

Exploiting social networking technologies in order to enhance internal communication within and across a large enterprise

Improving a Corporate Social Network

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Abstract

Today the use of the social networking technologies is becoming more common in users daily lives, both their professional and personal lives. Recently the application of social networking technologies' communication power has begun to be leveraged by enterprises in order to gain competitive advantage in terms of productivity and employees' efficiency & job performance.

However, there exist some gaps in the communication and coordination processes within a company between the different employees and groups involved in their professional activities. Overall, we can see that large enterprise employees lack identity with their companies due to their lack of voice and the small impact that they have within the large number of individuals that compose a large organization.

In this thesis we deeply analyze the factors that directly affect communication and collaboration between employees *within* a company and how we can improve this communication and collaboration using social network technologies. In this work we focus on the state-of-the-art and compare one of the most used social networks (LinkedIn) with the most used corporate network (Yammer) providing a tangible measure with the key performance indicators.

Afterwards we measure with Node XL software and its metrics samples of monitored corporate networks, introduce an innovation within the networks and show the improvement of the key performance indicators related to the software metrics that have changed in order to enhance some social network parameters that are the tangible measure of plenty of social corporate network issues.

Keywords: *social networking, large enterprises, corporate social networking, communication, collaboration, network metrics.*

Sammanfattning

Idag blir användningen av sociala nätverk teknik vanligare i användarnas vardag, både deras yrkesliv-och privatliv. Nyligen har börjat tillämpningen av sociala nätverk teknik kommunikation makt utnyttjas av företag för att skaffa sig konkurrensfördelar i form av produktivitet och anställdas effektivitet och arbetsprestation.

Men det finns vissa brister i kommunikation och processer samordning inom ett företag mellan olika medarbetare och grupper som deltar i sina yrkesverksamhet. Sammantaget kan vi se att stora företag anställda saknar identitet med sitt företag på grund av deras brist på röst och liten inverkan som de har inom det stora antalet individer som utgör en stor organisation.

I denna avhandling analyserar vi djupt vilka faktorer som direkt påverkar kommunikationen och samarbetet mellan de anställda inom ett företag och hur vi kan förbättra den här kommunikationen och samarbetet med sociala nätverk teknik. I detta arbete fokuserar vi på state-of-the-art och jämföra en av de mest använda sociala nätverk (LinkedIn) med det mest använda företagets nätverk (Yammer) ger en konkret med centrala resultatindikatorer.

Efteråt mäter vi med nod XL programvara och dess statistik exempel på övervakade företagsnätverk, införa en innovation inom nätverk och visar en förbättring av de centrala resultatindikatorer relaterat till programvaran statistik som har ändrats för att stärka vissa sociala nätverk parametrar som är konkret mått på många sociala företag nätfrågor.

Nyckelord: *sociala nätverk, stora företag, företagens sociala nätverk, kommunikation, samarbete, nätverk statistik.*

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"We are what we repeatedly do. Excellence then, is not an act, but a habit" (Aristotle) "Life's battle don't always go to the stronger or faster man. Sooner or later the man who wins is the man who thinks he can" (Vince Lombardi) "I firmly believe that any man's finest hour, the greatest fulfillment of all that he holds dear, is that moment when he has worked his heart out in a good cause and lies exhausted on the field of battle – victorious" (Vince Lombardi).

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List of Acronyms and Abbreviations

B2B	Business-to-Business
B2C	Business-to-Customer
CRM	Customer Relationship Manager
FBML	Facebook Markup Language
ICT	Information and Communication Technology
ISP	Internet Service Provider
OST	Organization Support Theory
POS	Perceived Organizational Support
UCC	User-Created Content
WFMS	Workforce Management System

1 Introduction

This chapter briefly describes the problem which this study has focused on. This is followed by a description of how this problem has been formulated, the implementation, the objectives of this project, and the limitations of this project. The chapter ends with a summary of the structure of the thesis.

1.1 Problem Statement

The problem that this master's thesis project addresses is how by analyzing the key performance indicators of the social networks under study we can show the problems and needs that workers have related to *internal communication and collaboration* and how can we improve the situation with some small changes.

1.2 Objectives

The objective of this master thesis is to integrate the existing functionalities of social networking technologies in order *to enhance internal communication within and across a large enterprise*. The overall objectives of this study can be summarized as:

- To study human interactions in a professional environment.
- To study gaps in the existing internal corporate communications.
- To study what flexibility exists in the workplace and its relationship to productivity.
- Research existing social networking technologies, tools, and functionalities.
- Analyze which metrics exist to evaluate the participation of members in a social network.
- Describe the results and what they involve as related to the gaps.
- Justify why the proposed solution could be the basis for future development.

The goals that we want to achieve with this deep study and implementation of a prototype are:

- To gain deep understanding of the professional/personal relationship environment.
- Understand how relationships give value to the interactional network.
- Establish a clear relationship between the organizational context, the concept of workplace flexibility, social technology, and productivity.
- Understand the gaps.
- Show the big picture of current communication tools, specifically LinkedIn and Yammer.
- Use Key Performance Indicators (KPIs) as tangible evidence of the current problems.
- Give an approach to a possible future structure and estimate the indicator improvements that could be possible.

1.3 Limitations

This thesis project does not focus on:

- Full inter-company communication, but rather the thesis focuses *only on internal* company communication and communication with clients and suppliers.
- Marketing guides and strategies to communicate with customers and suppliers
- Implementation of a commercial tool.
- A complete analysis and conclusions about the relevant policies that could be affected.
- The data of Yammer is mostly private, and the public data of LinkedIn is not sufficient to measure every KPI so this model is only an approach to measure some of them, but shows the situation and how we can estimate improvements.
- The networks that are simulated and changed do not belong to the same company, and do not belong to LinkedIn or Yammer because their data are not available. However the simulated networks are sufficient.

1.4 Structure of the thesis

This first chapter introduced the problem and framework for this thesis project. Chapter 2 provides general background information. Chapter 3 describes the relevant concepts of social networks. Chapter 4 reviews the state of the art in professional social networks, Chapter 5 explains the reasons for this study and how it was carried out; Chapter 6 shows the analysis and considerations to obtain the metrics results, the proposal with its simulations; and the relationship results between metrics and KPIs, Chapter 7 states conclusions obtained from these results Chapter 8 suggest future work and Chapter 9 contains some required reflections.

2 Background

This chapter reviews earlier studies in the fields of managing organizations, social organizations within an enterprise, current social network technology, and how all of these concepts can be used to create a business framework that will enable us to realize our objectives, such as: understanding the basis of networking organization and the relationships within these networks between the different actors, understand how these networks are relevant to a professional environment, how these networks vary depending on the position of an employee in the network (specifically whether they are a manager or not), which types of values can be introduced by each employee in a social network, and then locate the gaps in the internal communication within a organization.

After this background, the reader should be able to understand why the current technical solutions (that will be described) have been designed, follow some of these ideas, and understand how we can integrate these ideas in order to provide a solution to the current internal problems of an organization.

2.1 Theoretical Study and Concepts

In this section we will explain some basic concepts that are necessary to understand the origin of this study. We begin with an explanation of what a social network is, how it is composed of members, and how these members interact. These concepts formed the basis of the computer based social networking technologies we know so well today.

2.1.1 Organizational Context

In the field of social network research as related to an organizational context we find two major sets of issues that are studied. The first set of major issues concern the implications of social networks in terms of theory and practice, evolution, rules, and the features that characterize the development of social networks. The second set of major issues concern how these features and patterns should be researched and how the results of this research can be understood.[1]

As to the concept of a (social) network, we can say that a (social) network provides a context in which interactions between actors has a direct impact on other actor's actions. Using the classifications of Carpenter, Li, and Jiang[1], we will focus on two different classes of research into social networks:

- ***Social Capital research*** studies the mechanism of social networks, the outcomes of the actor's interaction within these networks, and how this study can give us some predictions about what can happen because of their actions[1].
- ***Network Development research*** studies the formation and change of social networks[1].

Both of these research classes could be further divided into two levels: ***interpersonal level*** research (where the actors being studied are individuals) and ***interorganizational level*** research (where the actors are organizations composed of individual members who represent the organizations). These concepts are summarized in **Error! Reference source not found.**

Table 2-1: Scheme for network research in an organizational context (based upon Table 1 of [1])

	Interpersonal Level	Interorganizational Level
Social Capital Research	How the network affects the individuals in an organization	How the network affects the organizations
Network Development Research	Networks composed by individual members. Facts of development and evolution.	Networks composed by organizations. Facts of development and evolution.

The concept of social capital research is built on the connection of two concepts: *social capital and embeddeness*. Social capital concerns the benefits and utility obtained by the participants in a social network. These benefits could be improvements in the effectiveness of searching for jobs and enhanced career development, enhancements to innovation, access to resources, and cost savings.

Embeddeness can be defined as a mechanism through which the network provides participants with resources, benefits, and values that can produce social capital[1]. Here we find a close relation between the actions of the participants in the network and the concept of embeddeness due to the interpersonal relations of the participants[1].

We can split embeddeness into two subtypes: *relational and structural embeddeness*. The first of these is due to the close ties that a participant has in a network. These ties link the closest people with whom a participant has built an environment of confidence, cooperation, and support in both directions producing shared norms, expectations, and points of view[1].

Structural embeddeness is more focused on the structural features of the network(s). It is related to the concepts of structural equivalence and structural holes of participants. These two concepts (structural embeddeness and holes) generate social capital for the participants[1].

With regard to social capital research we will further examine the interpersonal and interorganizational level locating these technical concepts within the framework we will focus on in our study, specifically an office or professional environment.

At the interpersonal level a focal actor can be an individual or a group. This level is used for the analysis of two types of effects: node-level consequences (such as career development, professional-role, and social behavior) and dyadic ties (second level) where the result of the actor's demands and requirements in most groups and their performance activities are the outcomes that constitute social capital[1].

Note that the node level is the personal and individual level, while the dyadic level is at the level of connections between actors in a network.

At the intraorganizational level most of the focal actors act as a group, but generally act independently. Most of these interactions take place at the dyadic level and the outcomes (network resources) often do not accrue to the group level, but rather the social capital benefits accrue to the whole network level[1].

A structural hole can be defined as a separation between non redundant contacts. They can be classified into three types:

Boundary	The member-node inside the organizational network is the only source of information.
Inside the organization	The colleague is the source of information. The information is redundant.
Outside the organization	Connections with different social groups having more information and greater heterogeneity.

If you are an employee, then a structural hole provides you the ability to bring a colleague with you. Now both of you can optionally bring someone or not bring someone else. Each of you will have less competitive advantage because neither of you represent the whole information of the organization, but if you collaborate you will both obtain more social capital and greater competitive advantage[2]. This limited advantage motivates each member of the network to broad their horizons and to connect with other nodes (i.e., members) to increase the amount of (information) value that they provide to the organization's network[2].

If there are a lot of structural holes at the boundaries of clusters within the network, then a member can acquire additional competitive capabilities, improve their ability to innovate, and enhance their job performance by collaboration with others across these gaps; this leads to a very tightly interconnected centralized internal network[2].

The different social circles that naturally develop feature many similarities, such as language, cultural links, immigrant status, and so on. However, there is evidence that individuals can be more creative and have more innovative ideas due to interactions with *different* types of people[2].

Forming these new connections and the information that flows via these new connections leads to various forms of gains by all the participants in these new connections. Normally managers positively value a person who contributes new ideas, thus motivating each employee to make their network wider and wider [2]. There are indications that a person who is able to build links that overcome differences (i.e., bridge the structural holes) will have better job performance[3].

The decision-making process, a part of an employee's job performance, is also influenced by the fact that it is generally not the individual employees who make decisions, but rather a manager who needs information from multiple sources in order to evaluate and integrate multiple different points of view, so that the manager can make the best decision[2].

An interesting issue that emerges in the development of the communication process through the different ties in the network is that although bridging the structural holes improves communications and the information quality, at the same time there may be an increase in risk because the different parts (of the network) should have confidence in each one of the parts[2].

This is very important for the object of our study, *the (employee's sense of) identity*, which is built into an interconnected network providing *coordination and collaboration* between the individuals of the organizational network hence improving *the (employee's) productivity*. People with a sense of group identity are better able to pool their information in order to get tasks done. However, this pooling is very difficult with a highly degree of structural holes[2].

In contrast to this trend we will show that, managers who have reduced the numbers of structural holes are able to provide better task execution and teamwork performance. This high interconnection level reduces the need for monitoring thus enhancing the formation of solid groups producing support between the members related to their point of view about corporate issues[2].

We conclude that the advantage of having outside connections does not always imply advantages with respect to internal performance, you have to balance both the internal and external information flows. We will examine this later, especially in relationship to legal issues[2].

2.1.1.1 Network Constructs

In this section we describe two points of view that can be used to characterize social networks: the external and internal views. The external view shows the resources that pass through the network and are leveraged by actors, thus leading to the manner in which these actors interact and use their ties to produce social capital value for the network[1]. In contrast, the internal view focuses more on the structural features of the network(s) where the actors interact internally rather than focusing on external resources.

Network Application Constructs: Following the same line as the external view, here the main idea is that the focal actors use their own resources or the access that they have to others to bring value to the network. The modeling of these intentional efforts are considered as valuable ties in the network application[1].

The network application constructs depend on two fundamental conditions: availability (that is the amount of possessed ties that an actor has) and the intention of the actor to use these ties[1]. It is important to link this concept with the employee and managerial points of view. Employees possess ties in social networks and they are willing to use all of them, in contrast with managerial ties[1]. We will talk about this in other sections.

Network Structure Constructs: Network structure constructs are related to the internal view. This concept focuses on the patterns and the effects that the network's formation, change, and evolution can produce in the participants. Two important concepts of network structure constructs are[1]:

Cohesion The relation between two actors that are linked, sharing a social tie with shared experience and an affective relationship.

Position The focal actor's location in relation within the complete network, as this describes the total scope of his or her internal connections.

Now that we have introduced these two concepts we will analyze each one of them.

With respect to network development research, we have to highlight that the network development opportunities provided by an extent network and an organization's strategic motivations to build the network are the two main forces that motivate an organization to encourage their employees to form links with other organizations[1].

Opportunities are the best means to capture the network social capital of well-imbedded actors. Actors search for new relationships with others in order to perform their activity to focus on their personal demands. For example, employees give a benefit to the network by adapting their workplace to new technologies, while management executives can develop ties between firms by following strategic links to benefit the company[1]. In later sections we will examine the great influence of the willingness of actors to build and leverage ties, for example the tendency to build these ties with similar actors (i.e., homophily). Social ties in the workplace can be influenced by other factors such as personalities, job characteristics, environmental pressures, reputation, and so on[1].

We have to say that the two sublevels in which network development research can be classified are the same as in social capital research, interpersonal and interorganizational levels.

2.1.2 Professional Context

Now that we have presented the important concepts of a network, in this section we start to build an analogy between networks and teams in the context of the professional business world.

2.1.2.1 Team and Interaction

The concept of a team constitutes one of the main objects of our study. Walker, Kogut, and Shan define a team as a group of people with complementary skills that collaborate in order to reach a common goal using team relationships, leadership and organizational environment, and a network[3].

According to Susskind, et al. those teams that have frequent communication between all of the members of the team exhibit greater productivity[4]. For this reason a team leader should increase the participation of all the members, guarantee a collaborative work environment, give opportunities to innovate, ensure results, and give security in terms of the involved know-how. They further state is impossible to achieve this productivity gain without an effective network that gives the managers a suitable environment to organize the structure of their team and to define the member's roles in the projects that are going to be carried out[4].

An interesting feature of the communications inside an organizational network that will be affected (and that we seek to improve in the course of our study) is the role of both formal and informal communications. Informal communications is the communications that occurs in the daily life of the employees based on their relationships. Susskind, et al. have observed that normally this informal communication takes place between members of the organization that belong to the same professional organization or are involved in the same type of professional activities[4].

2.1.2.2 Organizational Support Theory & Perceived Organizational Support

In order to give a complete big picture of Organizational Support Theory (OST) [5] and the reason why we seek to utilize this theory as a solution to the issues that actually exist in companies, we briefly explain OST.

OST suggests that the employees perceive the treatment given to them by the organization as a metric of how the company values their contribution and how involved they are in terms of their personal framework[5][6].

The organizational environment is continually a subject of the attention of the employees who collect a lot of information and create a common opinion together with their work-mates. This so-called perceived organizational support (POS) refers to the socialization process and structure of their organizational environment[5].

By giving a formal structure to the communication network and by leveraging the advantages of this as a platform we hope to create an easy, direct, and suitable communication system between these employees and that this communications will increase the organization's effectiveness[4][6].

With regard to informal communications, we should note that the functions that a manager has to perform will benefit from a well-organized network that can properly balance the cohesive ties and the structural holes of this network.

Susskind, et al. note that some studies have shown that the team leaders who have greater efficiency; are highly effective, have lower bindings, and have out-of-organization activities perform better than the rest of the members of their team[4]. The effect of supervisors and leaders is due to is the high amount of contact that they have with the company. Normally if the perception of the employer is positive, then these managers and leaders will be more committed to the organization – thus they will help to locate the weaknesses of the company and seek to give extra value by guiding the company on a more successful path[5].

POS not only focuses on the company as an entity consisting of the direct members of a network, but POS also includes co-workers and their jobs and the personal exchange of information that these workers have with each other. Normally workers with a similar hierarchical level of within the company have higher confidence between them than with the managers or others that are not structurally similar, so they tend to build a common judgment due to the social influence of their fellows [5]. According to Zagenczyk, et al. and Ramos & Ford POS is similar when employees have a structural equivalence (including their friendship ties). However, if this structural similarity does not exist, then the POS will **not** be similar although friendship tie exists between two members[5][6].

Although we will not focus on the customer in our study, we have to consider the relationship of the company with its customers and suppliers, as these entities will be part of some groups and they will interact with employees of a company, hence these relationships should be improved and should be considered according to OST[7].

We define relationship business performance as the enhancement of the operational level in the company-customer relationship that increases factors such as productivity, quality, and efficiency. These relationships can separately provide social capital, but in that case we will refer to the capital as relational capital. The main advantages of increased relationship business performance can be reducing costs, increasing the commitment to the relationship, innovation, and investment sharing[7][8].

The role of managers is very important in relationship business performance because they are the employees who should somehow define the relationship structures, practices, and projects; coordinate collaboration; and coordinate improvements in the interaction between the parties[7].

However, Kohtamäki, et al. say that the current IT-systems to share information do **not** help the relationship structure to contribute positively to the relationship performance between the company and the customer[7]. For this reason, the aim of our project is provide an interaction platform with all the available information and to make this information accessible from every device to members of a professional network.

2.1.3 Social Context

All of the concepts that have been described above are directly connected to the purpose of our study of social networks. The individual participating in a social network is an entity that manipulates other entities of network in order to solve problems and to reach objectives. All of these individuals are organized into groups to achieve these ends. Following Kadushin we can define a “broker” as an individual with high level skills to manipulate other people and information and who uses these skills to derive a benefit[9].

Cohesion and brokerage are present in any (social) network situation. In modern society we observe the trend to create communities. In order to perform this task efficiently it is important to find individuals with the capability of being associated with structural holes. These individuals will play the role of a broker by making connections within the network. The capability of the broker depends directly on his/her own base of connections, which is directly connected with the concept of cohesion[9]. The human feelings of safety, dependence, trust, competition, mastery, and effectiveness are directly interconnected with the main features of the concept of a social network, specifically: density/cohesion, structural holes, competition, and brokerage[9].

According to Greenberg and Hendrik, applying these concepts to our private and professional personal life is based on the following motivations [9]:

- Human activity and interconnections are natural, necessary, and proper aspects of the human condition. The social network provides safety and affiliation necessary to move the human being closer to other members of the network.
- Effectiveness is needed to do something and to learn how to do. It directly depends also on the autonomy and self-sufficiency of each member of the social network.

These two sets of driving forces should be exploited to create a competitive and collaborative professional environment. This environment should be flexible in order to exploit both competition and collaboration. The cohesion of people represents a disadvantage in competitive situations because all of the members embedded in a cohesive network have access to the same information and resources, hence no one will be able to take competitive advantage. In contrast, those members that have connections with other disconnected parts of the network have access to greater resources, hence giving them a solid benefit that can greatly benefit the network[9].

On the other hand, dense social networks provide a sense of trust, confidence, and cohesion producing collaboration between the members[9].

The most important issue is the location of trust. In a safety network, trust is related to the whole network, but its effectiveness is limited to the tie between two connected members of the network. While effectiveness is the basis of motivation and control, at the same time effectiveness is based on the safety of the different parts of the network[9].

These two factors (trust and effectiveness) contribute to give the network an extremely structural sense. What we want to realize is an “effective member” of a social network; such a member does not wish to be closer to **everyone**, but only to some other members of the social network with a focus on those that give this member some benefit[9].

Competition should occur in similar structural positions and responsibilities, while collaboration will occur between members independent of the member’s structural position. In order to build a more effective corporate network we want to enhance productivity in the intra-organizational network through collaboration between different structural levels and inside each of these levels we want there to be competition [9].

Small and cohesive networks in a larger corporate social framework produce a lack of identity inside the company. In these work-based networks, the people of the highest social class have more opportunities and ties (both strong and weak) than do employees of lower social classes[9]. In [9], Kadushin notes that Bonnie H. Ericsson[10] pointed to the increasing weak-tie diversity as one moves from employees to supervisors to managers to owners. A flexible workplace will enhance the feeling of member identity[11]. This requires stronger ties between the different parts of the corporate hierarchy in order to give each employee a high density in the level where his/her professional responsibility is, while at the same time balancing the effectiveness of the structural holes in a suitable direction in order to improve the trust of these ties.

2.2 Flexibility of the Workplace

Linda Huinink has said that as the flexible workplace strategy develops, the personal relationships established during professional work due to the interactions between employees become weaker; therefore there is a need to establish a connection between the effect of the flexible workplace and the level of trust in the information exchanged between employees and their managers[12].

2.2.1 Introduction to Flexibility

We will consider several aspects of flexibility, specifically: the flexible working concept, trust, employee satisfaction, transparency, and empowerment of the workforce.

2.2.1.1 Flexible Working Concept

Today work group members are frequently allowed to interact virtually through electronic devices and tools (from the office or at home). This introduces greater diversity in the employees due to cultural differences, geographical distances, and temporal differences (due to the employees being located in different time zones)[12]. In this context an important concept is *Teleworking*. Teleworking enables the employees to split their work time between the office and home by communicating via computer-based technology.

Some results that are expected from the establishment of the workplace are cost savings, enhancement of productivity, employees’ identity and satisfaction, flexibility, collaboration, and competition. This is always useful for the managers to leverage technology to have more control over their employees (monitoring)[12][13].

As we have said previously, we can expect that the direct personal relationships between employees can be negatively affected by Teleworking (independent of the level of social skills of the employee) the support from managers and colleagues decrease[12].

2.2.1.2 Trust

Each employee depends directly on information that supports their achieving their objectives and enables them to complete their tasks. Normally this information comes from their co- employees or managers[12][14]. However, according to Linda Huinink, some studies have shown that the trust relationship with managers and colleagues can be improved due to the technological support that the employees receive due to the technological advances incorporated to the workplace[12].

This increase in trust is very important because without trust flexible working is not going to work. Unfortunately, a flexible workplace will not directly affect your trust in your work mates, unlike the more direct personal interaction that you experience at the office during working hours[12].

Linda Huinink points out that these studies conclude that once an employee establishes a good personal relationship with a colleague or manager, their level of trust of this person is independent of whether or not they have direct personal contact. Due to this trust, the quality of the relationship is continuously enhanced, thus the level of monitoring of the employee by a manager need not be so intense[12].

Following this trend of virtual-supported relationships, monitoring by team members occurs because each member of the team wishes that their mates develop, accomplish their tasks, and reaching the goals imposed by the team's project schedule. As a result of this increased trust, the amount of monitoring needed is decreased[12].

2.2.1.3 Employee Satisfaction

Employee satisfaction is directly connected to the satisfaction of needs, wishes, and expectations, along with how the company can fulfill them. A high level of satisfaction implies greater motivation, efficiency, and effectiveness from the employee, giving the employee an increased feeling of identity that can yield high productivity.

Managers can play an important role in employee satisfaction by establishing a trust relationship with their employees[8][12][13].

The concept of flexibility emphasized an optimistic attitude and the point of view of employees by giving them privileges and accommodations in order to positively impact and enhance their creativity and maturity[8]. One of the reasons to introduce these changes is related to the modern work environment where technology is one of the main reasons for work stress. Additional workplace stressors include risk of job loss, relocation, organizational structure and politics, manager's interventions, project results, and family responsibilities[8][15].

An assumption is that employees wish to work when they want, rather than being limited to the core working hours of a company. Polzer et al. state that this flexibility enhances creativity and produces an increase in the commitment of the employee to the company, while at the same time increasing productivity[14].

Although this flexibility seems to give complete freedom to the employees, the managers play a very important role in monitoring and controlling the outcomes of the projects in which their employees are involved. The reason for this monitoring is due to several factors, such as distractions in life (for example, home issues). The concept of flexible hours should not simply be seen in terms of the hours that you are **not** working, but rather that this flexibility accommodates life's issues during the employee's professional life, causing working hours and non-working hours to be intermixed, thus making the daily schedule longer and more variable[14].

This balance of hours sometimes means that the employee stay at the workplace longer (for example, in the morning or evenings and during weekends). Polzer et al. indicate that instant access from the office and from home is very necessary to achieve the employee's goals[14].

Microsoft Corporation has reported that their main objective is to show the improvements that can be made and the reasons for why technology is the best way to generate competitive advantage for organizations. They state that the innovation offered by technology enables employees to increase their productivity, satisfy their need for trust, and provides employee satisfaction; in conjunction with adopting the flexible working concept[16]. They also state that IT currently has an important role in the changes in both businesses and organizations due to social changes, political changes, demographic changes, and so on; with wireless connectivity driving organizational progress towards a more interconnected work world[16].

They have highlighted the most important aspect of this new world of work/flexible workplace[16] are:

- **One world of business:** Companies must rapidly adapt in order to create a global network which allows them to manage their increasingly global businesses.
- **Always on:** Employees can work independently of when and where they are, based upon always being connected to the relevant data and persons.
- **Transparency:** Employees are continuously able to share information (although this sharing may be regulated).
- **Work-member evolution:** Companies seek to leverage the skills of both old and young employees by integrating the skills that both have in order to benefit the company by generating optimal results.

Microsoft Corporation believes that information and communication technologies (ICT) gives employees an increased ability to create, innovate, and communicate with their colleagues anytime anywhere, thus improving their performance and facilitating their achieving their goals. This extra capability is used by the organization to improve the decision-making process.

Sharing tasks between team members decentralizes the decision-making process, thus improving the productivity of each of the team members[16]. Unfortunately this technology is evolving very rapidly, so it takes time for the employees to adapt to new tools and advances – requiring that they continually improve their skills[16].

2.2.1.4 Transparency

The technology should help employees to access information faster thanks to software improvements. This information includes corporate data and intellectual property; hence access should be controlled according to corporate rules. Making this information available is referred to as transparency. According to Microsoft this transparency is critical to business success[16].

Employees, managers and executives should know what tasks have already been completed in order to develop new tasks, to make decisions, and to plan. Some of this information should be shared only within the organization, but some information needs to be shared with suppliers, customers, and all the business's stakeholders. In all cases the information should be shared in the most fluid way possible[16].

One of the issues that concern a company is the security of documents (with regard to their information content and who can access this information). Tools that can efficiently search for the content that an employee needs to complete their task are increasingly important due to the great amount of the information that is available and the amount of time lost in both searching and due to *not* finding the relevant information that does exist[16].

2.2.1.5 Empowerment of the Workforce

Another important role of technology is *empowerment of the workforce*. The trend of business globalization is producing an increasingly diverse work environment in terms of culture, gender, and age. Both Microsoft[16] and Shin[17] have indicated that technology that can help to provide a collaborative relationship between these diverse employees will benefit the company.

2.2.2 Outcomes and Issues

The empowerment of the workforce has a direct influence on the outcomes of the organization with regard to growth, technological changes, and legal changes. The organizational outcomes affected include the type of administration, the strategy of this administration, and distribution of responsibilities between the different employees, career opportunities, and group conflict. At the same time this empowerment has a close relationship with the group's performance, decision-making, cohesion, creativity, and so forth.[17]

For example, sex discrimination has occurred in the workforce, but this is changing and increasingly women are present in high level corporate positions[16]. Part of this change is due to technology and a flexible workplace which respect the needs of women with regard to their family and other life responsibilities[16].

Abendroth, et al. believe that our ability to increase the flexibility of the work-place leverages a combination of work-life and private life[18]. This flexibility should also reduce earning inequalities because of gender[18]. However, Abendroth, et al. indicate that studies have shown that increasing the availability of a mother during working hours has a benefit for their child, but it has a negative impact on the mother's work[18]. For this reason, we have to understand how to introduce tools that will enable *all* employees to have increased productivity.

While many managers talk about the value of experience and the value of older employees discrimination against older employees has occurred. This age based discrimination has frequently led to a great loss of value for the enterprise. The experience that older employees can transmit to younger employees could be a tool to destroy some barriers such as the lack of experience of younger workers limits their access to job positions and their participation in some projects [16][17].

However, for many older employees there is technology barrier, because they did not grow up in a technological environment, hence training is needed to develop their skills, but this training will take time. For this reason collaboration with the so-called Generation Y is very important. Generation Y is composed of talented young people with high skills as employees with constant and fluent access to information and connections with their colleagues[16][17].

One of the most important factors is that in this new world of work the company should satisfy the personal balance that employees wish to establish between their personal and professional life. Moreover, Microsoft claims that working when and where the employees want can have a direct impact on productivity[16].

Polzer et al. have stated that achieving corporate success through this employee welfare is the main objective for giving employees the feeling of comfort in order to reduce their stress level; while extras, such as entertainment (TVs, videos), comfort (sofas, fridges), and other ideas are part of a firm's overall strategy[14].

2.2.3 Economic Inequality

All of the factors described above can produce an inequality in earnings. Employees tend to compare their earnings with other employee within the same work-environment. The more homogeneous these employees are the lower the inequality of earnings. Earlier there were large inequalities in earnings based on gender and race, however these are not the only two features that can produce an inequality of earnings and as consequence produce problems within a work group[17]. In a company with a high percentage of recently hired (typically young) employees inequality can also exist, as has been claimed in an age discrimination suit against Google[19].

One approach to a solution is to build self-managed teams where the managerial authority is partially transferred to the employees who take on more responsibilities, hence altering the vertical division of hierarchical organizations. It has been demonstrated that self-managed teams have less inequality in terms of earnings[17].

The aim of my project is to make the workplace more flexible and to increase the collaboration of employees, while trying to avoid differences in employee earnings due to gender, age, and demographic location.

3 Social Network

This chapter describes the concept of a social network, its structure, its benefits, and the currently most important social networks and the services that they can provide in the context of a large company.

3.1 Overview

Social networking sites (such as Facebook, MySpace, and others) allow people to connect through communities, while social media sites allow people to share user-created content (UCC) (YouTube, Flickr). This UCC can be in form of videos, images, profiles, voting, commenting, and more[1]. Due to developments and advances in technology the difference between these two types of sites are continuously disappearing[20]. The result is social web sites which merge the properties of social networking and social media sites. These social web sites allow people to connect in order to build communities and to share user-created content (UCC).

As a result social web sites such as LinkedIn have been created. Corporate intranets have also been improved due to these advances. Kim, et al. have identified the essential advances as enabling information exchange within an online community, facilitating interaction between members of the community, sharing UCC and personal profiles, participating and expressing opinions in a social forum, supporting users, and providing a mechanism to find information[20].

Social technologies have changed the way in which a lot of people live, their overall personal connections, and even enable them to interact with people that they have never met before. In the last several years businesses are also changing. For example, according to Chui, et al. several media-platforms have been developed which provide a wide range of capabilities that benefit the company at lower cost and more quickly than the traditional media-platforms[21]. New technologies, their uses, and businesses have evolved due to a great deal of innovation. Chui, et al. state that the most important innovations have been adding the ability to publish, share, and access information individually or within a group[21].

3.2 Familiar Concepts of Social Networks

When we refer to the concept “social network”, we must always keep in mind some of the features and functionalities that these networks have. In the paragraphs below we will highlight some of these features and functionalities.

Each participant’s *personal profile* has fields which give the participant’s name, gender, photo, mail, interest, education, phone number, address, current employ, and so on. Kim, et al. postulate that in order to establish online connections there must be some kind of member discovery system to enable a participant to add new contacts, recommend friends, form groups, and to search based upon criteria such as name or other information[20].

Numerous factors foster online connections between two people, these include shared location, cultural features, languages, race, and employment. Kim, et al. state that these factors are the reason why some ties are stronger than others between network members[20].

Online groups go one step beyond simply connecting one member with others. Members can belong to groups and connect with others via the group. Each group has a manager or administrator who admits or denies access to the group. LinkedIn has a very good group structures based upon topics. The group can be public or private. In the later case a password or an invitation from an existing member is needed to join the group[20].

The connection between members is provided through *instant* and *text messaging*, public and private boards, and other services such as email. These public and private boards are also used to share UCC. Additionally, some mechanism may be available to share opinions related to the UCC, the most well-known is the famous “like”[20].

A mechanism to find information using a *key-word search engine browsing mechanism* is one of the most important aspects of social networks. Most sites provide such a mechanism to enable members to find people, groups, UCC, and other information. The search results can also have associated with it some recommendations related to the key-word(s) that were searched for. This is very useful in sites such as LinkedIn, which classify groups by people, jobs, companies, interest, and other criteria[20].

Although we will not focus on *open source software development* tools, for such projects it is important to find new members to joining your project. These members can be designers, who because they are users of the tool they see the project’s strengths and weaknesses from an objective point of view[20].

Now that we have described the general possibilities that a social web site can give a user, it is time to talk about specifics. The use of a social website depends on its users. Based upon Kim, et al. we classify these users into two types[20]: Individual users and businesses. We examine each of these two types below:

- **Individual user:** Normally an individual does not require instant or real-time communication, but rather they belong to a group or community and communicate with other members of this group or community daily. This communication can be a message sent to another member or a broadcast message sent to more than one member. This social web site communication has two implications: (1) a new means of communication and (2) new source of knowledge. With respect to the later, a significant amount of collective knowledge is built from the interaction of users[20].

Keeping updated and providing information that can help someone else is the primary objective of a community or network. These activities can also sustain the network. Such a network can also be a source of entertainment that can link many users who share a common interest, hence building ties between them[20].

For an individual, this great source of information can yielding knowledge as some skilled members contribute more and more information to enrich the network[20].

- **Businesses:** Social web sites can be useful for marketing products, attracting clients, and establishing new customer relationships. Businesses can configure and maintain a profile in the social web site. However, the business needs skilled people to exploit the value of the social technologies for the benefit of the company. For example, a business needs people to respond to (potential or current) client demands and these people should be qualified to do so[20].

One of the uses and the target of this thesis project is the corporate intranet. Some companies have already started to incorporate social network tools in order to enhance communication between their employees and to provide these employees with a way to share information. For example, solutions such as LinkedIn provide a personal connection between the members of an enterprise on professional topics[20].

Based upon the insights from Kim, et al. we will seek to leverage the power of the existing tools, by leveraging in a more efficient way the structure that the social network incorporates in order to make some innovative context changes in order to satisfy the company's current needs[20]. Therefore, we carefully define *social technologies* by saying that they are the products and services that allow social interactions in the digital world by introducing virtual communication between nodes in social networks. The greatest benefits of these networks are that they open the traditionally highly hierarchical architecture of the enterprise, hence overcoming cultural and location barriers. Chui, et al. have identified that implementation of social technologies in mobile devices supports this trend[21].

