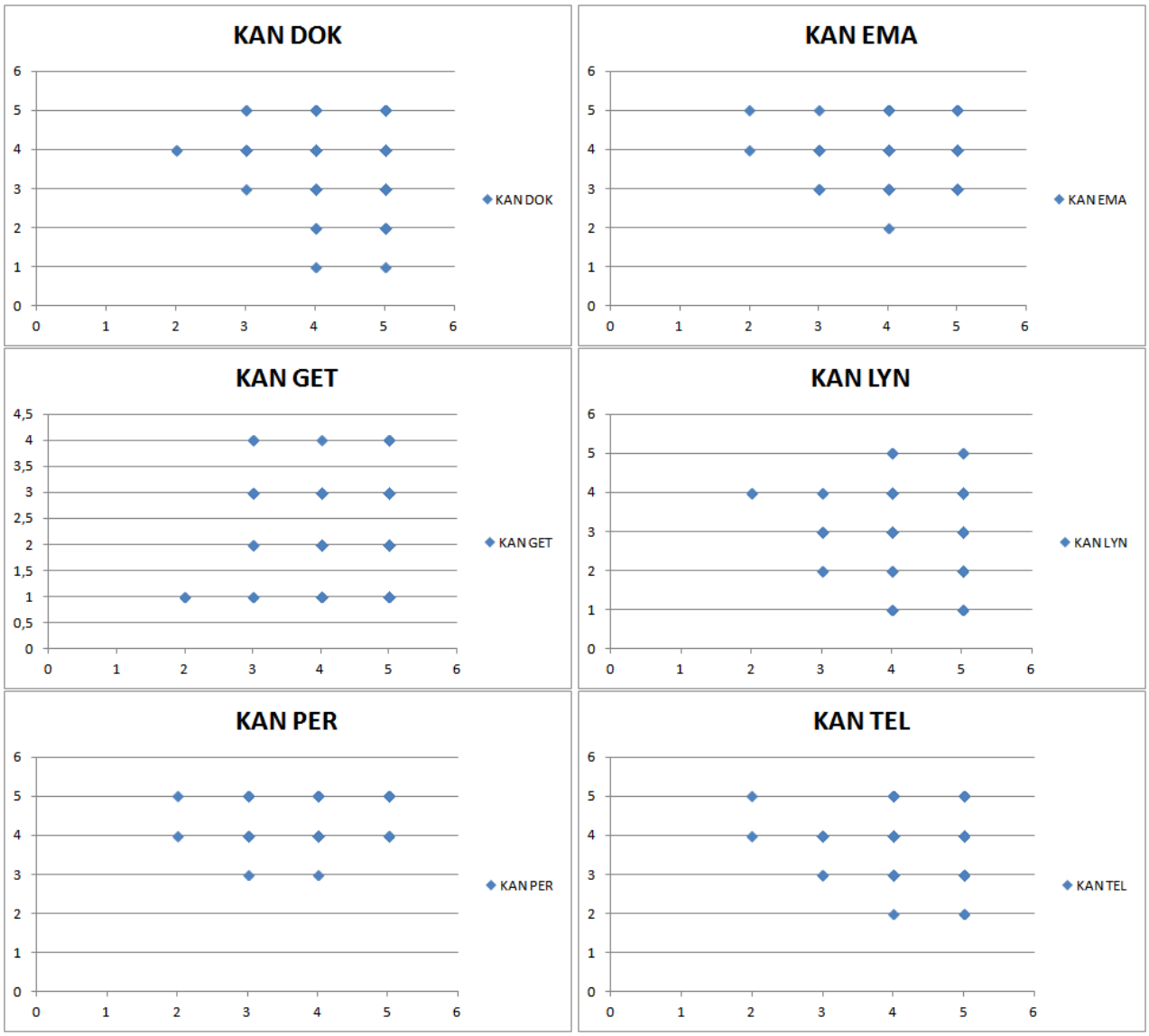
Regression Statistics	
Multiple F	0,61
R Square	0,38
Adjusted I	0,37
Standard I	0,59
Observati	120

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regressio	2	24,93	12,46	35,44	9,28432E-13
Residual	117	41,15	0,35		
Total	119	66,08			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	1,43	0,33	4,41	2,31444E-05	0,79	2,08	0,79	2,08
VED KON	0,18	0,08	2,22	0,028432072	0,02	0,33	0,02	0,33
HUR KON	0,45	0,08	5,92	3,24612E-08	0,30	0,60	0,30	0,60

17. Chapter 5.5 - Scatter plots independent variables communication channels and VID TAC



18. Chapter 5.5 – Multiple linear regression model VID TAC and communication channels

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,48
R Square	0,23
Adjusted R Square	0,19
Standard Error	0,65
Observations	120

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	6	14,31	2,38	5,71	3,21609E-05
Residual	113	47,16	0,42		
Total	119	61,47			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	1,55	0,76	2,04	0,043681258	0,04	3,06	0,04	3,06
KAN DOK	-0,07	0,08	-0,94	0,348401101	-0,22	0,08	-0,22	0,08
KAN EMA	0,01	0,11	0,13	0,897707523	-0,20	0,22	-0,20	0,22
KAN GET	-0,01	0,07	-0,15	0,878960774	-0,15	0,13	-0,15	0,13
KAN LYN	-0,11	0,07	-1,58	0,11772297	-0,24	0,03	-0,24	0,03
KAN PER	0,71	0,13	5,34	4,96999E-07	0,45	0,98	0,45	0,98
KAN TEL	0,01	0,10	0,10	0,919850916	-0,19	0,21	-0,19	0,21

11.1

19. Chapter 5.5 – Simple linear regression model VID TAC and KAN PER

SUMMARY OUTPUT

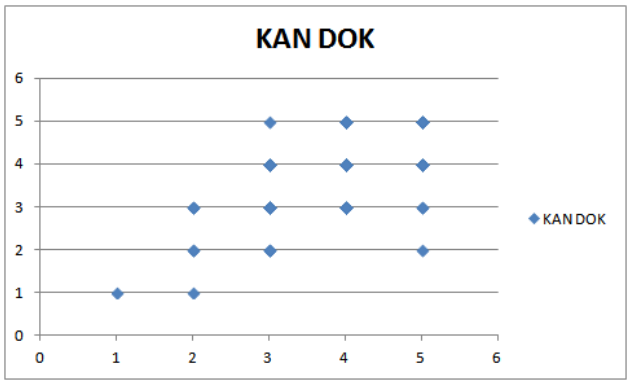
Regression Statistics	
Multiple R	0,45
R Square	0,20
Adjusted R Square	0,20
Standard Error	0,64
Observations	120

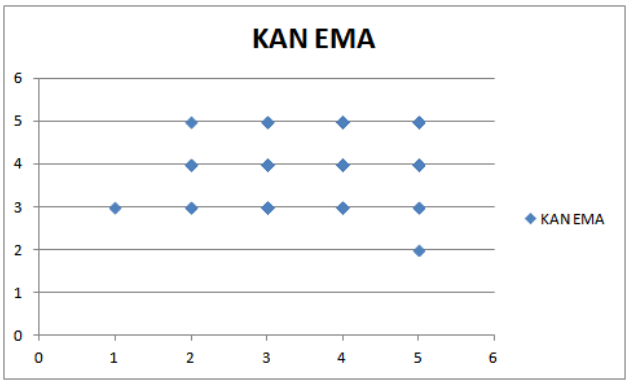
ANOVA

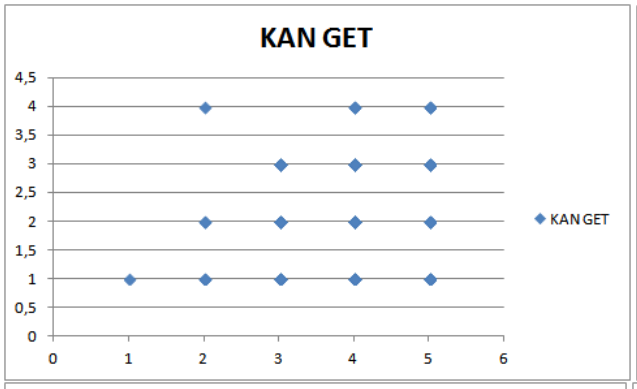
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	12,57	12,57	30,33	2,16142E-07
Residual	118	48,90	0,41		
Total	119	61,47			

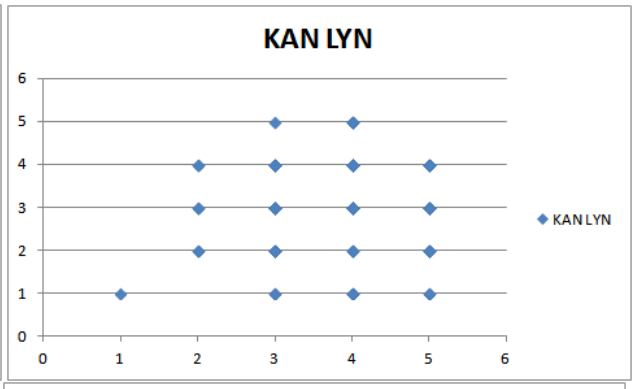
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	1,04	0,62	1,69	0,094531692	-0,18	2,27	-0,18	2,27
KAN PER	0,71	0,13	5,51	2,16142E-07	0,45	0,97	0,45	0,97

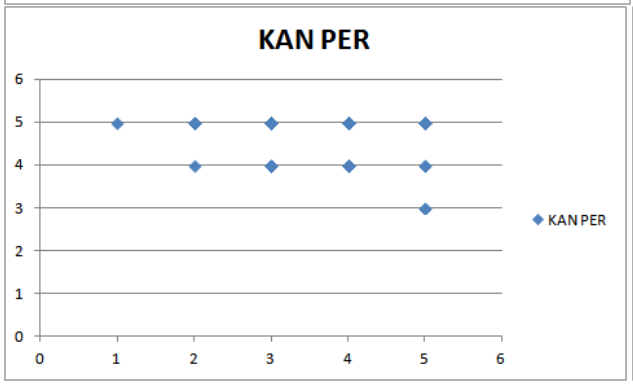
20. Chapter 5.6 - Scatter plots independent variables communication channels and VID EXP

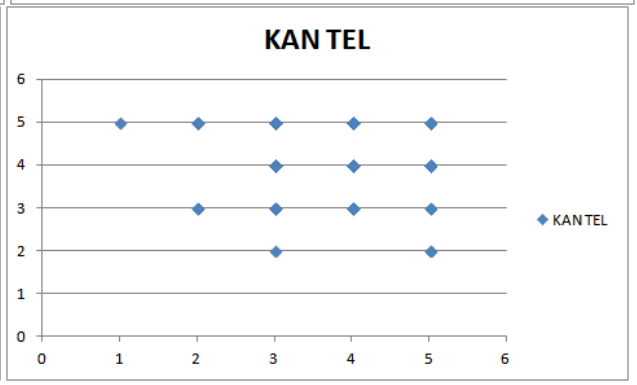












21. Chapter 5.6 – Multiple linear regression model VID EXP and communication channels

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,62
R Square	0,38
Adjusted R Square	0,35
Standard Error	0,69
Observations	120

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	6	33,48	5,58	11,57	4,56664E-10
Residual	113	54,49	0,48		
Total	119	87,97			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	1,50	0,82	1,83	0,069694928	-0,12	3,12	-0,12	3,12
KAN DOK	0,55	0,08	6,68	9,22836E-10	0,39	0,72	0,39	0,72
KAN EMA	0,17	0,11	1,51	0,13471258	-0,05	0,40	-0,05	0,40
KAN GET	0,03	0,07	0,41	0,681295837	-0,12	0,18	-0,12	0,18
KAN LYN	0,05	0,07	0,64	0,522635933	-0,10	0,19	-0,10	0,19
KAN PER	-0,01	0,14	-0,10	0,920978381	-0,30	0,27	-0,30	0,27
KAN TEL	-0,14	0,11	-1,31	0,191686225	-0,35	0,07	-0,35	0,07

11.2

22. Chapter 5.6 – Simple linear regression model VID EXP and KAN DOK

SUMMARY OUTPUT

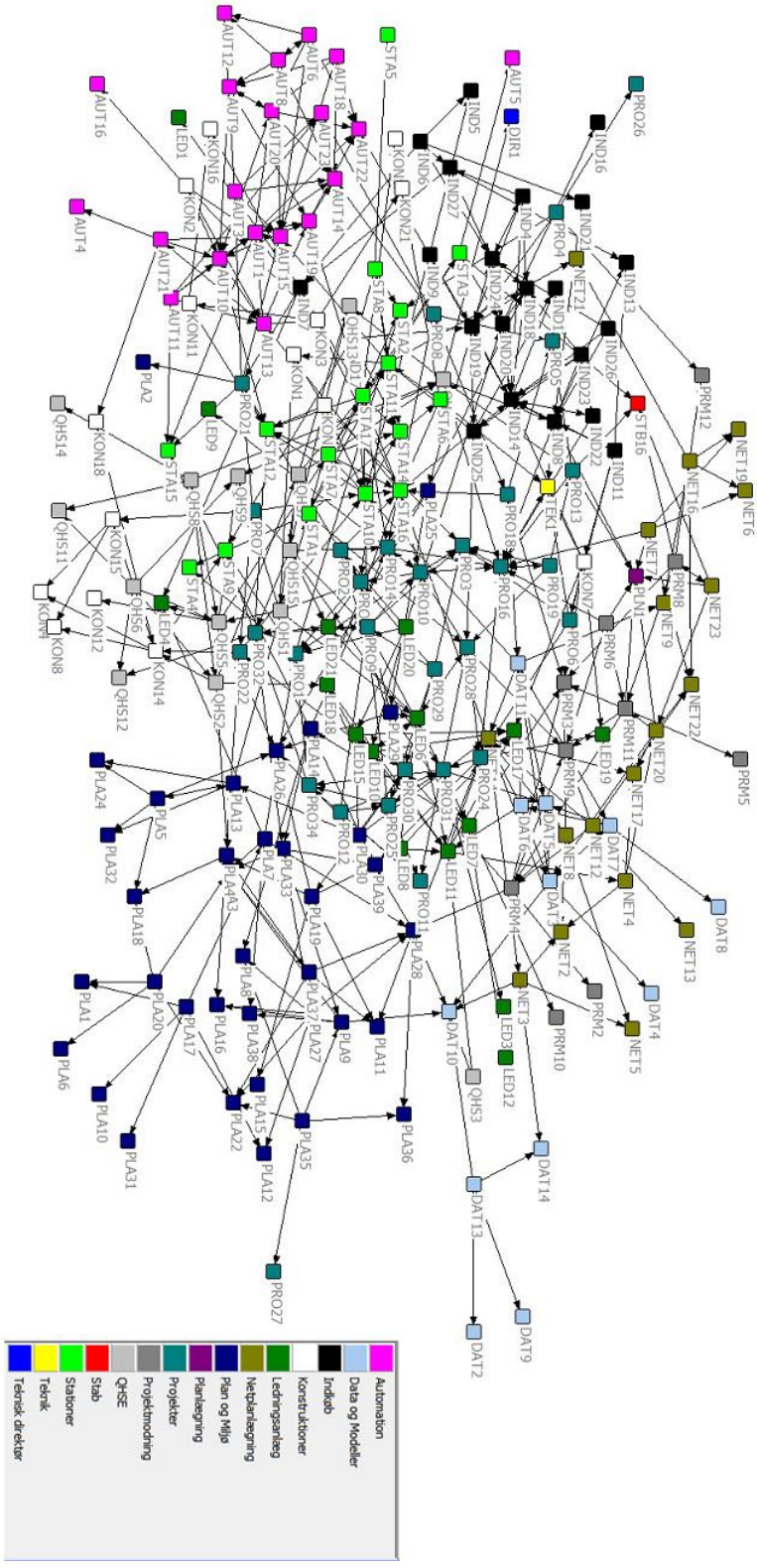
Regression Statistics	
Multiple R	0,60
R Square	0,36
Adjusted R Square	0,36
Standard Error	0,69
Observations	120

