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FACULTY OF TECHNOLOGY

Digital Marketing Plan for VTT's Conventional and Renewable Energy Solutions

Anna Tenhunen

ENVIRONMENTAL ENGINEERING
Master's Thesis
December 2016

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ABSTRACT
FOR THESIS

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Abstract

Social media has an integral role in today's businesses due to the rapid development of the internet and digitalization. Still, businesses do not fully utilize the potential of social media and majority of companies do not have a digital marketing plan. Strong social media profiles facilitate a platform to showcase the expertise and research facilities, and strong, active social media profiles do better in search engines. Social media profiles can also be used for starting discussions on related topics or participating in them by writing as administrator. The fundamental purpose of the social media profiles on different sites is to drive traffic to companies' sites and create leads.

This master's thesis was commissioned by VTT's Renewable Energy Processes team. The goal was to produce a digital marketing plan to enhance customer and project acquisitioning by utilizing social media (LinkedIn, Facebook, Twitter). In this thesis, the creation process of a digital marketing plan was studied especially from the perspective of VTT's Renewable Energy Processes. The most important social media channels for the team were determined, energy solutions based on their expertise were studied, and a plan was conducted from the perspectives of the organization and employees. In addition, a questionnaire was sent out to the employees of VTT's Solutions for Natural Resources and Environment organization. The purpose of the questionnaire was to gain an understanding of possible limitations and barriers for using social media professionally. In addition, it was used to map out the social media sites employees were already active at as well as what sites they might be interested in.

The formed digital marketing plan includes strategies for social media and content marketing. A digital marketing plan was produced based on a mission statement, reviewing resources and defining target audience. An important part of the plan was to analyze companies' as well as competitors' current social media presence. For the social media marketing plan, sites were chosen and site specific plans were created. A content marketing plan was made to facilitate the creation and curation of content. The content marketing plan was an integrate part of the digital marketing plan as the most common problem is creating captivating content continuously.

A trial social media profile was created in Facebook under the name VTTEnergySolutions. The profile was created in the beginning phase of this thesis and it was studied for the duration of approximately 5 months in 2016, from July to November. Based on the analysis, the reachability of a post could be increased by sharing it further to different discussion groups. There was also an interesting correlation between energy related events and increase in site traffic.

The produced digital marketing plan is aligned with VTT's new strategy. It focuses on utilizing the expertise of the employees, the VTTPeople, and increasing impact through creating and sharing content in the appropriate social media sites. Currently, the most important social media sites for the organization to be active in are LinkedIn, Facebook and Twitter. These are the chosen sites for Renewable Energy Processes to begin their social media activities at.

Based on the results obtained in this thesis, the VTT's official social media profiles in these social media sites will be utilized in the future according to the suggestions presented in the digital marketing plan. A Showcase page in LinkedIn under VTT's company page will be the platform for publishing content. The efficient use of current VTT related hashtags encouraged to create a new hashtag: #VTTEnergy. This new hashtag plays a key role in the strategy for Twitter. The trial social media profile VTTEnergySolutions in Facebook will be continued and other energy related teams will be sought out to share administrative responsibilities. An editorial calendar created in Outlook to assist the team to plan, produce and manage the contents.

Additional Information

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Työn nimi

Digitaalinen markkinointisuunnitelma VTT:n konventionaaliselle ja uudistuvalle energiaosaamiselle

Opintosuunta	Työn laji	Aika	Sivumäärä
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Tiivistelmä

Sosiaalisella medialla on tänä päivänä merkittävä rooli liiketoiminnassa internetin ja digitalisaation nopean kehityksen vuoksi. Tästä huolimatta yritykset eivät täysin hyödynnä sosiaalisen median mahdollisuuksia eikä suurimmalla osalla yrityksistä ole digitaalista markkinointisuunnitelmaa. VTT:n uusiutuvien energiaprosessien yksikkö tarvitsee strategisen linjauksen digitaalisen markkinointisuunnitelman muodossa. On tärkeää muodostaa uusiutuvien energiaprosessien yksikölle vakuuttavat sosiaalisen median profiilit, joissa voidaan tuoda luotettavasti ja kattavasti esille tietoa yksikön osaamisesta ja tutkimusinfrastruktuurista. Aktiiviset ja suositut sosiaalisen median profiilit ja niiden sisällöt näkyvät paremmin hakukoneiden hakutuloksissa. Profiileja voidaan myös hyödyntää avaamalla keskusteluja sekä osallistumalla niihin esimerkiksi ylläpitäjän roolissa. Eri sosiaalisen median sivustojen profiilien tarkoitus on kasvattaa VTT:n sivujen kävijämäärää ja tuottaa yhteydenottoja potentiaalisilta asiakkailta