3.3 Social Technologies in the Business World

In this section we will give a deeper explanation of how social technologies fit into the business world, which benefits are provided to the market sectors that we will study, and what the implications of establishing a social network are, the opportunities that exist, and the challenges that we will have to overcome.

3.3.1 Overview

Today social technologies include a variety of enterprise and consumer applications[21]. These social technologies are displacing other web-based technologies and e-mails due to their ability to facilitate connections between different individuals who are enabled to share something based on their interest, job, or other characteristics (such as nationality or membership in a group)[21].

According to Chui, et al. the most important features about social technologies are[21]:

- Social is a feature that can be included in any technology involving interaction between individuals and almost any economic activity is susceptible to being socialized.
- Social technologies can have a direct influence upon the behavior of individuals by giving them an online context, thus increasing the speed of communication and sharing information resulting in a more scalable and organized sense of a culture and its information. Thanks to these technologies an individual can have a great influence on a large number of individuals due to connections across geographies increasing the number of weak-ties.
- Social technologies allow the implementation of a platform which favors co-creation and transformation thanks to the production, distribution, and consumption of the shared information. The need for intermediaries is eliminated.
- Using social technologies you can build a social map of each individual. Giving an objective point of view about the social capability of each member of the network. This social map also reveals how people within organizations interact.

Creation of group structures with its own opinions and need breaking the corporate hierarchical structures.

Using social technologies we can create a platform to obtain feedback concerning any product by paying attention to the opinions of the customers. This can be used to enhance the product after each revision. This communication increases transparency between customers, organizations, and institutions. Also social technologies can be used to recruit additional talented and creative persons.

Workflow management systems (WFMS) incorporate functionalities such as a database, email, and other functions to provide additional services. According to Sally Dibb, such a workflow system can provide us with the advantages of integrating internal and external information, a document generation mechanism that automates managerial tasks and information transfer between employees, and searching capabilities to find previous relevant work (giving employees the information that they need at the moment while avoiding irrelevant information)[22].

There are different types of knowledge involved in a workflow system. Sally Dibb talks about *process knowledge* that includes facts about performance of a task (such as roles, routes, and rules; institutional knowledge, business procedures, roles and actors and their management) and environmental knowledge of the business (such as competitors, customers, industrial associations, and regulations)[22].

Is important to note the different forms in which knowledge can be presented inside a WFMS: workflow models, workflow history, data warehouses, documents for decision support, hypertext documents linked with WebPages, etc.[22]

According to Chui, et al., there are four main segments in the value chain of a company: product development, operations and distribution, the customer and the service that is given to the customer, and sales and marketing. Value can be added across the enterprise[21].

However, they claim that in order for a company to benefit from social technologies the company needs a large number of skilled employees, confidence and brand recognition from the customer's point of view (to build credibility in order to keep the consumer's trust), and they need to digitalize their distribution of recognized products[21].

One of the most important factors and objectives of our project is to enhance the productivity of the employees by using social technologies. This is based upon Chui, et al. saying that if a company is able to plan their different projects, execute, and incorporate suitable social technologies, then the company will be able to capture the potential value of their employees[21]. They make this claim since some studies have concluded if the company becomes be fully networked that incorporating social technologies can increase productivity of employee's interactions between 20-25%. This interaction includes all the common daily professional activities such as collaboration, finding information for their tasks, communicating, and so on – resulting in improvements in organizational process, structure, work performance, and culture[21].

These improvements are mostly based on the change from one-to-one communication relationships to many-to-many social communication channels. This change makes more information accessible, searchable, and sharable, thus saving a lot of time that used to be invested in writing, reading, classifying, and consulting with experts. Some studies suggest that the average improvement in collaboration across different enterprises sectors is ~66%[21].

Although we are always talking about the benefits for the company, we have to emphasize that the first beneficiaries of these social technologies are individuals, simply because without the individual benefit, a global company benefit cannot exist[21].

However, not everything is positive as if you enable people to share knowledge; you have to accept that there are some increased risks, such as: abuse of this information, attacks on colleagues or managers, opinions and criticism that are not related to the work that is to be done, violation of individual and corporate privacy, and more complex data security[21]. Despite these risks, the most important challenges are to capture the value provided by the social technologies by creating trust relationships, fostering internal and external communication with positive practices, breaking down location and cultural barriers, and reducing some of the identified risks[21].

Some companies worry about introducing a tool based on social technologies because they think that somehow productivity could be negatively affected due to the social technology distracting the employee from their core tasks.

Therefore, we have to be very careful when leveraging the power of social networks to avoid functionality that would cause a distraction[21].

3.3.2 Evolution, Opportunities and Challenges

The evolution of social technologies is mainly focused on transforming strong barriers into weak limits by encouraging the participation of external (to the company) participant in tasks and projects, while balancing the responsibilities between the external and internal participants in order to produce a global collaboration[21].

The ways in which groups are formed and information exchanged are breaking cultural, age, race, and demographic limitations. By looking at a social graph we can see how fully connected a networked company is. This social graph is a representation of the personal connections that a person has with others. These connections can be unidirectional or reciprocal[21].

The number of connections is an indicator of social capital, a concept that we will introduce in detail later, but here we will say that social capital describes in a general way how a person is trusted, relevant, and a source of knowledge to others. Of course the type of content can be classified in direct relation with the social graphs. Note that the content shared between different groups is the same content (as the content is shared)[21].

All of these concepts have been addressed earlier by various studies. These studies have shown that the adoption of social technologies have been greater in the customers/users sector than in the employees sector (as we will describe in detail below)[21].

Traditionally Web 2.0 technologies have increased profits by enhancing productivity through improved communication between stakeholders[21]. For this reason we want to follow this evolutionary path. These Web 2.0 technologies have produced gains that we will described in detail in the following paragraphs. The solution proposed in this thesis project seeks to continue to exploit these improvements by bringing these improvements into a company.

However, we see two main challenges to overcome: (1) a better search mechanism need to be provided in order to find content and connections and (2) collaborative and open networks are needed to improve vertical flow communication [21].

3.3.2.1 Target Audience

In order to improve internal corporate communication we seek to leverage social technologies. However, the adoption rate of social technologies by employees is too low, hence we have to increase this adoption rate[21]. The value of these social networks to employees can be increased if they are integrated into the daily enterprise work-flow to better connect employees and to connect employees with customers and business partners[21].

3.3.2.2 Challenges

In a large organization there is a great deal of information in personal profiles and descriptions of groups, projects, and tasks. Therefore we must have a suitable search process to enable the user to find exactly what they looking for.

Filtering out irrelevant data in order to give the employee only the relevant information is essential to achieve our goals[21]. The lack of a suitable means of closing this gap between the massive amounts of information that are available and identifying the relevant information is a key objective of our project. The system's responses to a user's query should be interactive; otherwise the user will not gain time that can be spent in task execution to improve their efficiency[21].

Identity management is another of the most important challenges, specifically how to build suitable personal profiles, manage, and connect them while maintaining the privacy of each user. Although the feeling of identity that we want to give to each employee represents a risk, the basis of this feeling is an identity that they can use to connect with others, so we must accept this risk[21].

Increasing productivity is directly connected with the flexibility of the workplace as we have explained earlier, but we have to realize that by adding **mobility** to the workplace we improve flexibility in terms of time, location, and access. The adaptation and connection of mobile devices is essential to achieve this increase in flexibility[21].

Integration and interoperability of social factors into existing and new social technology tools is necessary for managing the interconnections across the different channels within a network and between different social platforms[21]. Additionally, once we have integrated the existing and new communication tools, we have to guarantee coordination of real-time and non-real time information. Some tools already exist, such as video-conference rooms, chats, and timeline based communication with storage of messages (individual or groups); however, according to Chui et al. these tools have not been integrated in a correct way[21].

All these challenges need to be taken into account, but are not simply an objective to be achieved – they may help us to reach the next objective. Integrating even one tool into the corporate communication system and fostering its use by users would help with the integration of the next tool and so forth[21].

3.3.2.3 Prognosis

Once we integrate social technologies in a company to a sufficient extent, we have to perform some additional work to completely satisfy the needs of the enterprise and to leverage the abilities of the employees with these installed tools. Therefore, the incorporation of at least one social technology into employees' mobile devices is one of the main problems to be solved[20].

It is important that we correctly organize information. Our highest priority is to organize a database of members and groups. We have to guarantee that this information is up to date. We should find the most suitable way to do this in order to minimize the time required and to maximize the efficiency of the process of keeping it up to date[20].

3.3.3 Creation of Value across Industries

Chui, et al. has identified ten ways to produce value across an industry. Below we discuss them and highlighting which ones we will focus on[21]:

- **Co-creation:** Social networks can be tapped to solve product development problems that would not be overcome solely with internal resources by “crowd sourcing” (thus utilizing a wide range of participants). This requires that we look outside the company’s borders by including customers and others.
- **Operations and Distributions:** Here we define two sub-levels: (1) the forecast of demand (where social technologies can increase demand) and dividing up the different demand sources in order to improve the efficiency of the distribution process and (2) the distribution of business processes, where the social technologies are used to engage persons outside of the company and to outsource various tasks.
- **Marketing and Sales:** Social technologies can be leveraged to give insight into the customer’s opinions of the products, competitors, and the rest of the business segments. The most immediate form for this is feedback, but the information could also provide leads for business-to-customer (B2C) and business-to-business (B2B) marketers (for example, by generating social capital in the form of sales agents and specialized professional services).
- **Social commerce:** Social commerce could be realized as e-commerce, where mobile devices and virtual applications are used to purchase products, make payments, and to provide other services.
- **Customer Care:** Customer call center services could be based on database/knowledge platforms to give the most complete service possible.
- **Collaboration and Communications:** Very closely linked with co-creation, improving best and efficient practices requires avoiding spending time in unnecessary group meetings. Of course these meetings may be helpful for integrating new members in a project and involving other partners. Connecting remotely can provide virtual face-to-face human connections needed to perform tasks on time and reaching a project’s goals.
- **Matching talents:** Internal social networks can capture the output of talented employees, thus making the information that they generate more available, as well as gathering recommendations and other types of relevant details.

The value of these social technologies can only be captured if we take into account the huge volume of data that social technologies can gather[21]. We have to find a suitable degree of granularity to enable employees (and others) to share information successfully and rapidly[21]. We hope to find a solution to this problem in our project.

Our solution will focus on the value captured from communication within an enterprise, although communication between enterprises represents another major source of value that could be captured[21]. Currently 80% of companies are in the development stage of adopting social technologies for improving communications within the company and between the company and others[21].

Therefore, this is a great time to provide an integrated solution which exploits some innovative ideas. Most of these companies have employees with a high level of knowledge, skills, and preparation, so any tool should consider the importance of the interaction between groups of engineers, managers, consultants, and so on because it has been demonstrated that the more interactive a group is, the more competitive it will be, and this can be translated into enrichment of the networked company[21].

Another very important statistics is that 65% of an employee's time is spent communication with others[21]. Therefore if we improve this major task, then we will see a direct positive influence on the employee's task performance hence producing benefits to the company.

We should also consider that almost every company has employees who are not so high qualified or who are not familiar with these social technologies, so their adoption and use of these tools could like longer (or in fact never occur). Suitable training can have a great benefit if these employees adopt and use these tools more quickly and efficiently, but we should keep in mind that while the training is ongoing, the workers are not focused on their task, which temporally decrease their productivity[21].

The real challenge to capturing value is to embed social technologies in the employee's daily work, connecting every employees into a common network, so that each employee makes a contribution that can be leveraged[21]. We will propose a solution in this study.

3.3.3.1 Value across targeted sectors: our focus

Value can be created in two types of companies, product companies and service companies in business to business (B2B) and business to customer (B2C) markets. Below we describe some market sectors where we will focus our interest:

Professional Services: The professional services industry is very large and includes engineering, architecture, accounting, advertising and marketing, management, IT research, and legal fields. One of the main reasons to focus our attention on this sector is because these firms are more than a business, they are social organizations[21]. The projects that they carry out involve interactions with professional colleagues and relationships with customers and suppliers. Each step needs to aggregate the values of intellectual leadership, integrity, confidentiality, maintaining the reputation of the brand, and attract new customers[21]. This is only possible through collaboration within a well-structured organization where the professionals expect to share information and to internally publish content that could affect the organization's external reputation[21]. All of these activities can be benefit from use of social technologies.

The current use of social technologies in this market mainly focuses on coordination of projects using social platforms to coordinate people, creating guides to develop similar tasks and to solve problems, forming communities to share opinions, and asking for the experience of others in order to reduce the time needed to discover how to do something, thus reducing the overall execution time[21].

Social technology platforms can also be used to collect feedback from clients, not only about existing products, but sometimes in order to build communities where the customers give their own opinions, suggestions, and ideas for future products. This is also a source of recruiting talent[21].

With regard to *product development* one of the main sources of growth for this industry is access to expertise and information from the clients that can be adapted suitably and used with other clients. This is a collaboration process, hence social technologies could provide a great competitive advantage[21].

The flexible workplace within and between enterprises is positively affected by social technologies which foster the exchange of information between employees involved in common projects and with external expertise. Improving employee collaboration and participation leading to success in *operations*, requires that each employee identify with the company's brand. Unfortunately, in most cases this does not happen in a large company[21]. To create this *feeling of identity* we will improve the *flexibility of the workplace* through social technology in order to create and increase employee *productivity* in global terms[21].

We can easily find an application of social technologies in *marketing and sales*. Given the personal graphs of each employee, we have a great source of contacts with whom we can collaborate or from which we can attract new clients and participants. Enabling co-creation with this social technology, we have a huge source of information and shared resources[21]. However, this collaboration is not possible if employees do not have rapid access to the information and virtual communication tools to reach each employee. In this thesis project we exploit the concept of an office in the cloud in order to improve access to the relevant information and to facilitate communication between co-workers[21].

As the main objective it is to gain value, rather than to lose value. Often the most veteran employees are more and more distant from professional activities. To avoid losing their value (with respect to their experience and task performance) social technologies can be used to maintain their contact with the company, in order to help in some tasks, decisions, and training programs for new employees[21].

A big problem with social technologies in this sector (as well as many other sectors) is the slow adoption of social technologies. There are some professionals that do not see any reason to change their working routines in order to share a great deal of information. This lack of adoption typically happens in top management positions[21].

For clients and colleagues in many cultures a personal face-to-face relationship should not be lost when converting to virtual relationship. However, if the team members are in different locations and there is no way to easily contact them, then if you delay a meeting the result will be lower task performance, something that is not desirable. Not all clients and employees will feel completely comfortable adopting of social technologies in terms of trusting other employees and losing the privacy of their content[21].

As we see location and culture barriers are two of the big challenges to overcome. For this reason we will focus on large companies, as they must directly face these problems[21].

Social Technology Providers: Social technology providers are web companies, software companies, and IT service companies. These companies want to leverage social technologies to provide a platform for social interaction where their services lie and where their customers can access and interact with them[21].

We highlight five categories of revenue in this market: advertising targeting core customers by sending them advertisements in which they are interested and displaying advertisements via social sites, e-Commerce of either physical or virtual goods via social platforms, IT software and services concerning social technology software and its maintenance being made available in the cloud, value-added services with virtual payment for services, and donations of monetary gifts to public organizations[21].

We will focus only on IT software and services. This is the only market where we can tap the complete capability of an implementation for this study. The objective will be to improve the customer facing elements of a company in order to attract more customers due to collaboration between the company and its customers. Additionally, we will enable collaboration *within* the company. All the tools that will support this process will be running in the cloud in order to see that they are scalable. Companies, such as Yammer, have already developed some solutions[21].

3.4 Implications of Social Technologies

In this section we briefly explain the implications of the development, improvement, and establishment of social technologies at different levels. We specifically focus on individuals, the company, and policy makers.

3.4.1.1 Individual Level

Exploiting the advantages and overcoming the difficulties of adopting social technology are the main objectives of our effort to improve the flexibility of the workplace. Therefore, it will be very important that companies adopt this approach as rapidly as possible by utilizing both internal and external applications[21]. Internal applications are those that directly affect the environment *within* the enterprise. Here the most important issue is to discover how to combine technologies with the different practices and the employee's organizations in order to provide an efficient platform and mechanism for collaboration and adaptation[21].

Social technologies increase the abilities of high qualified employees by improving communication and collaboration, thus breaking the company's barriers with regard to location, language, and culture and in so doing enhancing the acquisition of a great amount of the knowledge created within a large networked enterprise[21].

The goal is to foster employees' use of social technologies that are incorporated in their daily life. The best way is to make sure that these tools enable the employees to solve real business problems and support the company's operations. This requires building complete and intuitive tools that can deal with all the information that could be useful to the employees.

With regard to the individual employee we believe that social technologies will allow a great flow of messages to be analyzed by each individual, thus we will be able to detect what the individual employee is interested in, learning from others, and improve the communication tools by getting feedback from the employees[21].

Several other important findings that we should discuss include the fact that the adoption of new technologies by users is occurring faster than was expected in comparison with previous technologies[21] and that not only should the employees be involved in this process of adoption, but we have to adapt the tool to be relevant for every level of the organization's hierarchy, because the objective is not to break the hierarchy, but to make the organization more transparent in both directions. Top level managers also have their own needs that must be addressed[21].

3.4.1.2 Corporate Level

As we have said a great impact on the business world would mainly affect the company by giving it extra value. As noted previously this value comes mostly from improving collaboration and communication. This improves the organization of the company in a fully networked company in both personal-behavioral and technical aspects[21].

We can extend these tools to external applications to weaken the communication barriers by creating inter-enterprise social applications that can be used by the various stakeholders. Unfortunately, companies are even more skeptical about adopting technologies than we might expect. Therefore we must start by introducing basic functional such as getting feedback from customers, then adapt and continue to gradually improve the system's functionalities[21].

3.4.1.3 Policy Maker Level

Collaboration and communication can elevate an individual in a community due to their sharing information and enhancing the community's general knowledge. As we might expect with every development, not everything presents an advantage. In this case there are many problems concerning intellectual property, violation of privacy, risk of reputation, and other damages that incur risks. However, in this context most companies think that the benefits that they might receive are much greater than the risks that these advances carry[21].

As we will focus on a professional profile-based design we have to think about privacy and identity issues, where some information can be relevant, essential, or simply superfluous.

For example, age, race, marital status, nationality, and other attributes could be controversial issues in relation to a job, therefore we have to carefully consider under which conditions this type of information should be collected and disseminated and what the purpose of collecting and disseminating is[21]. For example, in some countries some of this information (such as national origin) might not even be legal for the company to collect.

A professional profile should provide professional features and personal information such as leadership experience, self-motivation, and so on; but should **not** include social status or race. This is important because not only can this information be accessed, it can be transferred to others, hence we have to build our network so that we only collect and disseminate the most relevant information[21].

At the same time the information may belong to a person or a project, hence we must respect the intellectual rights of this material - even though we are exploiting co-creation and have the trust of members of the network, as we wish to encourage them to upload even more information, as well as transfer and initiate more projects we must respect their privacy and rights[21].

The content includes information exchanged during the collaboration process between members, so we should establish restrictions concerning political speech, opinions, criticism, obscenity, and so on in order to avoid legal problems[21]. We can classify these legal issues into the following [23]:

<i>Hosting Defense</i>	An ISP is not the responsible for information stored as content. There is not currently a law regarding these considerations, but as a user we can ask an ISP to disable access to specific information.
<i>Defamation</i>	Avoiding charges of defamation is a function of the so-called “innocent publication” concept. The context in which the publication occurred and the reason for publication can be used to limit the risk of defamation.
<i>Copyright Infringement</i>	Copyright infringement can include making a copy, adapting a work, and make either available to the public or broadcasting this content.
<i>Monitoring Debate</i>	We need to have employees who monitor other employees, but we will also need to monitor the exchange of information. It is recommended that the company should encourage users to report suspected infringements, the company should give users permission to delete information, provide a mechanism to report potential information troubles, and to provide mechanism to alert teammates of potential problems.
<i>Data Protection/ Privacy</i>	UCC and accounts at social media sites offer different levels of privacy for information. A suitable mechanism for identification and means should exist to avoid violation of privacy rights with regard to uploaded material. These policies are generally referred to as accepted use policies.
<i>Cyber bullying</i>	Bullying is expected to be less frequent in a professional environment, but some measures should be taken to avoid this problem.
<i>Acceptable use policies</i>	Considering the ways in which employees will engage via social media technologies, there should be personal accounts and limited external access, prohibition of posting inappropriate material, prohibition against using the tool for other purposes than strictly professional use, and licenses must exist for material created during different tasks.
<i>Privacy Policy</i>	Transmission of information outside of the group, department, and office, must be governed by a suitable policy. The use of data for marketing purposes and other purposes should be made clear when the data is collected.

4 State of the Art

This chapter describes the most relevant social networks and communication tools in order to give the reader a deeper insight into the current situation within a large enterprise. This chapter will focus on two specific social networks that have been created with a focus on corporate users: the Yammer Social Network and LinkedIn.

4.1 LinkedIn

In this section we introduce the main features of the well-known social network called “LinkedIn”. We will examine its development and innovations to provide a base for our own proposal.

4.1.1 Overview

LinkedIn is a professional social network based on centralized directories with all of a user’s contacts. These directories are associated with an individual professional or with groups[24]. The different types of groups will be explained later in this section.

4.1.1.1 Group Profile

The LinkedIn social network provides a complete profile of an individual or are group includes the following information[24]:

- Use of a professional headline: A couple of phrases that accompany your name and with a few words reflects who you are and what you offer in order to be attractive for recruiters.
- If a person is a freelancer or is interested in developing some freelance activity, then it is very important to note this in their profile.
- If you want to indicate that you are an expert in a field, you can give some references about your publications in order to give others a better idea about the contributions that you might make.
- Your profile should have links to your web page(s) and blogs relevant to your professional role(s).
- You should update your profile when necessary: Is not necessary to do this daily, as you might with a blog or other website, but you have to do it when you complete a project and you take on a new role, when you acquire a new ability, knowledge, or new responsibilities, and when you acquire a new contract or job position.
- You should join all the groups that would benefit you or where you can have a role to improve your collaboration and hence enhance your own work performance.

Keep in mind the fact that the team will decides what information is visible and how many “connections” will exist. Other customers can review a project’s profile[24].

4.1.1.2 Personal Profile

A user can join the network using his or her corporate email address. Initially an empty profile appears. It is up to the user to complete their personal profile as soon as possible in order to benefit from participating[24].

The basic profile information includes: name (it is important to properly state your name because this will make it easier for the other network members to find you), a professional headline (this should attract people's attention), and location and industrial experience (to make it easier for other members to contact you and to understand your ties)[24].

For each position, you must highlight the following fields: company name, job title, period of time that you were in this position, and a description of your tasks.

Additional profile information such as the following can be added[24]:

- **Web Sites:** In LinkedIn you can publish a maximum of three web pages in which you are interested for which you are the owner of the web page (of course it could be your personal web page). The idea is to inform other members of what you are interested in and to have additional space to publish all the information you wish.
- **Interest:** This information is important as allows you to improve your relationships with other employees. For example some groups share a hobby or an interest in order to build new ties between groups or to establish closer relationships that could help improve collaboration.
- **Groups and Associations:** This field is mandatory for a project as it gives the potential to build groups that can share a task, topic, or some investigation. For large groups it gives the possibility to share personal information, thus fostering new contacts and collaborations.

We have to consider that a large group does not give the ability to have close connections or to communicate with other groups or individuals, so this field should be understood as a first effort to build another more private group to start more interactive collaboration.

The closer the interaction between two members the more information is going to be shared. This information will not only relate to the individual's professional roles and goals, but this information can enhance their level of communication (for example, their personal email addresses, phone number, and so on).

- **Honors/Awards:** For a person or a project this field offers information about your abilities. In the case of a project or group this information could provide extra value.
- **Your profile outside of a company:** We do not cover this feature, as generally a company is not interested about sharing information, personal profiles, and qualifications of their employees nor the customers that they have[24].

With regard to LinkedIn there are two types of profiles in a professional network: Those that enhance *quantity* rather than the quality of connections; and those that make the opposite. While the first type of individual tries to connect to as many people as possible, the second chooses to connect only with those that they know really well, as keeping their linked members closer enhances the quality of their connections[24].

LinkedIn recommends the second approach, but in our solution, we will attempt to balance both approaches. The objective will be to enhance productivity by improving the flexibility of the workplace and the collaboration and competition aspects of an employee's daily professional life. Therefore it is necessary to have a great number of connections in order to accomplish the desired tasks and to achieve the objectives of the different projects in the most successful way by exploiting the connections that a person or a group of persons has or establishes during the project's development process. A goal is to foster a competitive feeling for the employees, while at the same time facilitating collaboration – hence the number of connections and their quality are both essential.

Another very important feature that illustrates this flexible communication is that some members want to remain connected with all of those members that they are related to the same professional sector, professional life, and/or common activities. On the other hand there are those users that are more focused on the diversity of their own networks, who wish to broaden their horizons away their own borders[24].

We have to highlight the most important feature that is the common aim of all these networks, the goal is to obtain some aid from others that can help you in your professional life, to obtain some benefits from these collaborations, and to achieve in some cases a common goal[24].

The identity of an employee is one of the issues that we will study. Personal networks can give an employee the possibility to make his or her work more visible, to highlight the tasks they have completed, to describe their skills, motivations, and desired future endeavors. Normally the most straightforward way to establish additional connections is via people who have a similar professional role, rather than with individuals that are above you in a corporate hierarchy. In our approach we hope to partially break this barrier[24].

The purpose of new connections and to their maintenance occurs because the first time that you met a person you expected to have some skills that are interesting for you or for a group that is working successfully on a topic to solve problems that are somehow useful for you. In a correctly designed network you should get exactly the information that you are looking for or that addresses your present needs. Meeting these needs is essential to deciding if you want to connect or not[24].

4.1.2 Other Relevant Functions

Some other important functionality that we will realize in our implementation is summarized in the following subsections.

4.1.2.1 Search Criteria

Being able to specify relevant search criteria is one of the most important features of a social network as this provides the user with an *efficient* search that enables them to find exactly whomever or whatever they need. Some of the different criteria are[24]:

Relevance	Relevance is based only on the key words that you entered. The more times a key word appears in a profile, the higher its position in the search results.
Relationship	The contacts that appear first are the ones that are directly connected to you. This is useful if you want to contact another person that is not introduced by one of your own contacts.

Relationships & Recommendations	Shows the most recommended profile of all the profiles connected to you. If you want help for a project, you generally would prefer to contact the most qualified person/group.
Connections	The numbers of connections help you to find these people that have the greatest number of connected profiles to advise you in your tasks.
Keyword	The keywords criteria show you the profiles that best match your keywords.

4.1.2.2 Recommendations

A social appreciation is very valuable for an employee when they have to make a decision in order to successfully complete a task. A relevant recommendation is something that can give the necessary support for their decision[24].

We have to take into account that the person who is giving a recommendation is putting his or her reputation at stake, so a skeptical attitude that may exist based upon a first impression when you meet someone or you read about them can disappear due to the risk involved in giving a recommendation[24].

The reason that drives someone to ask for a recommendation or to receive one is either that they have been working with someone or know someone well[24]. We suggest to that user some kind of recommendation/congratulation message to different specialized groups and whom to contact.

Not every relationship is symmetrical. Depending on the type of personal relationship you have and vice-versa. Establishing a relationship with a group that is working in a common field is different than establishing a relationship with a customer or service provider[24].

4.1.2.3 Keeping track of a profile's activities

In the part of "My Profile", we can include information that it updated daily for the different groups, discussions, connections, and state of the projects. This contains improvements and suggestions about other useful profiles[24].

4.1.2.4 Browser and email synchronization

LinkedIn includes the ability to import contacts that you have been in touch with before starting your virtual-social experience. The system should detect among these email contacts who belongs to the company, customers, and providers in order to grow your network as quickly as possible[24]. Although you may give your private email address, your privacy should be always respected by a company.

4.1.2.5 Finding a job

A major source of recruits for an enterprise will be employees of other enterprise. In order to encouraging employees to move from one company to another they must know of new job offers, the company must evaluate where an employee can fit better after developing some professional abilities in another company, what the potential employee can give to customers and collaborators, how the company can attract an employee, and so on. Finding the appropriate new employees will improve the value of an enterprise and enhance communication (both vertically and horizontally) in the organization's hierarchy[24].

The tool should improve the visibility and the attractiveness of each profile. Nobody is more conscious of the possibilities than you or your group of what your abilities are and the solutions that you can offer, so it is desirable to connect with managers and co-workers who can give you extra value with regard to new professional possibilities within your company[24].

Of course this advantage is also applicable in the other direction. The more information each member puts in, the better the search results that someone gets – thus leading to identifying the most relevant talented profile[24].

4.1.2.6 Get Connected via Groups

A number of types of groups can be created in a corporate network, these are[24]:

- **Personal/Professional (Networking in LinkedIn):** These networks involve people concerned with a concept, an idea, or an interest. A member has a common field of interest and also shares objectives and goals. To improve the identity of the employee within a company, we can facilitate the employee developing their own projects in collaboration with other employees. Of course the time spent in these personal projects should be strictly controlled.
- **Professional:** As previously described, one of the types of profiles that can be created is a group profile, related to a project, a topic, a department, or any other group of people whose professional tasks are closely tied and who want to collaborate.
- **Personal:** A personal network encourages the formation of relationships between the employees, so creating groups to plan free time events such as sporting events, can be an interesting feature.

Common features to take into account concerning groups are that they should be very clear, with a distinct profile, so that everyone that wants help from another group should understand the purpose and projects, the qualification of the members, and the benefits of each group after reading only a few lines[24].

4.1.2.7 Questions/Answer Section Functionality

The question and answer section enables you to share questions that fit into a group of questions related to a topic and can be answered by others based upon their knowledge and experience. We think that an obvious future task is to leverage group structures as a virtual place where you can formulate a question and have it answered by profiles from within your own contacts or outside of them[24].

4.1.2.8 InMail

InMail is a private messaging system that allows you to interact with others that are not connected with you. Using InMail we can expand our network by connecting with unknown people belong to our contact network. This mechanism enables you to connect with a third party as enabled by one of your contacts[24].

The benefits are the representation gained by someone close; in contrast with you're directly approaching an unknown person. This mechanism exploits the interaction between members of a network in terms of contacts and intentions. Of course you can leverage the potential power of your network by expanding it further and further[24].

4.2 Yammer

Yammer is the most widely deployed social network, used by more than 80% of the Forbes 500. It was launched in 2007 and is co-worker communication oriented. It is available on mobile device platforms in order to increase its mobility and accessibility[25].

As with LinkedIn, you can have different services depending on the monthly payment plan paid by the company[26]. It is a profile based network where members can upload information about themselves such as a name of their picture or current position. Similar to LinkedIn the group's implementation option is available; hence you can configure the level of privacy of the group and of your personal profile[27].

Other additional functionality is private messages, follow content, participate in discussions, and suggestions people and groups. The communication can be synchronous or asynchronous, you can vote, you have "like" button option, and can share files. You can join the network only with a corporate email address[28].

4.3 Network Tool: NodeXL

This tool is a simple way to reduce the visual complexity of the graph that represents your social network. It is integrated in Microsoft Excel and is easy to use. You can have a big picture of your network; modify the nodes, the edges between them, group vertices and other features including:

- Import and export networks in different formats (GraphML, Pajek, UCINet),
- Direct Connection to social networks (YouTube, Twitter, and Flickr),
- Flexible Layout, and
- Graph metrics calculation (we will use this within our analysis to collect results).

5 Method

In this section will explain our main objectives and how they will support our implementation. Also we explain what we can expect from our analysis.

5.1 Main Goals of the Study

The main goal of our study is to reflect on the fact that the current solutions that are being employed within companies in order to achieve better internal communication with the implementation of their own social internal private networks are not having the positive impact that the companies forecasted before and which they currently need.

In comparison with the huge popularity of open public social networks whose use seems to be greater than the internal corporate networks even in the professional context, we use Yammer [29] as it has the widest corporate used with 80% of Fortune's 500 companies [25] in order to utilize comprehensive and actual metrics [30] illustrating this negative trend.

The public social network that is used for comparison is LinkedIn [31]. This social network is widely used by the workers to communicate, obtain information from various sources, and link with other workers.

It is important to show the evidence about connections between the major issues explained in the background part with corporate social networks and the results that will be shown in our analysis to see how important these types of studies are.

5.2 How to reach our goals

First of all the data is extracted from the webpage analytics according to the considerations explained in the chapter on analysis. We have gathered Yammer data from case of success published on the Yammer webpage.

After that we adapted the KPI formulas to our context, because Lovett's key performance indicators [30] are mostly focus on the market sector.

After collecting the results we will show them separately and then we will compare following the similarities between different size groups. Once we extracted a conclusion about which indicators should be improved, we explain which changes or innovations could be incorporated into the corporate social network structure to improve these indicators.

After that we will use eight monitored corporate networks, which we simulate in order to obtain the metrics available in the software (NodeXL). Then we will compare the metrics obtained from these different networks and then we will introduce our proposed changes. After the simulations with the change are introduced we will show the dependence between the changes in the metric values related to the network's size and how this size affects the KPIs. After this analysis we will gain a deep understanding of the results obtained and the impact that they have.

5.3 Motivations

Social networking is current in the spotlight of many companies' main issues. It is a very broad topic where we can explore several paths.

The reason why we have chosen social networking is because most studies have reveal that workers are very interested in feeling more important to the company, they wish to create some buzz as individuals whose projects and initiatives could be accessible to the audience.

Examining some studies we find that social networks are motivating more users than simply the corporate ones. Therefore we must pay attention to the main features of these public social networks that attract so many audiences and leverage their abilities to enhance the private studies has carried me to compare Yammer with LinkedIn as the best options to solve the existing problems.

From the deep study of the problems that the workers face, I would try to improve the situation by drawing a tangible measure of the Key Performance Indicators as a possibility to obtain in the future better satisfaction feedback related to their use and advantages that they obtain from corporate social networks.

6 Analysis

6.1 Evaluation

In this section we can find a brief description, the formulas and their explanations about the current most important parameters to give a tangible measure to social media. The parameters previously described are the Lovett's Key performance Indicators (KPIs), but in the background they are based on a market perspective, so in this section the parameters are adapted to our business and re-defined.

6.1.1 Clarifying among usual metrics and KPIs

In order to describe the social network one could use social analytics metrics or KPIs. The differences between these two are shown in Table 6-1. Based on these differences I have decided to use KPIs[30]. These KPIs are described further in the next section.

Table 6-1: Adapted Lovett's Key Performance Indicators

Metrics	Metrics are numbers that are obtained from the analysis and monitoring of social media and its platform solutions without change these data. Metrics are commonly presented using visual methods such as charts or graphs.
Key Performance Indicators (KPIs)	Examples of KPIs are: Conversation Reach, Idea Impact, Active Advocates, Advocate Influence, Advocacy Impact, Resolution Rate, Resolution Time, Share of Voice, Audience Engagement, Satisfaction Score, Topic Trends, Sentiment Ratio, and others. The KPIs can be modified depending on the topic and sometimes we can find different formulas from different authors related to the same KPI. That happened because each KPI should be adapted to each study and each business.

This section describes Lovett's KPIs that are relevant to this thesis. The KPIs of this book are more focused on the marketing perspective, so they have been adapted following the bases of the formulas, but mixed with other concepts from researching and examples[30].

The data from LinkedIn have been extracted from different studies, statistics, and the homepage where information about the groups is available in each one of them.

The data from Yammer have been extracted from published reports in case of success, but in this case some approximations have been performed due to the lack of clear data in a couple of measures. The reason is that these data are mostly private for the enterprises that are using Yammer like a corporate social network.