ANOVA

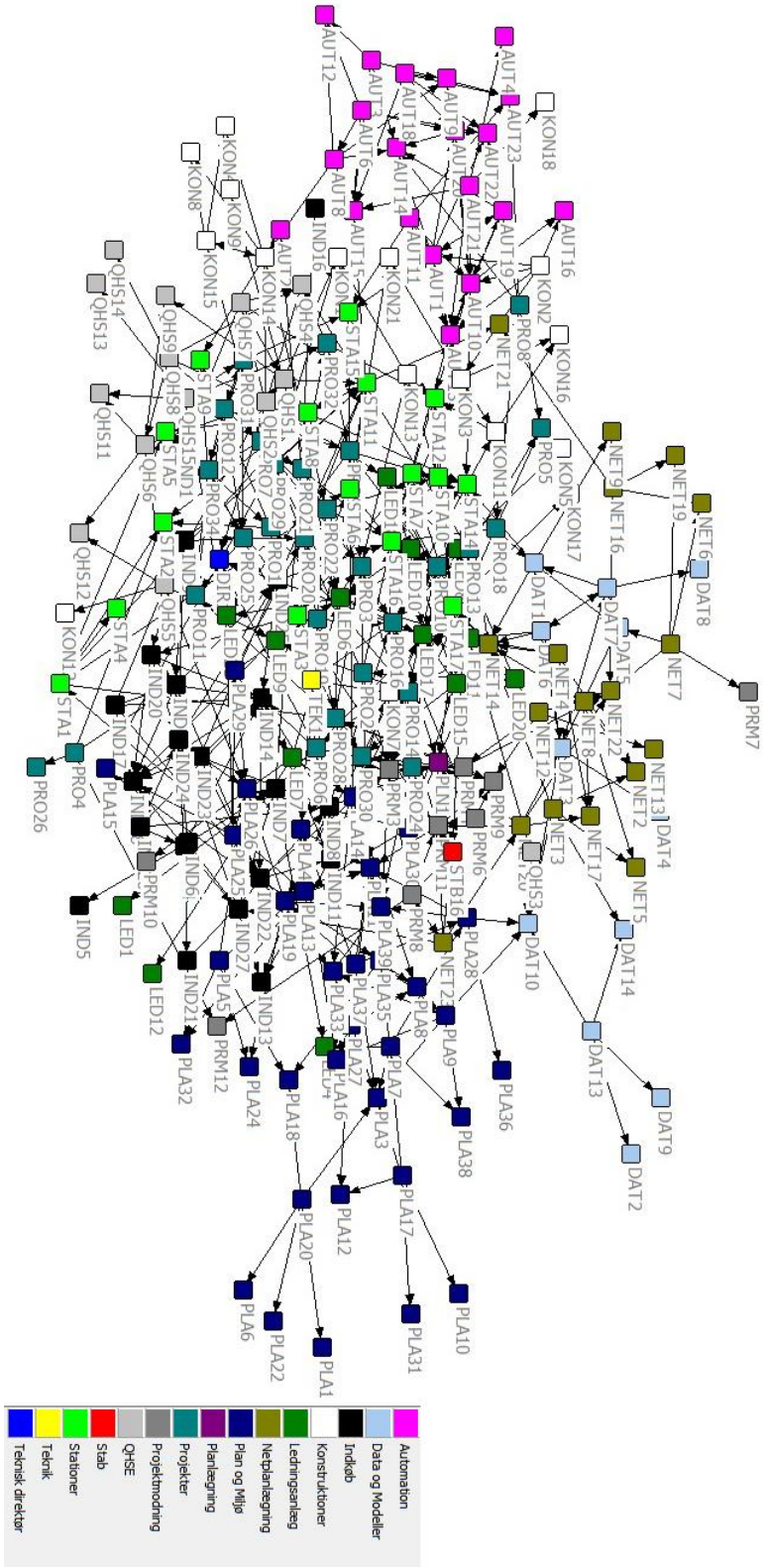
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	31,80	31,80	66,81	3,83776E-13
Residual	118	56,17	0,48		
Total	119	87,97			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	1,54	0,29	5,39	3,67432E-07	0,97	2,11	0,97	2,11
KAN DOK	0,61	0,07	8,17	3,83776E-13	0,46	0,76	0,46	0,76

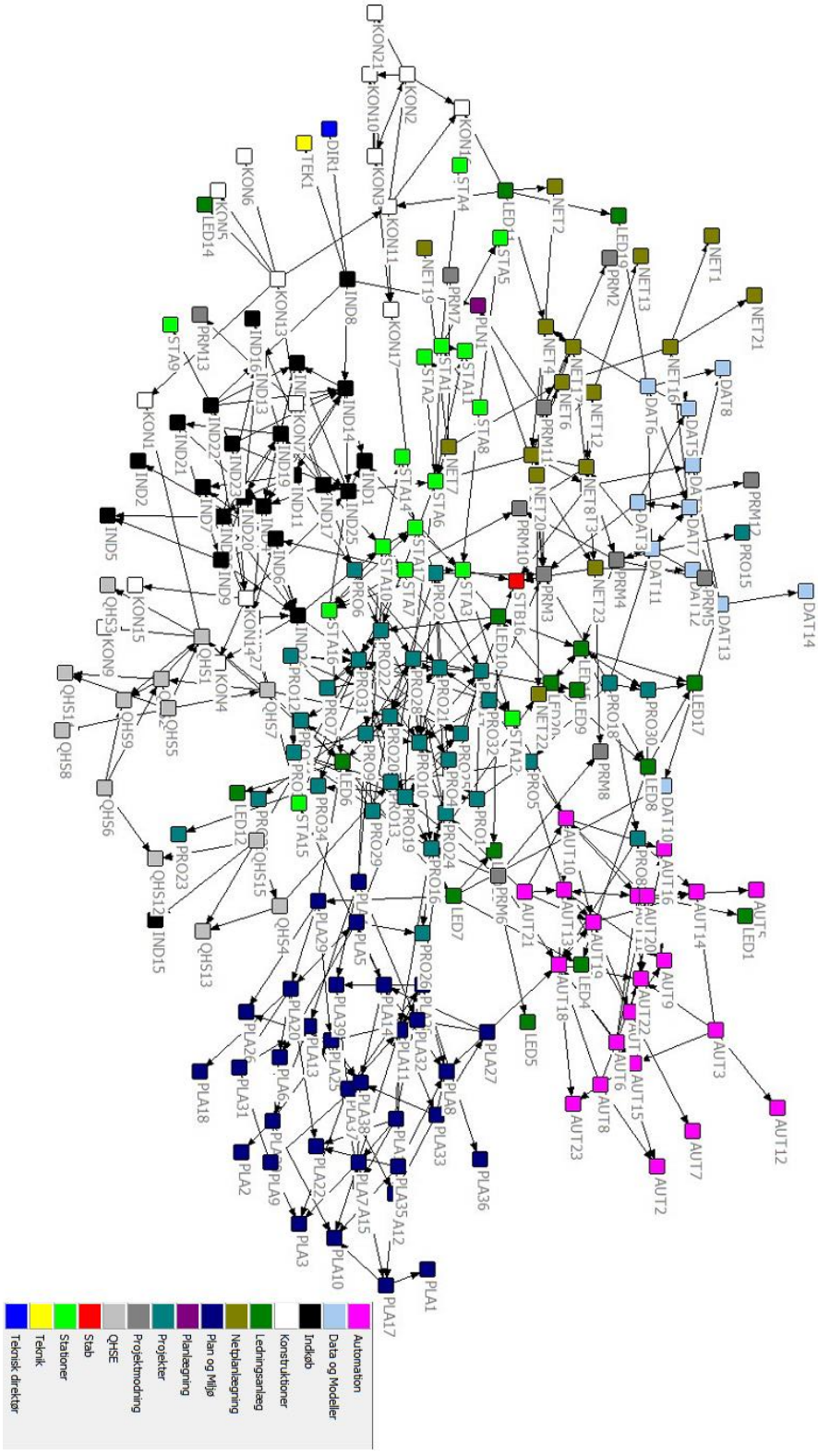
23. Chapter 5.7 – Visualization social network – VIDEN OFTE



24. Chapter 5.7 – Visualization social network – VIDEN VIGTIG

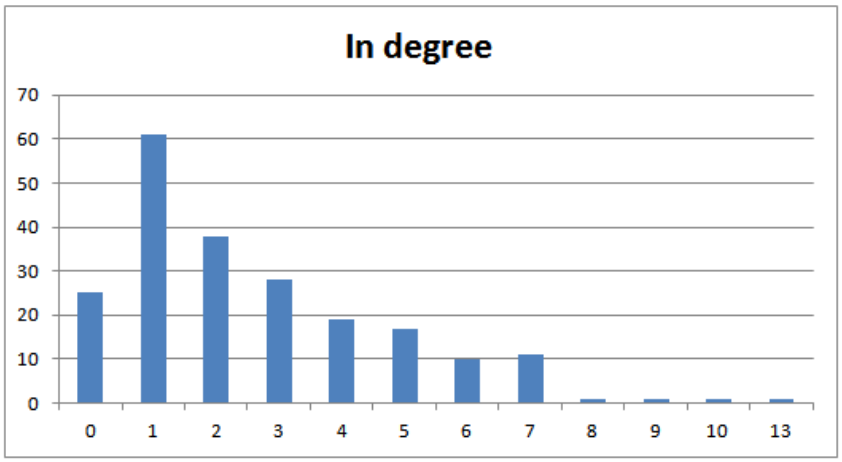


25. Chapter 5.7 – Visualization social network – SOCIAL



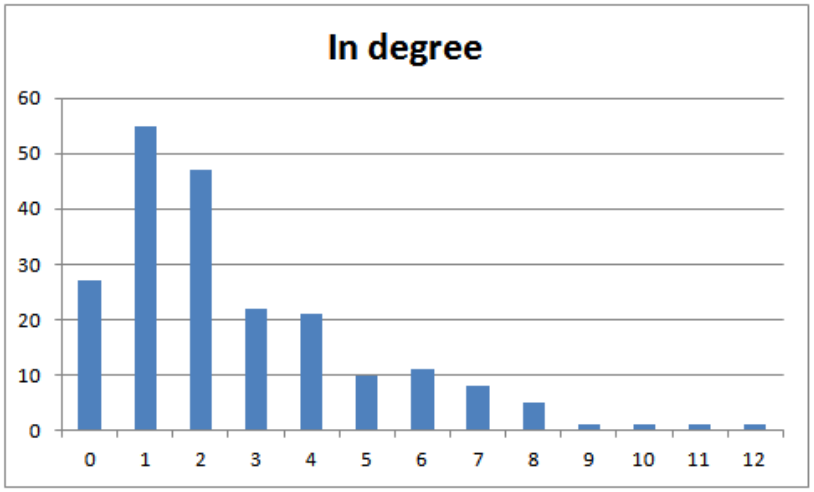
26. Chapter 5.7.1.1– VIDEN OFTE in-degree

# contacts	Count of Indeg
0	25
1	61
2	38
3	28
4	19
5	17
6	10
7	11
8	1
9	1
10	1
13	1
Grand Total	213



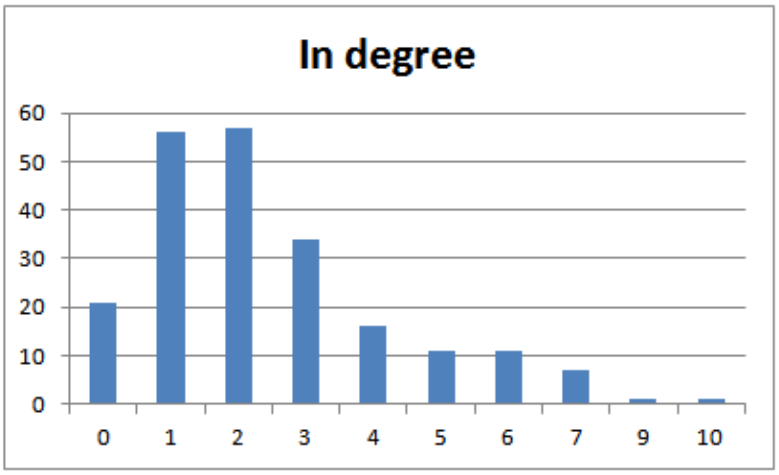
27. Chapter 5.7.1.1 – VIDEN VIGTIG in-degree

# contacts	Count of Indeg
0	27
1	55
2	47
3	22
4	21
5	10
6	11
7	8
8	5
9	1
10	1
11	1
12	1
Grand Total	210



28. Chapter 5.7.1.1 – SOCIAL in-degree

# contacts	Count of Indeg
0	21
1	56
2	57
3	34
4	16
5	11
6	11
7	7
9	1
10	1
Grand Total	215



29. Chapter 5.7.1.1 – Network in-degree correlation

	OFTE	VIGTIG	SOCIAL
OFTE	1		
VIGTIG	0,89	1	
SOCIAL	0,47	0,47	1

30. Chapter 5.7.1.1 – Simple linear regression model in-degree VIDEN OFTE and SOCIAL

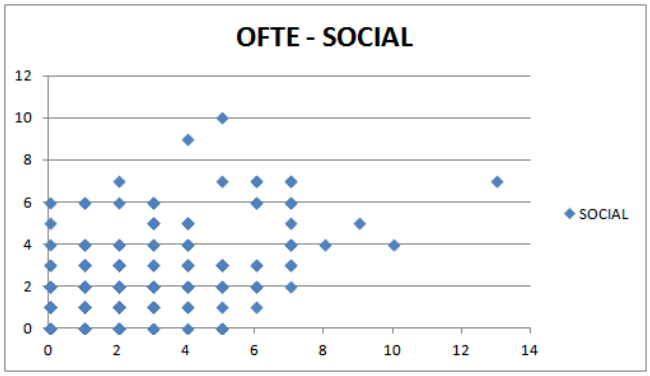
SUMMARY OUTPUT OFTE - SOCIAL

Regression Statistics	
Multiple R	0,47
R Square	0,22
Adjusted R Square	0,22
Standard Error	1,97
Observations	226

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	252,40	252,40	64,84	4,77051E-14
Residual	224	871,95	3,89		
Total	225	1124,34			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	1,21	0,20	5,89	1,40138E-08	0,80	1,61	0,80	1,61
SOCIAL	0,55	0,07	8,05	4,77051E-14	0,42	0,68	0,42	0,68



31. Chapter 5.7.1.1 – Simple linear regression model in-degree VIDEN VIGTIG and SOCIAL

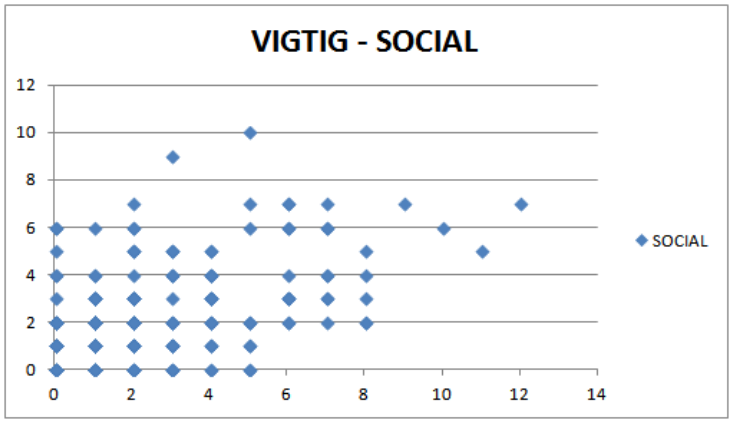
SUMMARY OUTPUT VIGTIG - SOCIAL

Regression Statistics	
Multiple R	0,47
R Square	0,22
Adjusted R Square	0,22
Standard Error	2,07
Observations	226

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	270,09	270,09	63,17	9,22575E-14
Residual	224	957,77	4,28		
Total	225	1227,86			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	1,14	0,21	5,29	2,86238E-07	0,71	1,56	0,71	1,56
SOCIAL	0,57	0,07	7,95	9,22575E-14	0,43	0,71	0,43	0,71



32. Chapter 5.7.1.1 – Simple linear regression model in-degree VIDEN VIGTIG and VIDEN OFTE

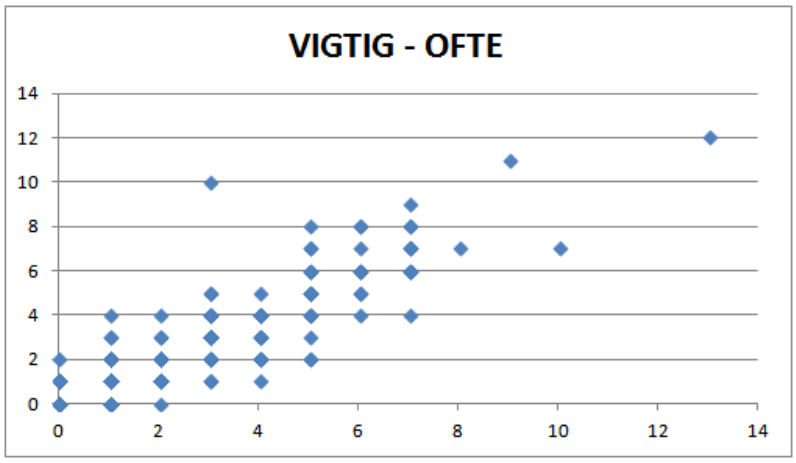
SUMMARY OUTPUT OFTE - VIGTIG

Regression Statistics	
Multiple R	0,89
R Square	0,79
Adjusted R Square	0,78
Standard Error	1,08
Observations	226