Tämä diplomityö on tehty VTT:n uusiutuvien energiaprosessien yksikölle. Työn tarkoitus oli tuottaa digitaalinen markkinointisuunnitelma kasvattamaan yksikön asiakashankintaa ja projektikantaa. Työssä käydään läpi digitaalisen markkinointisuunnitelman luomista erityisesti VTT:n uusiutuvien energiaprosessien yksikön näkökulmasta. Työssä selvitettiin kyseiselle yksikölle tärkeimmät sosiaalisen median kanavat, tutkittiin heidän osaamisen perusteella energiaratkaisuja sekä luotiin suunnitelma niin yksikön kuin sen työntekijöiden näkökulmasta. Lisäksi VTT:n luonnonvara- ja ympäristöratkaisujen (SONE) työntekijöille lähetetyllä kyselyllä selvitettiin työntekijöiden näkemyksiä sosiaalisen median ammattimaiseen käyttöön liittyen. Erityisesti mahdollisten rajoitteiden ja haasteiden kartoittaminen digitaalista markkinointisuunnitelmaa varten oli tärkeää. Kyselyn avulla myös selvitettiin, missä sosiaalisen median kanavilla työntekijät olivat jo aktiivisia sekä mistä he voisivat olla kiinnostuneita jatkossa.

Työssä tuotettu digitaalinen markkinointisuunnitelma sisältää strategialinjaukset sosiaalisen median ja sisältömarkkinoinnin näkökulmasta. Digitaalinen markkinointisuunnitelma muodostettiin määrittelemällä toiminta-ajatus, arvioimalla resurssit sekä määrittelemällä VTT:n uusiutuvien energiaprosessien kohdeyleisö. Tärkeä osa suunnitelmaa oli analysoida oma ja kilpailijoiden sen hetkinen sosiaalisen median näkyvyys. Sosiaalisen median markkinointisuunnitelmaan kartoitettiin sopivat sosiaalisen median kanavat ja sekä määriteltiin kanavakohtaiset suunnitelmat. Sisältömarkkinointisuunnitelma on tärkeä sisällön tuottamisen ja hallinnoinnin kannalta. Sisältömarkkinointisuunnitelma on tärkeä osa kokonaissuunnitelmaa, sillä tyypillisimmät ongelmat liittyvät jatkuvaan kiinnostavan sisällön tuottamisprosessiin.

Diplomityöprosessin alkuvaiheessa Facebook:iin muodostettiin kokeellinen sosiaalisen median profiili eli VTTEnergySolutions sivusto. Sivuston data analysoitiin viiden (5) kuukauden ajalta syksyllä 2016, heinäkuulta marraskuuhun. Havaintojen perusteella, julkaisujen saavuttavuutta pystyi parhaiten kasvattamaan jakamalla julkaisua eteenpäin erinäisiin keskusteluryhmiin. Lisäksi alan energiatapahtumilla havaittiin olevan selvä vaikutus sivuston kävijämäärissä.

Tuotettu digitaalinen markkinointisuunnitelma on VTT:n uuden strategian mukainen. Suunnitelma fokusoi hyödyntämään työntekijöiden, eli VTTPeople, vahvuuksia ja osaamista sekä luomaan impaktia tuottamalla ja jakamalla sisältöä valituissa sosiaalisen median kanavissa. Tällä hetkellä yksikölle tärkeimmät sosiaalisen median kanavat ovat LinkedIn, Facebook ja Twitter. Nämä kanavat ovat uusiutuvien energiaprosessien yksikölle ne kanavat, missä yksikön kannattaa aloittaa aktiviinen toiminta.