6.1.2 Measures

If you read Lovett’s book you realize that there are more measures than the ones that can be found in this thesis. Some of them have been discarded for different reasons, mostly because the data that is necessary is not available for the user, and because others are not relevant for the objectives of this study. Here you can find the adapted measures[30].

6.1.2.1 Foundational Measures

Lovett describes foundational measures [30], although he argues that they are not exact is going to be a suitable start to understand what we are measuring and how to adapt. These five are shown in the table below, already adapted and explained afterwards.

Table 6-2: Social Analytics Foundational Measures (adapted from Table 5-2 of [30])

Foundational Measure	Formula to calculate the measure
Interaction	$(Comments + Shares)/Post$
Engagement (%)	$\frac{Comments + Recommendations + Shares + Votes + Offers + Promotions + Discussions}{N Visitors} * 100$

6.1.2.1.1 Interaction

The social media interaction is the ratio of people who complete your activity with a specific participation[30]. In this case we consider establishing a ratio between the number of contributions posted by the group members and the answers that they receive in form of comments and shares[31]. We consider that is the best way to complete the action, and encouraging conversation.

We have decided that because the concept of interaction is active, rather than passive it requires the actions of sharing, submitting, or transacting[30]. So participating directly conversations with other links bookmarking, or simple answers, giving an opinion is the most active way in the case of social media groups.

6.1.2.1.2 Engagement

Social media engagement is the estimate of individual degree of participation regarding a specific topic[30]. In this case we consider that it is not possible to estimate this KPI as related many architecture of the topics, so we relate them to the whole group.

To expand our explanation of the concept we compare interactions that provide the ratio of people completing actions related to the different posts, and engagement that indicates the degree of involvement of each individual and how much each one invests in the group. We can consider it a measure of individual attention.

Engagement is commonly associated with specific activity such as a blog post or campaign in the field of marketing where people can generally read, converse, comment, and so on. What it means to participate in different manner.

That is why we consider also recommendations, such as likes, shares, comments, and other participation related to a post[31]. Engagement is evaluated with a score from 1 to 100, obtaining 50 or less indicates a poor level of engagement and greater than 50 indicates an extremely high engagement level[30].

In this case the formula that is proposed is based on what others have calculated for Twitter and Facebook[32].

6.1.2.2 Exposure KPIs

The next measures (shown in Table 6-3) are related to how far and wide and how fast your message travels via the different social media channels[30].

Table 6-3: Exposure KPIs Formulas (Adapted from Table 5-3 of [30])

Exposure KPI	Formula to Calculate the measure
Reach (members)	Seed Audience + Shared Network Audience
Velocity (members/min)	Reach / Time

6.1.2.2.1 Reach

This measure tells you the size of the audience that potentially you can reach. This can be very useful in showing which social media channels you can spread your information in the most effective way[30].

We should keep in mind that “reach” represents your potential. It is an estimate of your potential audience who read your message or not. It is a measure of how far your message can spread[30].

We study the structure of the social networks under study to give good an estimate as possible regarding the network structure of a social organization[24].

6.1.2.2.2 Velocity

Velocity is not about how far the information that you give can spread, but how fast it spreads. This measure gives an objective point of view about how relevant the information is that you share with other members. In most of cases information spread to thousands or millions of people may take days, weeks, or months[30].

The concept of time that appears in the formula is the “half-life time” of a post in a social media platform. We take it as a general average common to all the public social platforms that we will consider related to information obtained from informational sources[33].

6.1.2.3 Dialogue KPIs

In order to create and encourage dialogue it is necessary to produce relevant and interesting content to attract audience and foster their contributions[30]. The most important measures related to this are shown in Table 6-4:

Table 6-4: Dialogue KPIs formulas (Adapted from Table 5-4 of [30])

Dialogue KPI	Formula to Calculate the measure
Audience Engagement (participations/visitor)	$\frac{Comments + Recommendations + Shares + Votes}{N Visitors}$
Conversational Volume (visitors)	Reach * Engagement

6.1.2.3.1 Audience engagement

Audience engagement is the proportion of visitors participating in an activity by contributing comments, shares, or trackbacks. This last activity is not considered here as

LinkedIn does not provide functionality[34]. Audience engagement is the most important measure regarding the creation of a dialogue about a specific topic[30].

Normally engagement should track over time within a specific media channel. The different social platforms have links with Twitter, LinkedIn, and Facebook[35].

6.1.2.3.2 Conversational Volume

Studying variations in the audience engagement is useful to learn how hot an issue or topic is. Audience engagement should be tracked over time (one week in our study) to understand the normal volume of dialogue within a specific channel[30].

6.1.2.4 Interaction KPIs

Interaction can be a conversion event, such as getting someone to register for a webcast, or it could involve a transaction where a consumer turns over money across a social media channel, but the simple act of someone doing something constitutes interaction[30] and these KPIs are shown in Table 6-5.

Table 6-5: Interaction KPIs formulas (Adapted from Table 5-5 of [30])

Interaction KPI	Formula to Calculate the measure
Interaction Rate (values:0-1)	$\frac{\text{Comments} + \text{Recommendations} + \text{Shares} + \text{Votes}}{\text{Discussions} + \text{Offers} + \text{Promotions}}$
Conversion Rate (values: 0-1)	$\frac{\text{Completed Actions/Engaged Audience}}{\text{Audience(engagement audience*audience)}}$

6.1.2.4.1 Interaction Rate

Interaction rate is the percentage of unique users that have started to participate. This fosters the conversations (i.e. participate in the different post). Instead of measuring the attention of all visitors, in this case we obtain the percentage of those people who are already involved in a conversation, but not initializing a new conversation[30].

Keep in mind that the interaction rate is about identifying people that have not only expressed an interest, but also who have already started to satisfy the interest of others. This is one of the key indicators because you can see the effectiveness of your messages across the social channels and how it is received by your audience[30].

6.1.2.4.2 Conversion Rate

The conversion rate is considered a measure of success. As it indicates if you are or you are not capturing individuals to follow the conversation through their participation[30].

We use the formula's denominator with our targeted audience and the formula's numerator with number of individuals within the audience that complete actions. This value is important because although a lot of actions are completed not many are completed by different members, thus not capturing many conversions[30].

We assume that a real completed action is the one that includes a reply or a job shared, fostering the objective of the post.

6.2 Data Analysis

In this section we show the analysis of the data collected, the results obtained, and how they are linked in order to reach our conclusion and achieve our objective.

6.2.1 Important Considerations

The data extracted from LinkedIn has been gathered from 161 groups. These groups have different common features. They are public open groups to guarantee the validity of the data and access; very active, although in some cases the groups were not as active as they were some time ago; the data have been extracted for a time the time slot of 1 week of activity during 4 weeks in a row between February 2013 and March 2013, so the data is update; and finally we select groups with different numbers of members (from the ones that have 1 million users to others that have only some tens of members) in order to have a measure for different kinds of group[31].

From Yammer we have found tens of reports about the success of Yammer use in the different companies, normally the data found are economic data, but only some of them had data relevant to our study[29].

It is very important to understand the parallels established during this thesis between an enterprise and a LinkedIn group. This decision have been made since most of the studies that we can find today establish a comparison between a corporate network and Facebook or Twitter as social networks[35]. We also argue that the favorite functional for users is structured groups, which supports our reason to perform this study [36].

It makes more sense to compare with LinkedIn groups as they are the closest examples of public social companies to a company social network. A very general professional topic (the purpose of the group) cause's people to participate in different conversations based on other subtopics, but related to the general activity. A company social network has the same basic functionalities as LinkedIn does[24].

6.2.2 Gathering Data Samples

In order to clarify how the group's data have been extracted from LinkedIn, we show a sample[31]. Recently LinkedIn added statistics of each of the existing groups. An example of these statistics is shown in Figure 8-1.



Figure 6-1: Example of Group Statistics from LinkedIn for the group “Job Openings, Job Leads and Job Connections!”(Extracted from [31])

However, these statistics do not show the complete data, because they do not show the likes, recommendations, votes and shares, but only comments. Therefore we have to surf to different parts of the selection group bar to get this data. We can see the different options available from the LinkedIn toolbar in (Figure 6-2):



Figure 6-2: Group surfing bar (Extracted from [31])

We have also extracted information from the “promotions” group section (see Figure 6-3):

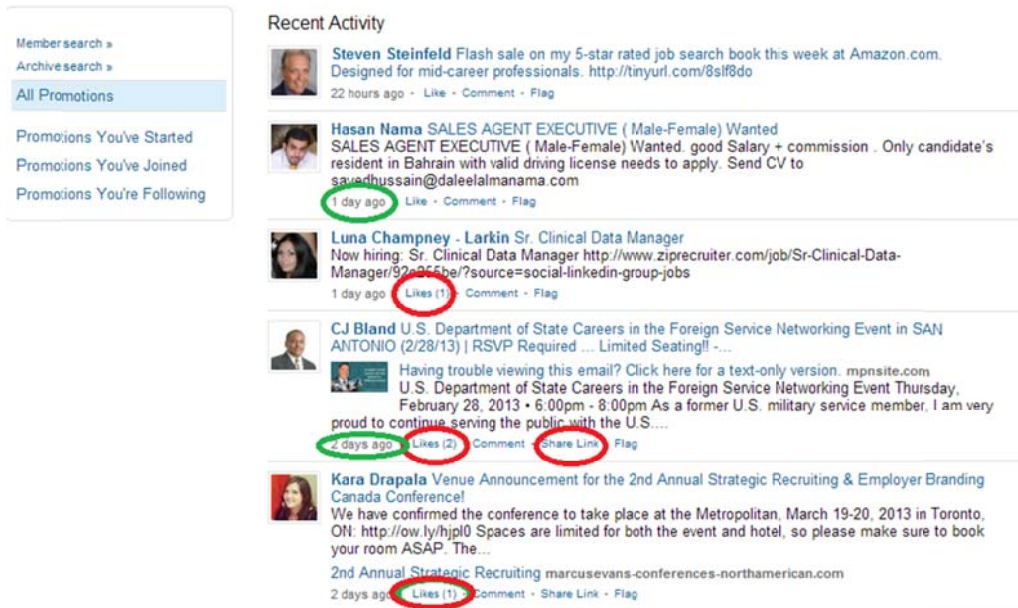


Figure 6-3: Promotions surfing bar simple (Extracted from[31])

We can see in red circles examples of likes and the share link option, and in the green circles how long the promotion was posted in order to extract the weekly data.

We have also extracted additional data from the “jobs” section, where we can see job postings shared by different members. We have narrowed the search by choosing jobs posted in the last week (as we can see in the green circles of Figure 6-4).

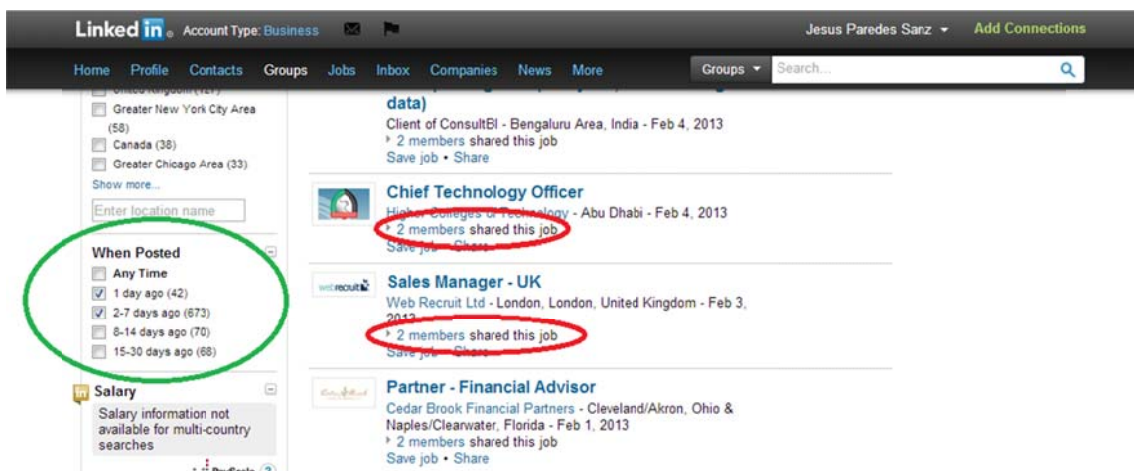


Figure 6-4: Job offer surfing group bar section(Extracted from [31].

Finally the group option “search” displays a menu where you can see all the polls and discussions, which have participation through votes, shares, comments, and recommendations that have been gathered for 1 week or more. Figure 6-5 shows an example:

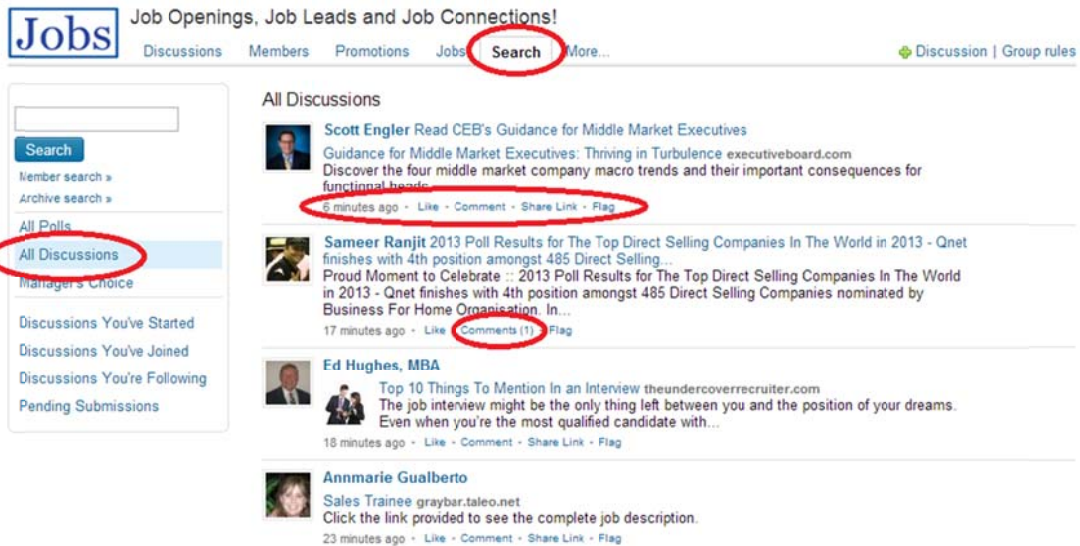


Figure 6-5: Discussions group section (Extracted from [31])

Figure 6-6 shows a sample with polls where some comments, likes, and votes are present as an example of group participation that should be gathered during 7 days.



Figure 6-6: Polls group section (Extracted from [31])

6.2.3 Measures and Results

In the following sections we show the results obtained from our analysis of both LinkedIn and Yammer networks.

6.2.3.1 Interaction

From the data gathered, we have calculated Interaction according to the formula in the Table 6-2 for each analyzed group. Based upon the number of members we have divided the groups into seven big groups according to this criterion.

After that we calculated the median in each of the LinkedIn groups and obtain the results shown in Table 6-6.

Table 6-6: LinkedIn interaction Results

Members	Interaction Median
300000+	0,439
100000+	0,321
10000+	0,357
5000+	0,499
1000+	0,070
100+	0,086
<100	0,198

From Yammer the data obtained in are shown in [37]–[40] Table 6-7 data according to the interaction formula:

Table 6-7: Yammer Interaction Results

Company	Members	Interaction
Deloitte Australia	2300	0,135
Vodacom	6087	0,1
Tyco	23425	3,1

Calculating the median related to the same size of the LinkedIn groups we compare them in Table 6-8:

Table 6-8: Interaction Results Comparison

Members	Yammer	LinkedIn
5000+	1,6	0,499
1000+	0,13	0,07

As we can see, the values obtained for Interaction have a considerable difference between both networks, although we should take into account that LinkedIn is much broader than any one of the Yammer companies’ networks, hence the values are higher in Yammer although a similarity exists when we decrease the number of networking members.

6.2.3.2 Engagement

We calculate the engagement following the formula from Table 6-2. We can find an explanation of how the number of visitors has been estimated from the data available in the references cited below.

We found that during the spring of 2012, the number of LinkedIn users was 150 million, and the number of unique visitors was 87,5 million[37]. So taking into account that today the number of members in LinkedIn is 187 million, we have estimated the number of visitors and the percentage of visitors today as shown in Table 6-9.

Table 6-9: LinkedIn Users Data Results

Members (mill)	Users(mill)	Ratio
150	87,5	0,571
187	106,8	0,571

So we assume that **57,013 %** is a weekly measure of the visitors to every group in order to estimate the visitors per week. Using that the engagement results in LinkedIn are shown in Table 6-10:

Table 6-10: LinkedIn Engagement Results

Members	Engagement Media (%)
300000+	0,967
100000+	1,380
10000+	2,318
5000+	3,823
1000+	4,360
100+	16,222
<100	46,175

To calculate the percentage of users in Yammer, we estimate them according to [38]. The frequency that workers use Yammer is shown in Table 6-11:

Table 6-11: Use of Yammer

Real Time	7%
Twice a day	8,9%
Once a day	15,8%
Occasionally	6,3%
Prompted by others	29,1%
Once every few days	32,9%

We assume that weekly users represent every line other than the last one in the Table 6-11, a 67,01% of the users are considered visitors.

Engagement has been estimated as a weekly measure. The results of Yammer are obtained from [39]–[42] and are shown in Table 6-12 below. The Forrester consulting engagement is from data in [41].

Table 6-12: Yammer Engagement Results

Company	Engagement (%)
Deloitte Australia	5,916
Vodacom	4,847
SMG	30,644
Forrester Consulting	11
Tyco	20,911

Establishing a comparison with LinkedIn according to the size of the company is shown in Table 6-13:

Table 6-13: Engagement Results, Comparison

Members	Yammer (%)	LinkedIn (%)
10000+	20,911	2,318
5000+	15,497	3,824
1000+	5,916	4,360

The results show that Yammer is a network that engages many more the participants than LinkedIn. However, we should say that in both cases these are not good values, as a positive engagement would yield values above 50%. So it is clear that this one of the parameters that we should try to improve.

6.2.3.3 Reach

In this section the results of the Reach KPI Reach are showed for both networks.

6.2.3.3.1 LinkedIn Reach

It is important to highlight that within a company, reach is related to the contacts that a member can have in the corporate social network. These contacts come from the work groups that a worker belongs to, while external members are contacts because of other reasons, such as friendship.

Again we consider the parallels with LinkedIn, such as the people to whom you can send information may be members that share a group with you and people who are contacts, although they do not belong to one of your groups.

One important limitation that we have is that it is not possible to know how many contacts of each member belong to the same group/groups, thus we are going to consider the widest case, and this means members that belong to the audience groups are **not** first level or second level contacts.

First of all we are present some results from the LinkedIn calculations where we consider the average of first and second degree contacts of a LinkedIn user. After this we show the different connections users have on LinkedIn [36] in the Table 6-14:

Table 6-14: LinkedIn's User Contact Statistics

% Users	Range of Contacts (members)
11,7	0-50
19,8	51-100
20,1	101-200
17,4	201-300
12,4	301-499
13,1	501-999
5,1	1000-10000

From this Table 6-14 we obtain the result of 200<average<756 first degree contacts. So adding the second degree contacts and considering that in the lowest case each one would have 200 and in the best case each one 756 contacts, then the variation of contacts will be for each LinkedIn member without adding the group audience is 41502<average<581180.

Given the estimate, we now have a minimum and maximum of first and second degree contacts, thus if we make a post that could be spread across our personal and professional network, *adding to the visitors of each group* that could read or could not read the message that I send, the lowest and the biggest number of first and second degree contacts, we find that the reach of LinkedIn groups as shown in Table 6-15:

Table 6-15: LinkedIn's Reach Results

Group Size	Minimum Reach (members)	Maximum Reach (members)
300000+	290809	830487
100000+	121851	661529
10000+	54157	593835
5000+	46087	585765
1000+	43251	582929
100+	41854	581532
<100	41541	581219

6.2.3.3.2 Yammer Reach

In the case of Yammer we consider the best by assuming that a message into one of the companies can reach all of the members of the Yammer company's network. Therefore the reach will be the number of users as is shown in Table 6-16.

Table 6-16: Yammer Reach Results

Company Size	Reach (members)
10000+	18875
5000+	6611
1000+	1625
100+	560
<100	10

In this case the companies with we could compare were [25], [37]–[54] are shown in Table 6-17.

Table 6-17: Yammer Reach Results

Company	Reach
Lexis Nexis	1100
Mentor Figures	600
Saint Francis	850
Vodacom	6087
Tyco	23425
Forrester	7000
Capgemini	20000
ModCloth	229
NationWide	13200
Scribnia	6
SwiftCurrent	3
Think Brilliant	5
Schipul	25
IPC	1400
SunCorp	1700
Deloitte	2300
SMG	6678

The comparison between Yammer[29] and LinkedIn[31] is shown in Table 6-18:

Table 6-18: Reach Results, Comparison

Group Size	Yammer (members)	LinkedIn (Minimum) (Members)	LinkedIn (Maximum) (Members)
10000+	18875	54157	593835
5000+	6611	46087	585765
1000+	1625	43251	582929
100+	560	41854	581532
<100	10	41541	581219

At first appearance the conclusion is that LinkedIn has much greater reach than any Yammer network, of course this happens because of the huge number of people registered in LinkedIn, but if we consider the group size and the range that they cover, for Yammer it will not be efficient to spread a message across the corporate network. We will see this well in the next KPI.

6.2.3.4 Velocity

According to the formula described before, in this section we show the velocity results concerning how many members per minute can be reached by a message.

6.2.3.4.1 LinkedIn Velocity

The key concept of the “half-life time” of a post, means the average time that the post is alive (i.e. when other members are fostering the conversation around it) is a constant called time in the formula. According to[33] we can consider a “half life time”

of a post in the most crowded networks such as Facebook, Twitter, and LinkedIn to have a value of 3 hours. We present the results using the unit *members per minute*, so the Reach will be divided over 180 minutes. These results are shown in Table 6-19:

Table 6-19: LinkedIn’s Velocity Results

Group Size	Minimum Velocity (members/min)	Maximum Velocity (members/min)
300000+	1742	4740
100000+	678	3676
10000+	302	3300
5000+	257	3255
1000+	241	3239
100+	233	3232
<100	231	3230

6.2.3.4.2 Yammer Velocity

A considerable number of companies that are Yammer users have been analyzed, however not all of them publish sufficient data to analyze the velocity. A solution has been proposed in order to try to estimate an approximate velocity.

A deep study showed a relationship between engagement, and “half-life time” based on data gathered from more than 500 WebPages[55]. Based on this we have estimated the half-life time depending on the engagement of each Yammer group following Figure 6-7 and added a General Average Value to estimate Yammer’s “half-life time” (see Table 6-20):

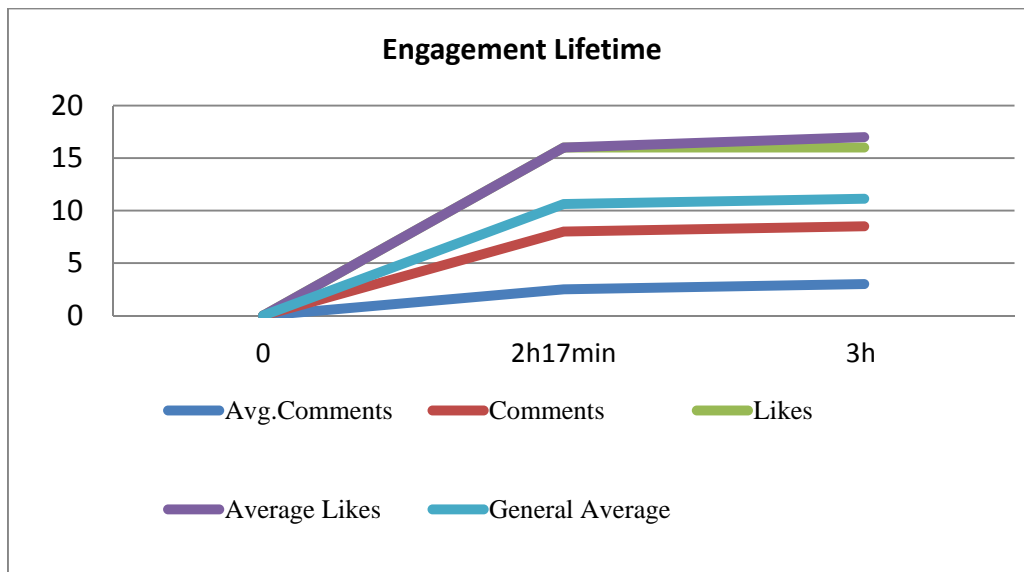


Figure 6-7: Engagement Lifetime (data obtained from [55])

As we can see in Table 6-20 that engagements up to some values are almost linear variations, so we consider them constants once the engagement value is over 16.

Table 6-20: Yammer’s Half-Life Time Estimate

Members	Yammer (min)	Half-Life Time(min)
10000+	20,312	180
5000+	15,497	95,9
1000+	5,916	54,8

Using this model, we calculate the velocity for those Yammer companies[25], [35], [37], [38], [40]–[42], [44], [46], [49] that we presented in the reach section and present these results in Table 6-21. Integrating this with the group size segments we get the results shown in Table 6-22.

Table 6-21: Yammer’s Users Velocity Results

Company	Reach (members)	Time(min)	Velocity(members/min)
Lexis Nexis	1100	54,8	20,07
Vodacom	6087	95,5	63,74
Tyco	23425	180	130,14
Forrester	7000	95,5	73,30
SMG	6678	95,5	69,93
Capgemini	20000	180	111,11
NationWide	13200	180	73,33
IPC	1400	54,8	25,55
SunCorp	1700	54,8	31,02
Deloitte	2300	54,8	41,97

Table 6-22: Yammer’s User Velocity

Members	Velocity (members/min)
10000+	104,860
5000+	69,153
1000+	29,650

We can conclude from these values that LinkedIn is much faster than Yammer in reaching the audience with a message. In some Yammer cases see that the time really long, and we will try to reduce it.

6.2.3.5 Audience Engagement

In this section the results of the Audience Engagement KPI are shown. The formulas previously considered in the tables described in the previous section are used.

6.2.3.5.1 LinkedIn Audience Engagement

The results obtained from the different groups and classified into the group size segments as we have done in the previous sections are presented in Table 6-23.

Table 6-23: LinkedIn’s Audience Engagement Results

Group Size	Audience Engagement (participations/visitor %)
300000+	0,452
100000+	0,529
10000+	1,024
5000+	1,010
1000+	0,732
100+	2,363
<100	11,421

It is important to remark that in this case the KPI has been shown as a percentage.

6.2.3.5.2 Yammer Audience Engagement

Table 6-24 shows the Audience Engagement of Yammer in the companies[39][40][43] where has been possible to calculate this KPI.

Table 6-24: Yammer’s Velocity Results

Company	Audience Engagement (%)
Vodacom	5,092
Deloitte Australia	569,948
Tyco	280,788

The comparison with LinkedIn to clarifies these results as shown in Table 6-25:

Table 6-25: Audience Engagement Comparison Results

Groups Size	Yammer	LinkedIn
10000+	5,0918	1,024
5000+	569,948	1,1
1000+	280,788	0,732

From the comparison we can see that Yammer is much more successful in audience engagement. The results clearly are satisfactory but values in both cases follow different trends in relation to the group size.

6.2.3.6 Conversational Volume

From the data previously presented in section 6.2.3.5 we can easily calculate the Conversational Volume. We have to take into account the limitations of how many of the visitors are connected at a time that a user sends a message/post.

6.2.3.6.1 LinkedIn Conversational Volume

The results of the conversational volume as function of the group’s size are showed in Table 6-26.

Table 6-26: LinkedIn’s Conversational Volume Results

Group Size	Conversational Volume (Visitors)	Conversational Volume (%)
300000+	1111,37	0,37
100000+	432,383	0.432
10000+	129,568	1,295
5000+	52,54	1,051
1000+	13,677	1,367
100+	7,124	7,124
<100	5,214	>5,214

Interesting to see how it decreases when the groups are being smaller and smaller.

6.2.3.6.2 Yammer Conversational Volume

Given the data of Audience Engagement and the number of visitors the results for Yammer’s conversational volume are shown in Table 6-27.

Table 6-27: Yammer’s Conversational Volume Results

Company	Conversational Volume (visitors)
Vodacom	11
Deloitte Australia	521
Tyco	9250

The results were expected to be similar to the ones presented in section 6.2.3.6.1; as if we have the audience more engaged we will have a higher volume of conversation.

6.2.3.7 Interaction Rate

This section describes the interaction rate for both social networks.

6.2.3.7.1 LinkedIn Interaction Rate

The interaction rate results that are obtained through the analyses of LinkedIn are summarized in terms of group segment size in Table 6-28.

Table 6-28: LinkedIn’s Interaction Rate Results

Group Size	Interaction Rate
300000+	4,145
100000+	3,171
10000+	5,549
5000+	8,005
1000+	11,41
100+	4,956
<100	2,388

6.2.3.7.2 Yammer Interaction Rate

The interaction rate results obtained through the analyses in Yammer[40][43] are presented in Table 6-29.

Table 6-29: Yammer's Interaction Rate Results

Company	Interaction Rate
Vodacom	10
Tyco	21,589

These results the same trend as the two previous KPIs, because of a higher value of Audience Engaged and Conversational Volume, the conversations are more encouraged in Yammer giving better interaction rates in comparison with LinkedIn.

6.2.3.8 Conversion Rate

It is important to remark that completing an action of this takes into account only the replies and the shares in the case of LinkedIn the results obtained can have a negative impact if we do not really focus on this fact.

The results from Yammer were not calculated, but were obtained from [29].

6.2.3.8.1 LinkedIn Conversion Rate

In this case the variation in conversion rate shown in Table 6-30 is not so large for the different group sizes.

Table 6-30: LinkedIn's Conversion Rate Results

Group Size	Conversion Rate
300000+	1,111
100000+	0,987
10000+	0,824
5000+	0,865
1000+	1,046
100+	0,442
<100	0,1

6.2.3.8.2 Yammer Conversion Rate

Although Yammer has a poor Conversion Rate, it is still significantly higher than LinkedIn's according to [56], as the conversion rate is 0,15 to 0,2.

If you have the audience more engaged, they are going to complete more actions; this means that they are going to comment on posts, foster conversations and discussions, share information, give recommendations, and so on. Although the conversion rate of LinkedIn is lower than for Yammer, both are low values.

6.3 Proposal

In this section we explain the general results to give the big picture of the indicators that we should try to improve and how we propose to do so.

6.3.1 General Results, Considerations and reflections

We are going to keep in mind one concept, the much larger numbers of members of LinkedIn in comparison with Yammer.

Is important to understand that the data of Yammer have been extracted from relatively small companies, so is interesting see the comparison between the parameters in those group sizes that are possible to compare, but also in those that are not en dash in order to extract a general conclusion for parameters and the effect of group sizes.

Of course, the group size is the main tangible value that we have to compare both networks and the one we base our proposal on. In the next section we present our conclusions from this initial analysis to help us with our proposal. The conclusions will be supported by references to other studies to support our proposal.

6.3.1.1 General Trend

It is interesting to examine the trend for small groups. If we pay attention to the data we can see that most of the KPIs have better values when the groups are composed by a small numbers of members than the groups that are very large.

It is known that in social technologies small groups have many more advantages related to team communication, better performance, greater sharing of information, faster communication speed, and greater participation[57].

This leads to Consideration 1: Generally small members of work group lead to higher KPIs values [58].

6.3.1.2 Interaction Considerations

According with the results presented in Tables 6-7 and 6-8, the values of interaction are not very high (normally we consider a good value to be s over 0, 5). However, looking at Table 6-9, only for groups between 5000 and 10000 is the interaction KPI close to this.

When team workers collaborate via a social network, the different members should try to update their conversation timeline, completing actions as well as possible to foster and support the ideas and proposal that others post.

We consider that the results obtained concerning interaction are generally satisfactory for both social networks, but this is one the values that does not follow the normal trend of improvement with a decrease in the number of group members, so we have to wonder how the large groups of LinkedIn increase this value *even* when most posts are not replied to or followed.

6.3.1.3 Engagement Consideration

We have to note that name the values of engagement are very correlated with the values for interaction. However the results for this KPI are in general very low, if we look at Tables 6-9,6-10,6-11, 6-13 and 6-14, although the smaller groups have in comparison a higher engagement in LinkedIn, in Yammer they grow with increasing group size (see Table 6-13). The general results do not overcome the 50% that is considered as the threshold for positive engagement[30].

Consideration 2: If we want to achieve better engagement, we should have smaller groups.

6.3.1.4 Reach and Velocity Considerations

LinkedIn has more members than any company's Yammer network, so as we could expect, the reach and the velocity of Yammer cannot be compared due to the numeric superiority of LinkedIn.

However, if we take a look at the data as a function of sizes, most of the posts and shares in LinkedIn have no replies (as was supported by the results of engagement), so the reach and the high velocity of LinkedIn are not giving as great a value to the network as we might expect. These high results are due to the large size of LinkedIn groups.

Consideration 3: Reach and the Velocity are affected by this effect of large number of members and can give an incorrect impression about the number of members that a social network should have. If we want to build a corporate network where information would be spread and caught efficiently by every member, it is important to quickly reach engaged members.

6.3.1.5 Audience Engagement Considerations

In this case Audience Engagement KPI the results of Yammer are much better than the ones for LinkedIn.

According to the results and considerations described in the previous sections we understand that although the velocity in Yammer is lower than in LinkedIn, the participation in Yammer better encourages conversation and exchanging information.

Of course we should highlight that small very active groups in LinkedIn do not have low participation and their velocity is higher than in Yammer.

Consideration 4: In both networks small groups have considerably better results in converting the potential audience into an engaged audience independent of the velocity and reach of the network.

6.3.1.6 Conversational Volume Consideration

We see that having audience engagement is very different in LinkedIn and in Yammer; here we see the same trend with regard to conversational volume.

The conversational volume is higher in Yammer, but in this case there are other factors that change the trend of increase values with a decrease in the size of groups, unlike what continuously happens for this the KPI based on LinkedIn's data.

For example the conversational minimum volume has a value of 5.214, but over a maximum of 100 members what is higher than the proportion of 1111, 37 over 300000.

Consideration 5: We cannot affirm that an audience engagement has a direct impact in conversational volume or only affected by the group size. Therefore other facts related to how companies manage and deploy their social networks that should be taken into account.

According to [59] some studies is important for the companies to understand *how* the social media networks are leveraged by their workers and with which objectives. The main purposes to use the social media are connecting with co-workers (almost 50%), and connecting with others for fun (47%) and interacting customers (44%).

6.3.1.7 Interaction Rate Consideration

LinkedIn interaction rate does not follow a decrease tendency with a decrease in group members, but as we can see in every case, the results are low. However while we have not much data about this KPI for Yammer; the two that we could gather have a higher KPI than LinkedIn results.

LinkedIn is a source of information that can help in our daily professional activity, it seems that the workers prefer to exchange information and encourage others inside a narrower network such as Yammer.

Linking this consideration with the previous one we have to say the connections (ties) are built in order to implement projects with a “fun factor” seems to motivate employees and improve their engagement. Of course we cannot forget two of the biggest issues that are treated in our study: identity and employee’s voice. According to Zhang et al. [38] social media platform can be used to initiate new ideas and reach goals, thus enhancing the knowledge of each of the members involved via personal contributions with the objective of being well-recognized inside their community. It is also important to guide new employees to participate.

Also according to DiMicco et al. [60] the main objectives of this motivation was to expect that people participate involving people with similar roles, responsibilities, and sector to advance their careers, give publicity to their projects, and to receive attention. Unfortunately, DiMicco et al. showed that these expectations were **never** met.

Other factors have been found by DiMicco et al. that affect social networking adoption in addition to the communication benefit with respect to co-workers, are privacy and buzz.