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	964,17	964,17	819,05	9,03681E-77
Residual	224	263,69	1,18		
Total	225	1227,86			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,16	0,11	1,45	0,148125594	-0,06	0,37	-0,06	0,37
OFTE	0,93	0,03	28,62	9,03681E-77	0,86	0,99	0,86	0,99



33. Chapter 5.7.1.1– VIDEN OFTE contacts direction

	Values			
Team	Sum of In	Sum of Out	% In team	% Outside team
Automation	50	6	89%	11%
Data og Modeller	19	5	79%	21%
Indkøb	53	19	74%	26%
Konstruktioner	14	16	47%	53%
Ledningsanlæg	24	11	69%	31%
Netplanlægning	27	15	64%	36%
Plan og Miljø	66	19	78%	22%
Projekter	64	46	58%	42%
Projektmodning	12	7	63%	37%
QHSE	22	20	52%	48%
Stationer	29	15	66%	34%
Grand Total	**380**	**179**	**68%**	**32%**

34. Chapter 5.7.1.1 – VIDEN VIGTIG contacts direction

	Values			
Team	Sum of In	Sum of Out	% In team	% Outside team
Automation	48	7	87%	13%
Data og Modeller	18	6	75%	25%
Indkøb	59	16	79%	21%
Konstruktioner	13	17	43%	57%
Ledningsanlæg	27	8	77%	23%
Netplanlægning	25	17	60%	40%
Plan og Miljø	67	17	80%	20%
Projekter	53	56	49%	51%
Projektmodning	8	11	42%	58%
QHSE	18	18	50%	50%
Stationer	29	15	66%	34%
Grand Total	**365**	**188**	**66%**	**34%**

35. Chapter 5.7.1.1 – SOCIAL contacts direction

	Values			
Team	Sum of In	Sum of Out	% In team	% Outside team
Automation	49	5	91%	9%
Data og Modeller	18	7	72%	28%
Indkøb	61	15	80%	20%
Konstruktioner	21	6	78%	22%
Ledningsanlæg	21	12	64%	36%
Netplanlægning	27	17	61%	39%
Plan og Miljø	72	9	89%	11%
Projekter	83	22	79%	21%
Projektmodning	5	9	36%	64%
QHSE	20	9	69%	31%
Stationer	27	10	73%	27%
Grand Total	**404**	**121**	**77%**	**23%**

36. Chapter 5.7.1.2 – VIDEN OFTE preferred communication channel

	Values					
Team	Sum of PER	Sum of TEL	Sum of EMA	Sum of LYN	Sum of AND	% PER
Automation	50	5	3	0	2	83%
Data og Modeller	20	4	1	0	0	80%
Indkøb	74	1	7	0	3	87%
Konstruktioner	23	0	5	0	3	74%
Ledningsanlæg	25	8	1	1	0	71%
Netplanlægning	34	1	3	0	7	76%
Plan og Miljø	71	5	9	0	0	84%
Projekter	109	4	7	0	0	91%
Projektmodning	16	3	1	0	0	80%
QHSE	35	6	3	0	0	80%
Stationer	43	0	2	0	0	96%
Grand Total	**500**	**37**	**42**	**1**	**15**	
Percentage	**84%**	**6%**	**7%**	**0%**	**3%**	

37. Chapter 5.7.1.2 – VIDEN VIGTIG preferred communication channel

	Values					
Team	Sum of PER	Sum of TEL	Sum of EMA	Sum of LYN	Sum of AND	% PER
Automation	53	5	2	0	0	88%
Data og Modeller	19	5	1	0	0	76%
Indkøb	72	0	5	0	8	85%
Konstruktioner	20	0	5	0	3	71%
Ledningsanlæg	27	4	3	1	0	77%
Netplanlægning	31	1	8	0	5	69%
Plan og Miljø	66	6	10	0	3	78%
Projekter	113	3	4	0	0	94%
Projektmodning	13	1	1	0	0	87%
QHSE	27	8	5	0	0	68%
Stationer	44	0	1	0	0	98%
Grand Total	**485**	**33**	**45**	**1**	**19**	
Percentage	**83%**	**6%**	**8%**	**0%**	**3%**	

38. Chapter 5.8 - Simple linear regression model VID AFD and VIDEN VIGTIG constraint

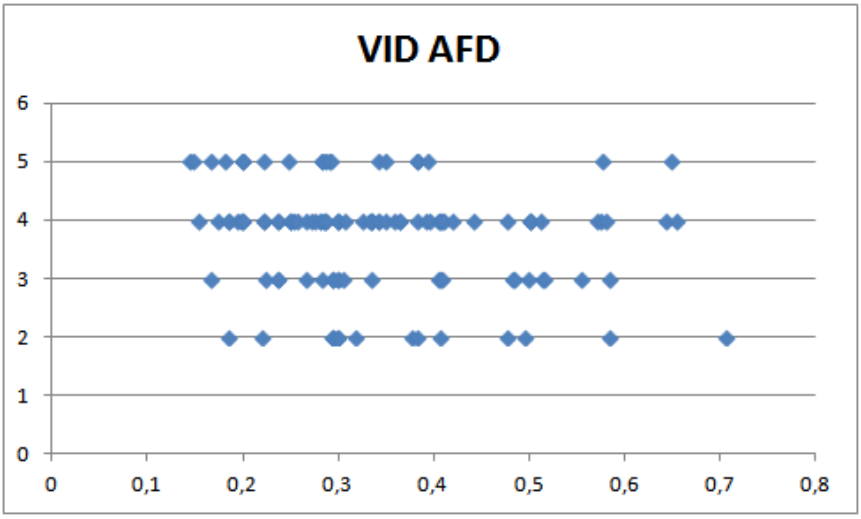
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,19
R Square	0,04
Adjusted R Square	0,03
Standard Error	0,88
Observations	120

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	3,45	3,45	4,44	0,037147608
Residual	118	91,54	0,78		
Total	119	94,99			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,21	0,24	17,89	2,07777E-35	3,74	4,67	3,74	4,67
Constrain	-1,36	0,65	-2,11	0,037147608	-2,64	-0,08	-2,64	-0,08



39. Chapter 5.8 - Simple linear regression model VID TEA and VIDEN VIGTIG constraint

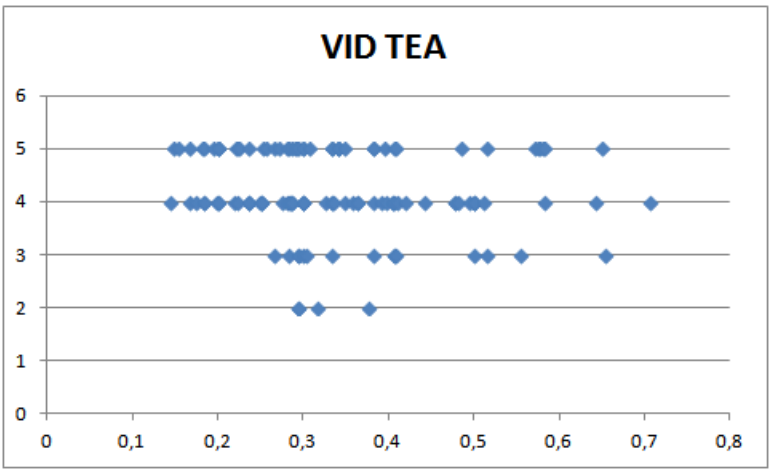
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,11
R Square	0,01
Adjusted R Square	0,00
Standard Error	0,78
Observations	120

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,81	0,81	1,34	0,250173909
Residual	118	71,16	0,60		
Total	119	71,97			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,41	0,21	21,26	3,5734E-42	4,00	4,82	4,00	4,82
Constrain	-0,66	0,57	-1,16	0,250173909	-1,79	0,47	-1,79	0,47



40. Chapter 5.8 - Simple linear regression model VID AFD and VIDEN OFTE constraint

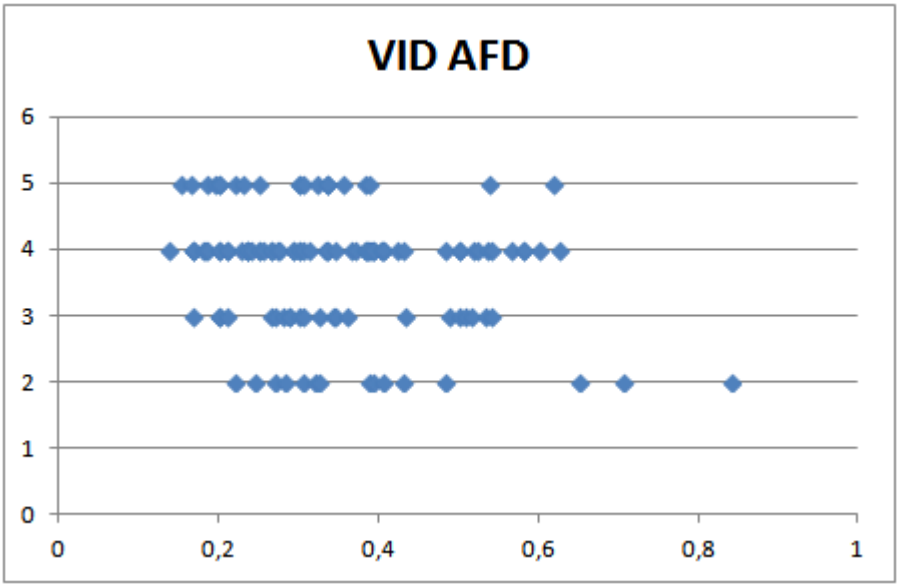
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,22
R Square	0,05
Adjusted R Square	0,04
Standard Error	0,87
Observations	120

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	4,66	4,66	6,09	0,015061114
Residual	118	90,33	0,77		
Total	119	94,99			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,25	0,22	19,18	4,56611E-38	3,81	4,69	3,81	4,69
Constrain	-1,48	0,60	-2,47	0,015061114	-2,66	-0,29	-2,66	-0,29



41. Chapter 5.8 - Simple linear regression model VID TEA and VIDEN OFTE constraint

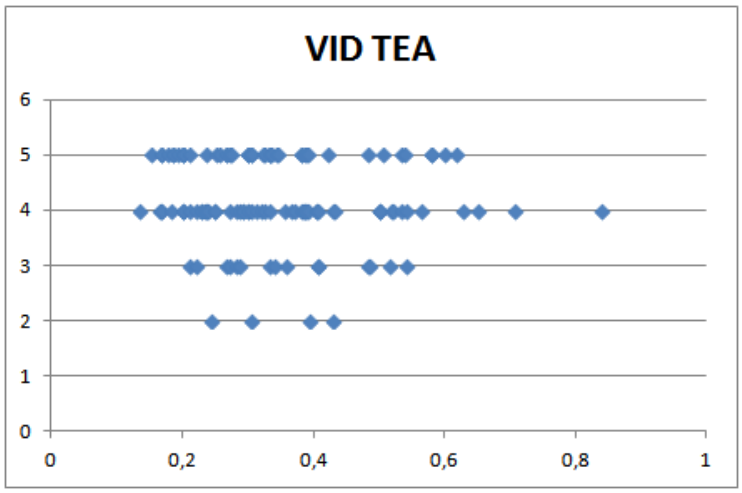
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,07
R Square	0,01
Adjusted R Square	0,00
Standard Error	0,78
Observations	120

ANOVA

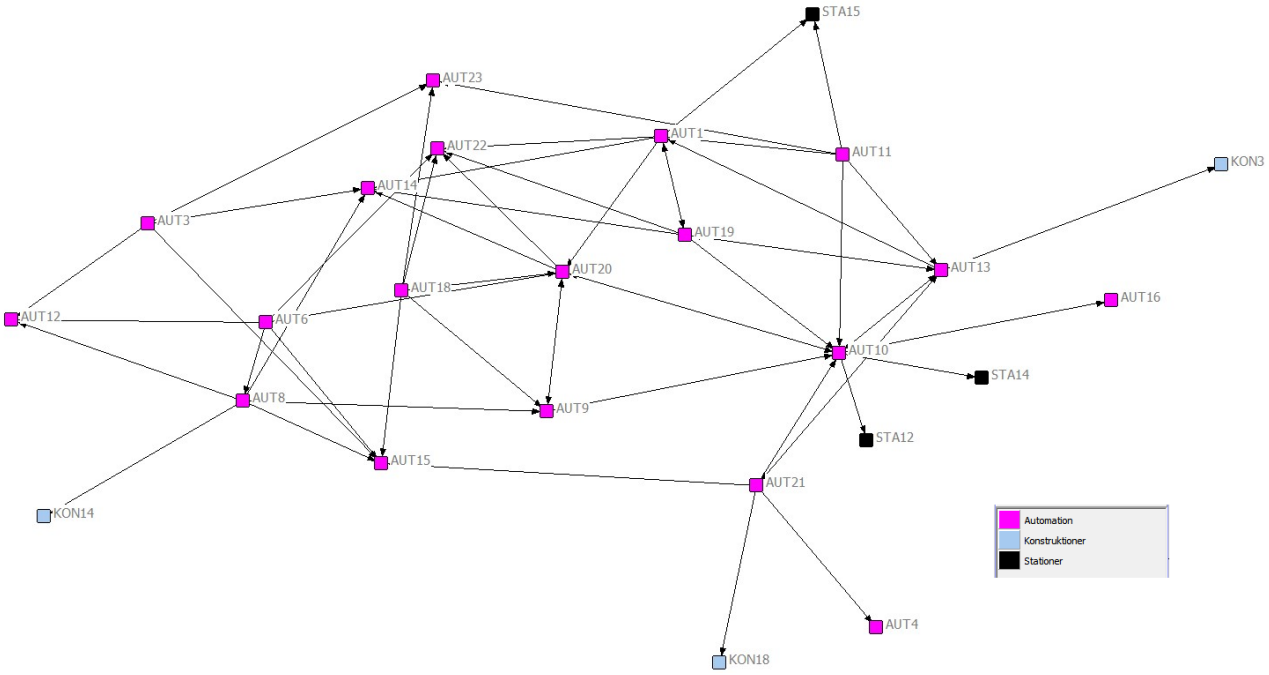
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,40	0,40	0,65	0,420794233
Residual	118	71,57	0,61		
Total	119	71,97			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,33	0,20	21,95	1,74171E-43	3,94	4,72	3,94	4,72
Constrain	-0,43	0,53	-0,81	0,420794233	-1,48	0,62	-1,48	0,62