Osa suunnitelmaa on hyödyntää VTT:n virallisia sosiaalisen median profiileja valituissa kanavissa. LinkedIn:ssä hyödynnetään Showcase -sivustoa VTT:n yrityksen sivun alla. Twitterin strategia pohjautuu VTT:n onnistuneeseen hashtag -nimikkeiden käyttöön. Uusi hashtag, #VTTEnergy, otetaan käyttöön lähitulevaisuudessa. Facebook:n VTTEnergySolutions sivuston ylläpitoa jatketaan ja ylläpitovastuuta jakamaan haetaan VTT:n muita energiatutkimukseen liittyviä yksiköitä. VTT:n käyttämään Outlookiin on myös tehty julkaisukalenterityökalu helpottamaan tiimin työtä sisällön suunnittelussa, tuottamisessa ja julkaisemisessa.

Muita tietoja

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This master's thesis has been commissioned by the Renewable Energy Processes organization of VTT Technical Research Center of Finland. The thesis has been written during a six (6) month period in the fall of 2016. The purpose of this thesis was to produce a digital marketing plan containing strategies for social media and content marketing based on a survey of energy networks considering thermochemical processes and biohybrids. The goal was to produce a social media tool bag that can be integrated into the busy work of researchers.

When I got the acceptance phone call from my thesis instructor Hannu Mikkonen in May 2016, I was filled with joy to have the opportunity to write my thesis for VTT. This project has been so interesting and rewarding that I feel almost a bit sentimental that this project is now finished. I have learned a lot during this process and have had the chance to get to know some amazing people along the way. If I could, I would thank you all here, but apparently my thesis is rather long already…

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A completed thesis is the highlight of the year 2016, this has been the best birthday and Christmas present I could have ever given myself. I am ready to graduate and head on to future endeavors.

In Oulu, 16.12.2016 Anna Tenhunen

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LIST OF ABBREVIATIONS AND SYMBOLS

BFB	Bubbling Fluidized Bed
B2B	Business-to-Business
B2C	Business-to-Customer
CCS	Carbon Capture and Storage
CFB	Circulating Fluidized Bed
CFD	Computational Fluid Dynamics
CH4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CPU	CO2 purification unit
CSP	Concentrated Solar Power
DNI	Direct Normal Irradiance
FC	Fixed Carbon
GHG	Greenhouse Gas
HDO	Bio oil Upgrading Tests
HHV	Higher Heating Value
HTL	Hydrothermal Liquefactioning
H_2	Hydrogen
KPI	Key Performance Indicator
LVH	Lower Heating Value
MGC	Marketer-Generated Content
NCP	Network Control Protocol
NGL	Natural Gas Liquids
NO	Nitrogen monoxide
NOx	Nitrogen oxides
NO_2	Nitrogen dioxide
N_2	Nitrogen
N_2O	Nitrous Oxide
O_2	Oxygen
PC	Personal Computer
PV	Photovoltaics
RES	Renewable Energy Sources
SME	Small-Medium Enterprise
SONE	Solutions for Natural Resources and Environment
SO_2	Sulphur dioxide
UGC	User-Generated Content
VM	Volatile Matter
VOC	Volatile Organic Compounds
VTT	Technical Research Centre of Finland
WWW	World Wide Web

1 INTRODUCTION

The potential of digital marketing is not fully utilized by majority of companies. Especially in Finland, the utilization rate is lagging behind when compared to other countries in the Europe and USA. (Lintulahti 2014a) Due to the rapid development of the internet and digitalization, social media has become a low threshold platform for customers to search information and enquire about experiences before actually committing to a specific service provider. To be the one finding the customers at that stage has a chance to reach out directly to a potential customer, which is an advantage over one's competitors. (Apăvăloaie 2014) Research centers' financing has become more reliant on self-funding as government funding has decreased. It is essential to find new ways for customer acquisitioning to ensure operations. As the energy sector is going through an immense transition, research centers offering services and solutions for customers in the field of energy generation and utilization, have interesting marketing possibilities in different platforms on the internet.