Consideration 6: There are factors that influence the people to interact more and obtain information via a closer, more personal, well defined and narrow network than in a wider and richer structure.

6.3.1.8 Conversion Rate Consideration

Keep in mind that here we are evaluating people that exchange information, and who act in a professional environment to accomplish their task, contrasting them with members that only interact, but not foster the conversation.

We can expect from the values and from the results of the interaction rate KPI, in which Yammer is more that a great amount of information does not foster users to contribute [61].

Consideration 7: LinkedIn is a large network, despite the great amount of information available people do not try to find specific answers there, but do so in a narrower and well defined network.

Is interesting to see that LinkedIn has in its conversion rate the opposite trend, the smaller is the group, the worse is the flow of conversation. Both networks have low values for this KPI and should be improved to increase this KPI.

6.3.2 Proposal Specifications

Traditionally email has been the main online channel to communicate, exchange information, coordinate tasks, carry out projects, and so on. Nowadays the tendency has been to liberate the information and removing the burden of emails within social media channels[62].

A lot of studies have examined the daily overflowing inbox of workers[62], and how it affects their job performance. As can be read (mostly the reference that belong to Yammer studies), the biggest success of the social media incorporation was to decrease the number of emails sent between members[49].

However our results have shown that social media is not being used by the workers as much as the companies need, the overflow of information has been translated to personal profiles and group timelines in social media platforms that are still too burdened.

We cannot ignore the fact that social networks show a clear dependence on the group size, and this is important to continuously keep in mind that the idea was to prove through the analysis in the previous section and our conclusions that although it is **not** the *only* factor, group size could be critical in efforts to enhance the effectiveness of corporate social networks.

So based on the considerations derived above and other studies included in the references, the proposal of this study will be explained, developed, and evaluated as described in this section.

6.3.2.1 General Approach

The proposal focuses on managing, instead of one personal profile that is able to link with other members and joins a lot of groups, and keeping this personal profile for each user; but give the user the ability to have more than one profile. These additional profiles will represent the most basic entity in a company: “a project”. As a general view, we suggest the representation shown in Figure 6-8:

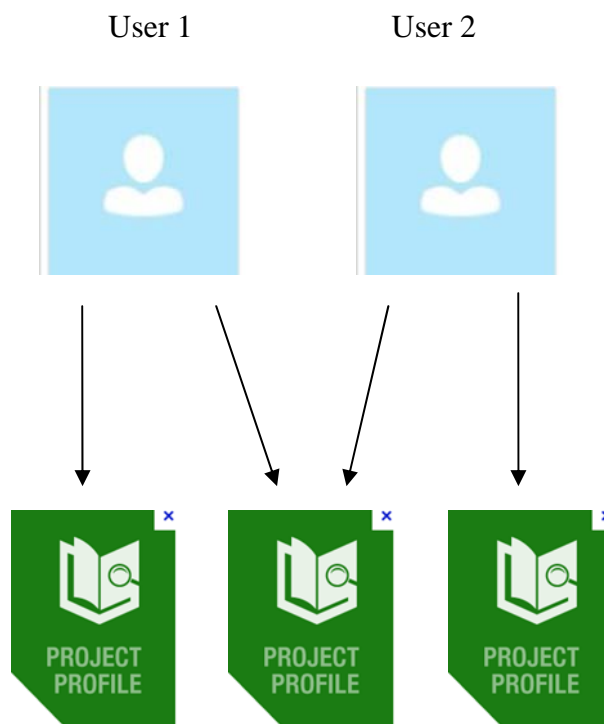


Figure 6-8: Representation of the proposed innovation

The idea is that each project profile involves only persons that are in the project, so a project profile is a *shared* profile. Inside this, we upload and update key information about the project and only the team members can.

These profiles are limited to the members involved in this project, so will act like as a small group in which very specific and well-defined information is shared among the participants. The objective is to avoid traditional social media groups that can become very large or do not cover a topic deeply enough to foster participation.

The idea is to design shared project profiles as narrowed groups allowing them to interact with other personal profiles and project profiles in the network as a *profile entity*. These profile entities are first class objects in the system and we can apply KPI analysis to them.

6.3.2.2 Expected Results

As we have shown above, there is a close relationship between graph metrics and KPIs. We use the Node XL software[63] to simulate our models, improve the metrics and establish a relationship between these metrics and our KPIs. In some cases we will illustrate the relationship between KPIs and the metrics based on the simulation results.

6.3.2.3 Definition of Parameters

There are 3 parameters that we have to fix in order to perform the simulation:

- Maximum number of workers per project,
- Maximum number of project profiles per worker, and
- Number of connections between project profiles.

6.3.2.3.1 Workers per Project

One of the most important parameters of the study, according to Kreitner, Kinicki, and Cole [58] is concept of team as a *small* group of people whose skills are complementary and leveraged to reach a common goal. Small groups consist of groups between 2 and 25 people, but effective teams have an average of 10 members. So we will take 10 members as the ideal size for a project.

6.3.2.3.2 Maximum number of project profiles per person (worker)

A worker is a person who has a limited ability; hence they can perform only a certain number of tasks. In this case we limit the maximum number of parallel projects that a person is able to carry out by assuming a maximum of 3 projects per worker.

This means that each can access up to 3 project profiles (which represent 3 additional nodes within the network) and his own personal profile.

6.3.2.3.3 Number of Connections

The numbers of connections to the project profile nodes were simulated with of 1, 2, and 3 connections for each node.

These values establish the In/Out degree if each node in a network *before* modify the network following a greater real simulation. The networks have been extracted from a NodeXL database[64] where Tweeter Corporate Networks were monitored and measured before modify the networks (it is how we have obtained a previous In/Out degree).

Firstly we extracted the metrics from the simulation of each network and on average the In/Out degree was 3, so this seems to be suitable value as we modified our networks giving us as real situation as possible.

A general overview of the simulations: We carry simulations out with 1, 2, or 3 “shared project profiles”, and in each case, we have given these new nodes 1, 2, and 3 In/Out connections with another new node to see how the metrics changes in each case.

6.4 Network Simulation and Results

The NodeXL[63] software was chosen to perform the analysis and simulation of the monitored networks. In this case we have corporate communication networks of eight different companies[64]: IBM(1159 users), Boeing(1268), PwC(1090), IEEE(136), Emirates(511), Cisco(87), Aetna(1043), and Dell(887).

The section will provide the full analysis of the network, their metrics, and how these affect the KPIs.

6.4.1 Node XL metrics

Not every metric that NodeXL can provide is useful to our study, so we describe only those that are meaningful for our goals based on[65].

6.4.1.1 Reciprocity

In terms of reciprocity we have two different metrics:

The Edge Ratio is the ratio of correspondence between the ties from a node “A” to the rest of nodes and the rest of corresponded ties from them to the node “A”.

The Reciprocated Vertex Pair Ratio is the number of adjacent vertices connected to the node with ties in both directions, divided it by the number of adjacent nodes.

We can establish a conceptual relationship between these two metrics and the interaction, engagement, interaction rate, audience engagement, conversion rate and conversational volume KPIs.

6.4.1.2 Density

Density is defined as an estimate of the network’s connection grade. It is estimated to be between the number of existing ties and the maximum number of ties.

We are going to draw a relationship with interaction and engagement, conversational volume and audience engagement because the denser is the network, the more ties it has so we can find higher number of post, comments, likes and shares.

6.4.1.3 Clustering Coefficient

The clustering coefficient is the neighborhood’s density level for each node. This parameter indicates the level of sub-communities present.

We will establish a relationship between this metric and audience engagement, conversational volume, interaction rate, conversion rate, interaction and engagement KPI’s.

6.4.1.4 Diameter and Average Longest Distance

Diameter is the longest shortest path through the network and the average longest distance is the average of shortest paths between nodes. Reach, engagement, and Velocity are the KPIs most associated with these two concepts.

6.4.1.5 Modularity

Modularity is a measure of the grouping quality when the graph has groups. If the value is high, then the graph has dense connections between the nodes within the same group, but connections are thin between nodes that belong to different groups.

Audience Engagement, interaction, and engagement KPIs, are interesting relationships to establish with these measures.

6.4.1.6 Eigenvector Centrality and Page Rank

Eigenvector Centrality is a value give to a node that is increased if the node is connected with other nodes with a high value of eigenvector centrality. It is useful to establish the rank of pages.

Page Rank is the importance of each node of the network using a link analysis algorithm developed by Larry Page. In this case we use the median value instead of the average value.

6.4.2 Simulations Metric Results from the networks

In this section the metric results of the network simulations are presented. First the networks were simulated *without* any change.

6.4.3 Simulation Process

Based upon the groups that are already built inside the network due to member's interactions, we introduce one, two, and three project profiles for each member, with a maximum of 10 members connected with a project profile node.

At the same time, for each case we have simulated one, two and three connections per project profile. So we have nine simulations of each one of the eight monitored networks. A total number of 72 simulations were performed in this study.

In order to make the idea clearer, consider the case of Cisco social network which has 84 members, these 84 nodes interacting within the network. If we want to introduce 1 project profile per member (each with a maximum of 10 members), we introduce 9 new nodes, if we want 2 project profiles 18, and with the last case will be 27 new nodes within the network. Note that we have placed 10 members in each of the first 8 projects and the final 4 members in the 9th project.

It is necessary to highlight that is necessary to group people connecting them with the project profiles taking into account these people that should be (already) connected, so that the relevant people who belong to the same community/group within the network, rather than connecting them randomly. We have this information available in NodeXL functionality that group people who has ties already established.

Finally is also essential to explain that the connections established between shared project profiles nodes and the nodes that exist already in the network are *bidirectional*. We consider that if member A and member B share an additional profile, there is a tie in the network going in both directions: from A and B to the shared profile and vice versa.

6.4.4 Simulation Results

In this section we show the metrics obtained for 1, 2, and 3 project profiles drawing in each case a comparison with the original network. In each of the figures shown the sub-cases of 1, 2 and 3 connections between project profiles is shown the evolution as we increase the number of connections.

As we have seen all along during the development of this project we are based our study on the **premise** that the key to change is the group's size. Therefore, we have ordered the values in relation with the network's size to see how the network's size affects the values. We must to keep in mind that network size is one of the most important parameters in our study.

6.4.4.1 Reciprocated Vertex Pair Ratio & Edge Ratio

First all the values for the different networks are shown for the original networks. As we can see we cannot ignore the close relationship between the reciprocated vertex pair ratio and the edge ratio metrics due to the evolution graph similarities (see Figure 6-9 and 6-11). Note that the abscissa axis is normalized between 0 to 10 although the real range of values is from 87 to 1268.

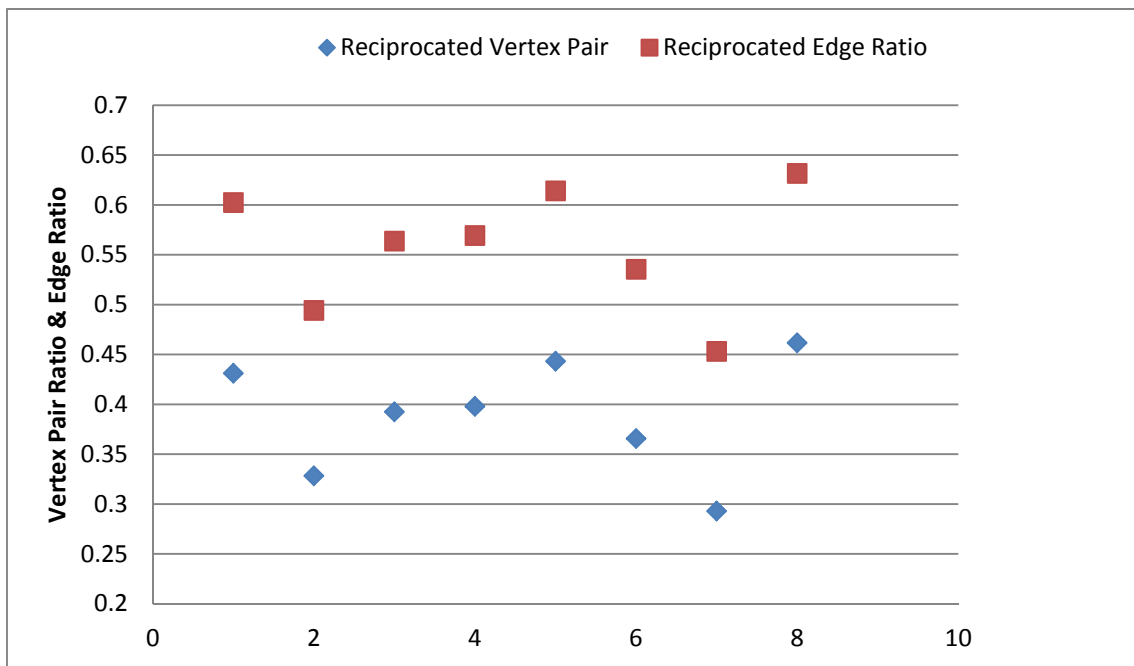


Figure 6-9: Vertex Pair Ratio and Reciprocated Pair Ratio. Original network samples

Comparing these results with the results obtained following our modifications, we show the results with 1, 2, and 3 project profiles in the 6.4.4.1.1 section.

6.4.4.1.1 Edge Ratio

We can find the values for edge ratio with 1, 2 and 3 shared profiles.

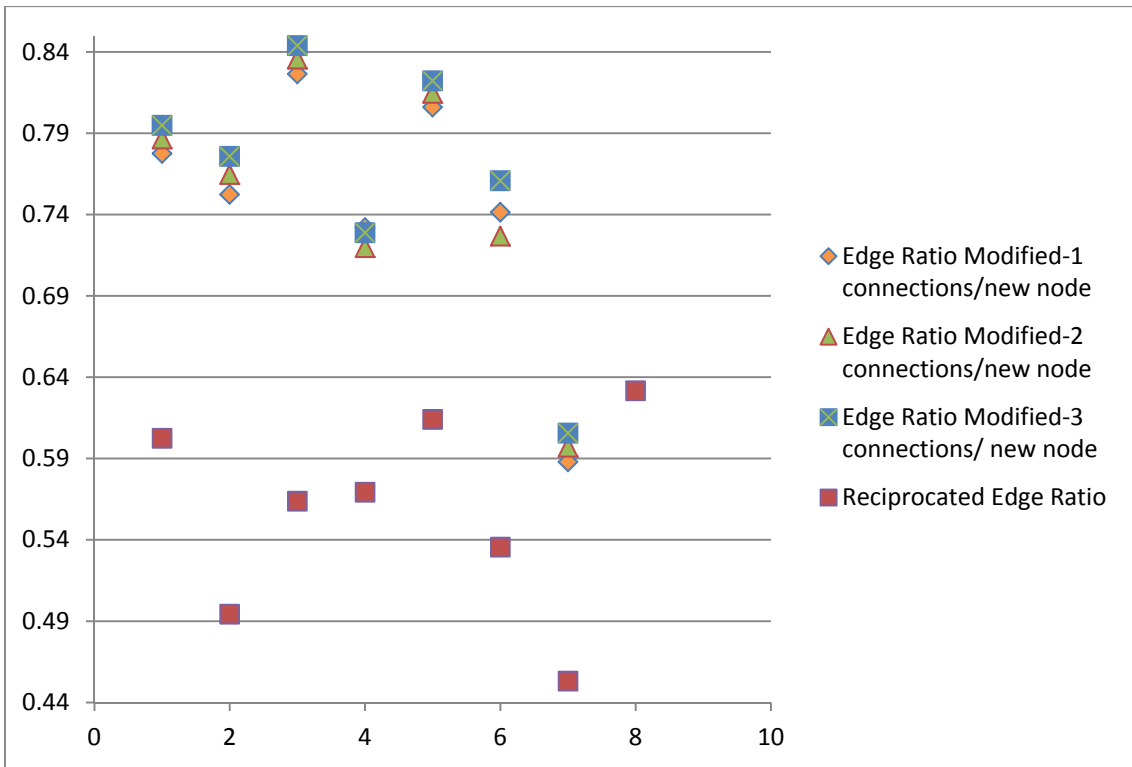


Figure 6-10: Edge Ratio, 1 shared profile introduced.

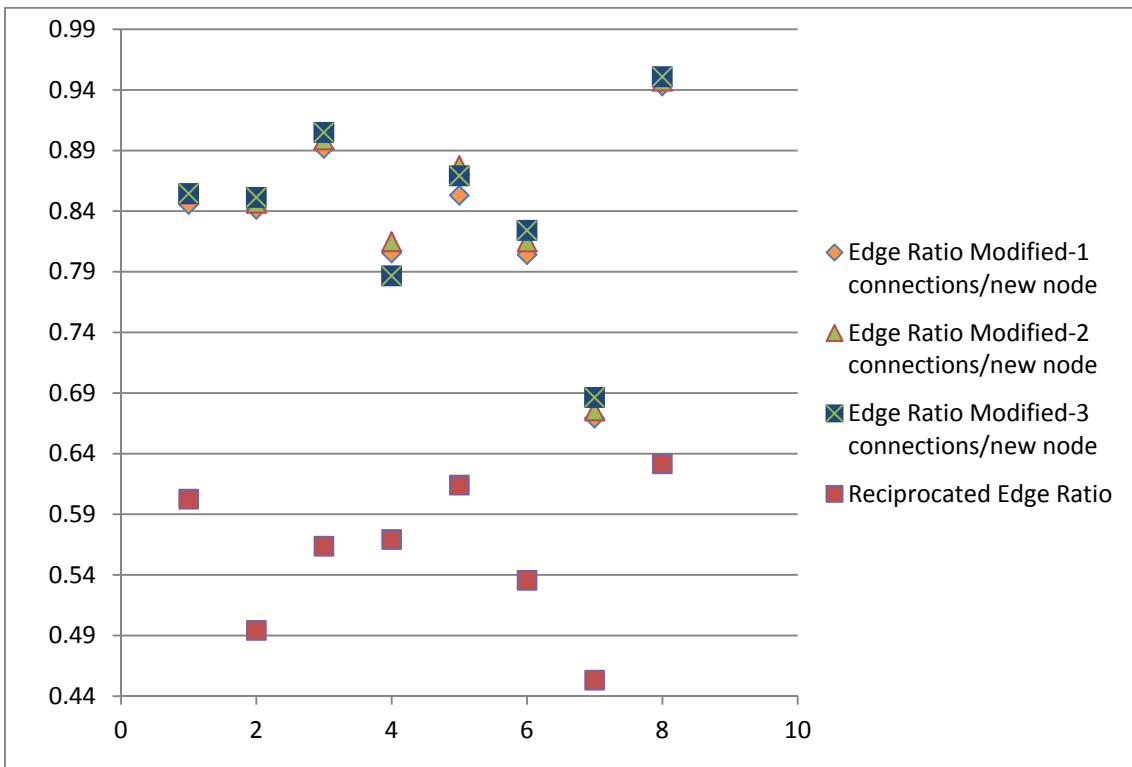


Figure 6-11: Edge Ratio, 2 shared profile introduced.

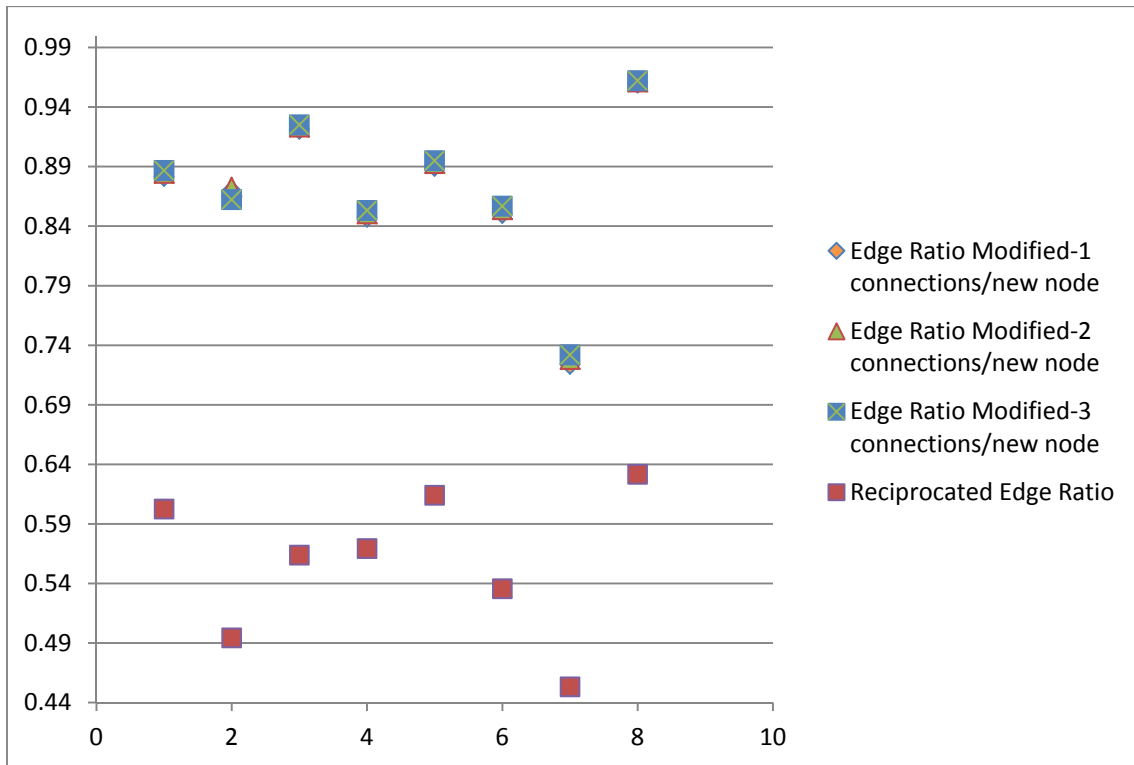


Figure 6-12: Edge Ratio, 3 shared profile introduced.

As we can see there is not a significant change between the metrics in regards to the number of connections to a project profile node, but there is a clear improvement when we increase the number of new nodes (corresponding to projects) introduced within the network.

Of course this improvement was expected because the connections established between the nodes already existed and the “project profile” node are direct and bidirectional.

6.4.4.1.2 Reciprocated Vertex Pair Ratio

The reciprocated vertex pair ratio shows similar behavior as the vertex pair ratio metric shown above previously, as we show in Figures 6-13, 6-14, and 6-15.

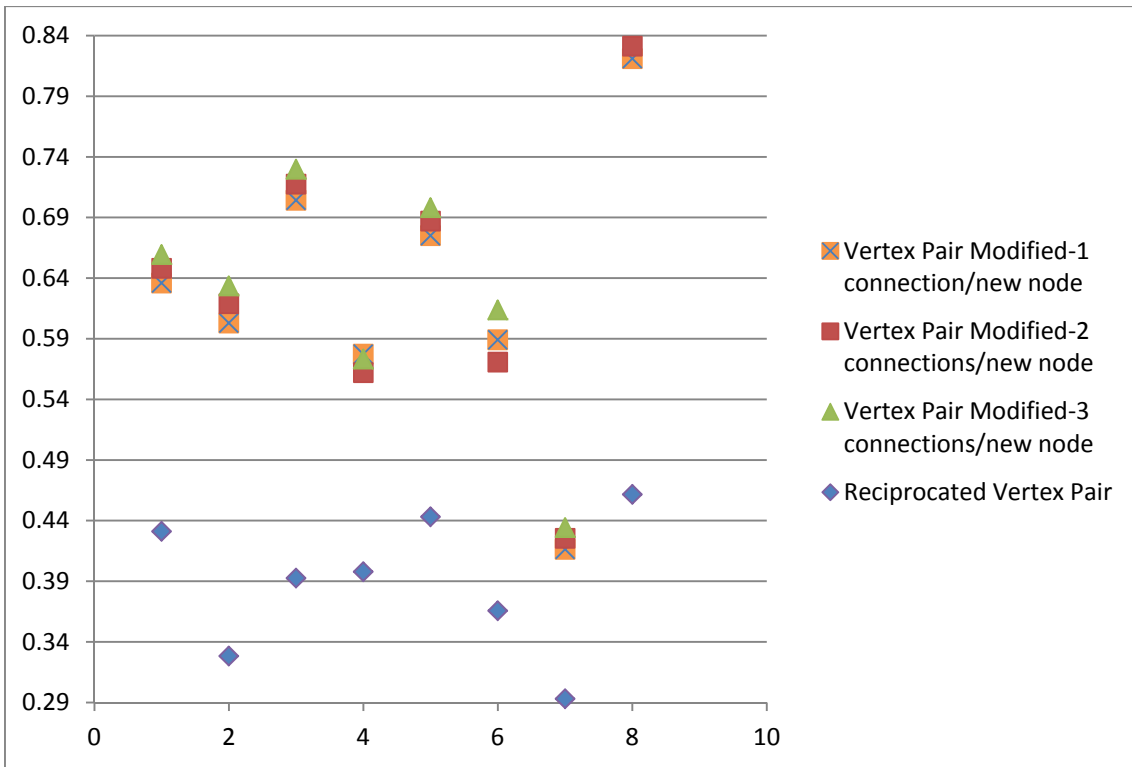


Figure 6-13: Vertex Pair Ratio, 1 shared profile introduced.

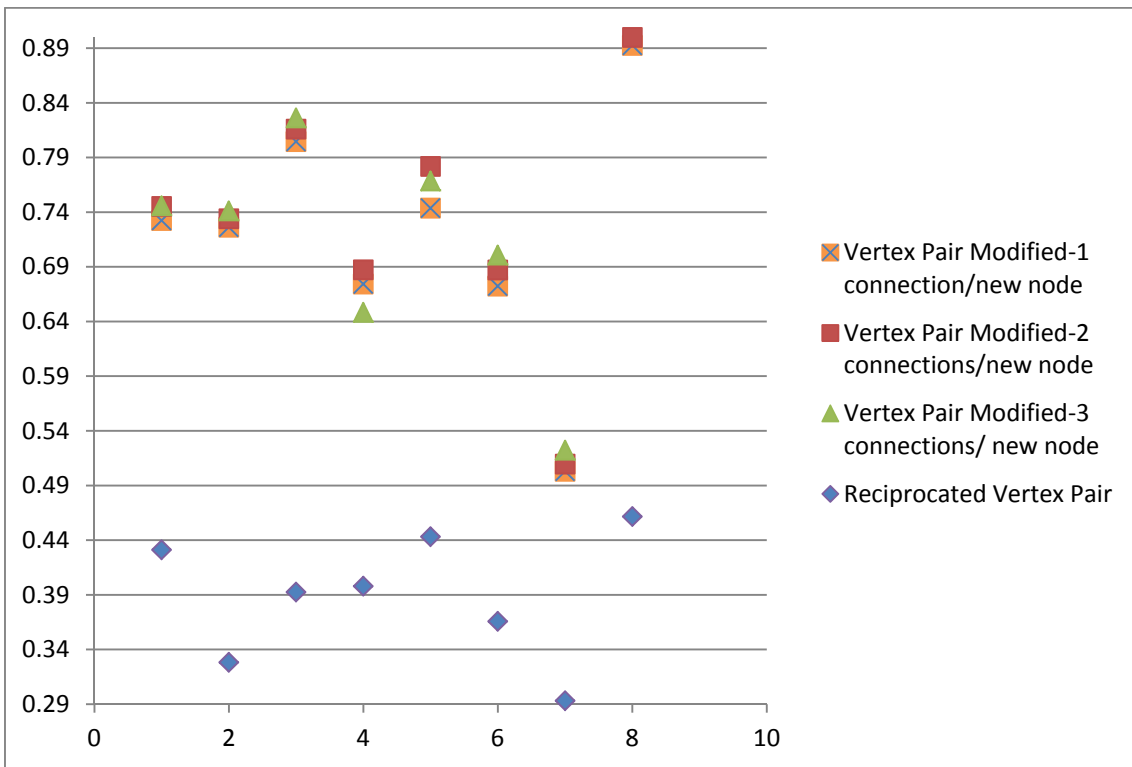


Figure 6-14: Vertex Pair Ratio, 2 shared profiles introduced

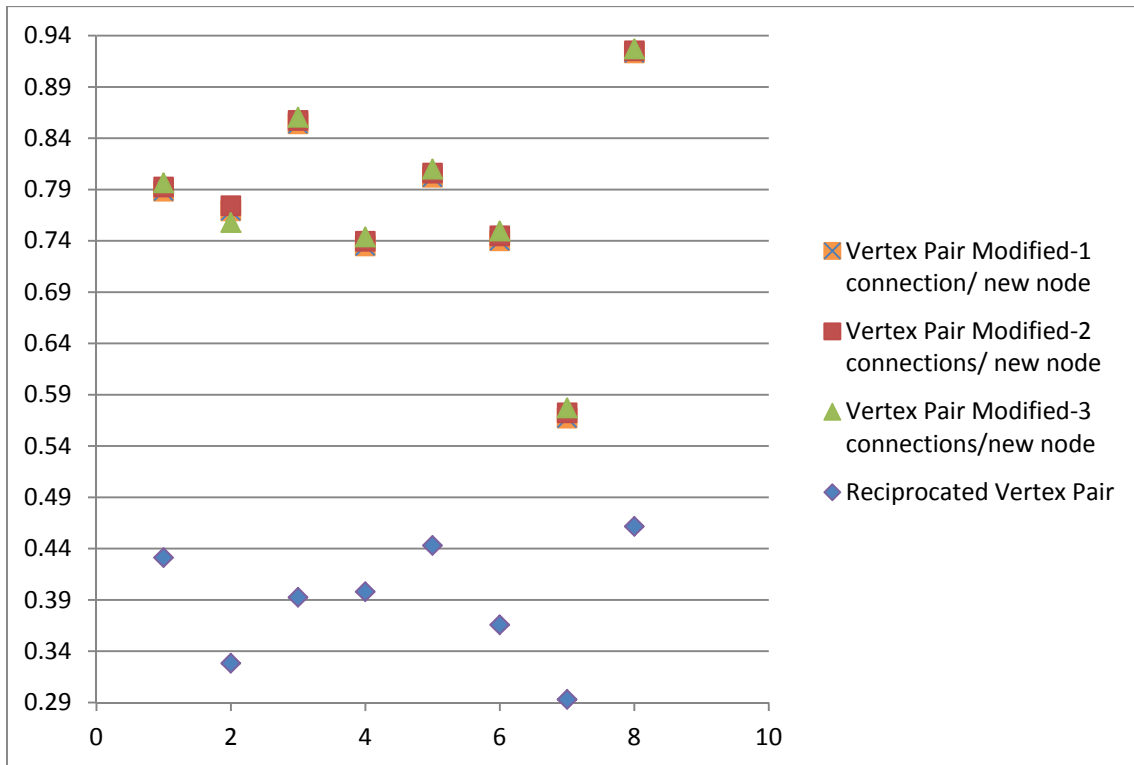


Figure 6-15: Vertex Pair Ratio, 3 shared profiles introduced.

6.4.4.2 Diameter and Average Distance

We present the diameter and the average distance together due to the relationship between these two measures. The values for the original monitored networks are shown in Figure 6-16.

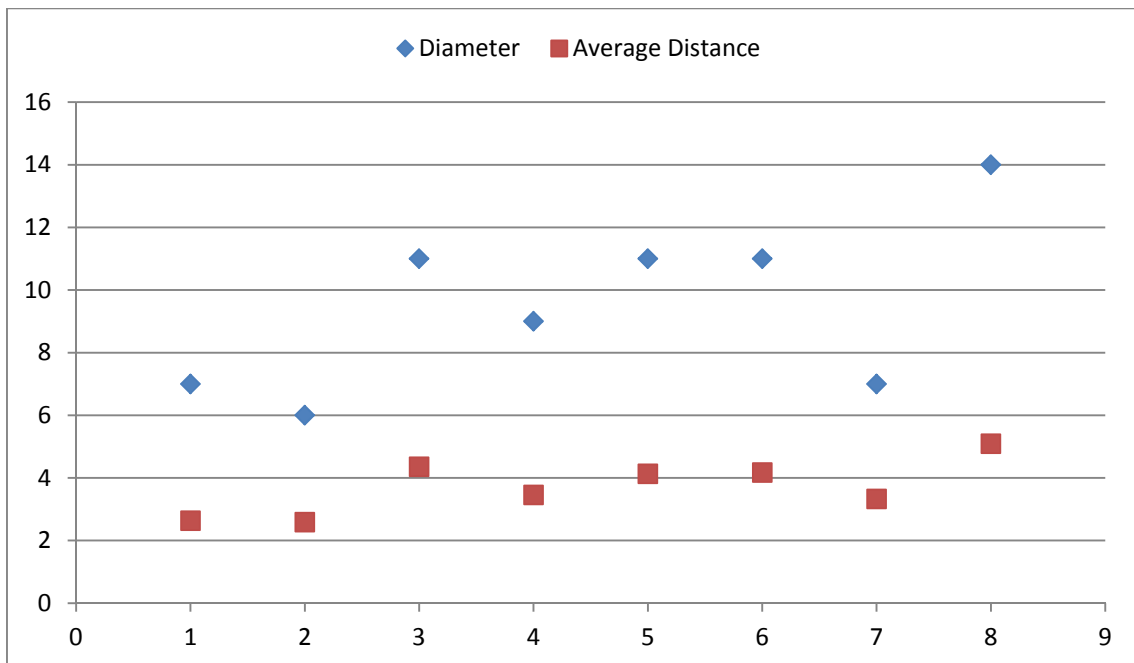


Figure 6-16: Diameter and Average Distance. Original network samples

As with the earlier every metrics, we can see the evolution related to the changes introduced within the network with the additional nodes in sections 6.4.4.2.1 and 6.4.4.2.2

6.4.4.2.1 Diameter

We separately show both metrics in order to make the evolution clearer for the reader by following the same order in every section.

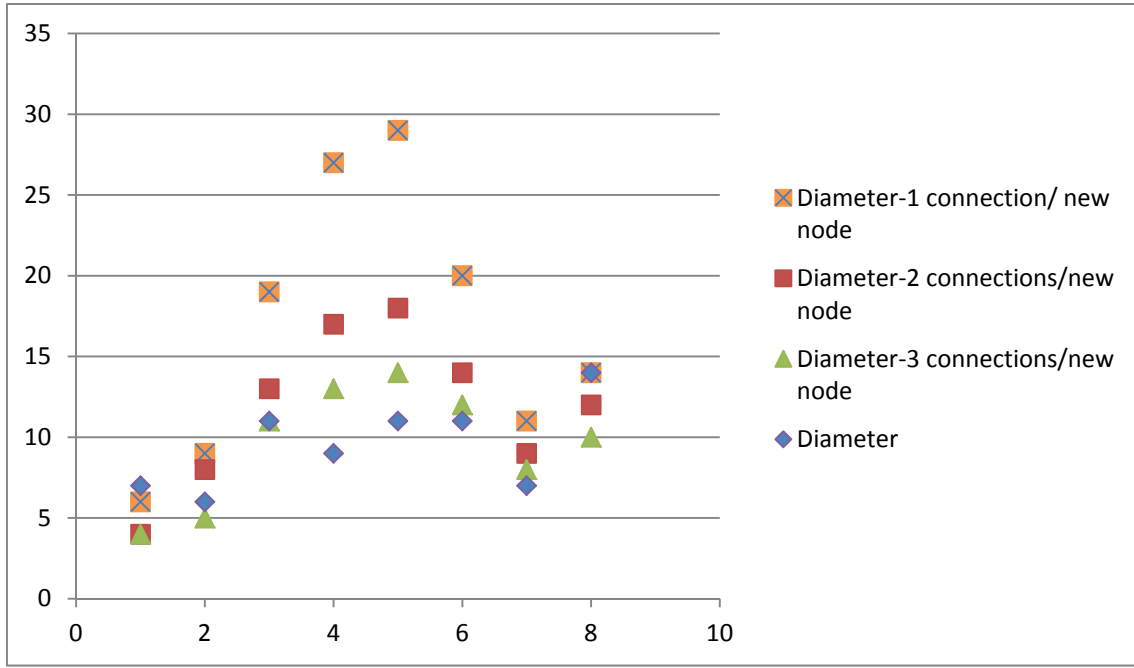


Figure 6-17: Diameter, 1 shared profile introduced.