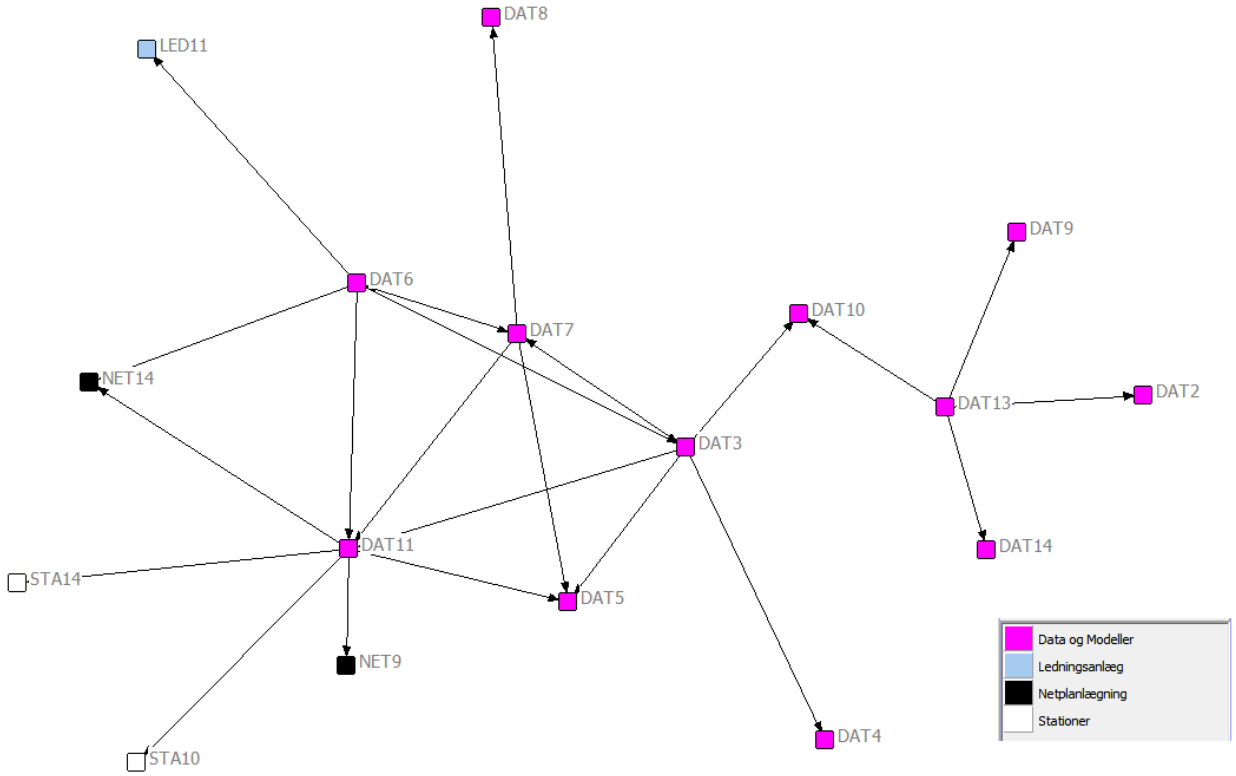


42. Chapter 5.8.1 – Team network visulizations VIDEN VIGTIG

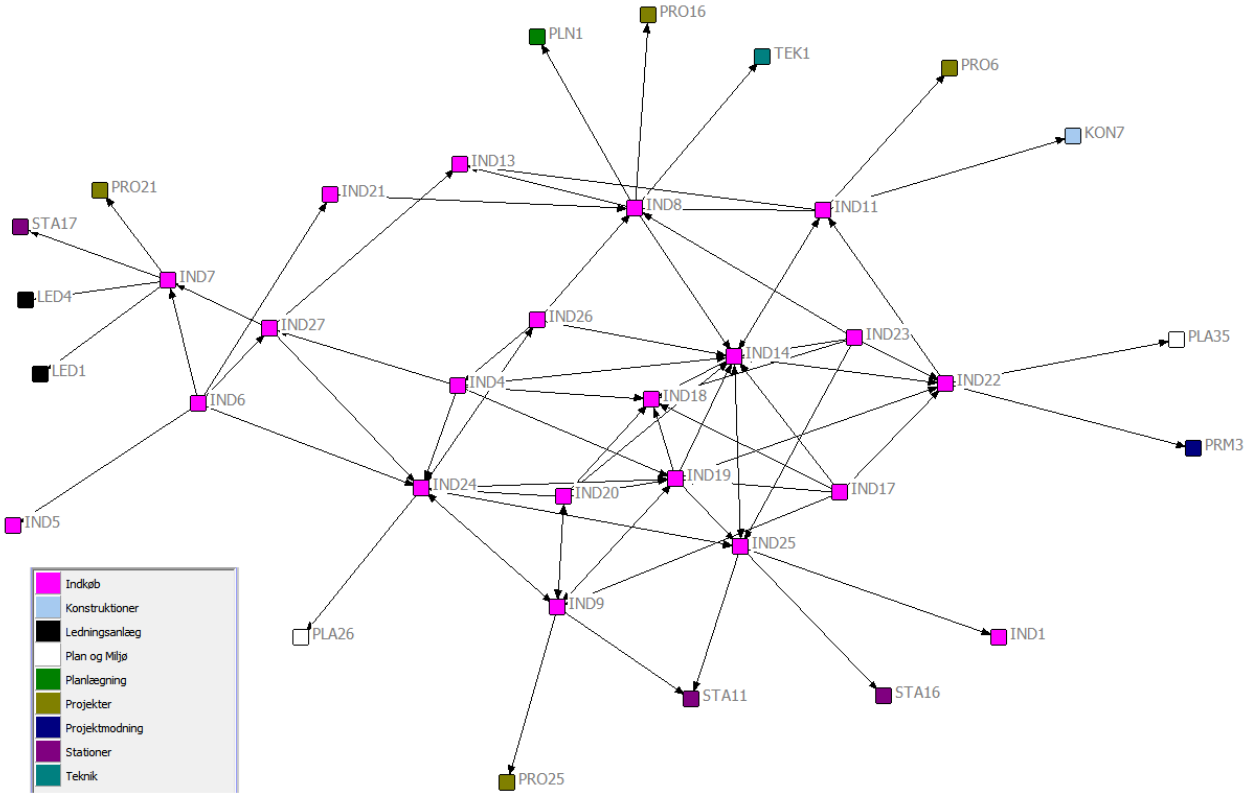
42.1. Automation



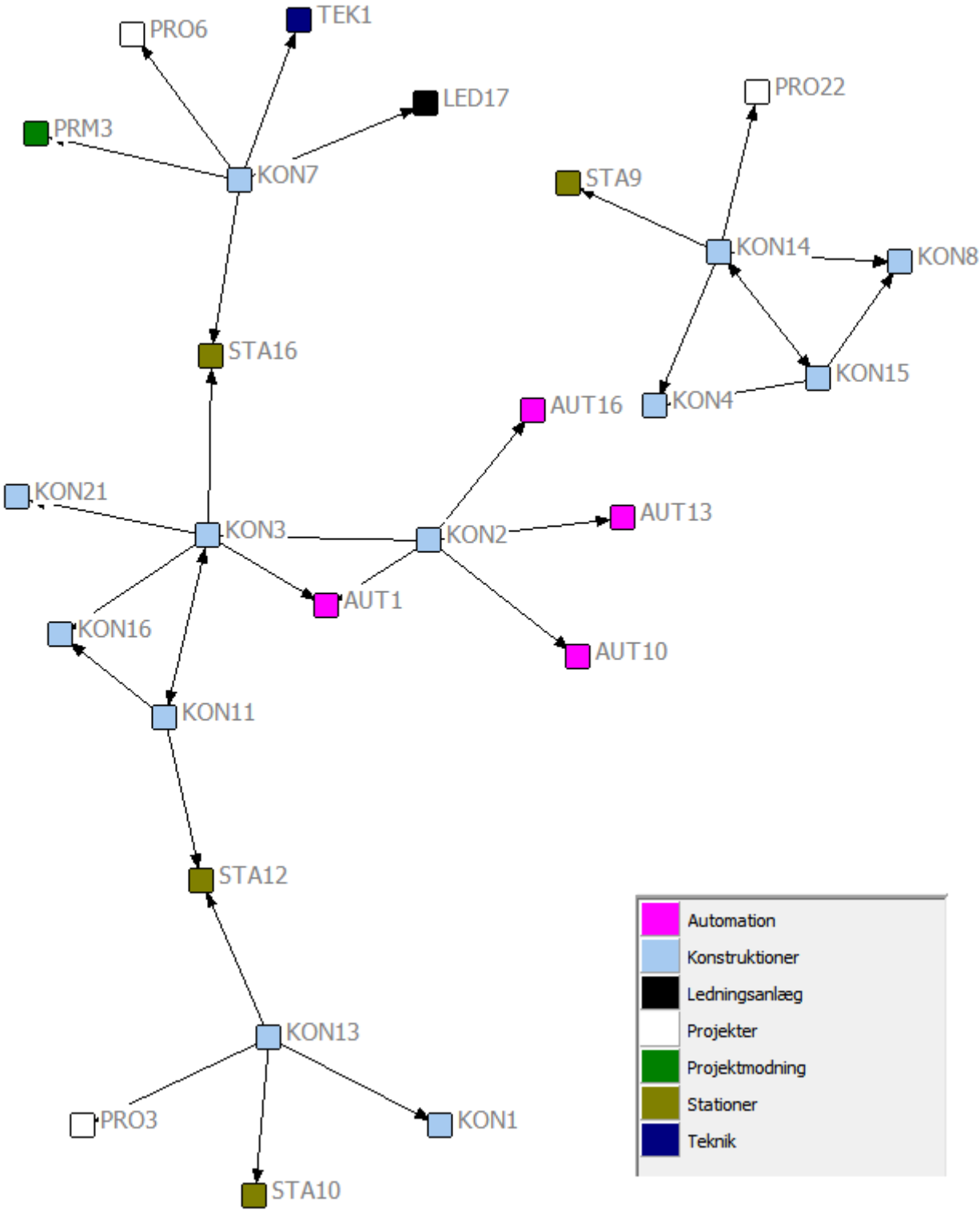
42.2. Data & Modeller



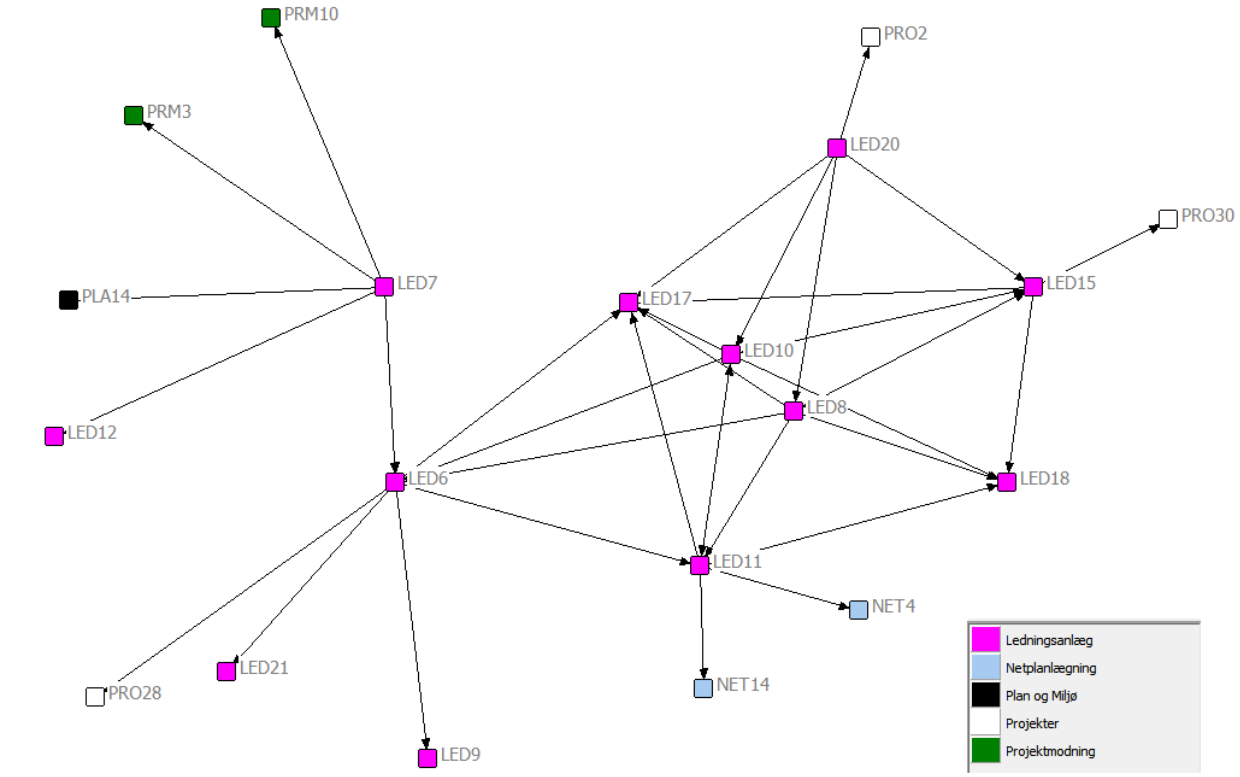
42.3. Indkøb


PRO16
PLN1
TEK1
PRO6
KON7
IND13
PRO21
IND21
IND8
IND11
STA17
IND7
LED4
IND27
IND26
IND23
PLA35
LED1
IND4
IND14
IND22
IND6
IND18
PRM3
IND24
IND19
IND20
IND17
IND5
IND25
IND9
IND1
PLA26
STA11
STA16
PRO25
Indkøb
Konstruktioner
Ledningsanlæg
Plan og Miljø
Planlægning
Projekter
Projektmodning
Stationer
Teknik