1.1 VTT Technical Research Center of Finland

This master's thesis is commissioned by Renewable Energy Processes of Solutions for Natural Resources and Environment (SONE) of VTT Technical Research Centre of Finland. VTT was founded in 1942 and today, it is the leading research and technology company in the Nordic countries and is one of the top research centers in Europe. VTT's turnover in 2015 was 184.5 million Euros and had 2 470 employees. VTT has a national mandate and serves both public and private sectors. Through multidisciplinary research and development, VTT creates new technologies, solutions and services for businesses and wellbeing of the society. VTT cooperates closely with industry, research institutes, universities and authorities. VTT offers services in the fields of bioeconomy, low carbon energy, sustainable and smart city, smart industry, digital society, health and wellbeing, pilot plants, research and development infra as well as overall business development. (VTT 2016a)

1.2 Background

A significant proportion of the global power generation is produced by combusting fossil fuels. Majority of industrial and municipal energy production is based on fossil fuels for supply security. (Szemmelveisz et al. 2009) Use of fossil fuels produces greenhouse gas (GHG) emissions creating global problems resulting in climate change. (Szemmelveisz et al. 2009) Energy providers are looking for new technologies and resources to fulfill the growing demand for emission free energy and environmental protection. It is important to decrease the fossil fuels' role in energy supply security. (Tietjen et al. 2016) In many countries, interests towards renewable energy sources in the global energy sector is expected to go through a big transition as cities are aiming towards low or zero carbon emissions. (Tietjen et al. 2016) The EU relies heavily on renewable and low-carbon source bioenergy to be a key factor in replacing fossil fuels as well as achieving climate and energy targets set for 2020 and beyond. (Giuntoli et al. 2016)

To manage climate change, new energy and environmental policies are being made and effective ones are adjusted constantly. By the year 2020, compared to 1990, it is expected for energy efficiency to increase by 20 %, greenhouse gases to decrease by 20 % and the energy consumption to decrease by 20 %, also transportation is expected to lower its emissions by 10 %. Goals for 2030 are to reduce GHG emissions by 40 % (compared to 1990) and to increase the share of renewables to 27 %. (Giuntoli et al. 2016) To fulfill these goals, potential customers are looking for possible ways to continue operations and to improve their businesses. Research centers, like VTT, have a chance to offer their expertise. For example, improved utilization of biomass, a better understanding of combustion properties, fuel characteristics and ash behavior are research questions that need to be answered to fulfill the goals. (Tietjen et al. 2016) One way to engage with the potential customers is to utilize social media to showcase expertise and facilities.

Social media has changed the power structure in the today's modern world. Social media is a dominating force that can make or break a business, change minds, increase sales, build and shape a brand or a business. The consumer behavior has changed and forced companies to review their digital marketing strategies. (Nord et al. 2016, Sareah

2015, Constantinides 2014) Digital marketing grows more important constantly and it is necessary to have a digital presence (Tachibana 2014).

The role of social media has become an integral element of 21st century business: to survive the age of empowered customer, engaging in the social media is a strategic imperative (Constantinides 2014, Felix et al. 2016). Social media sites have proven to be effective platforms for different marketing purposes. (Nord et al. 2016, Sareah 2015) By tapping into the conversations in social media, companies can use social media platforms to reach consumers and gather information. However, there is still a lot of untapped potential. Majority of companies do not have an actual digital marketing plan. (Felix et al. 2016)

1.3 Thesis Objective and Structure

The purpose of this thesis is to create a digital marketing plan for the conventional and renewable energy solutions at VTT by finding potential online marketing channels to enhance customer acquisitioning. The focus is on thermochemical processes and solar energy technologies.

This master's thesis is outlined technically based on VTT's expertise in thermochemical processes, solar energy and dynamic modelling. The theory section is built on three elements: social media, digital marketing and a technical review of Renewable Energy Processes expertise. A review is made on social media from the perspective of creating a digital marketing plan (Section 2.1), literary review for the digital marketing from the perspectives of social media and content marketing (Section 2.2), and a technical review of combustion, pyrolysis, gasification, fuels, thermochemical reactors and solar energy (Section 2.3).