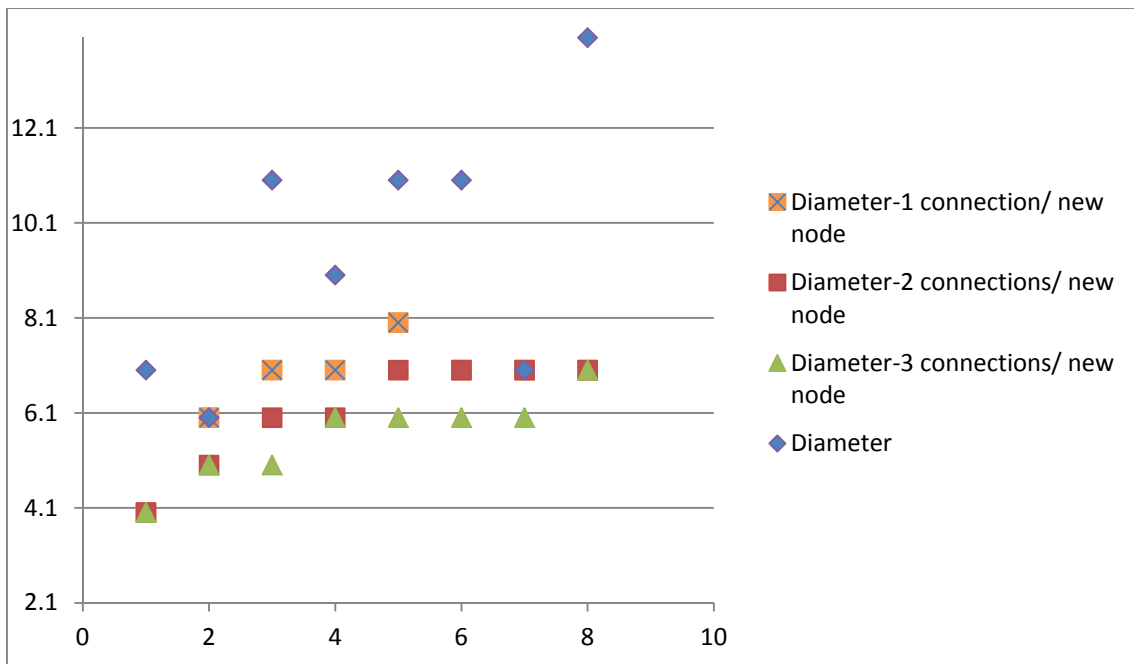


Figure 6-18: Diameter, 2 shared profiles introduced

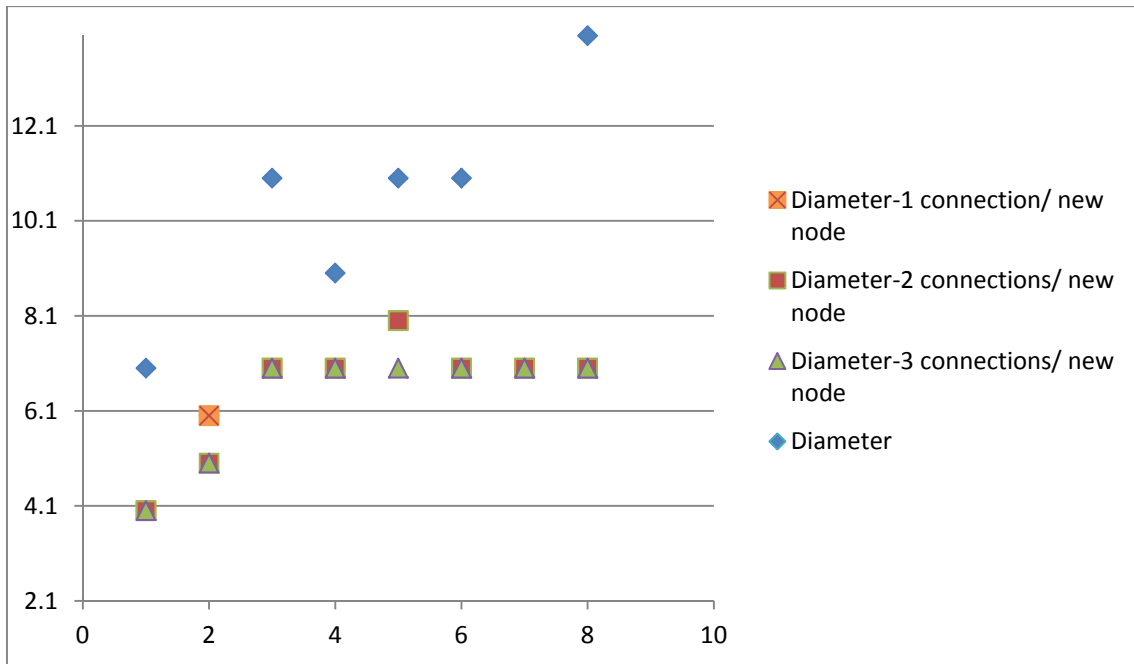


Figure 6-19: Diameter, 3 shared profiles introduced

As we can see, the diameter is *reduced* not only when more nodes are introduced within the network, but also when these nodes are more connected. This occurs because reduce the number of hops to reach every node in the network. We expect to obtain similar results for the next section.

6.4.4.2.2 Average Distance

In this section we show the values of the three cases described previously always comparing them with the original samples.

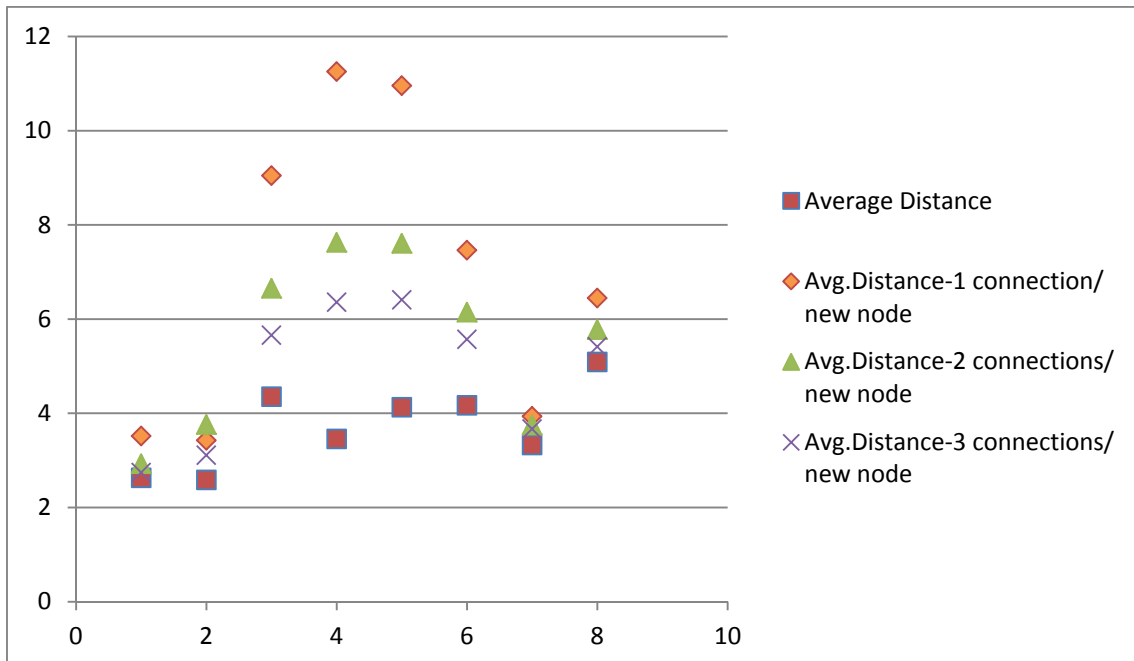


Figure 6-20: Average Distance, 1 shared profile introduced

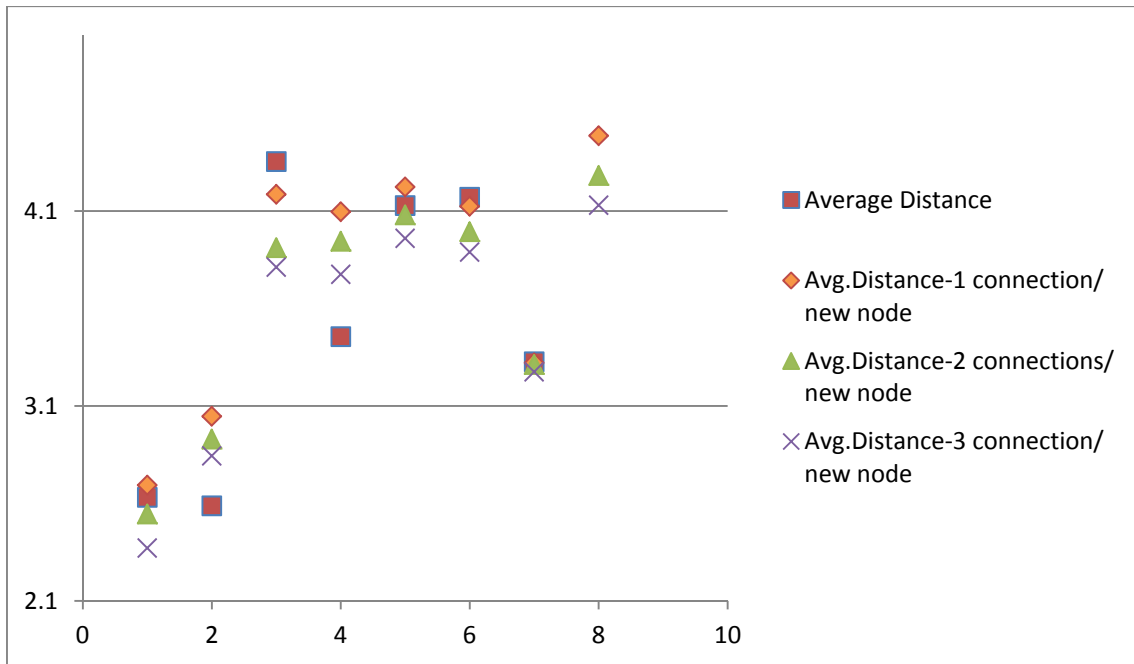


Figure 6-21: Average Distance, 2 shared profiles introduced

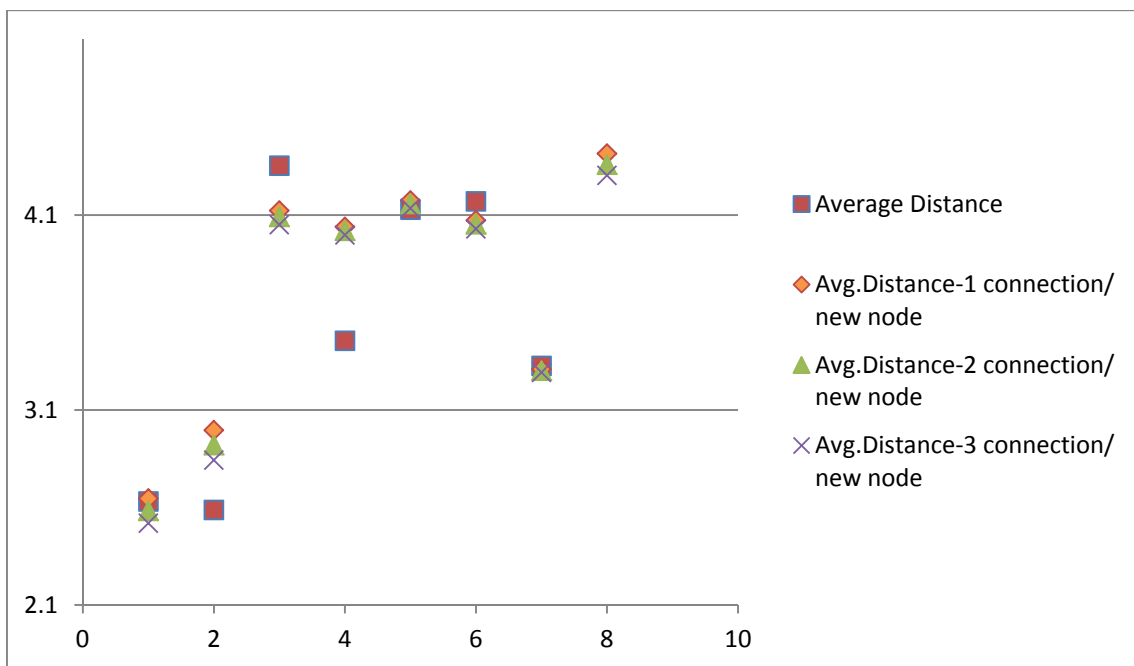


Figure 6-22: Average Distance, 3 shared profiles introduced

In this case there we can see a very slight decrease, so we cannot affirm that the values change in general.

6.4.4.3 Graph Density and Modularity

It is interesting to show the evolution of these graph density and modularity because they have relationship with the *quality* of connections, both in the whole network and within communities. As with this project to improve the communications *within* the network and *within* the communities these results are very important.

We start as usual with the network values before introducing any change. These are shown in Figure 6-23. It is interesting to see that the graph density start shown in this Figure suggests a *negative* trend with increasing size of a network. We can find the other three cases in the next two sections.

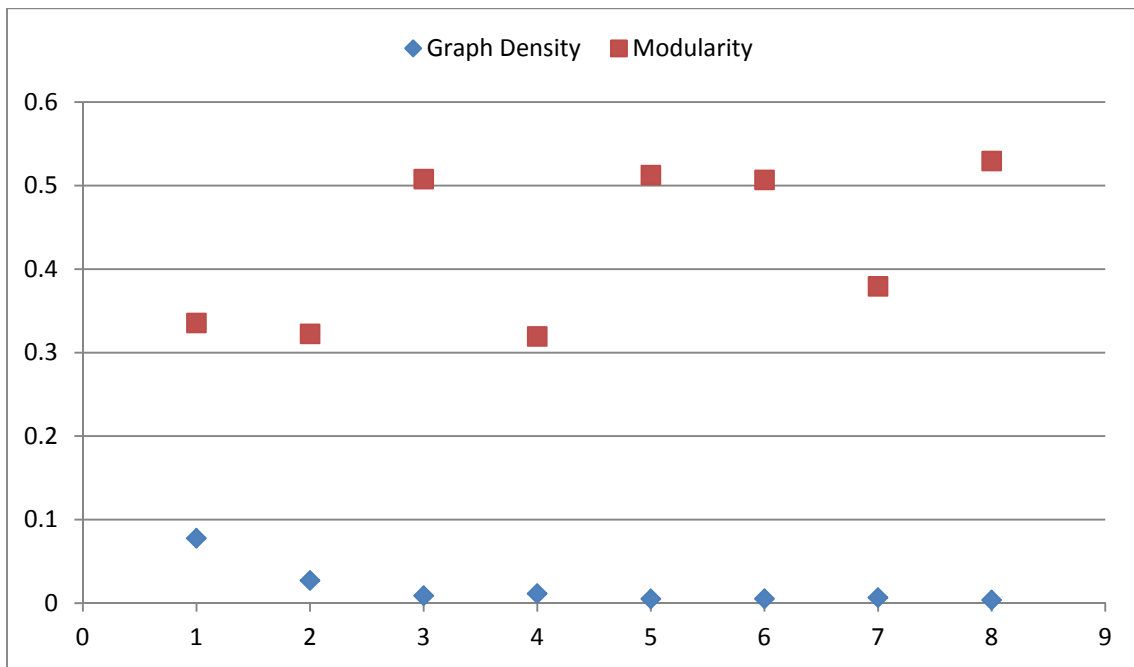


Figure 6-23: Graph Density and Modularity. Original network samples

6.4.4.3.1 Graph Density

In this section we provide the values of the metric graph density as we do in every sections of the chapter. We can see an increase in the graph density with 1, 2, and 3 connections from the Figure 6-24 to Figure 6-26, although it is very small, and a decreasing trend.

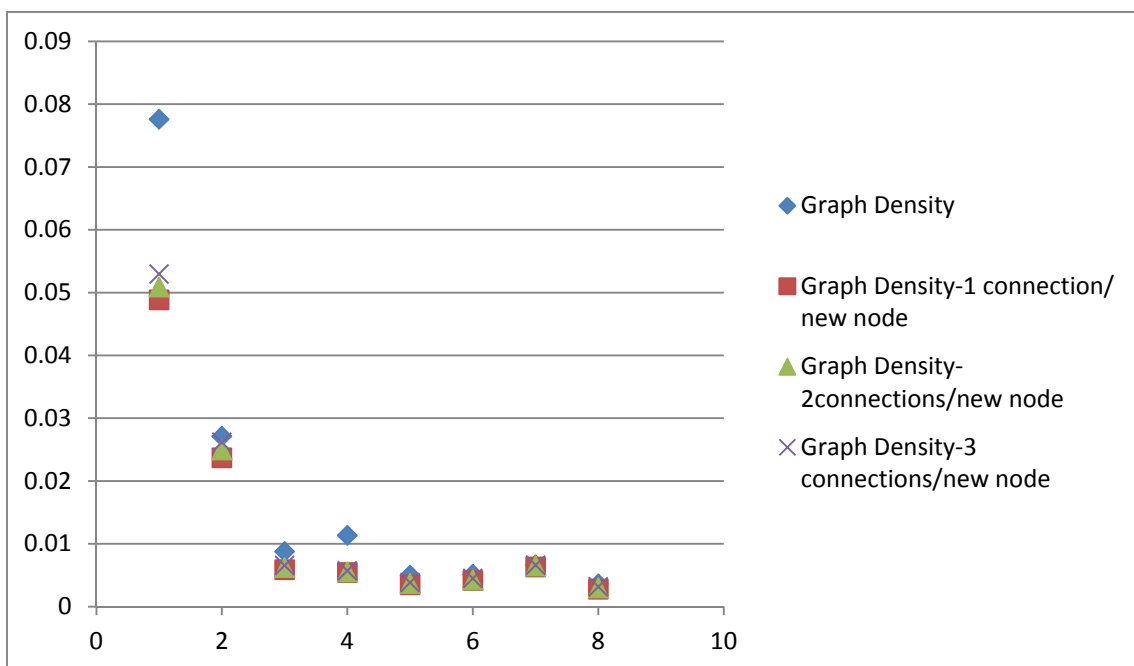


Figure 6-24: Graph Density, 1 shared profile introduced

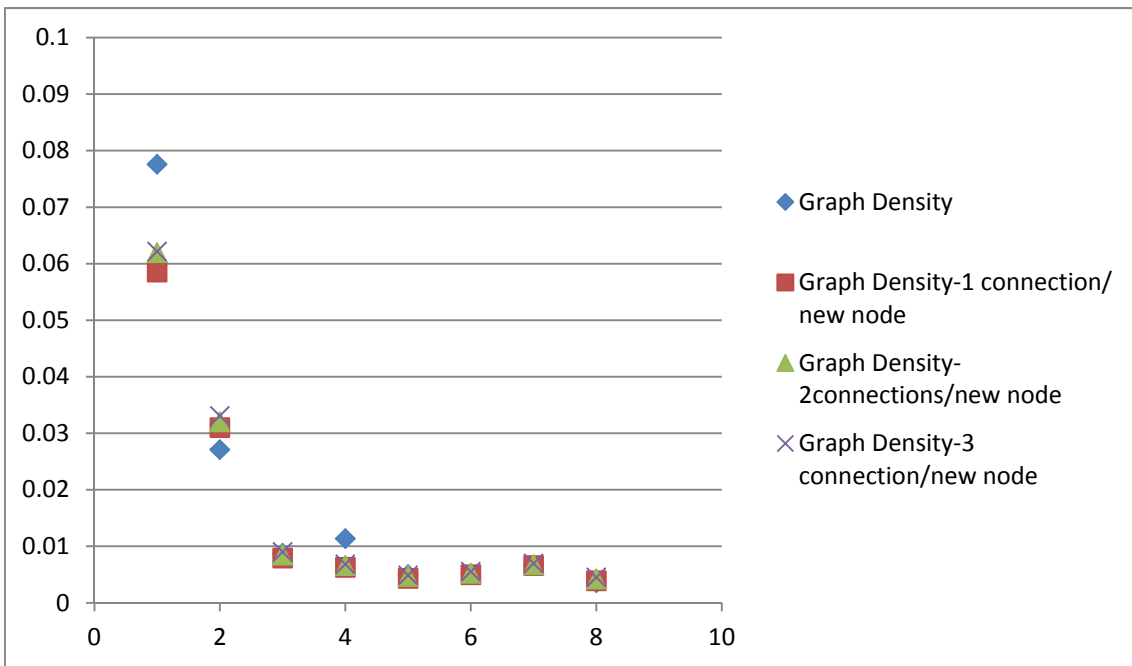


Figure 6-25: Graph Density, 2 shared profiles introduced

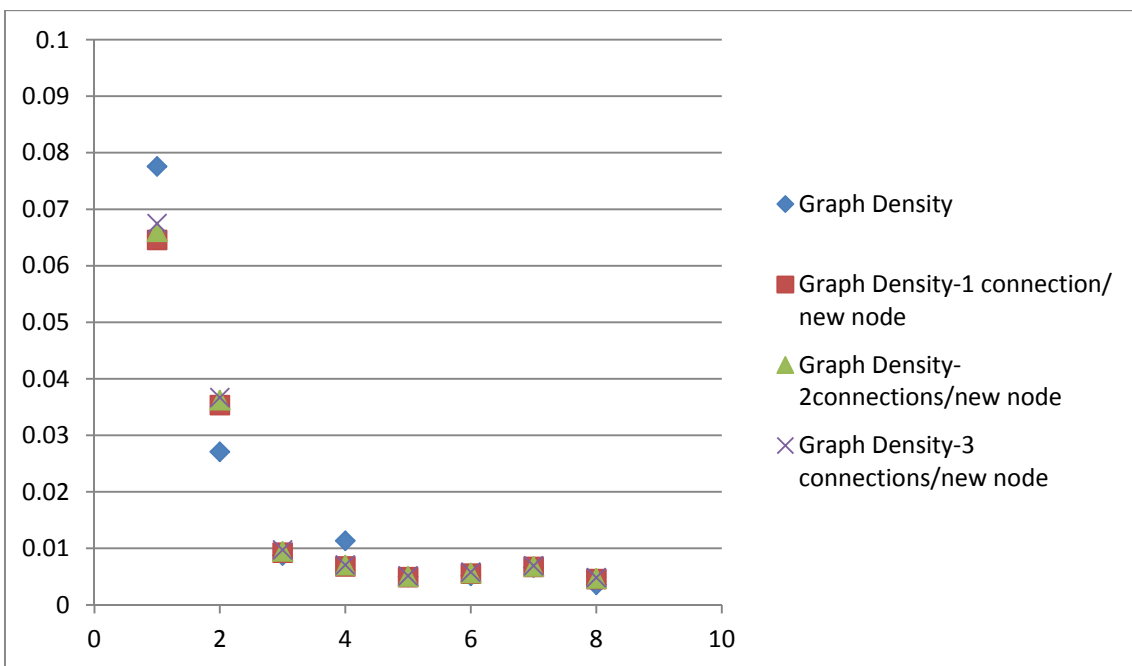


Figure 6-26: Graph Density, 3 shared profiles introduced

6.4.4.3.2 Modularity

In this section we present the values of the modularity metric gathered from the simulated networks. We can see that modularity decreases with an increase in the number of shared profiles. The values are very similar independent of the number of connections.

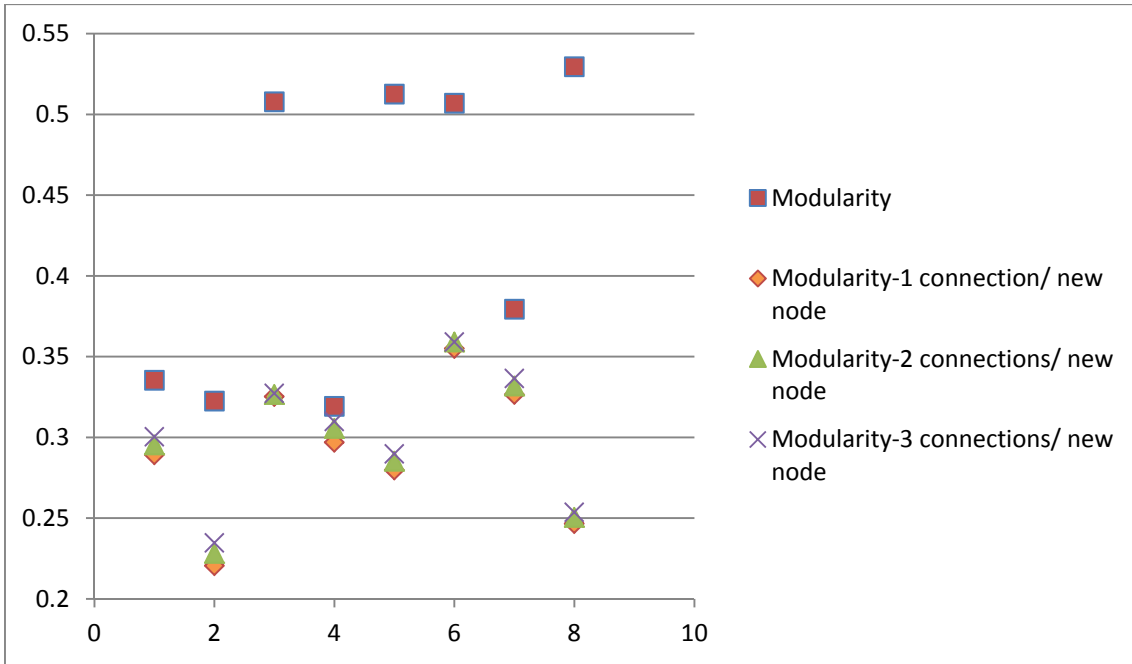


Figure 6-27: Modularity, 1 shared profile introduced.

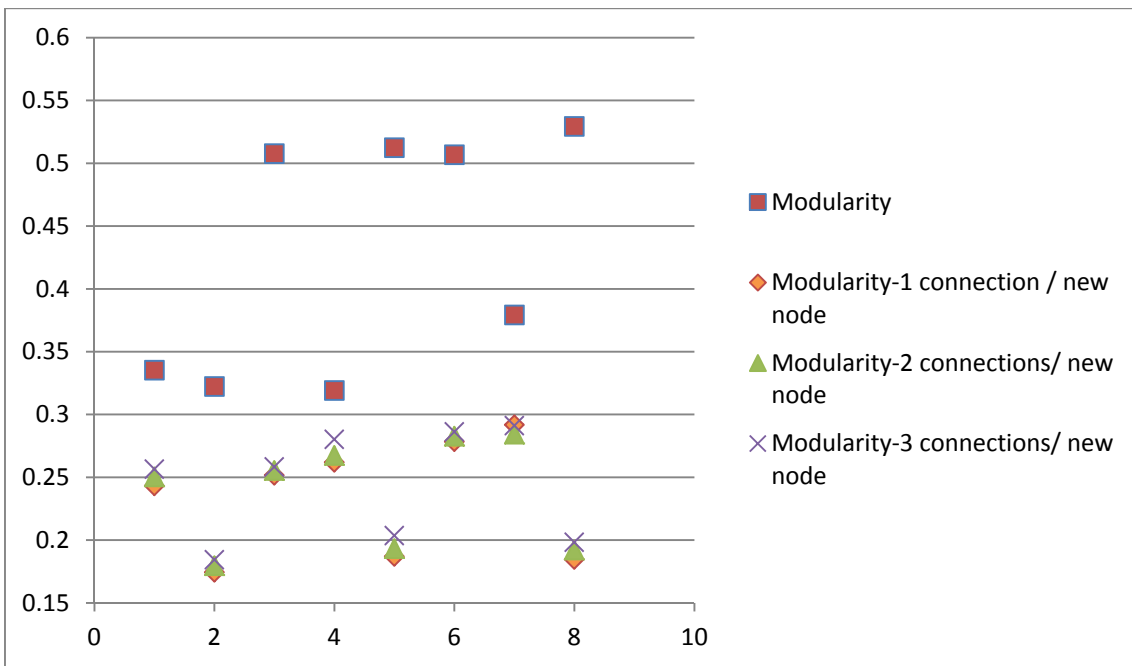


Figure 6-28: Modularity, 2 shared profiles introduced

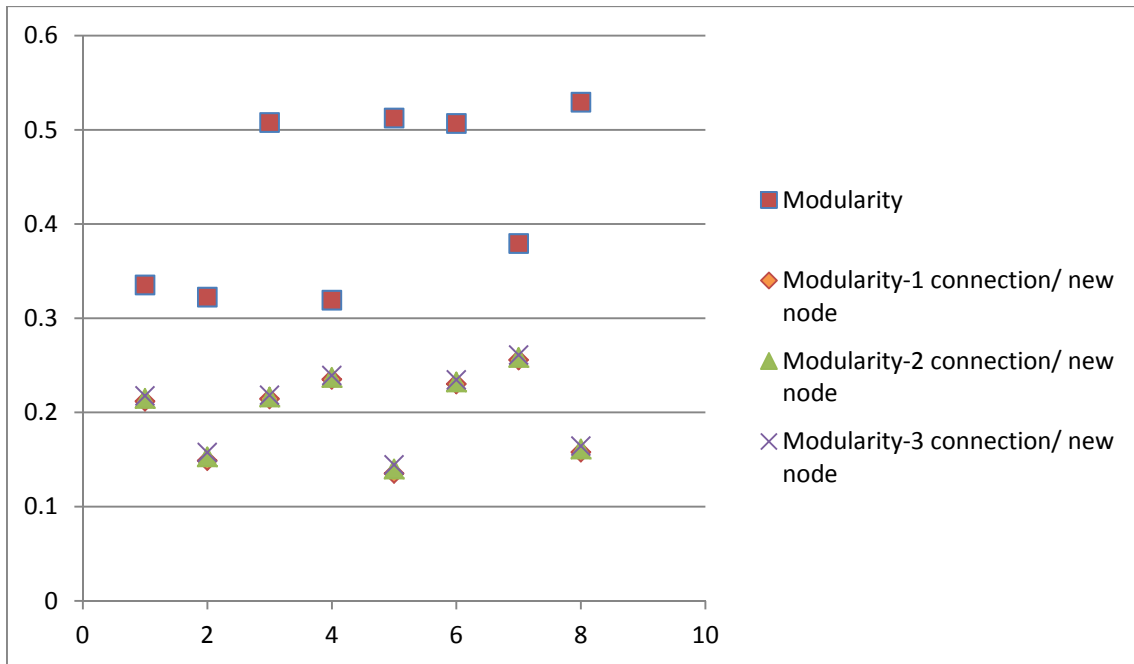


Figure 6-29: Modularity, 3 shared profiles introduced

6.4.4.4 Clustering Coefficient

The average clustering coefficient is another interesting metric to show. As we want to foster the interaction between members of sub-communities while at the same time we want to better connect the sub-communities. So the behavior of this metric is one of the most important for your study. The more shared profiles that are introduced, the greater the decreased in the value of the average clustering coefficient.

The results for the original networks are shown in Figure 6-30, while the results for the modified networks are shown in Figures 6-31, 6-32, 6-33.