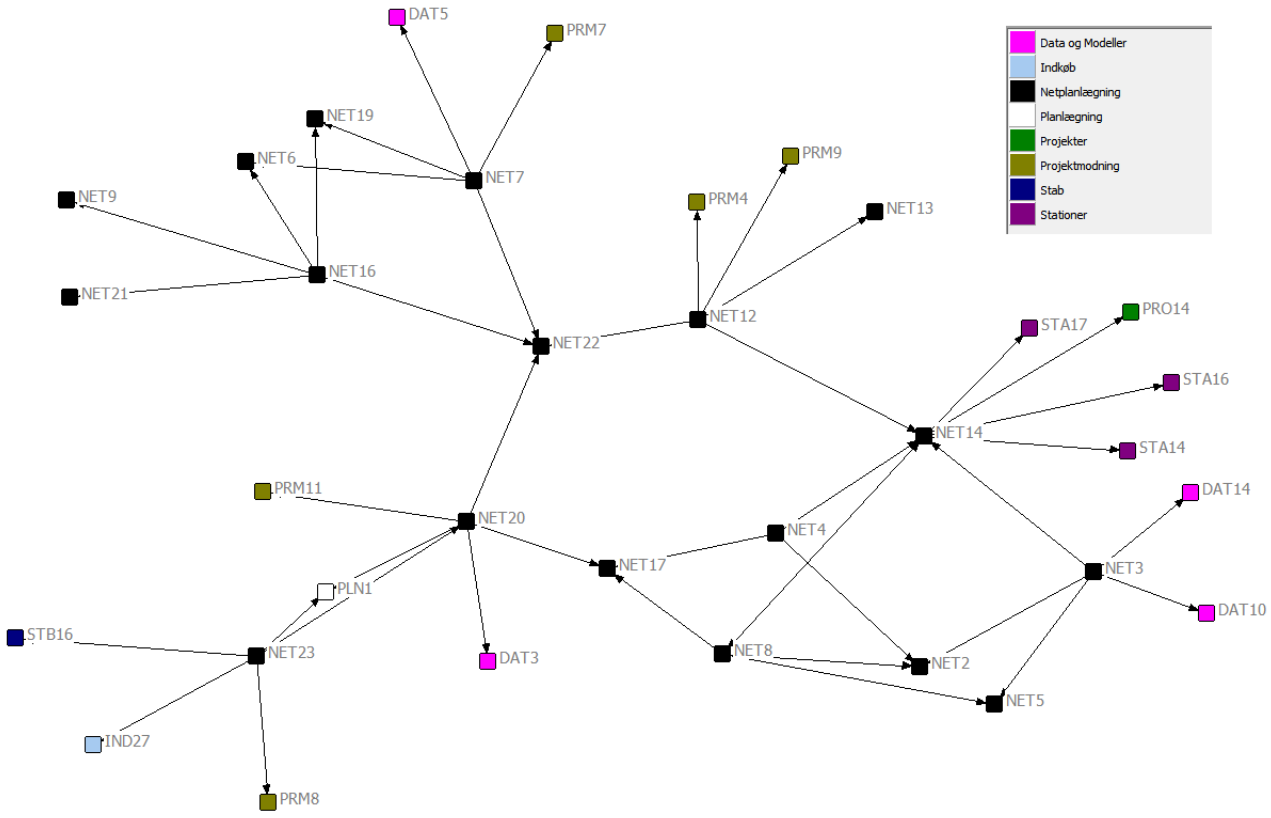
42.4. Konstruktioner



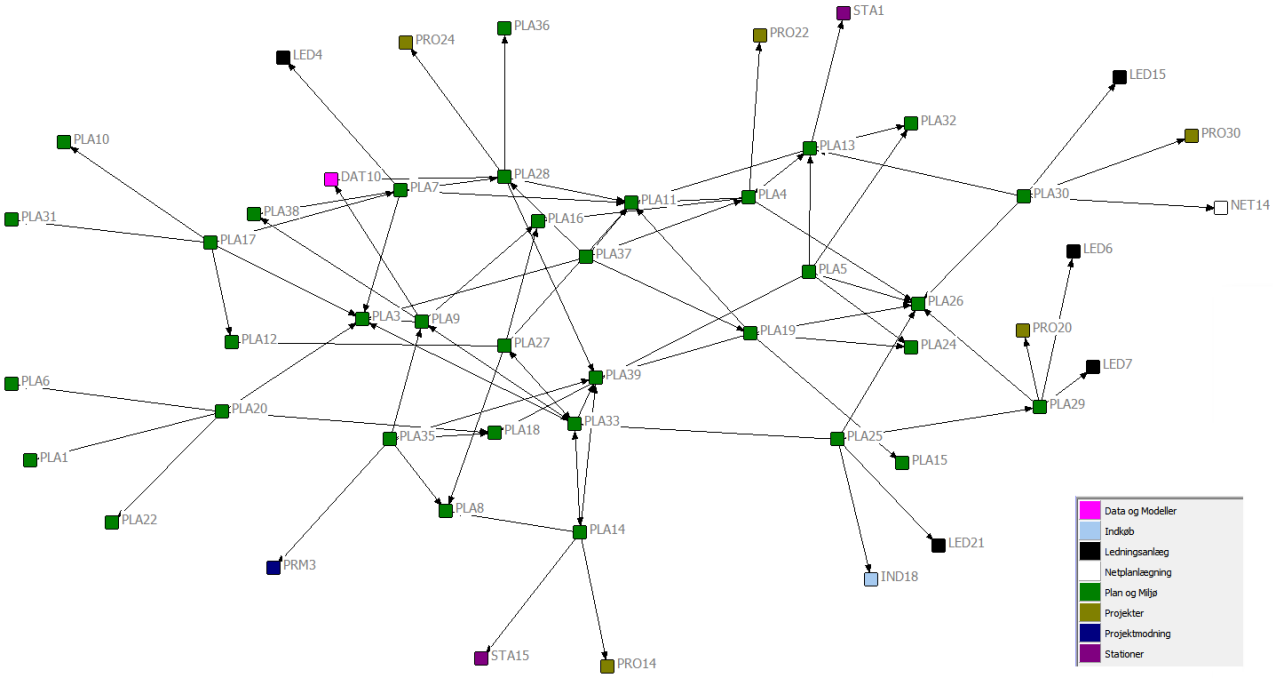
42.5. Ledningsanlæg



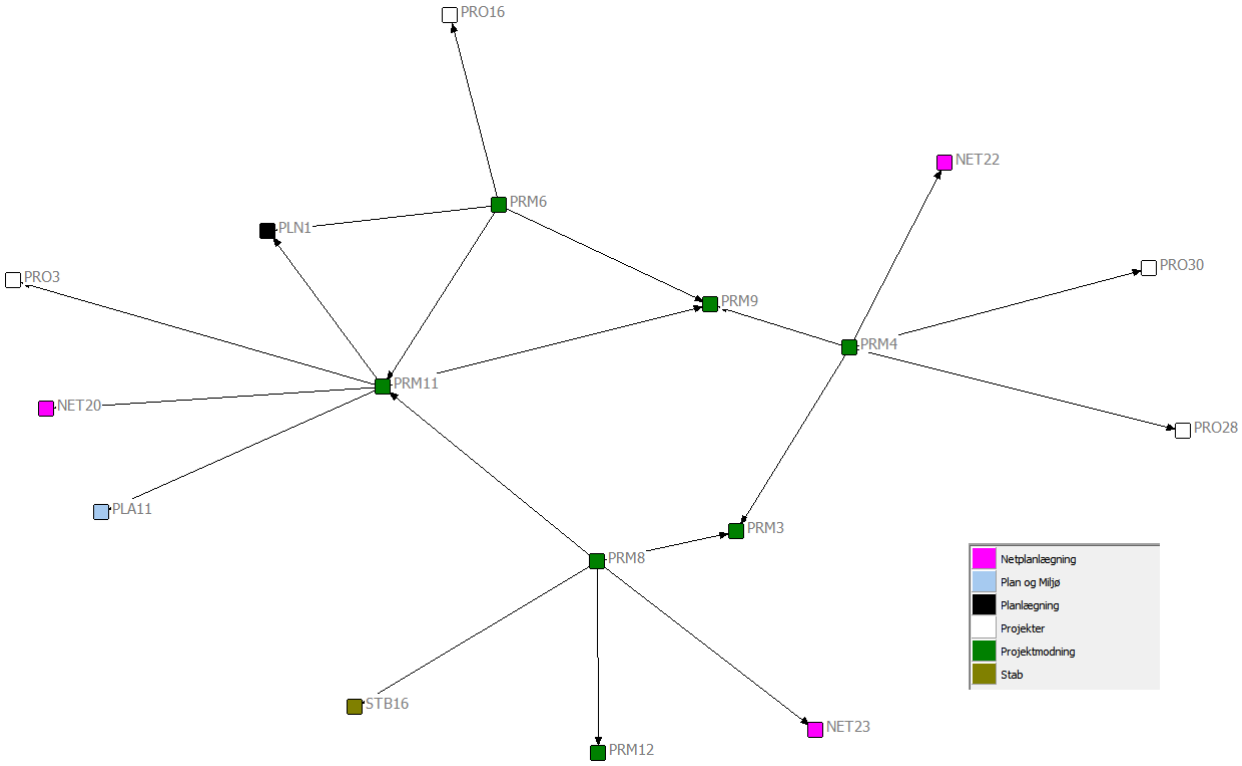
42.6. Netplanlægning



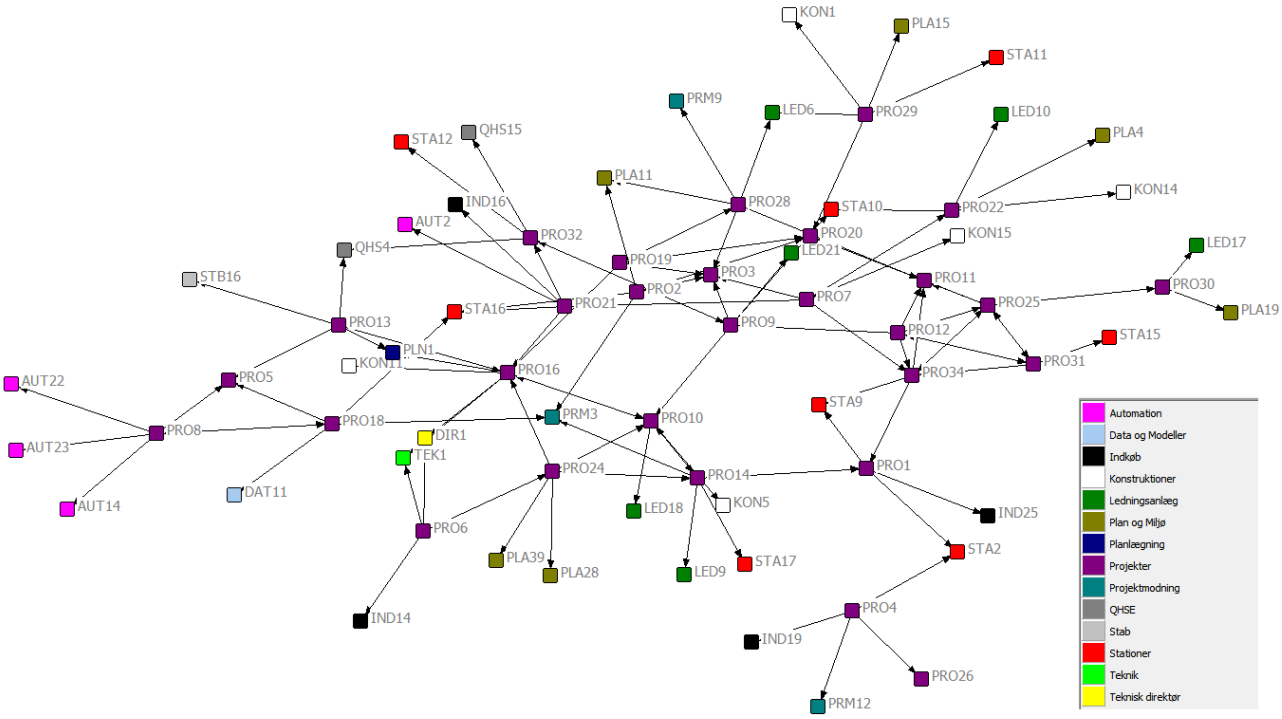
42.7. Plan & Miljø



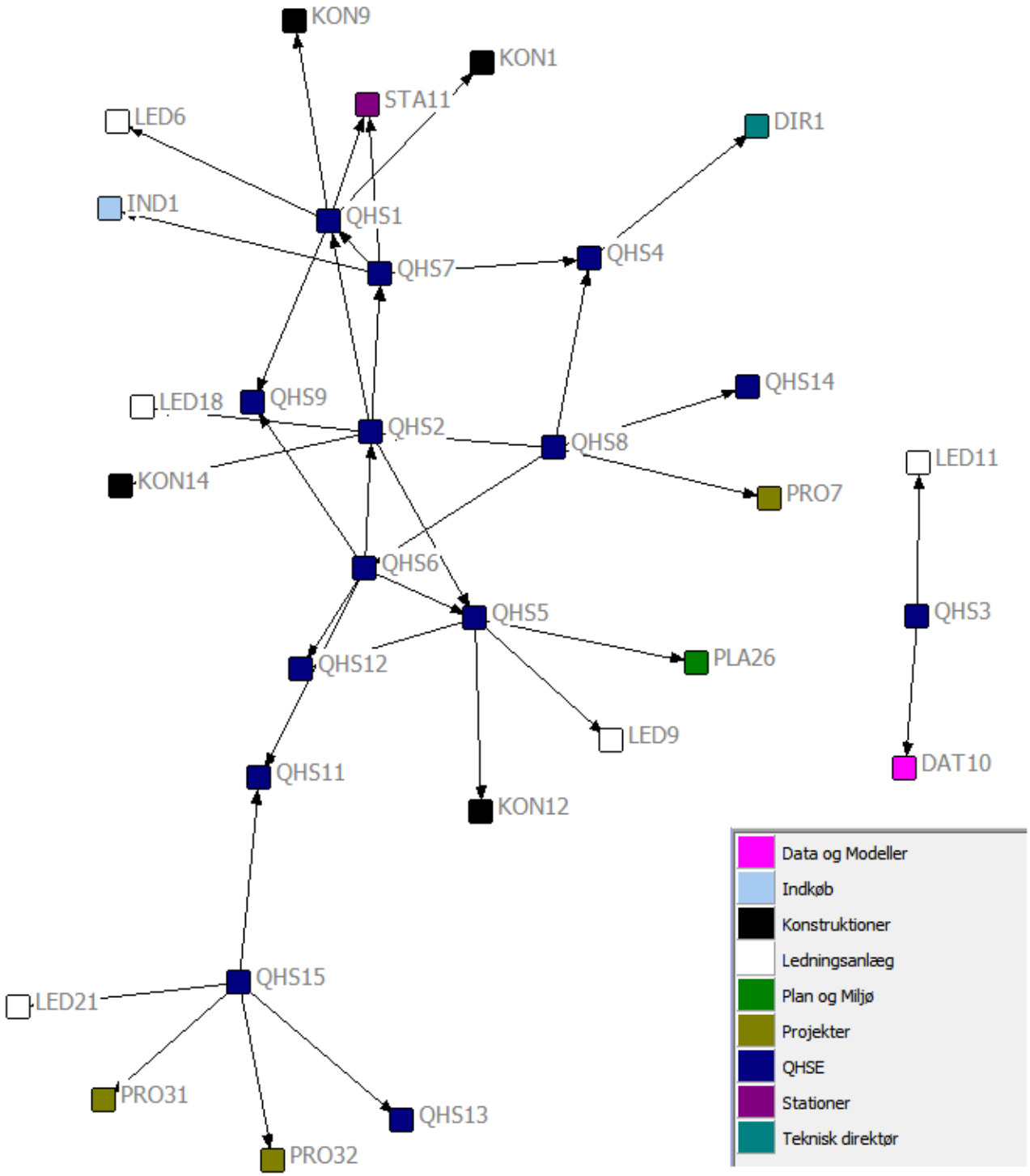
42.8. Projektmodning



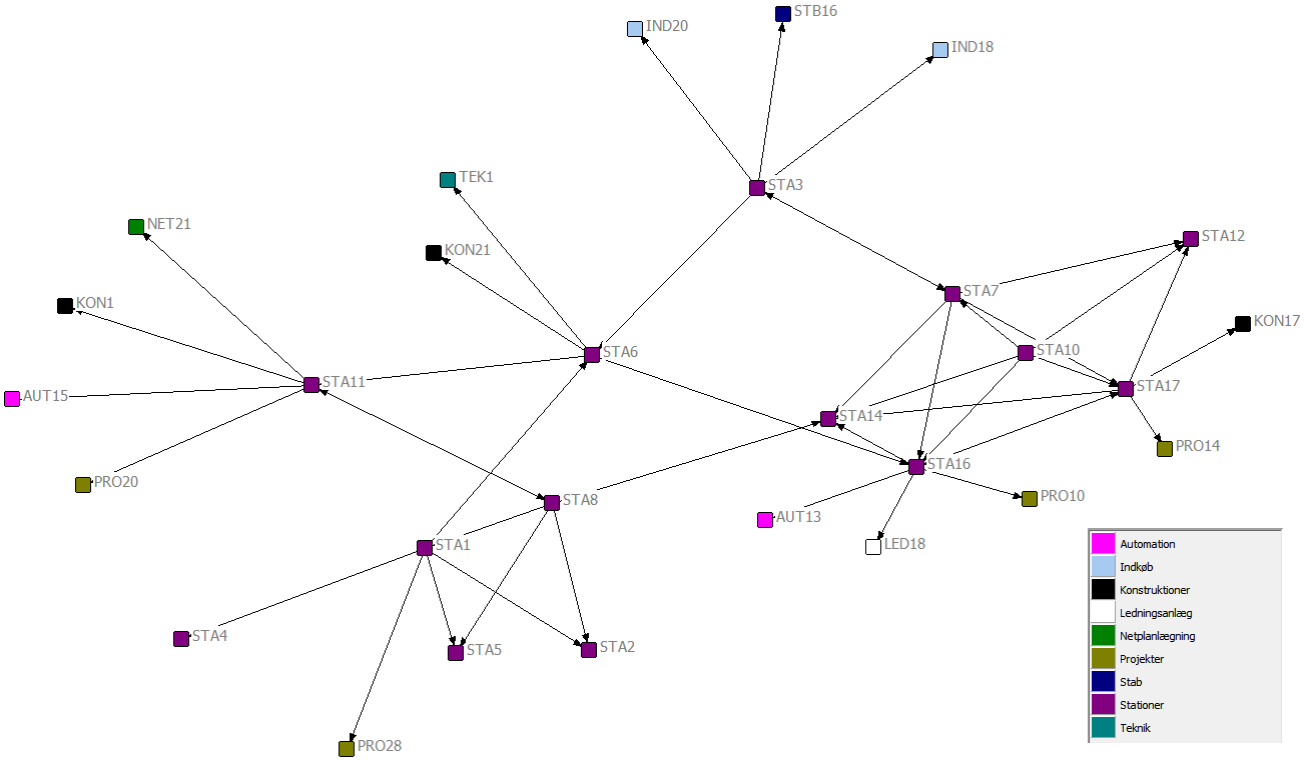
42.9. Projekter



42.10. QHSE


KON9
KON1
STA11
LED6
DIR1
IND1
QHS1
QHS4
QHS7
QHS14
LED18
QHS9
QHS2
QHS8
LED11
KON14
PRO7
QHS6
QHS3
QHS5
PLA26
QHS12
LED9
DAT10
QHS11
KON12
QHS15
LED21
PRO31
QHS13
PRO32
Data og Modeller
Indkøb
Konstruktioner
Ledningsanlæg
Plan og Miljø
Projekter
QHSE
Stationer
Teknisk direktør

42.11. Stationer



11.3

43. Chapter 5.8.1 – Simple linear regression team density and in-team contacts

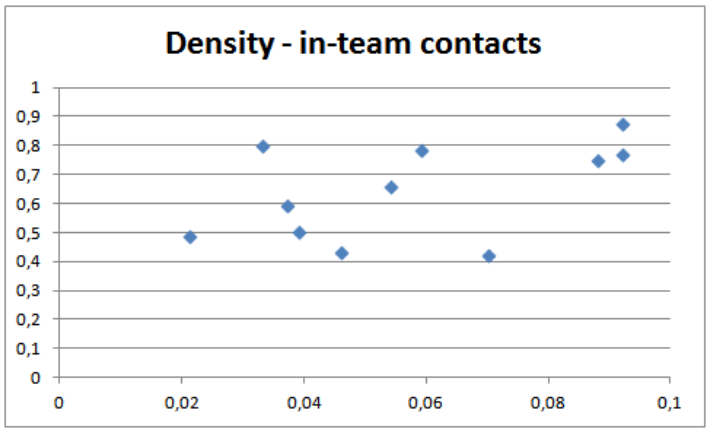
SUMMARY OUTPUT Density

Regression Statistics	
Multiple R	0,51
R Square	0,26
Adjusted R Square	0,18
Standard Error	0,02
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,00	0,00	3,20	0,107412078
Residual	9	0,00	0,00		
Total	10	0,01			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,01	0,03	0,23	0,824262627	-0,06	0,07	-0,06	0,07
In-team contacts	0,08	0,04	1,79	0,107412078	-0,02	0,18	-0,02	0,18



44. Chapter 5.8.1 – Simple linear regression team density and in-degree>5

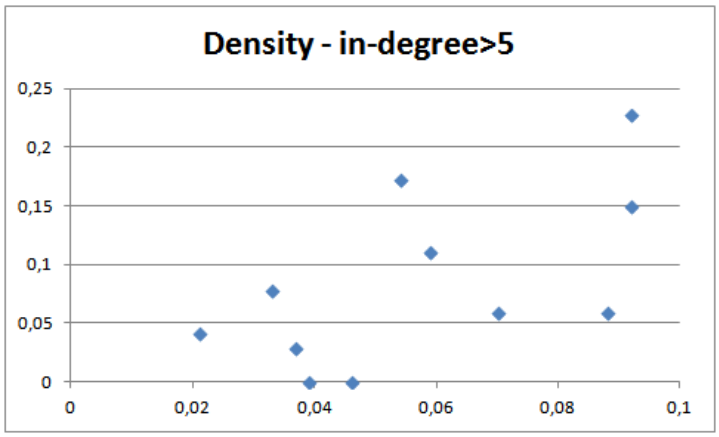
SUMMARY OUTPUT Density

Regression Statistics	
Multiple R	0,61
R Square	0,37
Adjusted R Square	0,30
Standard Error	0,02
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,00	0,00	5,29	0,047002768
Residual	9	0,00	0,00		
Total	10	0,01			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,04	0,01	4,00	0,00310453	0,02	0,06	0,02	0,06
In-degree >5	0,21	0,09	2,30	0,047002768	0,00	0,41	0,00	0,41



45. Chapter 5.9 – Multiple linear regression VID TEA and team network measures

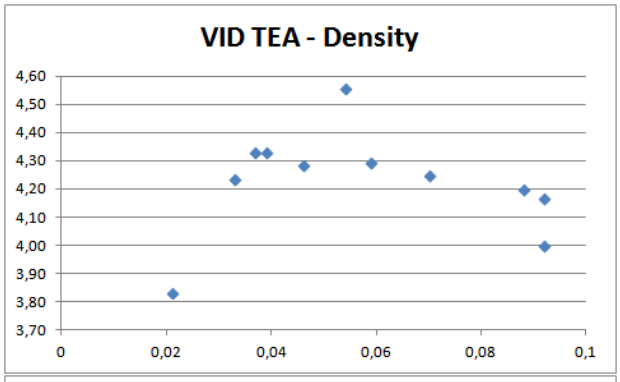
SUMMARY OUTPUT VID TEA

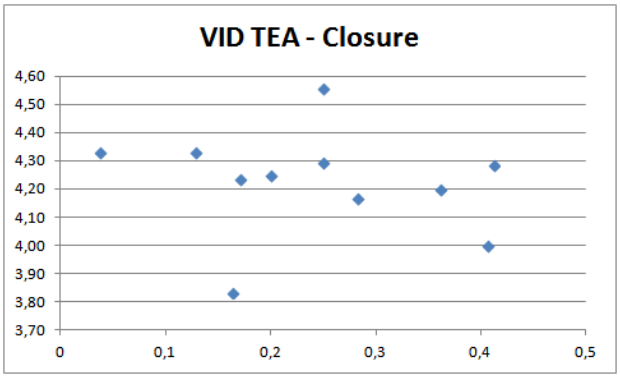
Regression Statistics	
Multiple R	0,28
R Square	0,08
Adjusted R Square	-0,32
Standard Error	0,21
Observations	11

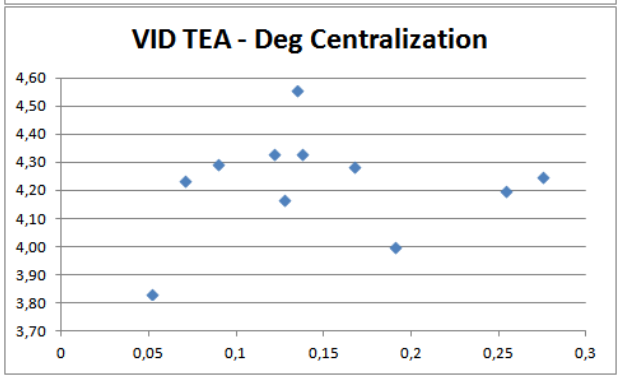
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	0,03	0,01	0,20	0,895425684
Residual	7	0,32	0,05		
Total	10	0,35			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,24	0,18	23,12	7,19046E-08	3,80	4,67	3,80	4,67
Density	-0,67	4,19	-0,16	0,878067421	-10,57	9,24	-10,57	9,24
Closure	-0,351990326	0,750856428	-0,468785127	0,653471815	-2,127483645	1,423502992	-2,127483645	1,423502992
Deg Centralization	0,763200995	1,261352018	0,605065822	0,564227152	-2,219422576	3,745824566	-2,219422576	3,745824566







46. Chapter 5.9 - Multiple linear regression VID AFD and team network measures

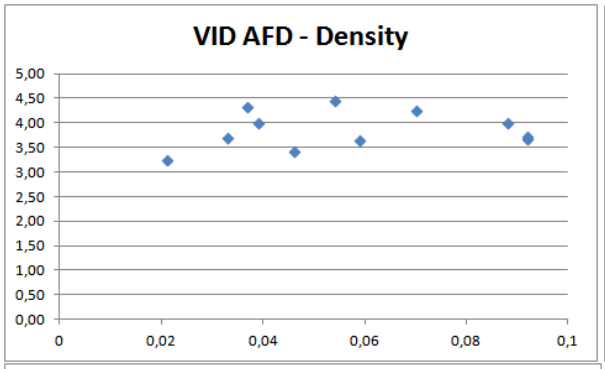
SUMMARY OUTPUT VID AFD

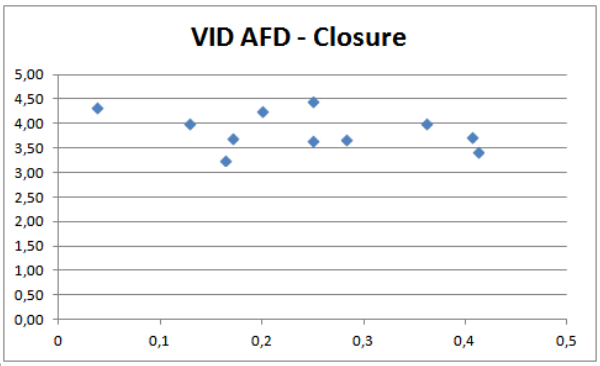
Regression Statistics	
Multiple R	0,75
R Square	0,56
Adjusted R Square	0,37
Standard Error	0,30
Observations	11

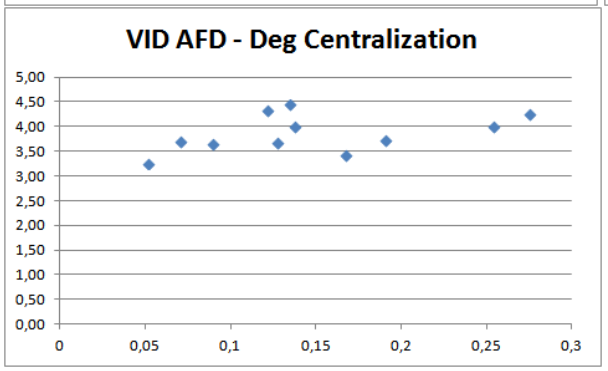
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	0,81	0,27	2,96	0,107209727
Residual	7	0,64	0,09		
Total	10	1,44			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	3,77	0,26	14,63	1,66355E-06	3,16	4,37	3,16	4,37
Density	3,81	5,88	0,65	0,537379011	-10,09	17,71	-10,09	17,71
Closure	-2,462244755	1,05409143	-2,335892964	0,052159375	-4,954774913	0,030285404	-4,954774913	0,030285404
Deg Centralization	3,199857441	1,770751775	1,807061546	0,113702996	-0,987305149	7,38702003	-0,987305149	7,38702003







47. Chapter 5.9 - Multiple linear regression VID AFD and team network measures – reduced

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,73
R Square	0,53
Adjusted R Square	0,42
Standard Error	0,29
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,77	0,38	4,56	0,047712553
Residual	8	0,67	0,08		
Total	10	1,44			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	3,81	0,24	15,82	2,54533E-07	3,25	4,36	3,25	4,36
Closure	-2,10	0,86	-2,44	0,040527412	-4,08	-0,12	-4,08	-0,12
Deg Centralization	3,81665852	1,438467165	2,653281641	0,029107233	0,499547292	7,133769747	0,499547292	7,133769747

48. Chapter 5.9 – Simple linear regression VID AFD and closeness

SUMMARY OUTPUT VID AFD

Regression Statistics	
Multiple R	0,35
R Square	0,12
Adjusted R Square	0,02
Standard Error	0,38
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,18	0,18	1,24	0,293769163
Residual	9	1,27	0,14		
Total	10	1,44			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,13	0,27	15,40	8,95954E-08	3,52	4,74	3,52	4,74
Closure	-1,12	1,00	-1,11	0,293769163	-3,39	1,15	-3,39	1,15

49. Chapter 5.9 – Simple linear regression VID AFD and degree centralization

SUMMARY OUTPUT VID AFD

Regression Statistics	
Multiple R	0,43
R Square	0,18
Adjusted R Square	0,09
Standard Error	0,36
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,27	0,27	2,04	0,187153459
Residual	9	1,18	0,13		
Total	10	1,44			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	3,52	0,26	13,46	2,87069E-07	2,93	4,11	2,93	4,11
Deg Centralization	2,31	1,62	1,43	0,187153459	-1,35	5,97	-1,35	5,97

50. Chapter 5.9 – Team averages of variables

Team	Values	VID TAC avg	VID T-E avg	VID EXP avg	VID AFD avg	VID TEA avg	VED KON avg	HUR KON avg	KOL IMØ avg	KAN DOK avg	KAN EMA avg	KAN GET avg	KAN LYN avg	KAN PER avg	KAN TEL avg	TIL GEN avg	TIL OUT avg	TIL IN avg	Resp %
Automation	12	4,67	4,00	3,58	3,67	4,17	4,17	4,00	4,75	3,75	3,50	1,75	2,58	4,83	4,17	5,00	4,75	4,50	52%
Data og Modeller	5	4,00	3,80	4,00	4,00	4,20	4,60	4,00	4,40	4,00	3,80	1,20	2,80	4,40	3,80	4,80	4,60	4,60	36%
Indkøb	17	4,18	4,29	3,65	3,65	4,29	4,29	3,88	4,47	3,53	4,18	2,59	3,24	4,76	4,41	4,59	4,65	4,53	65%
Konstruktioner	7	4,71	4,14	3,86	3,43	4,29	4,29	3,57	4,43	4,00	4,43	1,86	2,86	4,71	4,43	4,86	4,86	4,57	32%
Ledningsanlæg	7	4,71	4,00	3,43	3,71	4,00	4,14	3,86	5,00	3,43	3,71	2,00	3,43	5,00	4,29	4,86	4,86	4,14	33%
Netplanlægning	9	4,89	4,22	4,11	4,33	4,33	4,33	4,44	4,89	3,89	4,22	1,89	2,78	4,78	3,89	5,00	4,44	4,22	39%
Plan og Miljø	17	4,59	4,35	4,00	3,71	4,24	4,12	3,94	4,65	3,88	4,24	1,76	2,88	4,76	3,88	4,88	4,41	4,18	44%
Projekter	24	4,38	4,00	3,79	3,25	3,83	4,21	3,75	4,21	3,58	3,96	2,38	3,17	4,83	3,96	4,46	4,25	3,75	71%
Projektmodning	4	3,75	4,25	3,75	4,25	4,25	4,25	4,00	4,50	3,75	4,25	2,00	4,00	4,75	4,25	5,00	4,75	4,50	31%
QHSE	9	4,11	3,89	4,22	4,00	4,33	4,22	3,89	4,78	4,22	4,11	2,78	3,33	4,67	4,22	4,89	4,78	4,56	60%
Stationer	9	4,44	4,00	3,67	4,44	4,56	4,44	4,33	4,56	3,44	3,89	2,33	3,44	4,78	4,56	4,78	4,67	4,56	53%
Grand Total	**120**	**4,43**	**4,11**	**3,82**	**3,74**	**4,18**	**4,25**	**3,94**	**4,56**	**3,73**	**4,03**	**2,13**	**3,09**	**4,78**	**4,14**	**4,77**	**4,57**	**4,28**	

51. Chapter 5.9 - Multiple linear regression VID AFD and team scores relations variables

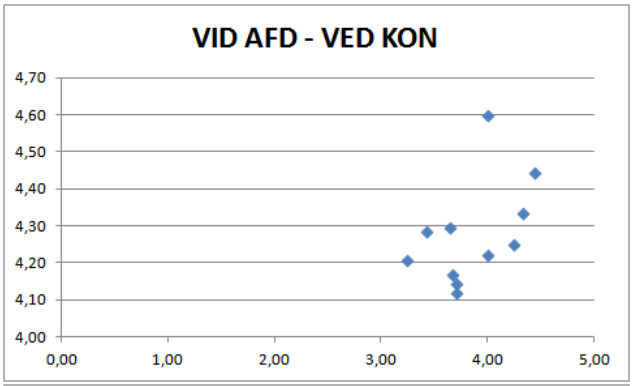
SUMMARY OUTPUT VID AFD

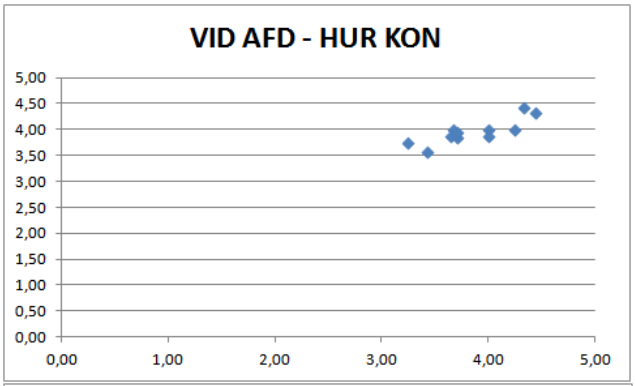
Regression Statistics	
Multiple R	0,93
R Square	0,86
Adjusted R Square	0,77
Standard Error	0,18
Observations	11

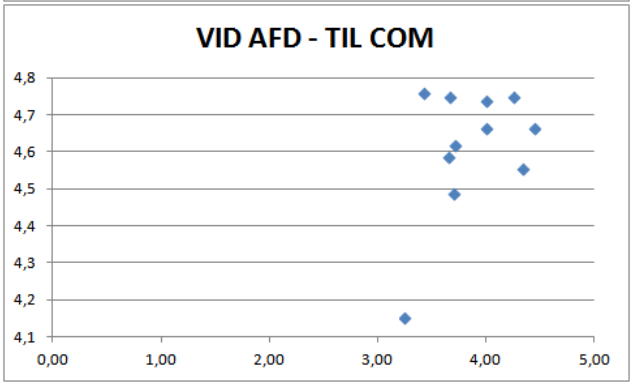
ANOVA

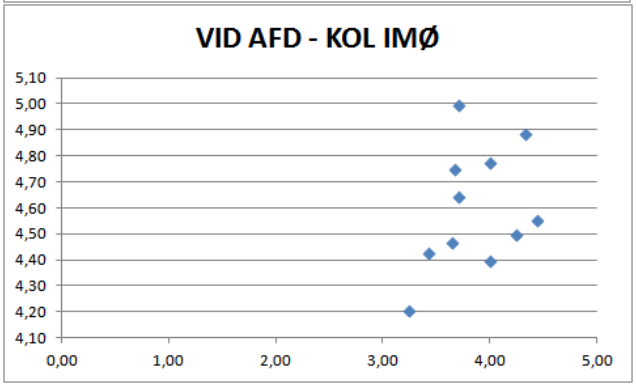
	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	1,24	0,31	9,25	0,009742263
Residual	6	0,20	0,03		
Total	10	1,44			