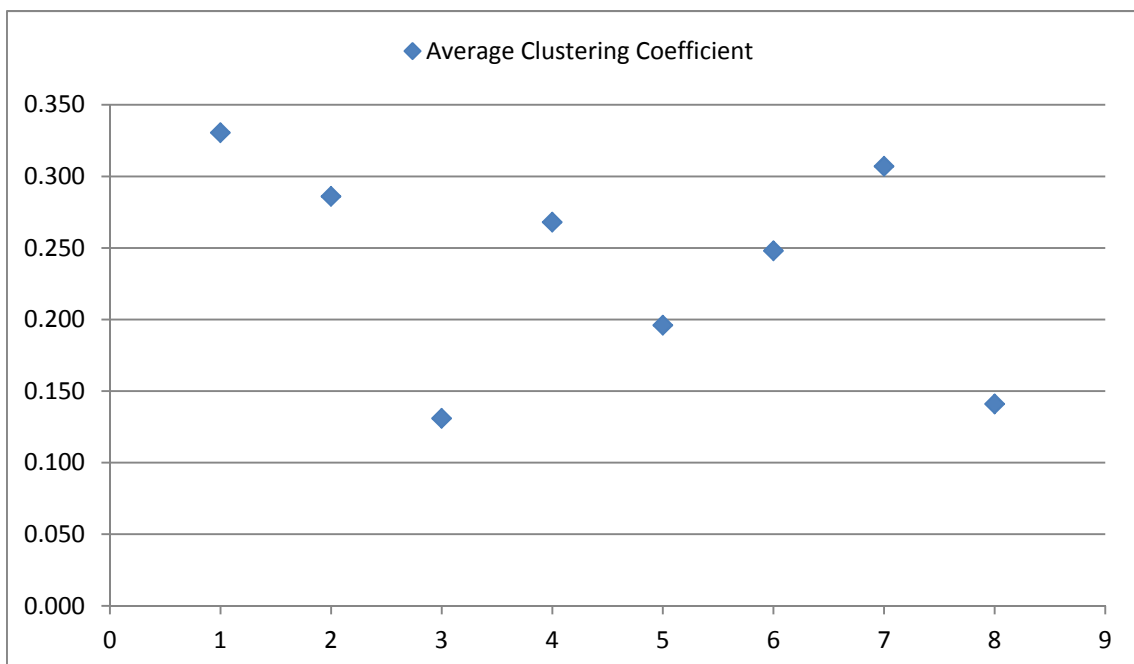


Figure 6-30: Average Clustering Coefficient, Original Network Sample

After introducing the new nodes:

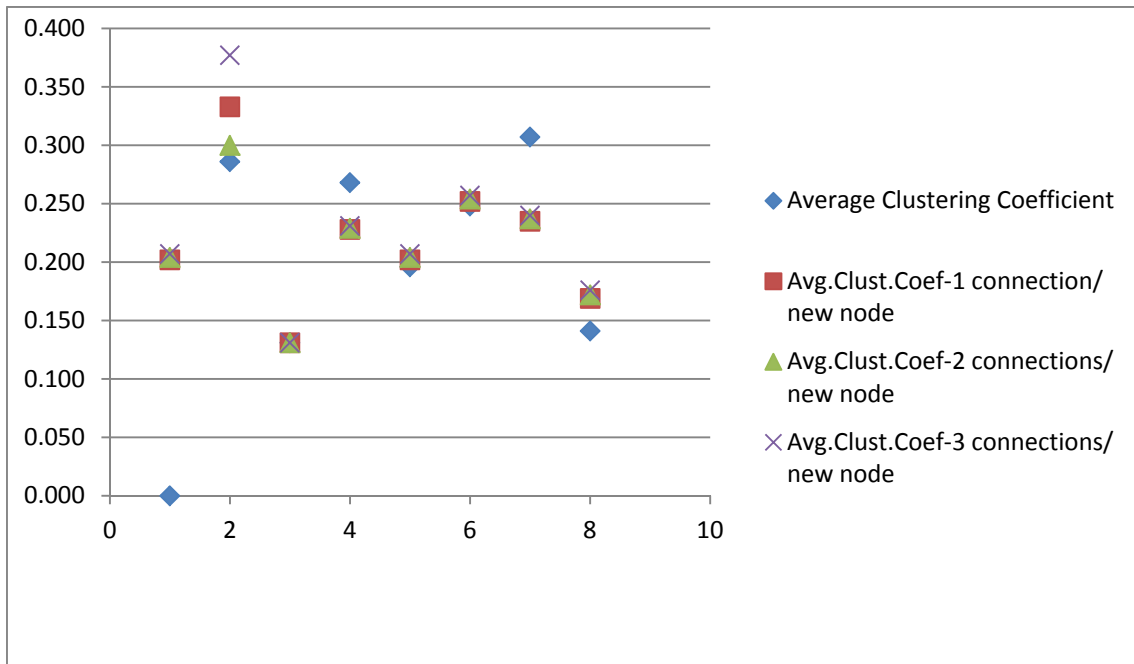


Figure 6-31: Average Clustering Coefficient, 1 shared profile introduced

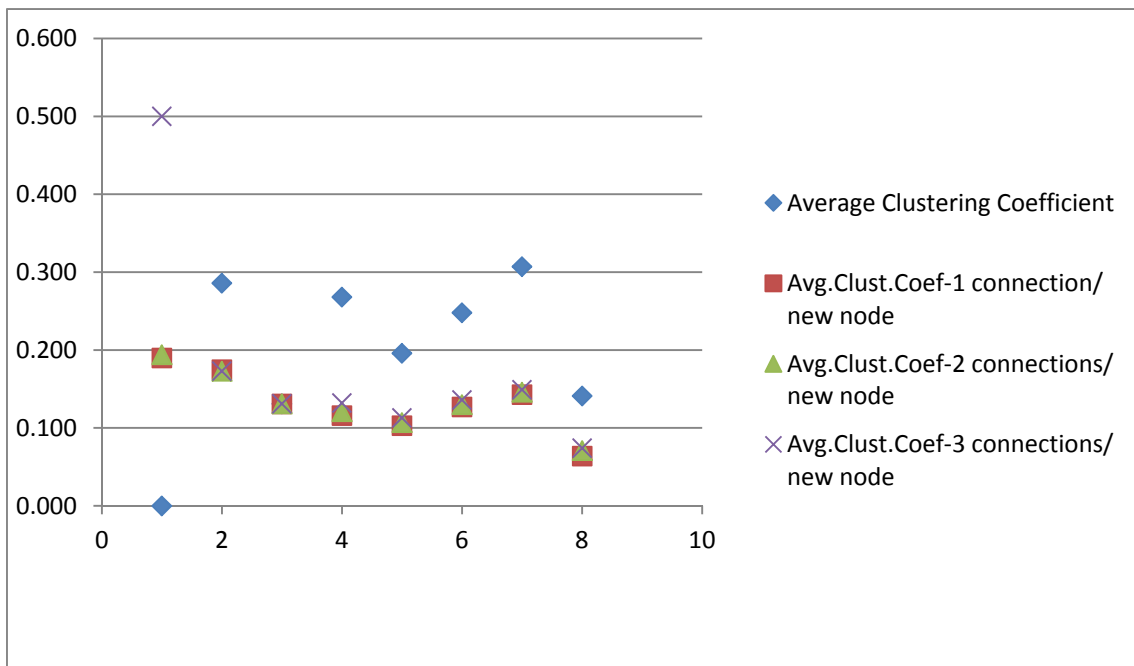


Figure 6-32: Average Clustering Coefficient, 2 shared profiles introduced

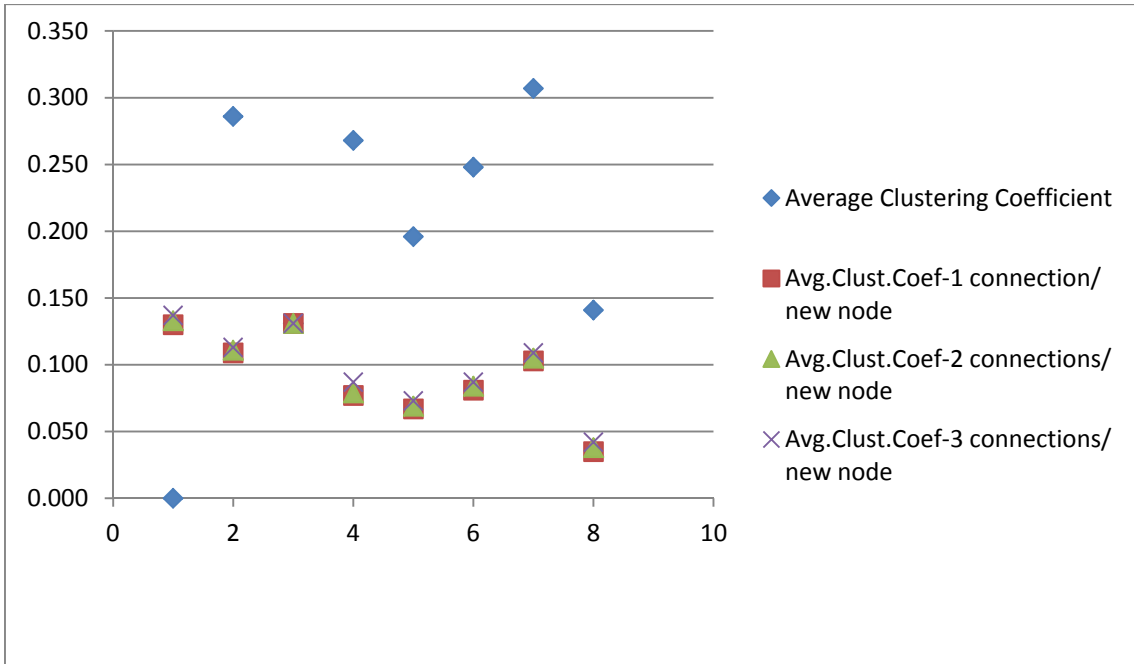


Figure 6-33: Average Clustering Coefficient, 3 shared profiles introduced

6.4.4.5 Eigenvector Centrality and Page Rank

Firstly we will show the average eigenvector centrality for the networks (see Figure 6-34), then we modify the networks (see Figures 6-35, 6-36, and 6-37). As we can see the more shared profiles and the larger the network, the smaller the average eigenvector centrality is.

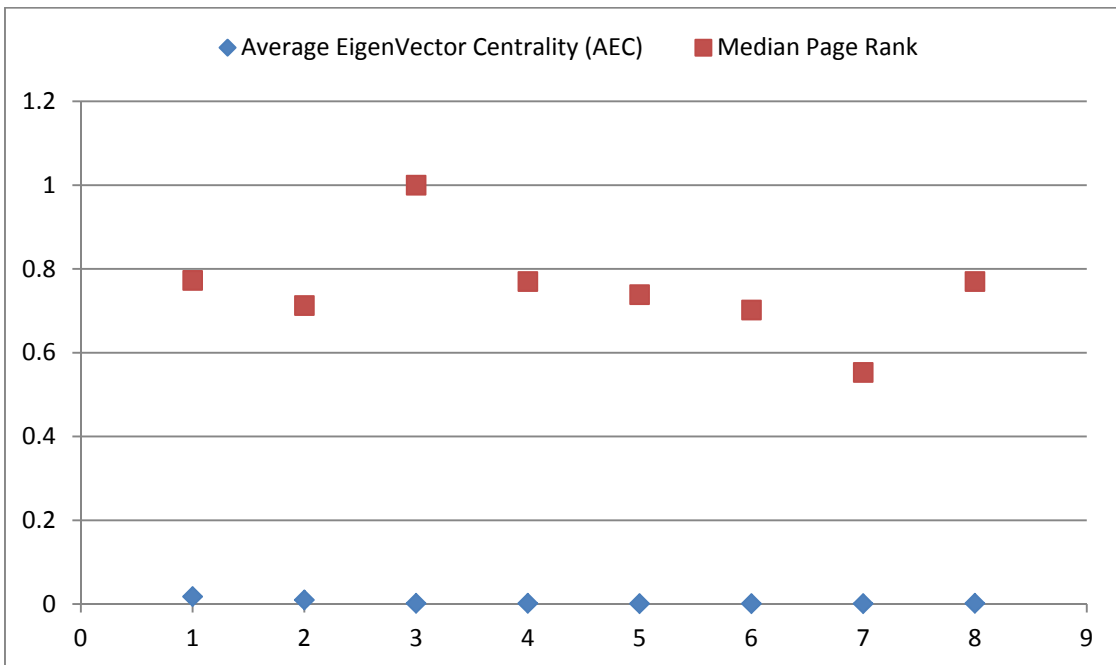


Figure 6-34: Average Eigenvector Centrality and Page Rank, Original Network Sample

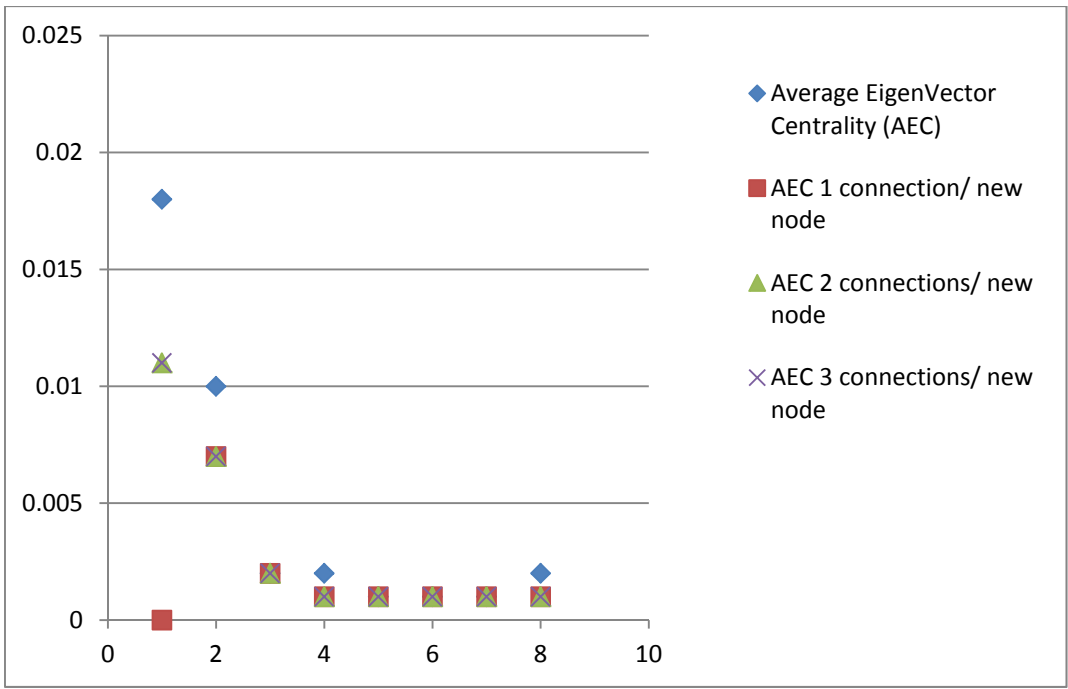


Figure 6-35: Average Eigenvector Centrality, 1 shared profile introduced

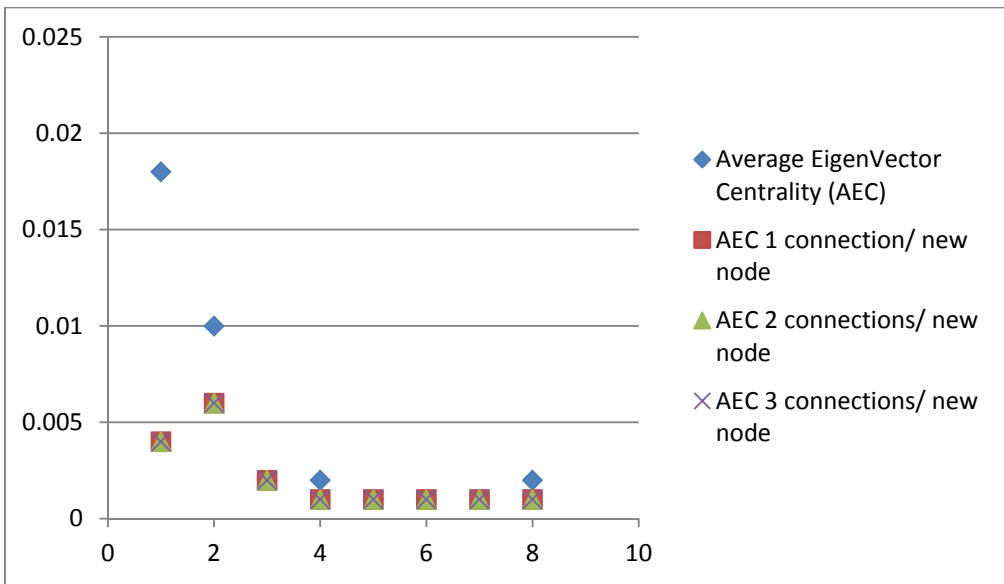


Figure 6-36: Average Eigenvector Centrality, 2 shared profiles introduced

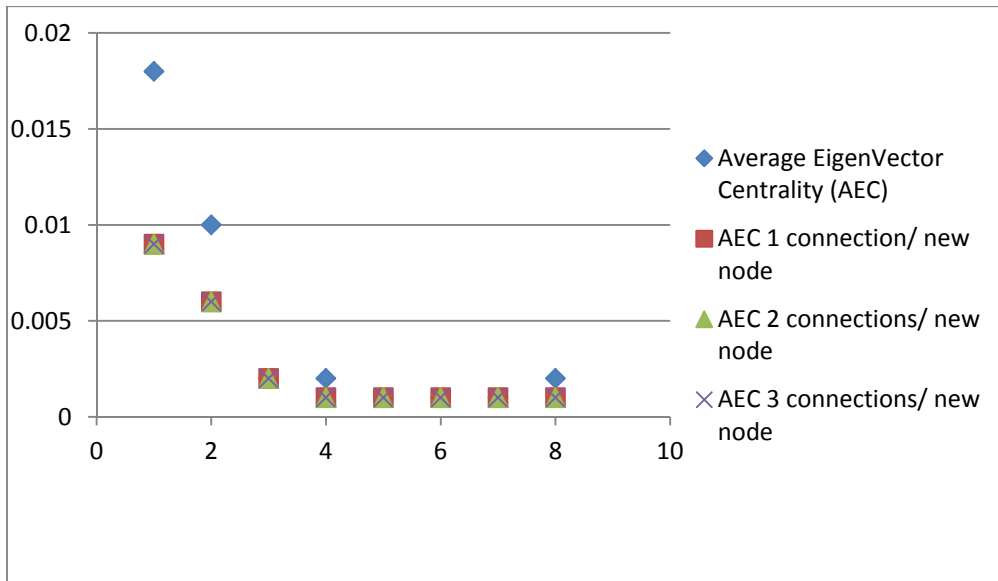


Figure 6-37: Average Eigenvector Centrality, 3 shared profiles introduced

6.4.4.5.1 Page Rank

Here we show the page rank results for the original networks (Figure 6-34) and the modified networks (Figures 6-38, 6-39, and 6-40). It is interesting to see how the results of the algorithm developed by Larry Page, one of the most important algorithms in searching for information and originally used by Google to improve their search results changes when the network is modified more when we introduce large numbers of shared profiles.

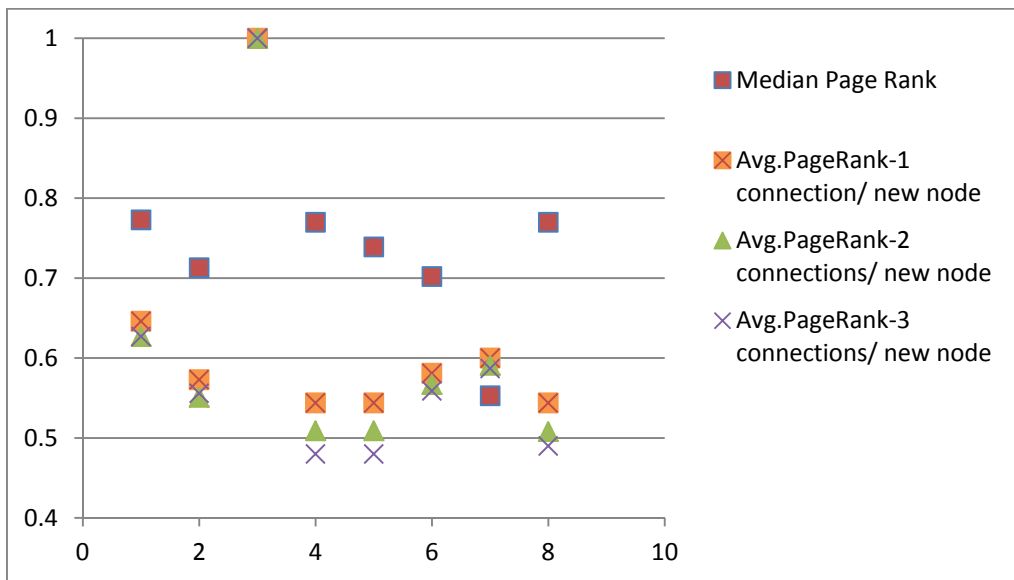


Figure 6-38: Page Rank, 1 shared profile introduced

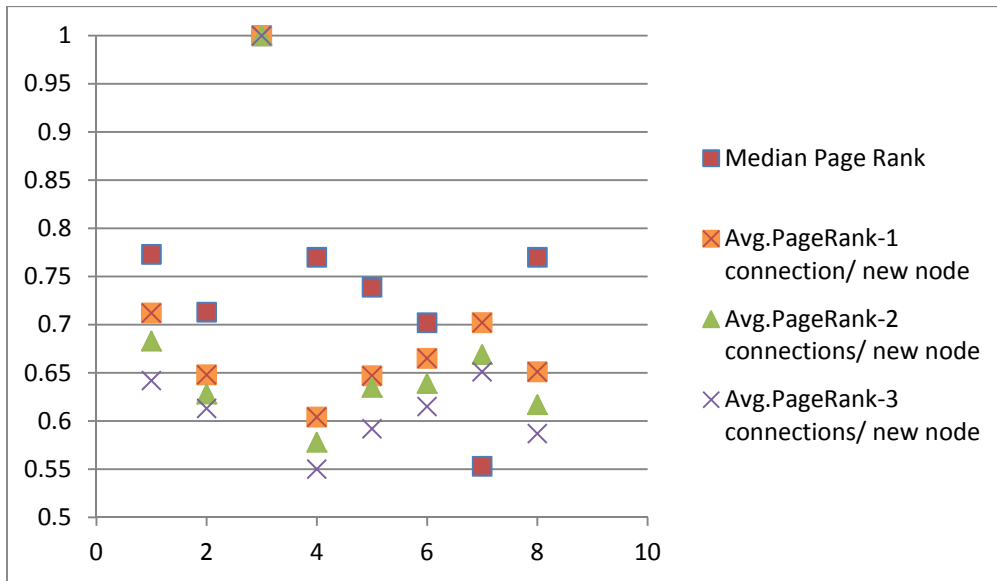


Figure 6-39: Page Rank, 2 shared profiles introduced

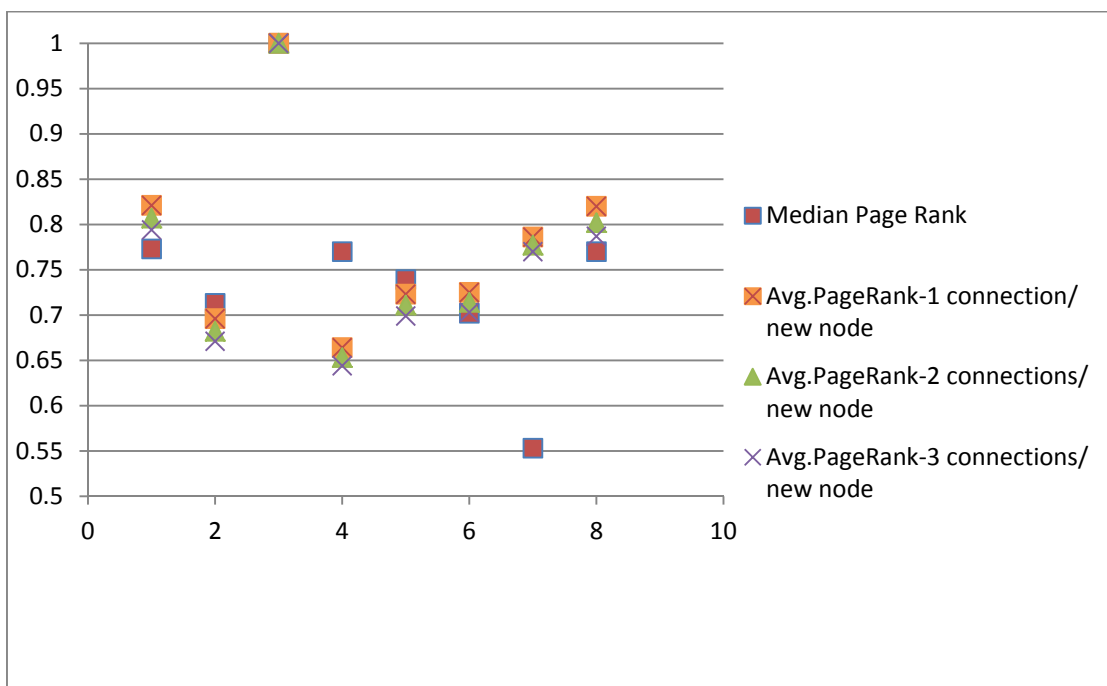


Figure 6-40: Page Rank, 3 shared profiles introduced

Here we do not show any relationship of Page Rank with our KPIs, but this result will be discussed in the conclusion section.

6.4.5 Relationship between metric changes and KPIs

Here we describe the relationships between the graph metrics and their variations and the KPIs. It is essential to explain that we have drawn the figures and the tables to classify the results according to the group size or network size.

It is necessary to establish the relationship between the group network size, in order to connect our graph metrics and the KPIs from simulations based on data gathered from Yammer and LinkedIn.

As we have said earlier, the data that we have used in most of these cases is private data and only few samples (listed in the Table 6-31) are available for public use, thus it was impossible to obtain data for very large networks or groups that would be comparable in size with LinkedIn.

Table 6-31: Corporate Social Networks Sizes

Company Internal Network	Number of Members (Original network/ 1 project profile/2 project profiles/3 project profiles)
Cisco	87/96/105/114
IEEE	136/150/164/178
Emirates	511/562/614/666
Dell	887/976/1065/1154
Aetna	1043/1148/1253/1358
PwC	1090/1199/1308/2417
IBM	1159/1275/1391/1507
Boeing	1268/1395/1522/1649

So to show the relationships between the graph metrics and KPIs, we have used LinkedIn and Yammer data for networks that have approximately the same size as those listed in Table 6-31.

6.4.5.1 Figure Further Explanation of our figures

In every figure we are going to draw conclusions with the help of a regression line in order to understand how the samples change. The structure of the figures follow this organization: X axis contains the value of the graph metrics, ordered by network size; and Y axis contains the value of the KPI ordered in the same manner by network size.

After show the samples, if they follow a clear trend, this relationship can be approximated by a straight line, a logarithmic, potential, or exponential regression line. In these cases we will show R^2 (reliability of tendency line) and the relationship's equation.

Definition R^2 : Reliability of tendency line is a parameter that reflects the relation of the variables X and Y in a regression model where you approximate the points by a line or a curve to clarify the relationship between the variables. It can cover the values of $0 < R^2 < 1$. The value of 0 indicates that there is not a strong relation between X and Y , and the value of 1 is the maximum relation, so the values of the one variable will affect the other[66].

If the dispersion of the samples is high, the value of R^2 will be very low (normally values of $R^2 > 0,5$ are considered good approximations. We will discuss the results regarding the best approximation with the correspondent R^2 and even if the value of R^2 does not exceed the threshold of 0,5 ; we are going to consider our solution as a start to improve the equation in the future.

We have established a threshold of R^2 value as 0,3, so for R^2 results obtained that belong to the range 0,3-0,5 we will **not** consider them as satisfactory results, but can consider them as an approximation to the real relationship between values.

6.4.5.2 Reciprocated Vertex Pair Ratio and Edge Ratio

After understanding both concepts definitions, and taking into account how these two metrics have been improved in the different networks, we are going to show firstly if we can expect an improvement of the *Interaction*. The idea has been building more bidirectional ties, and establishing the parallels with comment and answer; fostering the answer to the different comments increasing these metrics.

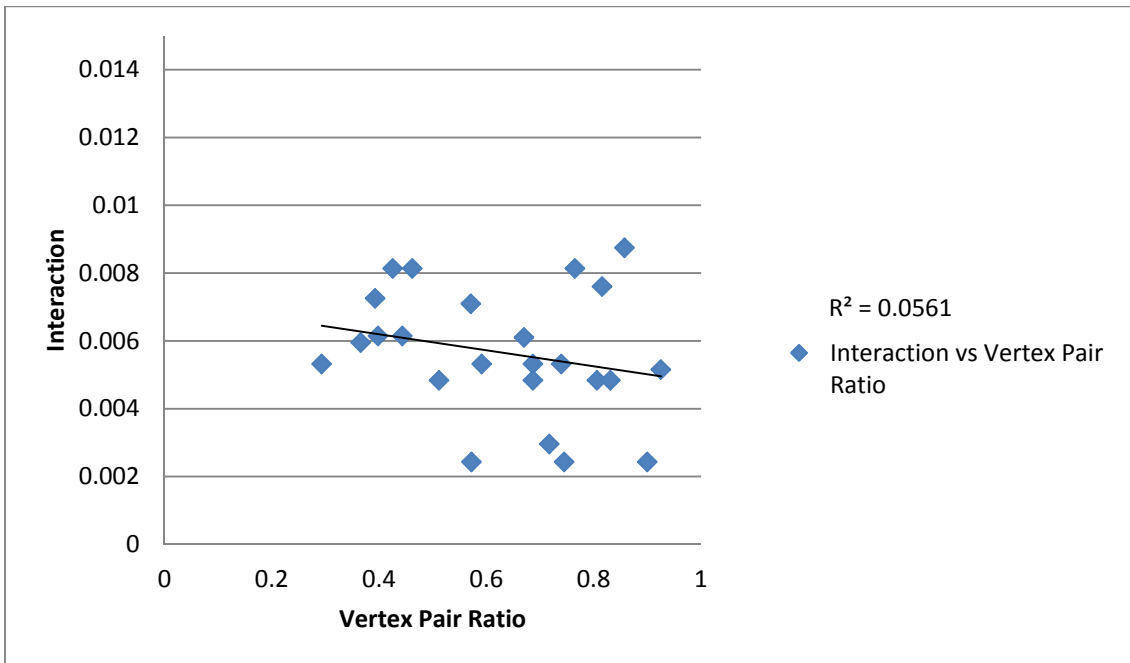


Figure 6-41: Interaction vs. Pair Ratio Dependence

We can see here that a slight decrease in interaction when the vertex pair ratio increases, but we cannot affirm this decrease due to the low value of R^2 . For this reason we have to conclude that this graph metric and KPI pair are independent parameters.

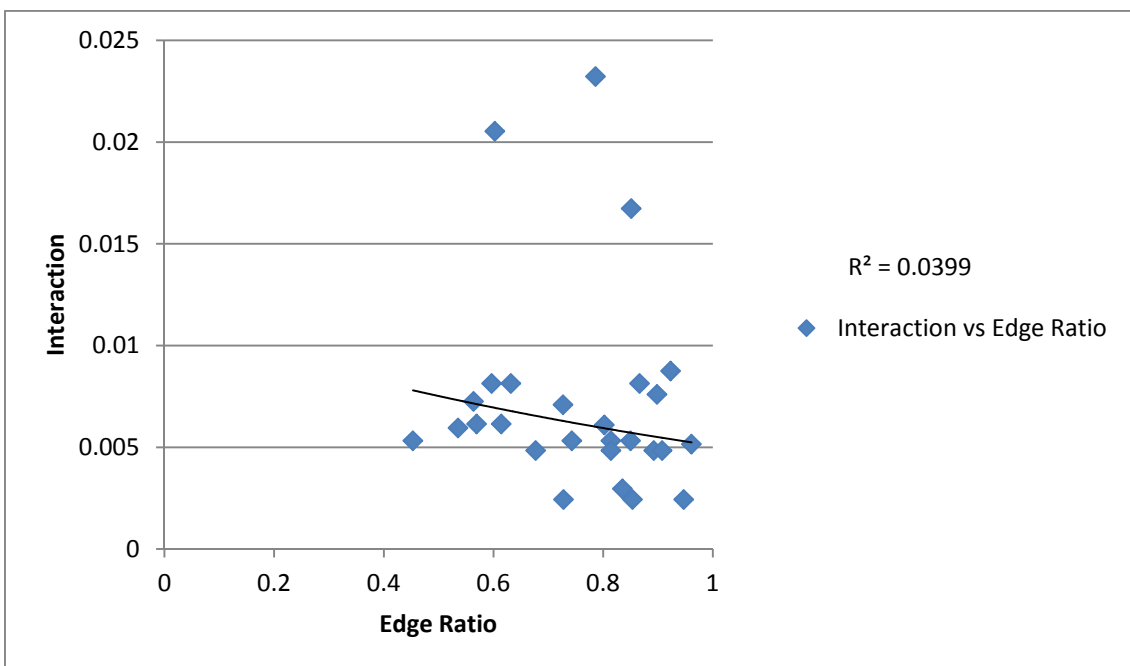


Figure 6-42: Interaction vs. Edge Ratio Dependence

In this case we see that increasing the Edge Ratio, the value of interaction decreases. It is normal because we are increasing the number of ties from a node A to the rest in comparison with the ties in the other sense what makes the interaction lower. However we have to say that they are independent values due to the value of R^2 .

We can see that our change within the networks is able to provide a change related to the **interaction**, but very weak and not predictable. Of course if we establish the relationship with interaction, is necessary to analyze also the *engagement*.

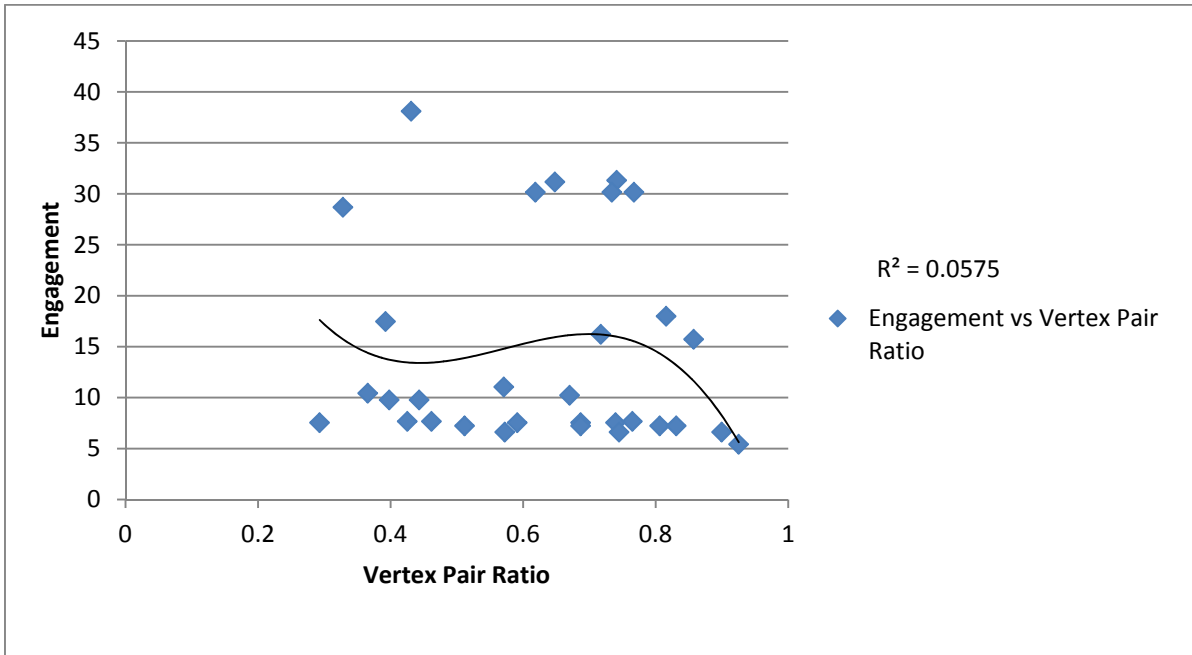


Figure 6-43: Engagement vs. Vertex Pair Ratio Dependence



Figure 6-44: Engagement vs. Edge Ratio Dependence

There may be a decrease in engagement as vertex pair ratio increases, but due to dispersion of these results, we **cannot** conclude that changing edge value we will produce a clear and significant change in *engagement*.

Another KPI that should be linked with the vertex pair ratio and edge ratio is the *interaction rate*. We expect that increase vertex pair ratio metric, the interaction rate also increase. The edge ratio should follow the same tendency according to its definition.

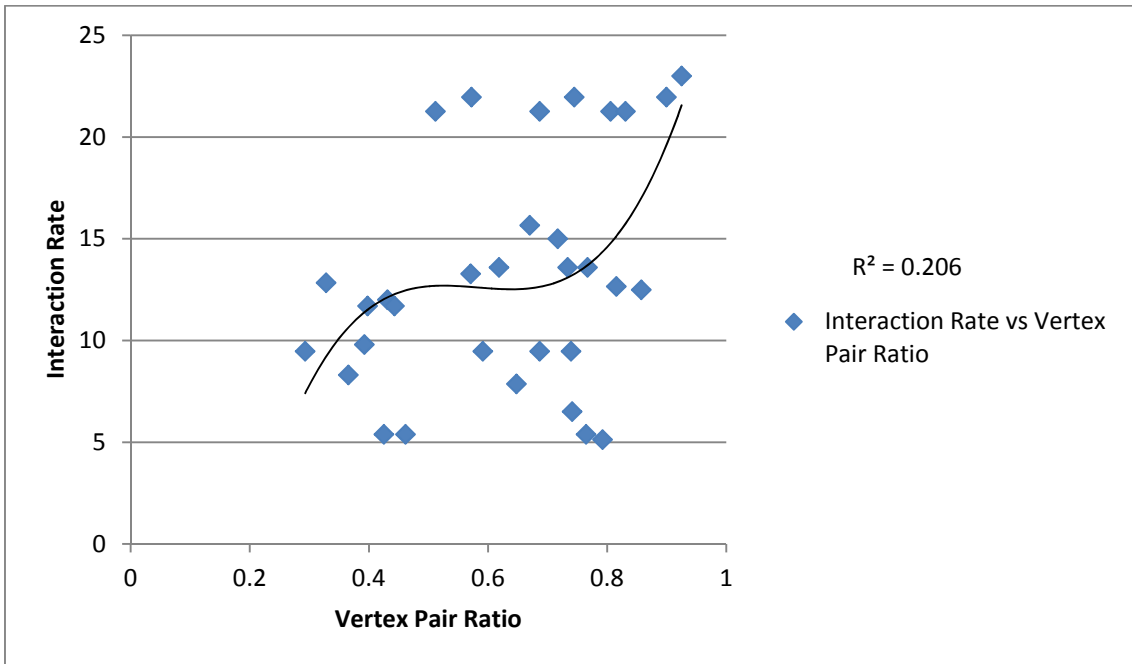


Figure 6-45: Interaction Rate vs. Vertex Pair Ratio Dependence

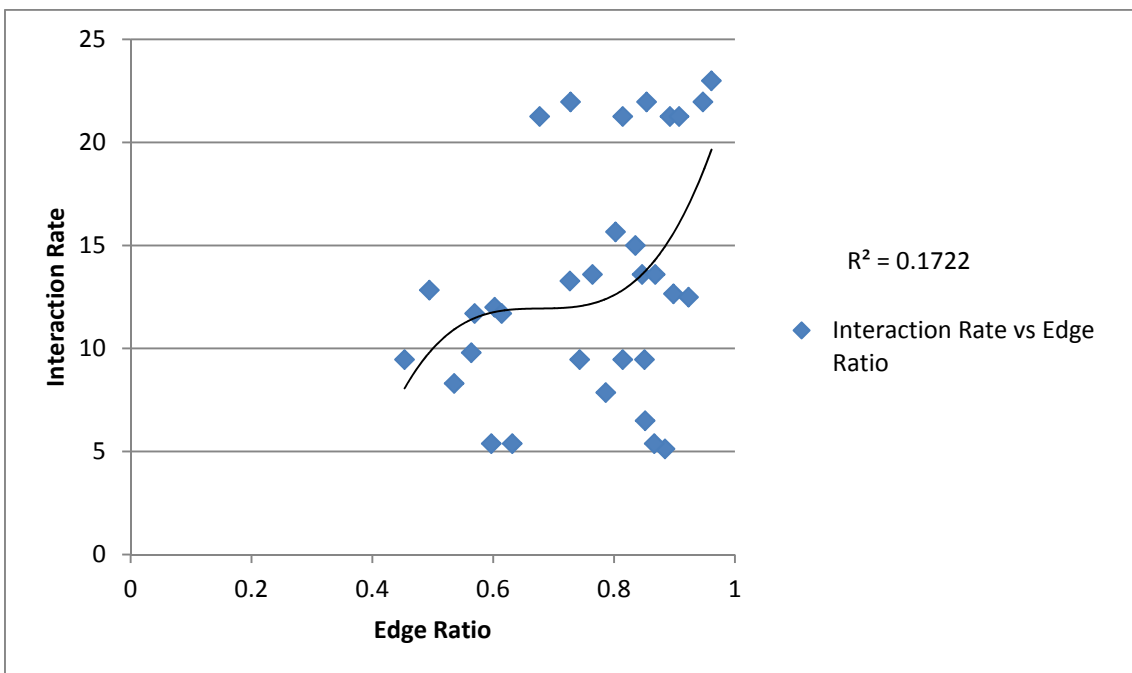


Figure 6-46: Interaction Rate vs. Edge Ratio Dependence

As the regression line shows, the gradient is positive, but the samples are split with around 50% over and under the line, thus due to the distance from this line there is a high dispersion. Hence we **cannot** guarantee that increasing the number of nodes as we have done will improve the interaction rate.