	Coefficients	*Standard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-5,08	2,76	-1,84	0,115083599	-11,82	1,67	-11,82	1,67
VED KON avg	0,15	0,63	0,24	0,815615665	-1,39	1,69	-1,39	1,69
HUR KON avg	1,28	0,34	3,73	0,009768855	0,44	2,12	0,44	2,12
KOL IMØ avg	-0,15	0,40	-0,36	0,731308434	-1,13	0,84	-1,13	0,84
TIL COM avg	0,84	0,41	2,04	0,087813666	-0,17	1,84	-0,17	1,84









52. Chapter 5.9 - Multiple linear regression VID AFD and team scores relations variables – reduced

SUMMARY OUTPUT VID AFD

Regression Statistics	
Multiple R	0,92
R Square	0,85
Adjusted R Square	0,81
Standard Error	0,17
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	1,22	0,61	21,99	0,000561203
Residual	8	0,22	0,03		
Total	10	1,44			

	Coefficients	*Standard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-4,80	1,56	-3,08	0,015147715	-8,40	-1,21	-8,40	-1,21
HUR KON avg	1,26	0,22	5,82	0,000396582	0,76	1,76	0,76	1,76
TIL COM avg	0,79	0,30	2,65	0,029402269	0,10	1,48	0,10	1,48

53. Chapter 5.9 - Multiple linear regression VID TEA and team scores relations variables

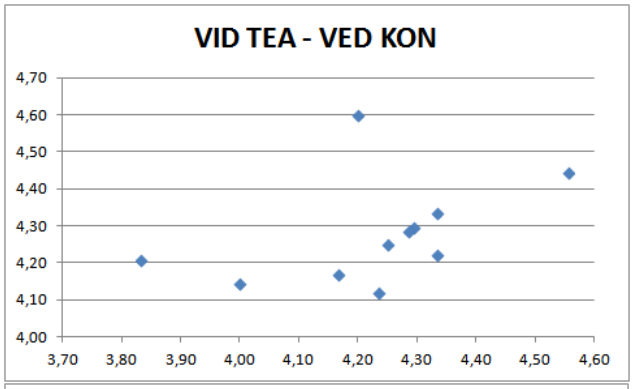
SUMMARY OUTPUT VID TEA

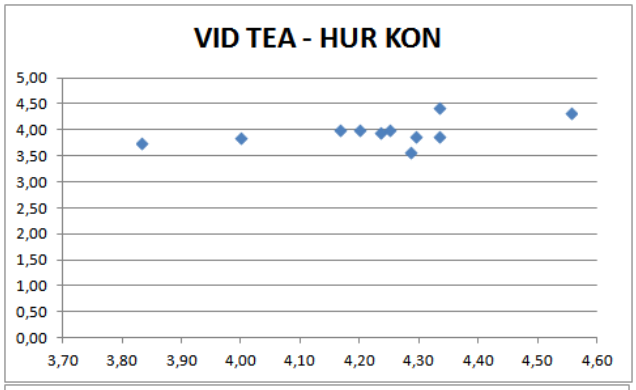
Regression Statistics	
Multiple R	0,83
R Square	0,69
Adjusted R Square	0,48
Standard Error	0,14
Observations	11

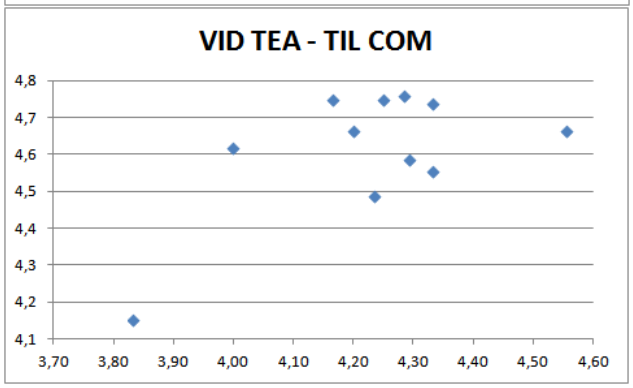
ANOVA

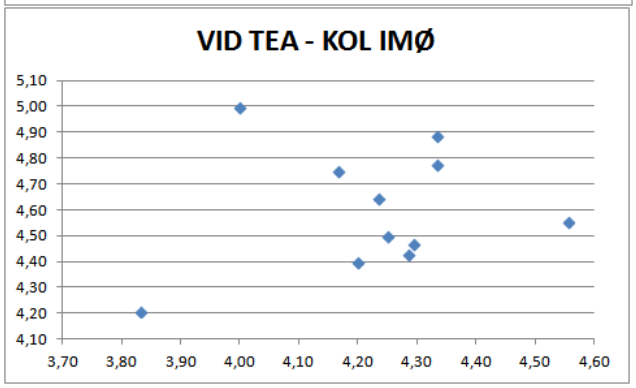
	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0,24	0,06	3,27	0,094822508
Residual	6	0,11	0,02		
Total	10	0,35			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,71	2,04	0,35	0,738145051	-4,27	5,69	-4,27	5,69
VED KON avg	-0,14	0,46	-0,29	0,778692817	-1,27	1,00	-1,27	1,00
HUR KON avg	0,50	0,25	1,98	0,095353331	-0,12	1,12	-0,12	1,12
TIL COM avg	0,77	0,30	2,52	0,045106993	0,02	1,51	0,02	1,51
KOL IMØ avg	-0,31	0,30	-1,04	0,337802794	-1,04	0,42	-1,04	0,42









54. Chapter 5.9 - Multiple linear regression VID TEA and team scores relations variables – reduced

SUMMARY OUTPUT VID TEA

Regression Statistics	
Multiple R	0,78
R Square	0,61
Adjusted R Square	0,51
Standard Error	0,13
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,21	0,11	6,24	0,023309024
Residual	8	0,14	0,02		
Total	10	0,35			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0,04	1,22	-0,03	0,975734871	-2,86	2,79	-2,86	2,79
HUR KON avg	0,37	0,17	2,16	0,063017729	-0,03	0,76	-0,03	0,76
TIL COM avg	0,61	0,23	2,59	0,032032015	0,07	1,15	0,07	1,15

55. Chapter 5.9 - Multiple linear regression density and team scores relations variables

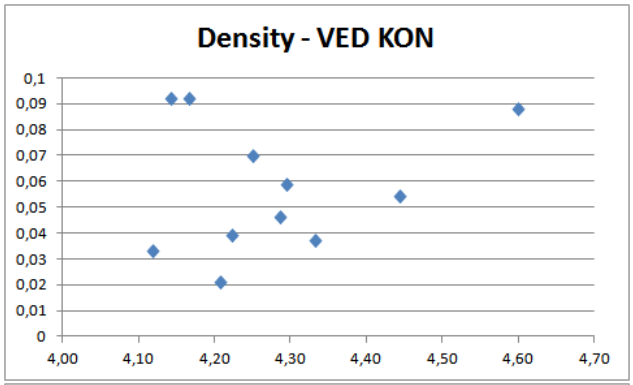
SUMMARY OUTPUT Density

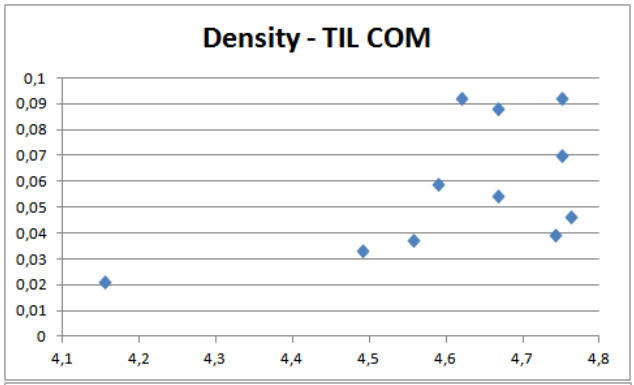
Regression Statistics	
Multiple R	0,62
R Square	0,38
Adjusted R Square	-0,03
Standard Error	0,03
Observations	11

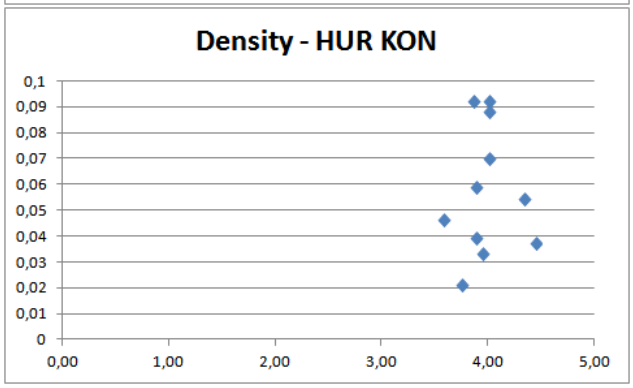
ANOVA

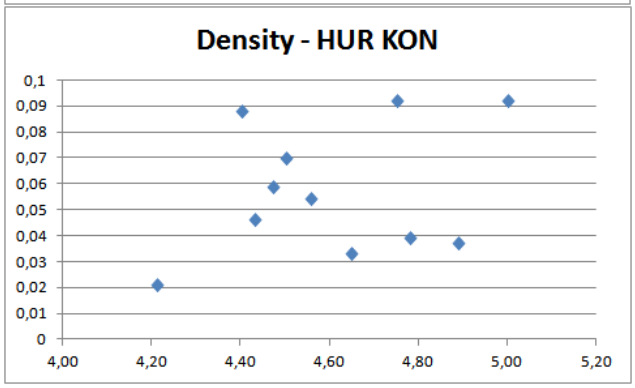
	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0,00	0,00	0,94	0,502208951
Residual	6	0,00	0,00		
Total	10	0,01			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0,54	0,38	-1,41	0,207577631	-1,48	0,40	-1,48	0,40
VED KON avg	0,06	0,09	0,74	0,486650505	-0,15	0,28	-0,15	0,28
HUR KON avg	-0,03	0,05	-0,62	0,557721773	-0,15	0,09	-0,15	0,09
TIL COM avg	0,05	0,06	0,92	0,394360255	-0,09	0,19	-0,09	0,19
KOL IMØ avg	0,04	0,06	0,76	0,475150117	-0,09	0,18	-0,09	0,18









56. Chapter 5.9 - Multiple linear regression density and team scores relations variables – reduced

SUMMARY OUTPUT Density

Regression Statistics	
Multiple R	0,57
R Square	0,32
Adjusted R Square	0,16
Standard Error	0,02
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,00	0,00	1,93	0,207612447
Residual	8	0,00	0,00		
Total	10	0,01			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0,34	0,21	-1,63	0,140786426	-0,81	0,14	-0,81	0,14
TIL COM avg	0,07	0,04	1,68	0,132284857	-0,03	0,18	-0,03	0,18
KOL IMØ avg	0,01	0,03	0,32	0,753851335	-0,07	0,09	-0,07	0,09

SUMMARY OUTPUT Density

Regression Statistics	
Multiple R	0,56
R Square	0,32
Adjusted R Square	0,24
Standard Error	0,02
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,00	0,00	4,16	0,071816923
Residual	9	0,00	0,00		
Total	10	0,01			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0,31	0,18	-1,72	0,119388457	-0,72	0,10	-0,72	0,10
TIL COM avg	0,08	0,04	2,04	0,071816923	-0,01	0,17	-0,01	0,17

57. Chapter 5.9 - Multiple linear regression closure and team scores relations variables

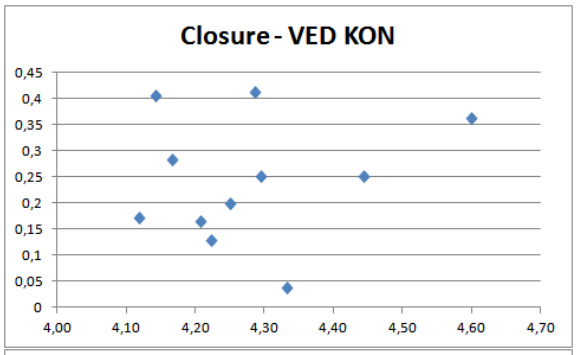
SUMMARY OUTPUT Closure

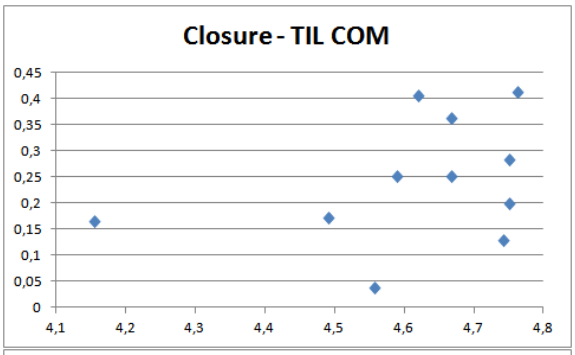
Regression Statistics	
Multiple R	0,77
R Square	0,59
Adjusted R Square	0,31
Standard Error	0,10
Observations	11

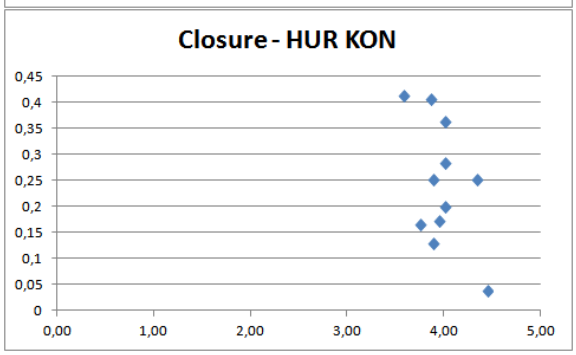
ANOVA

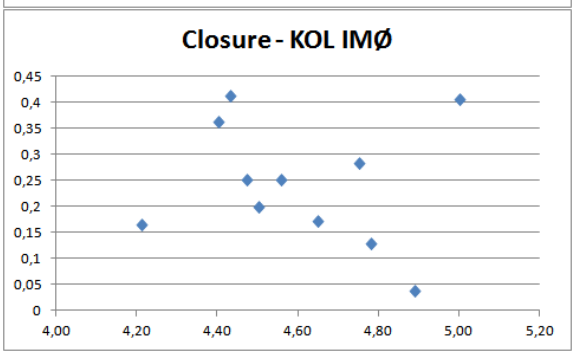
	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0,08	0,02	2,14	0,193507186
Residual	6	0,06	0,01		
Total	10	0,14			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-1,60	1,47	-1,09	0,318250984	-5,21	2,00	-5,21	2,00
VED KON avg	0,50	0,34	1,49	0,187104249	-0,32	1,32	-0,32	1,32
HUR KON avg	-0,44	0,18	-2,38	0,054404273	-0,89	0,01	-0,89	0,01
TIL COM avg	0,12	0,22	0,54	0,605970853	-0,42	0,66	-0,42	0,66
KOL IMØ avg	0,19	0,22	0,89	0,405261196	-0,34	0,72	-0,34	0,72









58. Chapter 5.9 - Multiple linear regression closure and team scores relations variables – reduced

SUMMARY OUTPUT Closure

Regression Statistics	
Multiple R	0,64
R Square	0,41
Adjusted R Square	0,27
Standard Error	0,10
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,06	0,03	2,83	0,117477731
Residual	8	0,08	0,01		
Total	10	0,14			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,06	0,98	0,06	0,953408701	-2,21	2,33	-2,21	2,33
VED KON avg	0,34	0,24	1,41	0,195252139	-0,22	0,91	-0,22	0,91
HUR KON avg	-0,32	0,14	-2,30	0,050333657	-0,65	0,00	-0,65	0,00

SUMMARY OUTPUT Closure

Regression Statistics	
Multiple R	0,52
R Square	0,27
Adjusted R Square	0,19
Standard Error	0,11
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,04	0,04	3,30	0,102604875
Residual	9	0,10	0,01		
Total	10	0,14			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	1,24	0,55	2,25	0,050647808	0,00	2,48	0,00	2,48
HUR KON avg	-0,25	0,14	-1,82	0,102604875	-0,56	0,06	-0,56	0,06