Audience engagement is other KPI that could be affected by the vertex pair ratio and edge ratio metrics. We should not forget that changing these two measures means establishing ties between nodes which appear when a message is transferred from one node to another.

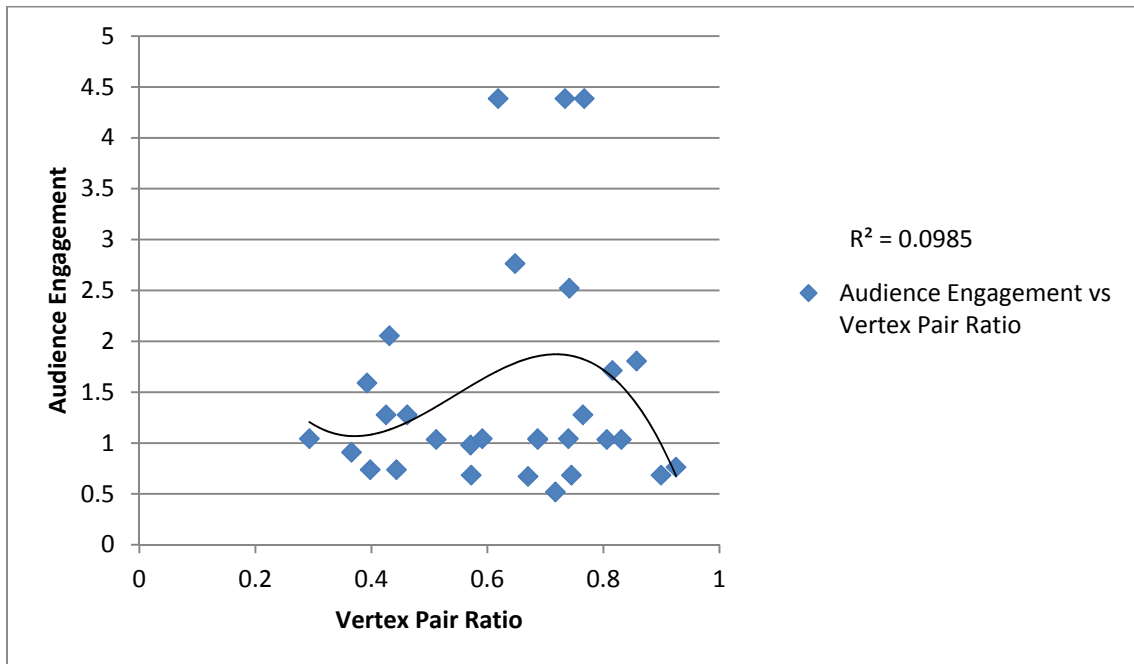


Figure 6-47: Audience Engagement vs. Vertex Pair Ratio Dependence

Here we can see in Figure 6-47 that most of the values of the audience engagement KPI have similar values independent of values of vertex pair ratio. Hence audience engagement will **not** be changed when the vertex pair ratio is increased.

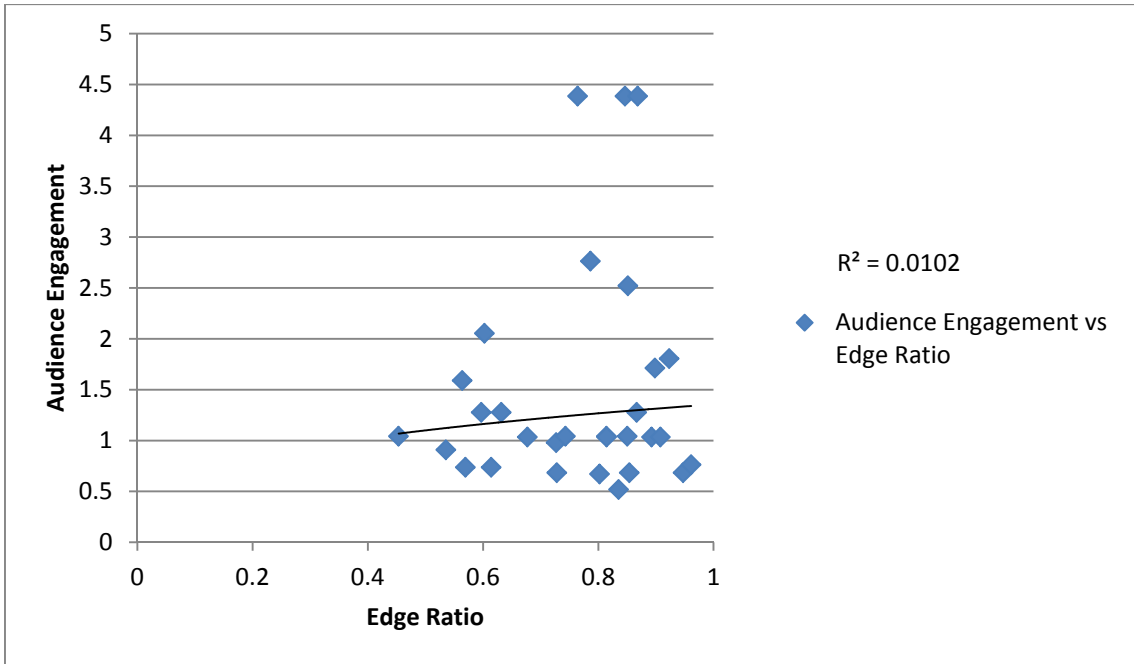


Figure 6-48: Audience Engagement vs. Edge Ratio Dependence

We can reach a similar conclusion for the edge ratio as with the vertex pair ratio (see Figure 6-48). Finally we show the *conversion rate* KPI, one of the key KPIs that is a measure of success as it reveals whether members are fostering the conversations or not.

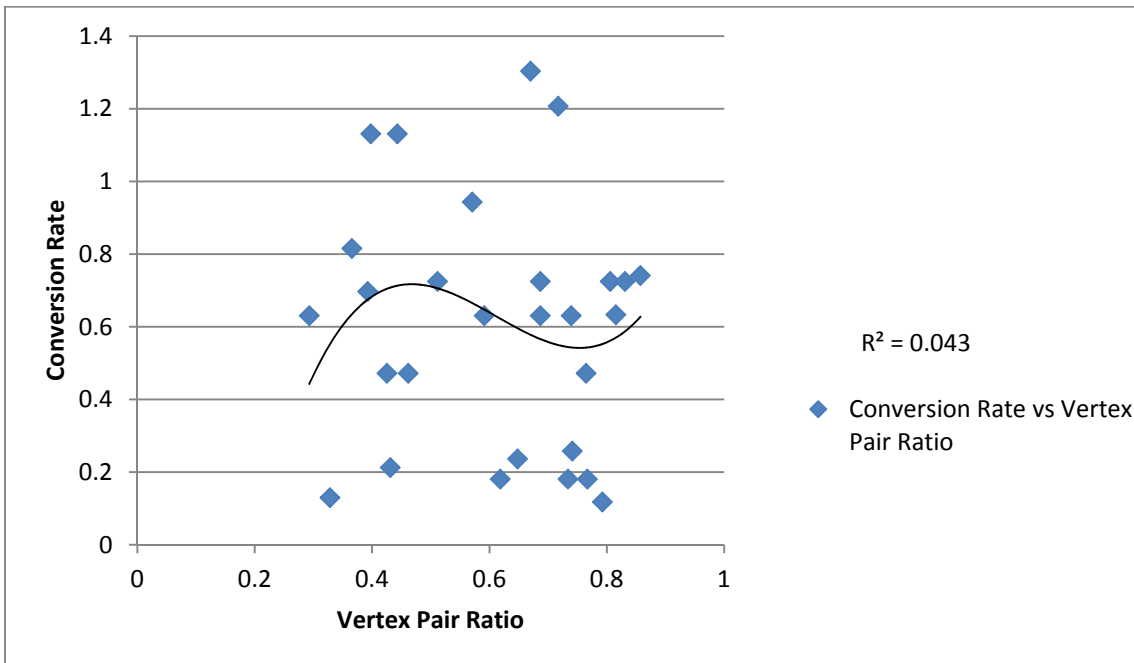


Figure 6-49: Conversion Rate vs. Vertex Pair Ratio Dependence

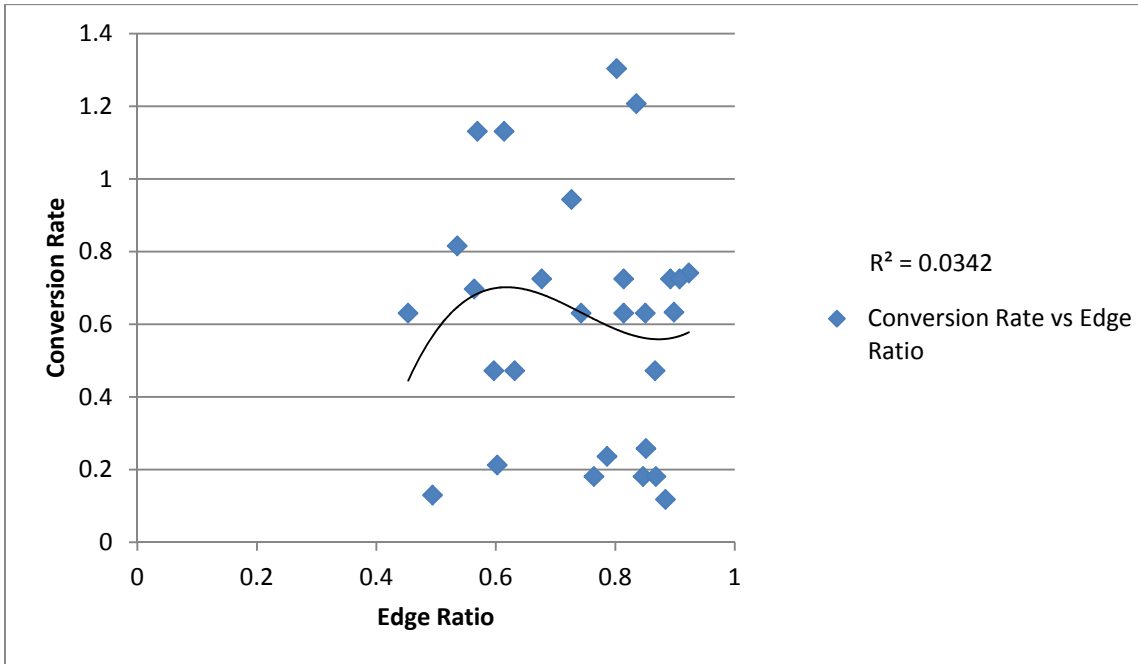


Figure 6-50: Conversion Rate vs. Edge Ratio Dependence

As can be seen in Figures 6-49 and 6-50 the dispersion of the values means that we **cannot** say that vertex pair ratio or edge ratio affect the conversion rate KPI.

6.4.5.3 Graph Density

There is a strong relationship of *engagement* with graph density. We can see clearly that the samples follow a similar trend. Therefore we can affirm that increasing the graph density, increases the engagement according to the formula shown in Figure 6-51. A similar phenomenon happens with the interaction KPI as shown in Figure 6-52.

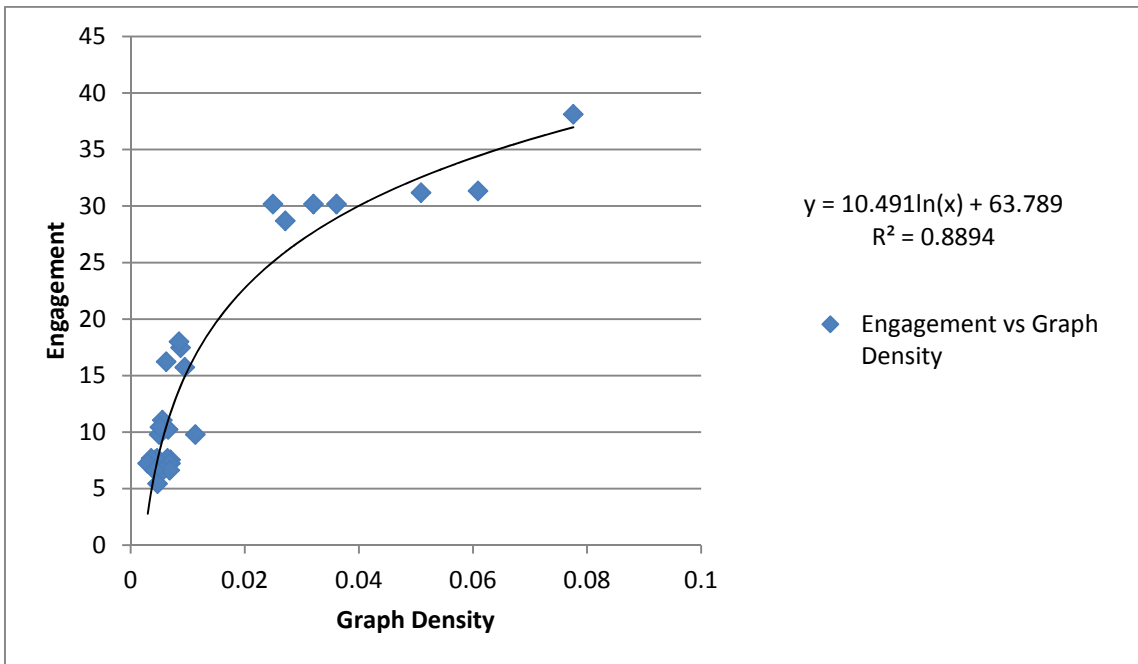


Figure 6-51: Engagement vs. Graph Density Dependence

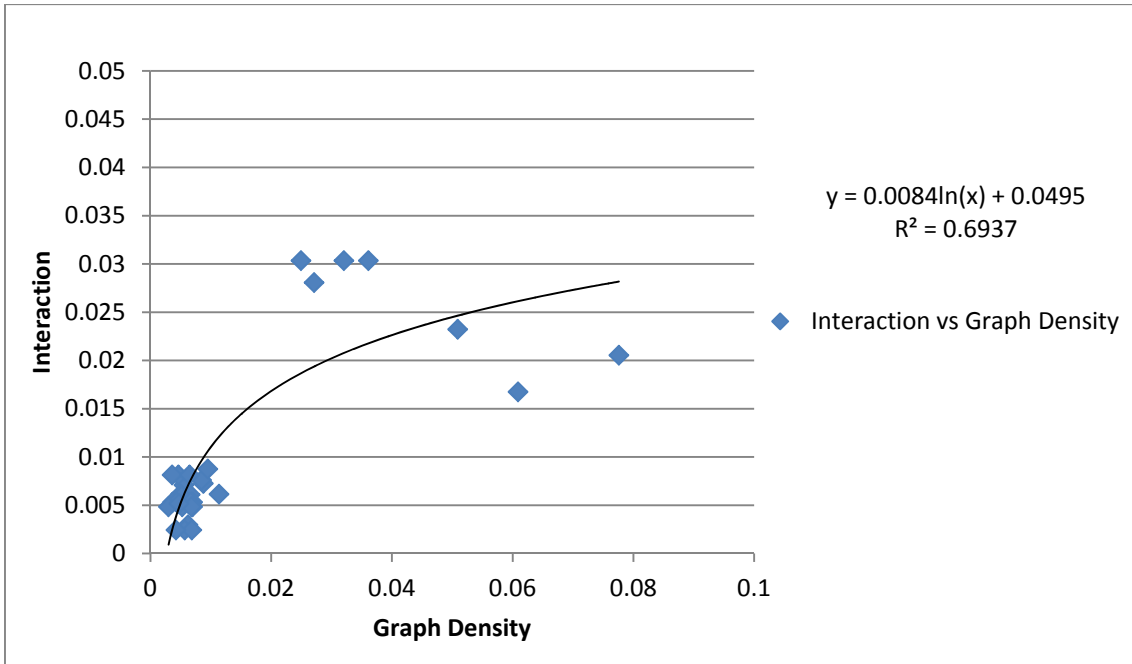


Figure 6-52: Interaction vs. Graph Density Dependence

Although the samples are more dispersed than in the engagement case, we can also affirm that increasing the graph density, we can increase the interaction KPI. This is reasonable if we consider the relationship between density and engagement KPI.

Having shown the relationship with engagement, we also have to consider the relationship with conversational volume, because of the dependence showed in the formula for conversational volume (Figure 6-53).

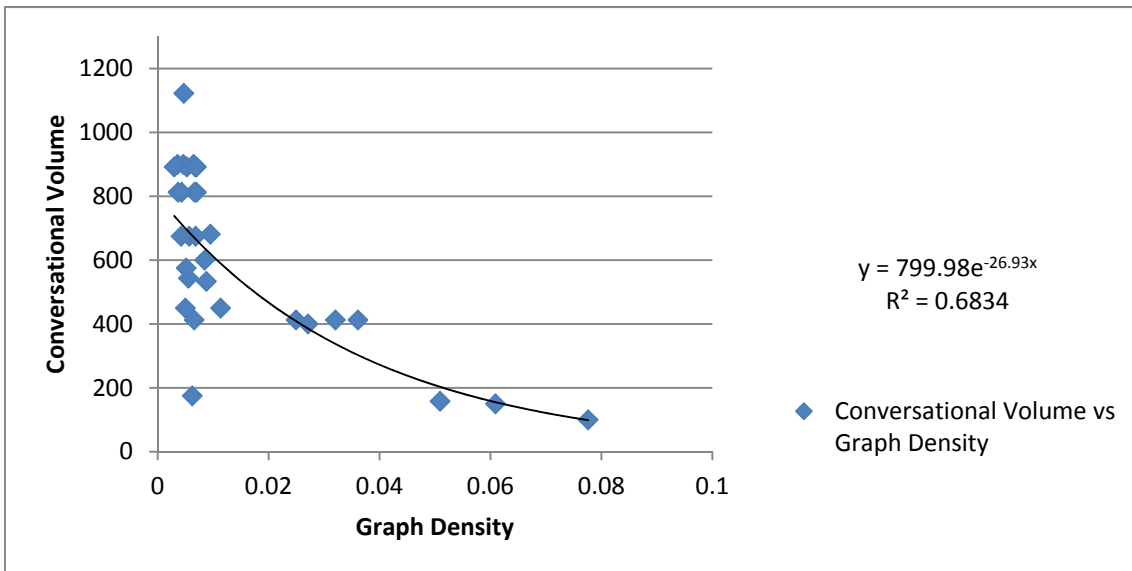


Figure 6-53: Conversational Volume vs. Graph Density Dependence

Increasing the graph density here we have obtained satisfactory results also, where the conversational volume decreases exponentially. Increases graph density produces a logarithmic increase in audience engagement as shown in Figure 6-54.

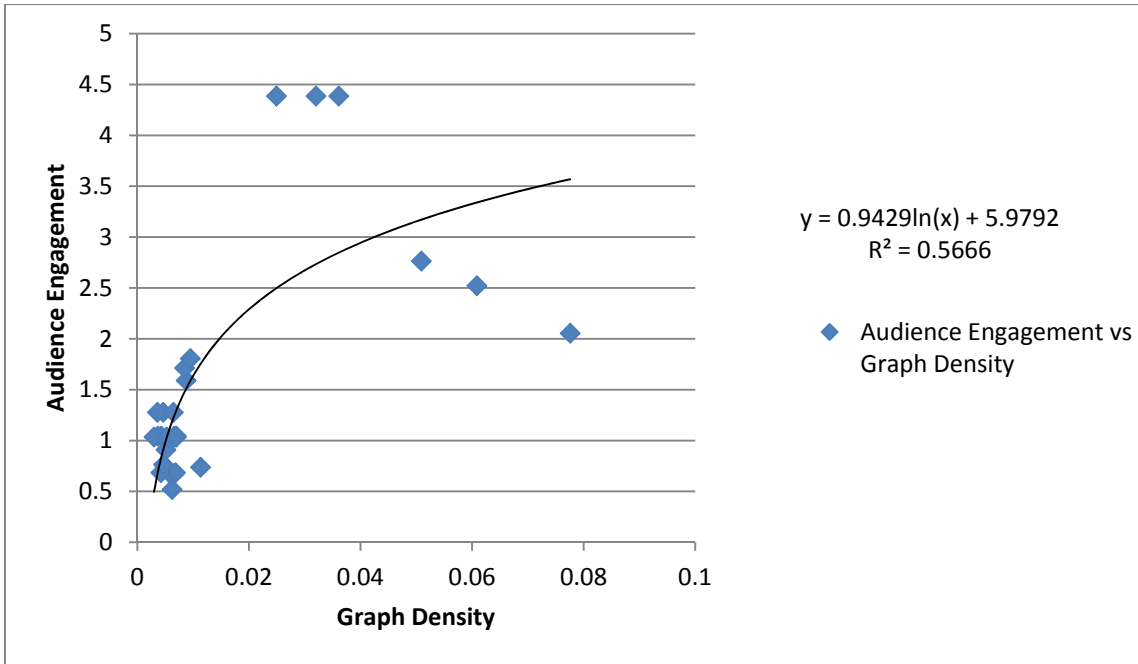


Figure 6-54: Audience Engagement vs. Graph Density Dependence

6.4.5.4 Modularity

As we have defined earlier, the modularity expresses the quality of connections between the members within a group. Therefore is interesting to see how modularity affects some important KPIs.

First show how *audience engagement* could be directly affected by modularity.

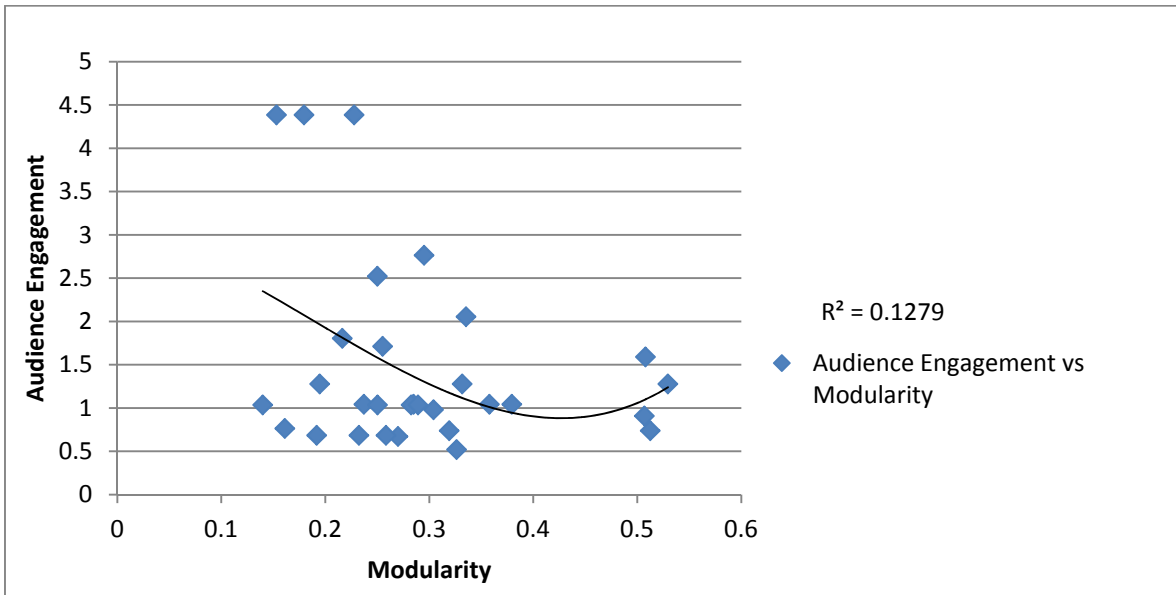


Figure 6-55: Audience Engagement vs. Modularity Dependence

We can see in Figure 6-55 that increasing modularity decreases audience engagement (although there is some dispersion at low values of modularity). This means by enhancing the connections within a group, the connection between *different* groups becomes weaker. However, we cannot say that the parameters are dependent due

the fact that R^2 value is low. Hence we may wonder what happens with the values of interaction and engagement.

From Figure 6-56 when modularity increases, the value of interaction decreases although the range of values is very small. We **cannot** say that there is a predictable relationship because of the R^2 low value.

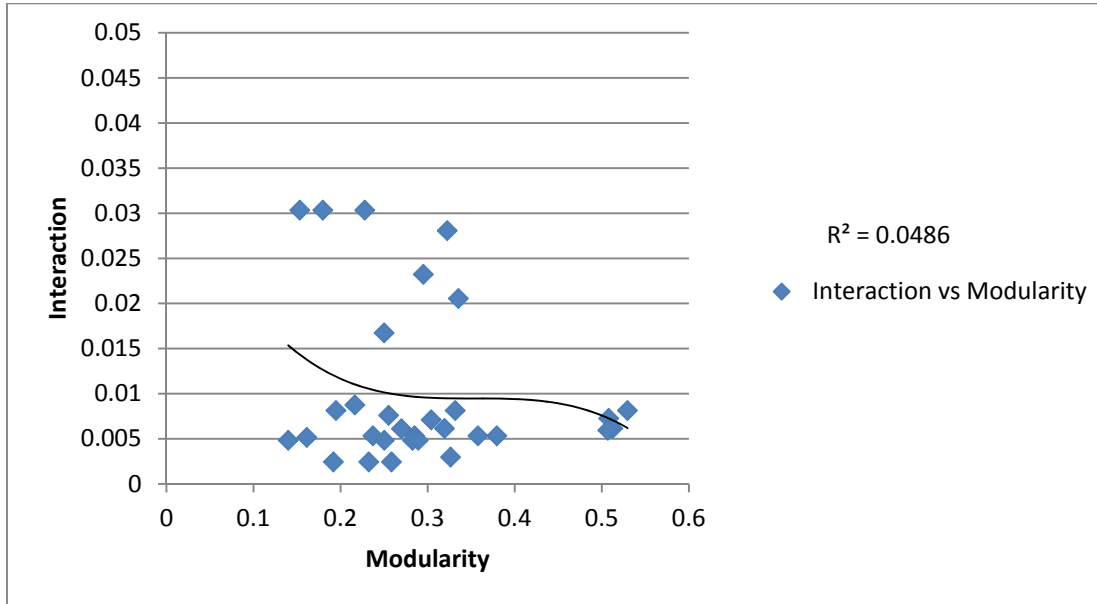


Figure 6-56: Interaction vs. Modularity Dependence

Although from Figure 6-57 it seems that the values of engagement are also reduced with an increase of the modularity, but the dispersion of the samples is high, hence we **cannot** affirm that there is a relationship between them.

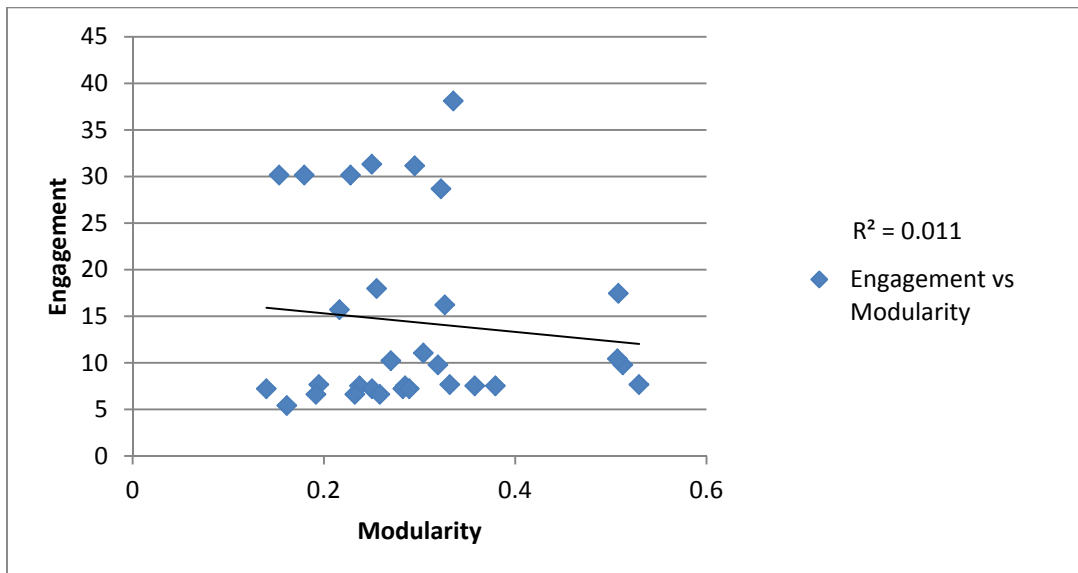


Figure 6-57: Engagement vs. Modularity Dependence

It makes no sense to try to establish a relationship between modularity and conversational volume or interaction rate due to their dependence on engagement.

6.4.5.5 Clustering Coefficient

In this case we analyze the level of presence of sub-communities. We seek to establish relationships with *audience engagement*, *interaction*, *engagement*, *conversational volume*, *interaction rate*, and *conversion rate* KPIs.



Figure 6-58: Audience Engagement vs. Clustering Coefficient Dependence

If we foster the presence of sub-communities, we can achieve an increase in audience engagement KPI shown in Figure 6-58, but we cannot consider it predictable given the low value of R^2 . Let us see if there is related *to interaction and engagement*.

Increasing the clustering coefficient has small increase on the interaction KPI, but this is relatively small and the low value R^2 does not support a clear dependence on this increase.

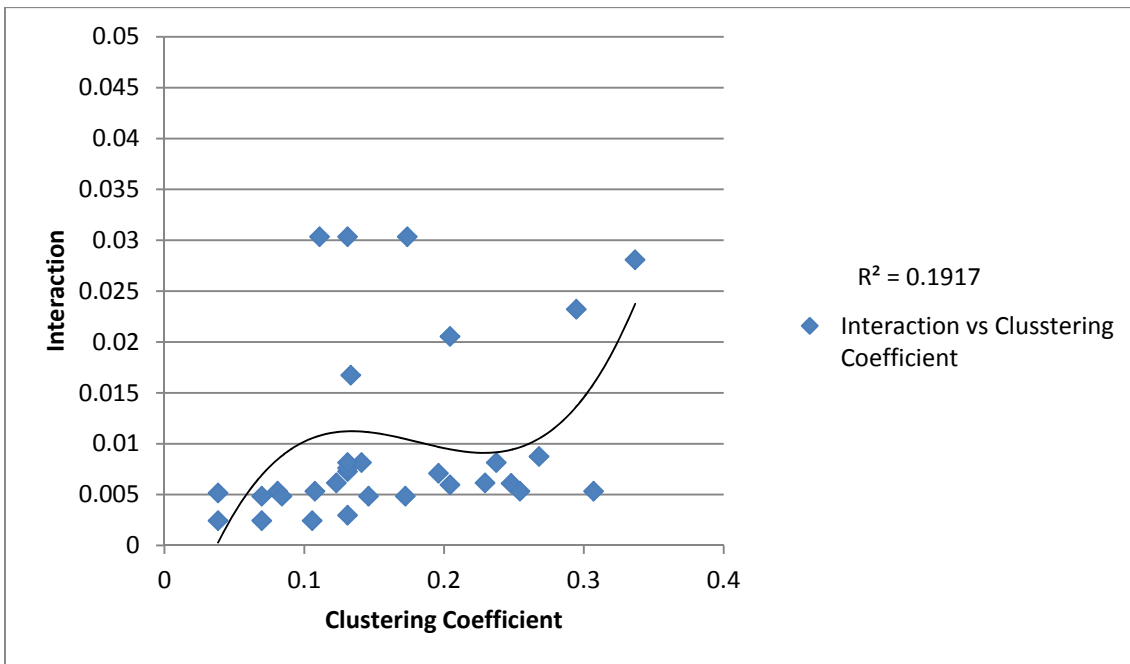


Figure 6-59: Interaction vs. Clustering Coefficient Dependence

In the case of engagement, we can see that increasing clustering coefficient, the engagement increases, but taking a look to the samples; we are not able to predict any value due to the dispersion of the samples.

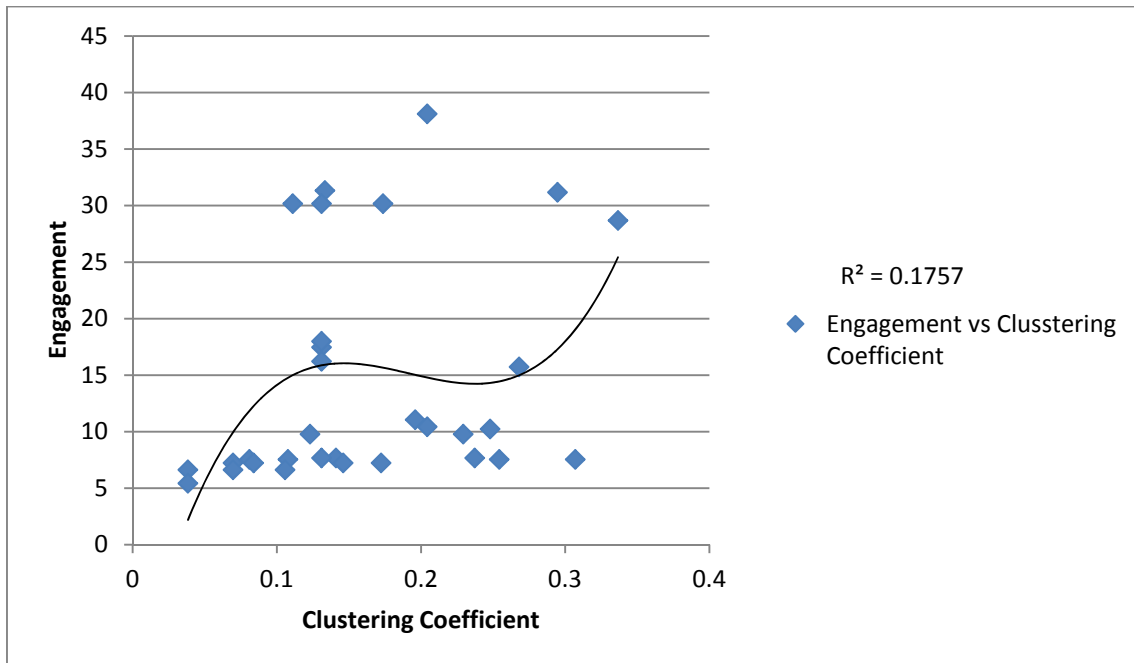


Figure 6-60: Engagement vs. Clustering Coefficient

Regarding *conversational volume* if take into account the large range of values that the conversational volume can have (as shown in Figure 6-61), we might want to say that increasing the clustering coefficient decreases the conversational volume. This would be expected because if we foster conversations and participation between small communities, then the level of conversational volume regarding the whole network should decrease. However we cannot say this due to the low value of R^2 .

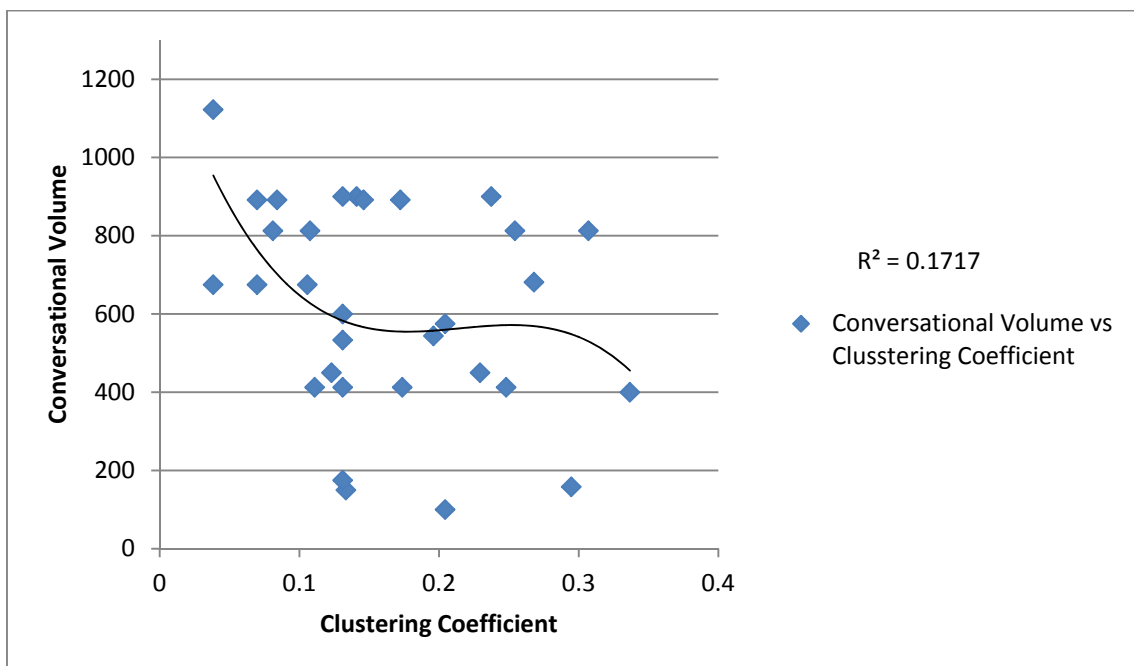


Figure 6-61: Conversational Volume vs. Clustering Coefficient Dependence

However, regarding *conversion rate and interaction rate*, they **can** be affected by changing the clustering coefficient. Although the values of the R^2 do not reach the 0,5 level needed to consider them satisfactory, that the results shown in Figure 6-62 and Figure 6-63 show some dependence

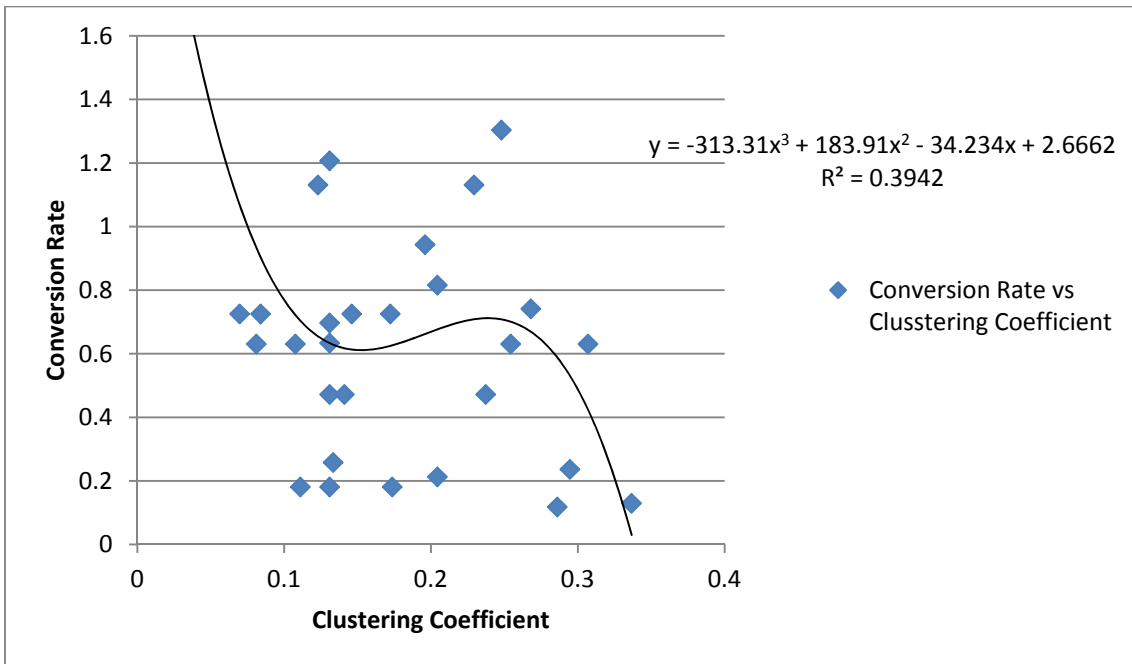


Figure 6-62: Conversion Rate vs. Clustering Coefficient Dependence

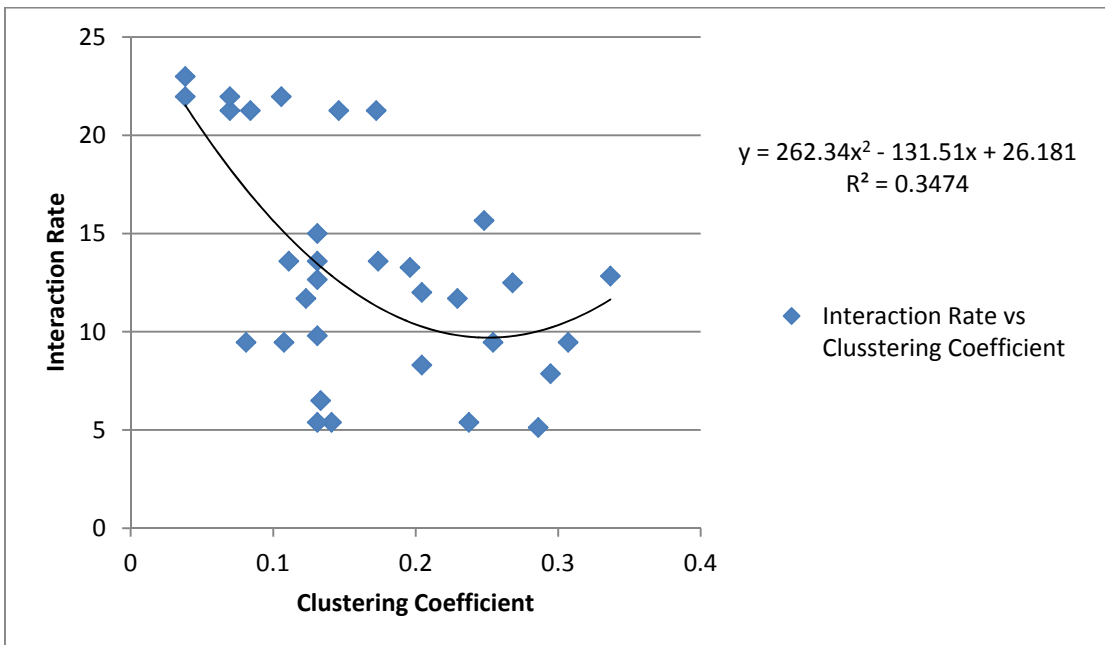


Figure 6-63: Interaction Rate vs. Clustering Coefficient Dependence

6.4.5.6 Diameter

The diameter metric should be clearly related to the reach and velocity KPIs. We can see this in Figures 6-64 and 6-65.

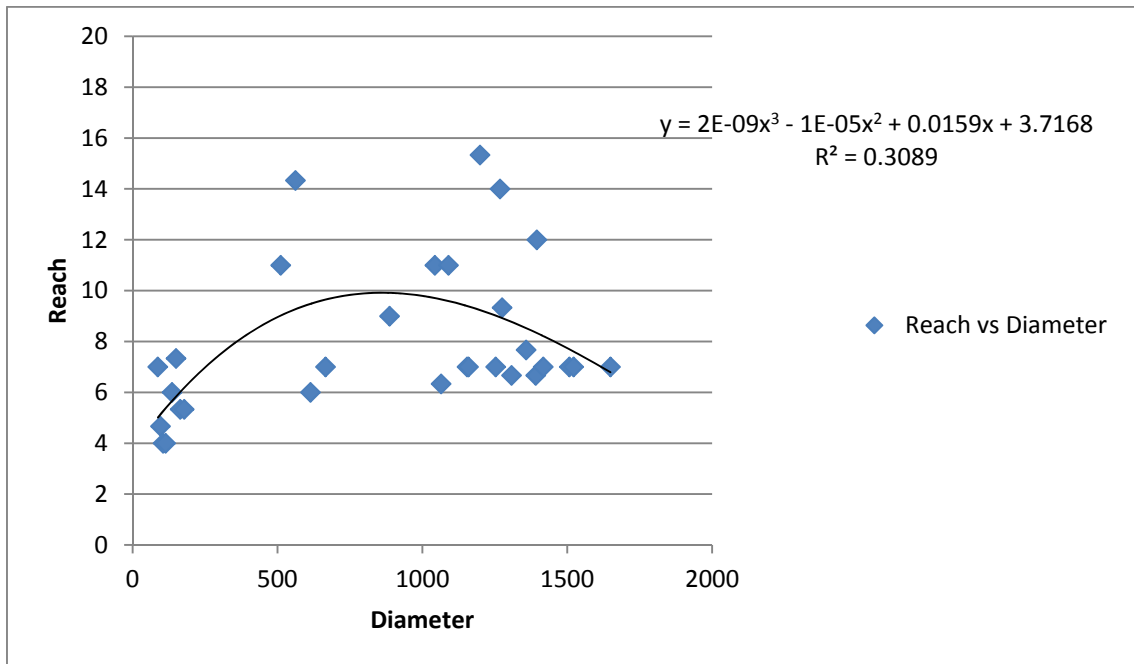


Figure 6-64: Reach vs. Diameter Dependence

Increasing the number of nodes of the network, we change the reach. However, our equation is not satisfactory due to the low value of R^2 , but we can consider our model a rough approach to the improvement, unfortunately it is not clear that we can make predictions.

Figure 6-65 shows the of diameter relation with velocity.

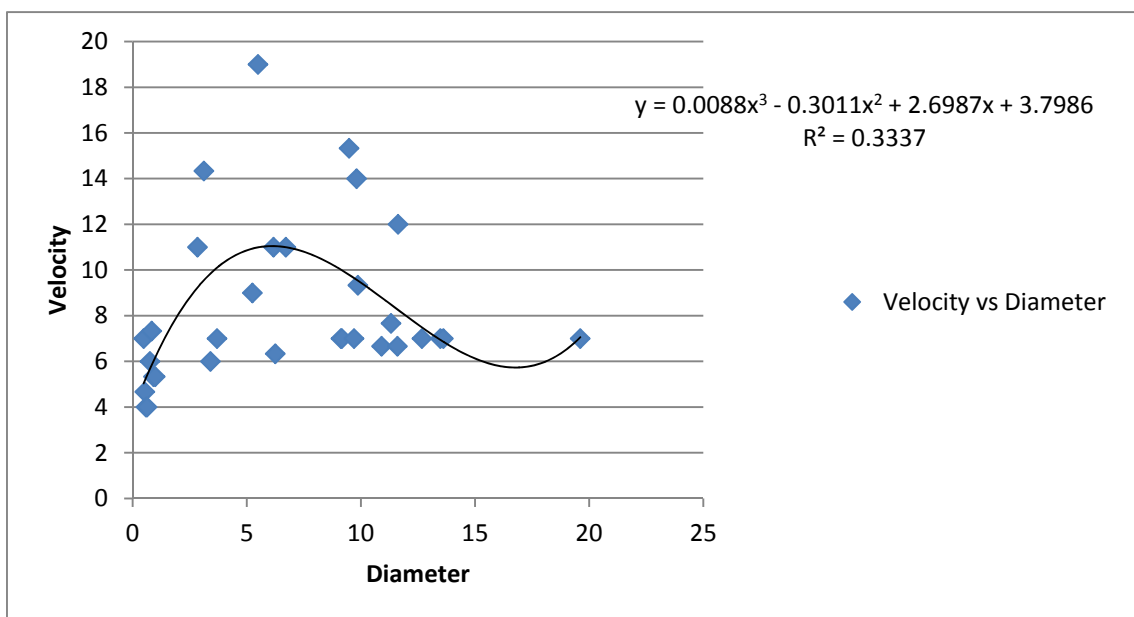


Figure 6-65: Velocity vs. Diameter Dependence

Even though we have a really huge network, we have to remember that engagement is the key factor related to the “*half-life*” time of a post within a network. Figure 6-67 shows the “half-life” time.

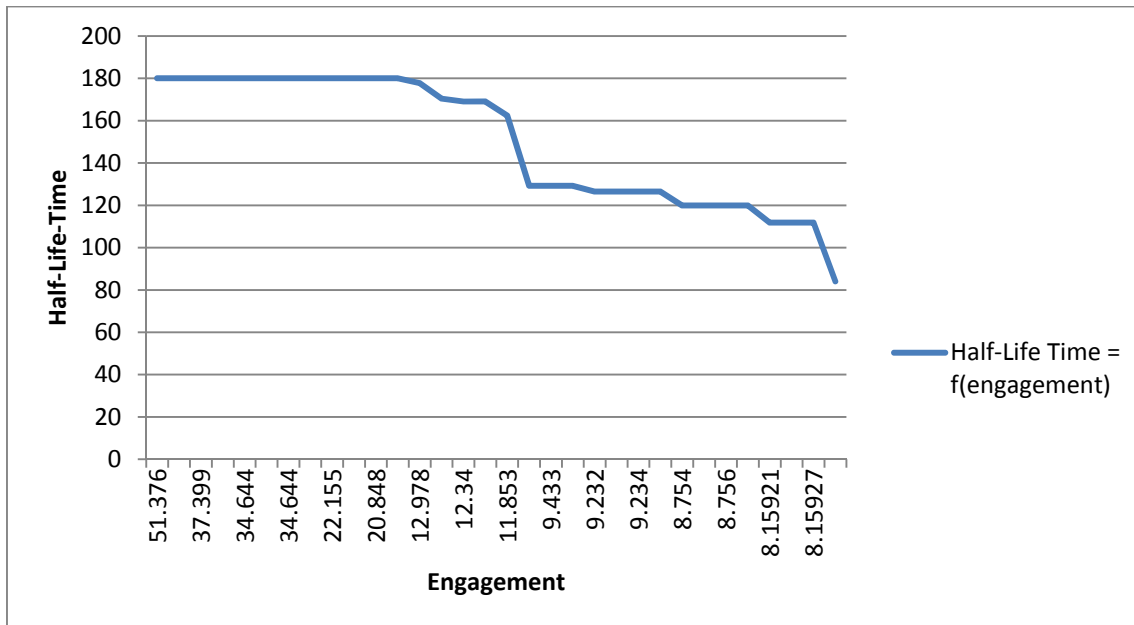


Figure 6-66: Variation of the half-life time relative to engagement values

We **cannot** say that increasing the size of our network will make our message spread channel faster without establish a relationship between engagement and diameter.

Figure 6-67 shows engagement as a function of diameter. This figure suggests that increasing the diameter of the network decreases the engagement a lot. Thus we can conclude that decreasing the diameter; makes our network faster (in that it rapidly spreads a message and the message reach our audience), but we cannot say that this is the best way to perform this task.

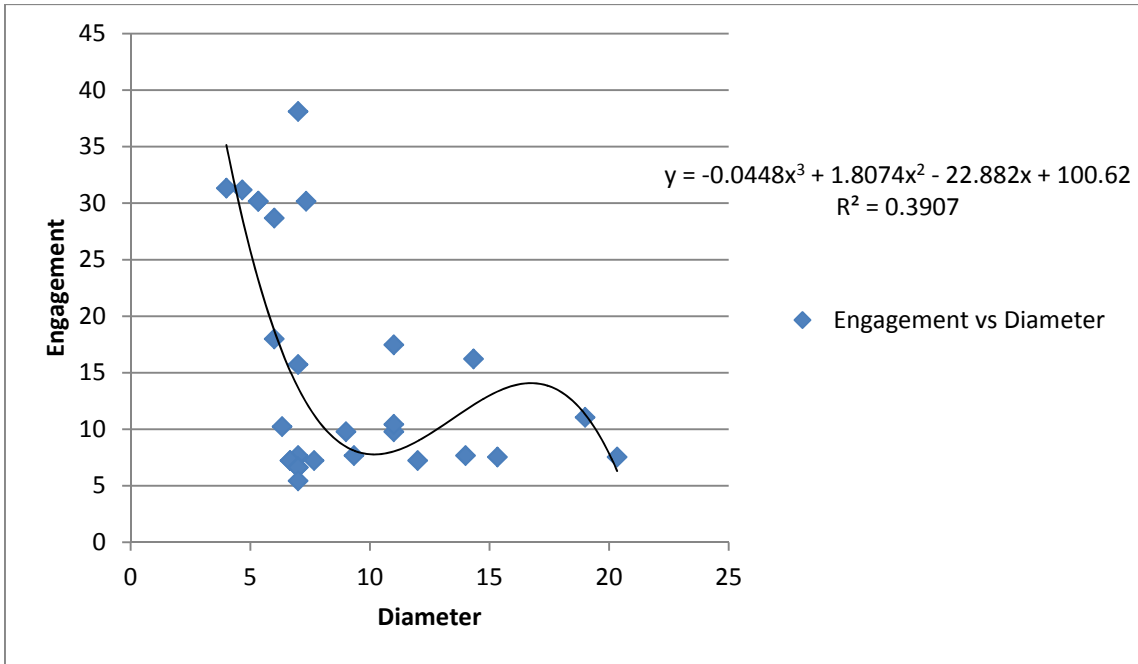


Figure 6-67: Engagement vs. Diameter Dependence

6.4.5.7 Average Distance

What we have tried to do with the average distance metric is to decrease it in order to make the connections between different nodes shorter. The objective is to make facilitate connections between the different network members. We would like to establish a relationship between this metric and the *reach and velocity* KPIs.

Figure 6-68 shows that as the average distance increases, we have greater reach. This potential relationship is close to being satisfactory based on the value of R^2 .

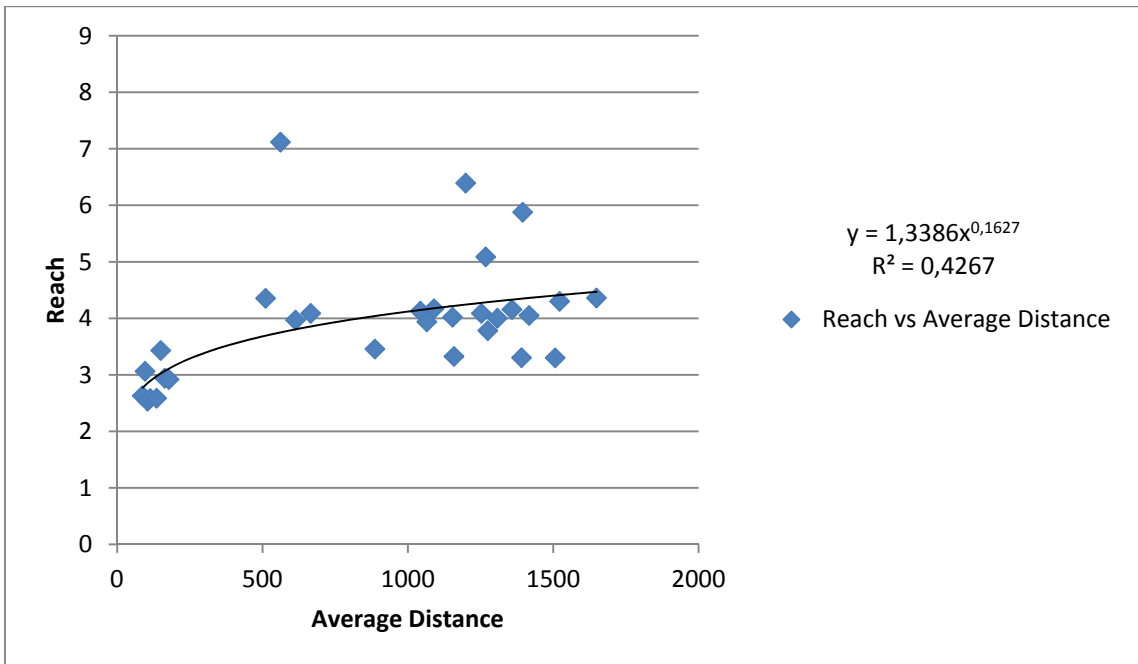


Figure 6-68: Reach vs. Average Distance Dependence

While it seems that the velocity will increase with an increase in average distance (as shown in Figure 6-69), we have to consider the previous “*half-life-time*” relationship with the engagement KPI. We can obtain a rough approximation considering the R^2 value.

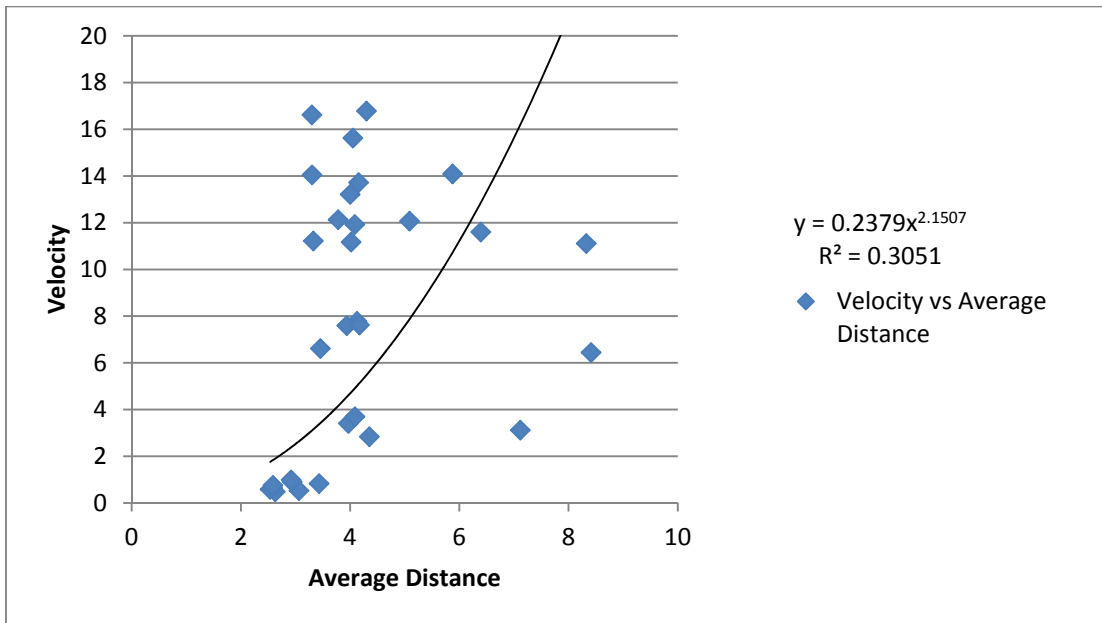


Figure 6-69: Velocity vs. Average Distance Dependence

Figure 6-70 shows that of the average distance increases then engagement decreases significantly; this means that we have to narrow our network and connect it in a proper way to make it faster, making the communication easier and faster between non adjacent nodes (members).

In that case we have a satisfactory relationship as fit to a third grade polynomial because is the one with we obtain the higher value of R^2 .

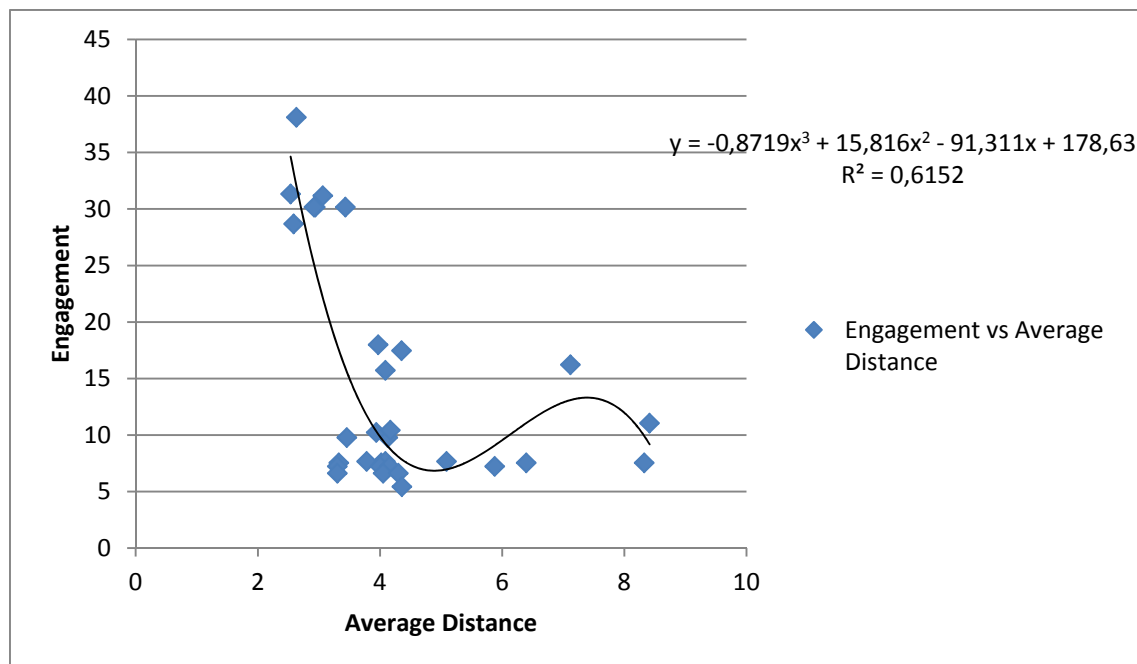


Figure 6-70: Engagement vs. Average Distance Dependence

6.4.6 Analysis of the Results

First we show in Figure 6-71 a general overview of the results. The spaces with grey color mean that the parameters have not relationship at all; the spaces indicate blue that we have achieved a rough relationship (R^2 values are into the range 0,3-0,5) and green means that we could find some dependence formula, and white indicates those that we do not think that have conceptual relationship at all.

Metric/KPI	Interaction	Engagement	Audience Engagement	Conversational Volume	Interaction Rate	Conversion Rate	Reach	Velocity
Edge Ratio								
Vertex Pair Ratio								
Diameter		0,39					0,32	0,33
Average Distance		0,62					0,43	0,31
Graph Density	0,69	0,89	0,57	0,68				
Modularity								
Clustering Coefficient					0,35	0,39		

Figure 6-71: Achieved Results

We should balance the level of relationships between different graph metrics and KPIs. As we can see in the figure above; more than one graph metric affects somehow a given KPI.

We are going to explain each KPI effectors based on our results.

6.4.6.1 Interaction

As we show in Figure 6-52 the graph density is the only graph metric that has an impact on the interaction KPI. In this case the R^2 value of 0.6937 reflects the fact that the *interaction is considerably improved* following a logarithmic relationship of the form:

$$y = 0,0084\ln(x) + 0,0495$$

Of course we should be careful with this statement due to theoretical issues; as interaction is a very general KPI and there are a lot of metrics that are related to the interaction KPI. Although we have shown most of the rest of the graph metrics are independent of this KPI, we cannot be sure that this will to be true for every network.

6.4.6.2 Engagement

In the case of engagement diameter has a R^2 value of 0,3907 and average distance has a R^2 value of 0,6152. The graph density increases the engagement with a R^2 value of 0,8894 which much higher than for the other two graph metrics. So we can conclude that the next two relationships affect engagement (y) as described in Figures 6-67 and 6-70.

$$y = 0,2379x^{2,1507}$$

$$y = 10,491\ln(x) + 63,789$$

We have to consider that the graph density has more influence in comparison with the other two graph metrics on the KPI engagement, so we can conclude that **engagement is increased by our model** due to the high influence through logarithmic dependence over engagement with a higher R^2 than other relationship established with other metrics.

6.4.6.3 Conversational Volume

Conversational volume has a good relationship with a $R^2 = 0,6834$ with the graph density metric. Figure 6-53 shows a decrease in the conversational volume with increasing graph density, so all we can conclude that according to the data obtained **the conversational volume will be lower** according to the equation:

$$y = 799,98e^{-26,93x}$$

6.4.6.4 Interaction Rate

In the case we only have a relationship with the clustering coefficient (with a R^2 value of 0,3474). This should be improved however due to this low R^2 we **cannot** say that our modifications to the network will increase or decrease the interaction rate.

6.4.6.5 Conversion Rate

The case of conversion rate is similar to the results for interaction rate. We have a R^2 value of 0.3942, which shows some dependence on the clustering coefficient, but we consider the equation a rough approximation.

6.4.6.6 Audience Engagement

Only one graph metric that affect audience engagement KPI. This is the graph density with a R^2 value of 0.5666 that provide a smooth increase in the audience engagement KPI. We can conclude **that for these particular networks (those included in our study) this KPI is improved with increasing graph density**, but we cannot be sure that every network will have an Audience Engagement KPI increase in the same way as the R^2 value of that is not much above the threshold.

The formula to predict the evolution of the audience engagement is:

$$y = 0,9429\ln(x) + 5,9792$$

6.4.6.7 Reach

The reach KPI is affected by diameter. Thus with our modifications to the network we reduced the diameter of the network which reduces the reach KPI with a relationship of R^2 value of 0,3187. At the same time the average distance is also reduced, but in this case it produces an increase of the reach KPI with a R^2 value of 0,4267.

Once we reduce the diameter and the average distance at the same time, and taking into account that the second one will have higher impact on the value of Reach, we can say that our model **will increase the KPI Reach but we cannot say that is the best method to increase this KPI**.

6.4.6.8 Velocity

In the case of velocity diameter and average distance are also the two graph metrics involved in the change of Velocity KPI. In the first case the value of the velocity is going to decrease or increase depending on the range with a R^2 value of 0,3337. While the average distance has a R^2 value of 0,3051, such that the velocity increases considerably as a function of average distance.

In this particular case we have to study each network, because we can see in the Figures presented in the previous sections that the velocity increases in some cases and decreases in others, and taking into account the low values of R^2 in both cases, we **cannot** predict a behavior regarding as a function of the group size.

6.4.7 Goals Achieved

With to the objectives described in the Chapter 1, it is time to discuss if we have achieved them or not. First we have to say due to the large number of documents researched we could achieve a deep understanding of the problems existing within a corporation with regard to the social relationships and teamwork collaboration, the demands, the gaps, and how the companies trying to solve the problems of the current technologies.

Regarding the relationship between social networking technology and workplace flexibility and productivity, we have to say that although the background links these three key concepts, the study and the proposed improvement have showed results according with the participation and collaboration and social technologies, enabling us to obtain tangible results regarding productivity and workplace flexibility by improving this social technology. However, it is necessary to gather further information through network monitoring and workers.

Finally, we have to say that we could achieve a deep understanding of the current social network technologies and the gaps that they are still trying to solve, while giving a measure of the current situation though the Key Performance Indicators (KPIs) and linking them with the most used graph metrics. We also showed that some of these KPIs can be improved.

7 Conclusion

We must say that the initial objective was very ambitious. The world of social networks is very wide, and currently companies are working hard to make use of an open set of possibilities, but it is difficult to make revolutionary improvements to enhance every feature.

Nevertheless the results obtained have shown some improvements are possible in the KPIs that we use. An enhancement for companies is normally converted into money; so there are plenty of strategies to obtain an increase. We can say that we have partially achieved our goals because it is not possible to reflect a tangible result with a productivity comparison or a definitive workplace flexibility study. However, our first aim was to enhance the KPIs and we could do this for some of them.

If we have to describe how new studies could follow this path or at least attempt to relate to the emerging corporate social media situation, we have to say that it is essential to focus only on one social network and within a single corporation. One of the limitations of this study is the lack of homogeneous data about the actual situation in a company.

Ideally we would like to have access to the social network of a real corporation, monitor results, introduce some changes, gather results and compare. Additionally we would like to contact with employees whose needs could be gathered. There is no doubt that graph metrics and KPIs have a direct relationship, and that it is worth to continuing researching.

Another important conclusion is that it will be very difficult to improve every KPI so each company should study which KPIs are most important and focus on improvement of the most relevant KPIs.

Finally, we have to describe the results obtained related to the Page Rank algorithm. We must say that we can use this result to expect improvement in communication speed between the different teamwork groups. Inside each of the shared profiles, we would have information about an ongoing project, so this information could be used to look for relevant topics and task that have already been performed or in process, hence greatly enhancing (at the global corporate level) coordination and collaboration.

Of course it is always good to increase the contact between professionals that belong to the same sector.

8 Future Work

Obviously there remain a lot of tasks to be performed concerning corporate social networks. We have to see this study as a base for future studies. The next steps to be taken should be view focus first on following the same work path, in order to obtain private corporate social network results.

Given these results, changes should provide better relationships with the network graph metrics, and then we should obtain more reliable equations of how the KPIs are enhanced.

As we can see, it is not possible to obtain a parallel enhancement of every KPIs, thus each company should select which KPIs have a greater value. A beta of the functionality would be interesting to compare the KPIs with and without the introduction of specific functionality.

Whether our proposed model is the best and it would fit with a company's needs, then the final task will be to introduce the desired functionality within the social network. I strongly recommend for future research, a deep understanding of the particular corporation's needs and the current social network (if it exists) because the needs can be different in every cases, hence it is important to understand which factors will have what a direct impact on relevant KPIs.

We cannot forget that although the KPIs have some formulas already defined regarding (such as Lovett's), the features of the different social networks change, hence the functions and their parameters should be adapted and changed individually continuously for each case.

With respect to the Page Rank results, it is necessary to perform deep research into this interesting topic; the parameters shown during this report could be changed in order to broaden the search engine utilities that are used within a corporation.

9 Required Reflections

This study attempts to give a general overview of several matters important to an employee's professional life. It is a good example of how the technology has a direct impact on the company and their employees' daily life, growth, and objectives; how employees can connect to every node within a corporate social network with regard to social, business, and technical issues.

This study showed how the social network is a very broad topic, while a lot of improvements might be carried out. Also it is important to have this study as an example of how to address future problems and the need to give deep insight into the path that should be followed to obtain tangible results.

It is worth considering how the innovations proposed within this thesis could improve the daily professional life of the reader; keeping in mind the key points of this study, the current solutions and the company's needs. We should think about the huge future impact on the medium and large sized companies in relation to the flexibility presented and how they can address their worker's demands in order to solve some of the internal communication problems. Although this study cannot show an optimal implemented solution, it should open a new research line for the future.

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