59. Chapter 5.9 - Multiple linear regression degree centralization and team scores relations variables

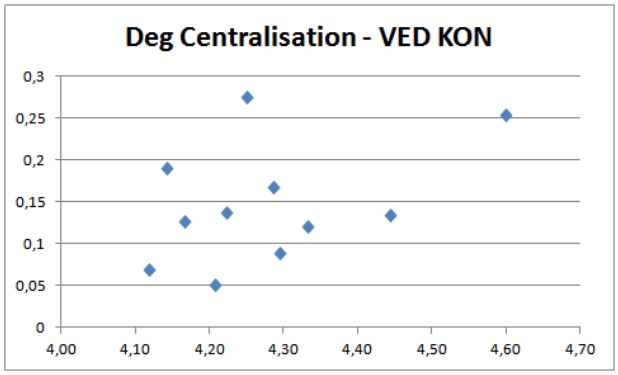
SUMMARY OUTPUT Deg Centralisation

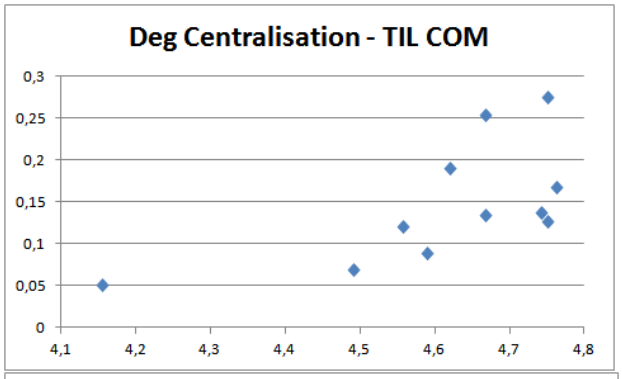
Regression Statistics	
Multiple R	0,72
R Square	0,51
Adjusted R Square	0,19
Standard Error	0,06
Observations	11

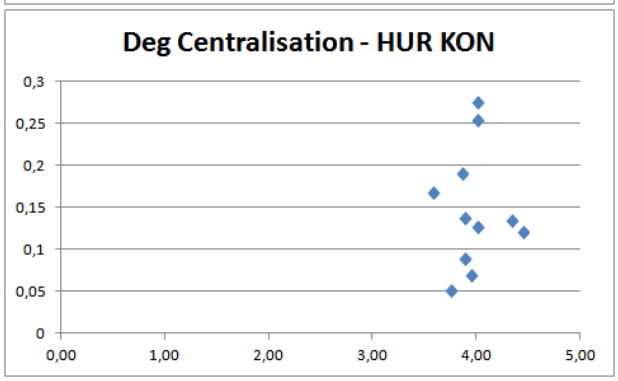
ANOVA

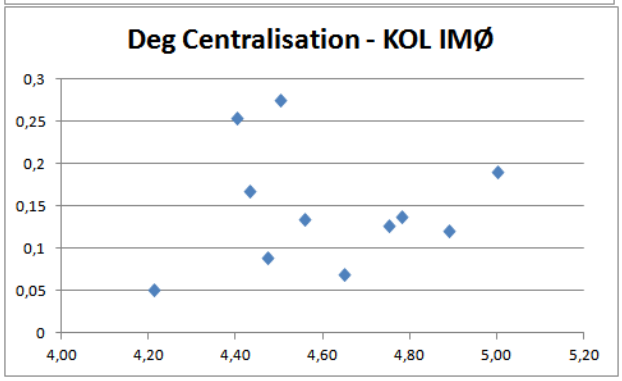
	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0,03	0,01	1,58	0,292610838
Residual	6	0,02	0,00		
Total	10	0,05			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-1,65	0,96	-1,72	0,136410532	-3,99	0,70	-3,99	0,70
VED KON avg	0,22	0,22	1,00	0,356926939	-0,32	0,75	-0,32	0,75
HUR KON avg	-0,06	0,12	-0,52	0,624887737	-0,35	0,23	-0,35	0,23
TIL COM avg	0,21	0,14	1,47	0,191830544	-0,14	0,56	-0,14	0,56
KOL IMØ avg	0,03	0,14	0,21	0,841992413	-0,31	0,37	-0,31	0,37









60. Chapter 5.9 - Multiple linear regression degree centralization and team scores relations variables – reduced

SUMMARY OUTPUT Deg Centralisation

Regression Statistics	
Multiple R	0,70
R Square	0,49
Adjusted R Square	0,36
Standard Error	0,06
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,02	0,01	3,83	0,068063847
Residual	8	0,03	0,00		
Total	10	0,05			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-1,57	0,65	-2,40	0,042983552	-3,08	-0,06	-3,08	-0,06
VED KON avg	0,16	0,13	1,23	0,255412054	-0,14	0,45	-0,14	0,45
TIL COM avg	0,23	0,10	2,20	0,059233062	-0,01	0,46	-0,01	0,46

SUMMARY OUTPUT Deg Centralisation

Regression Statistics	
Multiple R	0,63
R Square	0,39
Adjusted R Square	0,33
Standard Error	0,06
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,02	0,02	5,84	0,038863896
Residual	9	0,03	0,00		
Total	10	0,05			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-1,01	0,48	-2,11	0,064293364	-2,09	0,07	-2,09	0,07
TIL COM avg	0,25	0,10	2,42	0,038863896	0,02	0,49	0,02	0,49

61. Chapter 5.10 – Simple linear regression model group explicit VID AFD - VIDEN VIGTIG constraint

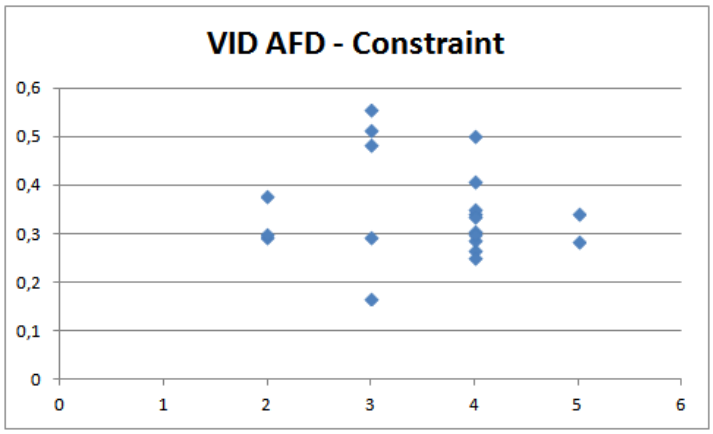
SUMMARY OUTPUT VID AFD CON

Regression Statistics	
Multiple R	0,12
R Square	0,01
Adjusted R Square	-0,04
Standard Error	0,90
Observations	20

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,22	0,22	0,27	0,610833204
Residual	18	14,73	0,82		
Total	19	14,95			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	3,93	0,76	5,19	6,20878E-05	2,34	5,52	2,34	5,52
constraint	-1,09	2,10	-0,52	0,610833204	-5,51	3,33	-5,51	3,33



62. Chapter 5.10 – Simple linear regression model group explicit VID TEA - VIDEN VIGTIG constraint

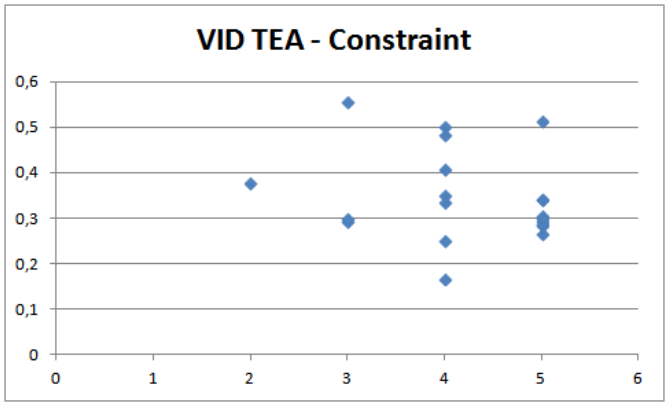
SUMMARY OUTPUT VID TEA CONST

Regression Statistics	
Multiple R	0,21
R Square	0,05
Adjusted R Square	-0,01
Standard Error	0,90
Observations	20

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,69	0,69	0,86	0,367307476
Residual	18	14,51	0,81		
Total	19	15,20			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,87	0,75	6,48	4,28973E-06	3,29	6,45	3,29	6,45
constraint	-1,93	2,09	-0,92	0,367307476	-6,31	2,45	-6,31	2,45



63. Chapter 5.10 – Simple linear regression model group explicit VID AFD - VIDEN OFTE constraint

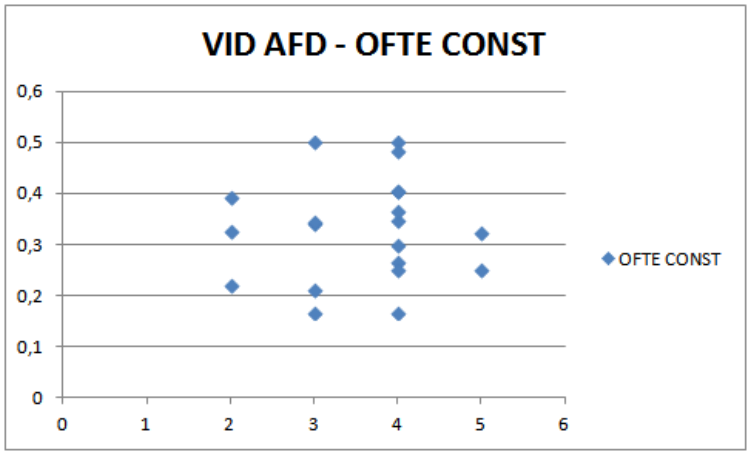
SUMMARY OUTPUT VIF AFD OFTE CONST

Regression Statistics	
Multiple R	0,05
R Square	0,00
Adjusted R Square	-0,05
Standard Error	0,91
Observations	20

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,04	0,04	0,05	0,831737784
Residual	18	14,91	0,83		
Total	19	14,95			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	3,40	0,71	4,83	0,000135173	1,92	4,89	1,92	4,89
OFTE CONST	0,44	2,06	0,22	0,831737784	-3,88	4,77	-3,88	4,77



64. Chapter 5.10 – Simple linear regression model group explicit VID TEA - VIDEN OFTE constraint

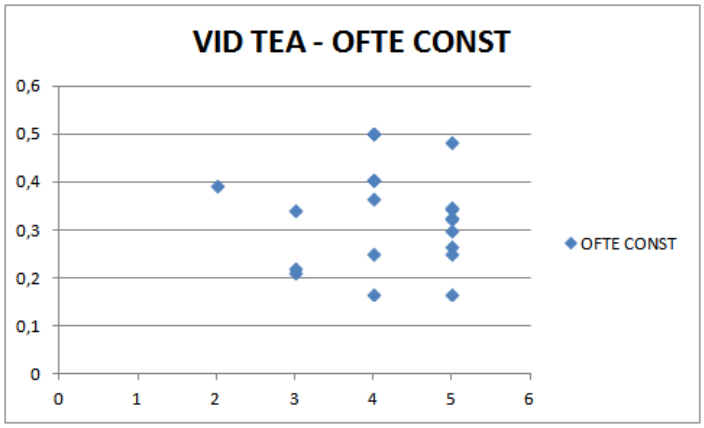
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,04
R Square	0,00
Adjusted R Square	-0,05
Standard Error	0,92
Observations	20

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,02	0,02	0,03	0,871209629
Residual	18	15,18	0,84		
Total	19	15,20			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,31	0,71	6,06	9,96486E-06	2,82	5,81	2,82	5,81
OFTE CONST	-0,34	2,08	-0,16	0,871209629	-4,70	4,02	-4,70	4,02



65. Chapter 5.10 - Simple linear regression model group tacit VID AFD - VIDEN VIGTIG constraint

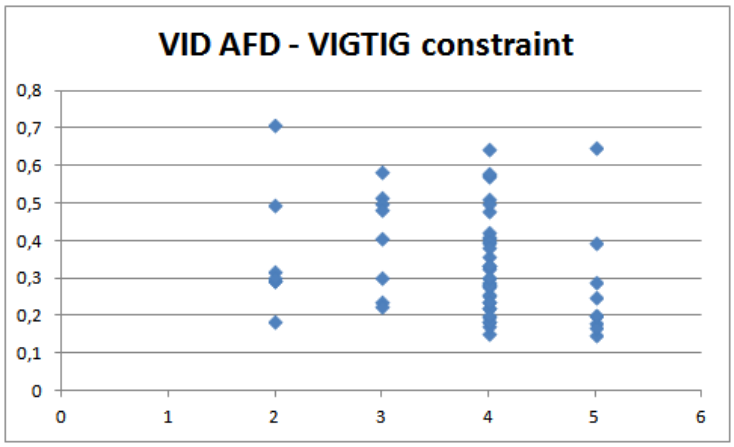
SUMMARY OUTPUT VID AFD CONST

Regression Statistics	
Multiple R	0,22
R Square	0,05
Adjusted R Square	0,03
Standard Error	0,83
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1,95	1,95	2,86	0,096089649
Residual	59	40,28	0,68		
Total	60	42,23			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,22	0,28	15,13	5,69341E-22	3,67	4,78	3,67	4,78
constraint	-1,28	0,76	-1,69	0,096089649	-2,80	0,24	-2,80	0,24



66. Chapter 5.10 - Simple linear regression model group tacit VID TEA - VIDEN VIGTIG constraint

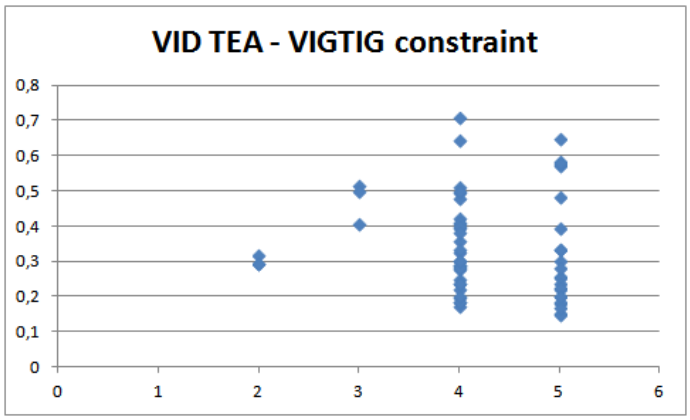
SUMMARY OUTPUT VID TEA CONST

Regression Statistics	
Multiple R	0,08
R Square	0,01
Adjusted R Square	-0,01
Standard Error	0,77
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,20	0,20	0,35	0,558366193
Residual	59	34,58	0,59		
Total	60	34,79			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,37	0,26	16,89	2,82217E-24	3,85	4,89	3,85	4,89
constraint	-0,41	0,70	-0,59	0,558366193	-1,82	0,99	-1,82	0,99



67. Chapter 5.10 - Simple linear regression model group tacit VID AFD - VIDEN OFTE constraint

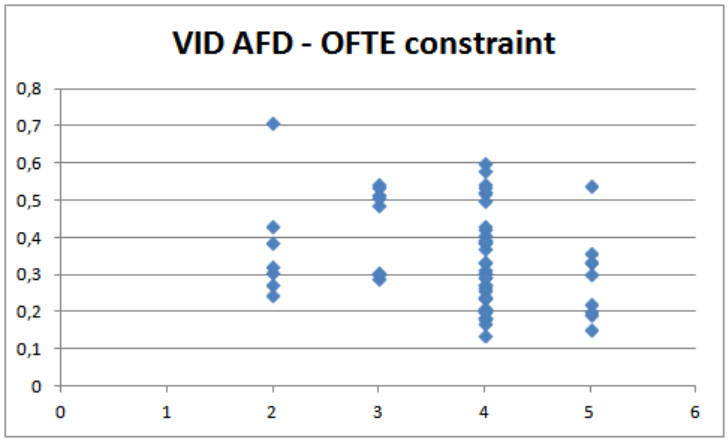
SUMMARY OUTPUT AFD OFTE

Regression Statistics	
Multiple R	0,25
R Square	0,06
Adjusted R Square	0,05
Standard Error	0,82
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2,68	2,68	4,00	0,050062311
Residual	59	39,55	0,67		
Total	60	42,23			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,34	0,29	14,73	2,00898E-21	3,75	4,93	3,75	4,93
OFTE CONST	-1,59	0,80	-2,00	0,050062311	-3,19	0,00	-3,19	0,00



68. Chapter 5.10 - Simple linear regression model group tacit VID TEA - VIDEN OFTE constraint

SUMMARY OUTPUT VID TEA OFTE

Regression Statistics	
Multiple R	0,13
R Square	0,02
Adjusted R Square	0,00
Standard Error	0,76
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,56	0,56	0,97	0,327698412
Residual	59	34,22	0,58		
Total	60	34,79			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,48	0,27	16,36	1,35126E-23	3,93	5,03	3,93	5,03
OFTE CONST	-0,73	0,74	-0,99	0,327698412	-2,21	0,75	-2,21	0,75