In Section 3, VTT's expertise is showcased. The possibilities for process modelling and simulation as well as thermochemical conversion facilities are presented. Also a short summary of VTT's new strategy, published in 2016, is presented in this section. VTT strategy outlines certain strategical decisions made in the digital marketing plan.

Section 4 presents the methods used in this thesis. A trial social media profile, VTTEnergySolutions, was created in Facebook to establish a content publishing test ground to gain information on planning, creating and publishing different types of content. The information gained from the trial profile is used for the content marketing plan. Also a questionnaire was sent out to the employees of Solutions for Natural Resources and Environment (SONE) to map the current usage of social media sites and identify possible barriers for the utilization of social media at a professional level. These methods had an important role for the development of the digital marketing plan.

In Section 5, the results of the trial social media profile and the questionnaire are presented. Also, the digital marketing plan is constructed under this section (5.3).

2 THEORY

The development of the internet to a global commodity service constantly creates new technologies and applications (Leiner et al. 2016). The internet is for everyone to access freely and it is not governed by anyone, yet it contributes to over 2.2 trillion dollars in annual retail sales (Leiner et al. 2016, Stevens 2016). In 2016, there were 3.42 billion internet users, which is over 46 % of the total world population (InternetLiveStats 2016). The massive user base and easy, free access of the internet offers interesting opportunities for businesses as well as consumers. Online presence is important; it is simply not an option in today's world to not have it. If you are searched online, chances are that there is material of you even if you have not been the one uploading it. (Apăvăloaie 2014, Tachibana 2014) Studies show that lack of online presence is associated with a small and poor company (Apăvăloaie 2014).

Digital marketing is an efficient marketing tool, yet it is not fully utilized especially in the industrial sector. Efficient digital marketing is more likely to be achieved when an actual digital marketing plan is created. Understanding the different forms of digital marketing, such as content and social media marketing, and being able to utilize different types of tools is necessary in order to become a master at digital marketing. (Lintulahti 2014)

2.1 Social Media

The development of internet and information and communications technologies have led to the development of social media platforms, which are actively used worldwide. The main function of social media is to facilitate social interaction for its users. Social media platforms create the facilities for the interactions. Users search information, share content, engage socially, form and maintain relationships, join groups, identify themselves, etc. A social media site like LinkedIn e.g. supports connecting with the business world and offers its users to build relationships with potential employers, employees, colleagues, customers, etc. (Penni 2016) Social media is also known as "user generated communication" or the next generation World Wide Web (WWW)

known as Web 2.0 (Brengarth & Mujkic 2016; Michaelidou et al. 2011; Oxley 2013, p. 1-32).

Web 2.0 is a web service, which focuses on users to share information and collaborate online. Web 2.0 is interactive, user controlled, and free or inexpensive. It is a simple way to create and share content. It is a "collection of technology, business strategies and social trends that makes connectivity between people much easier" (Brengarth & Mujkic 2016). Users have been able to two-way communicate by text, now they can also communicate by photos, video and audio. (Brengarth & Mujkic 2016; Oxley 2013, p. 1-32)

2.1.1 Development of the Information and Communication Technologies

The information and communications technologies have gone through an immense transition due to digitalization made possible by the development of the internet (Elitas 2015). In 1967, the plan for the first computer network concept ARPANET, predecessor of the Internet, was first published. By 1969, already four host computers were connected via ARPANET. After this, computers were added quickly to the ARPANET and this lead to a functionally complete Host-to-Host protocol, Network Control Protocol (NCP), and other network software. After creating NCP, the development of different applications could begin. (Leiner et al. 2016)

For the research community, S. Crocker established a Request for Comments function for informal, fast way of sharing ideas with other network researchers. By 1972, the electronic mail (e-mail) concept was first introduced and the functions "read", "file", "forward" and "respond to messages" were created. “From there, e-mail took off as the largest network application over a decade”. ARPANET grew into an open architecture network environment, the internet. (Leiner et al. 2016)

The development of Local Area Networks, Personal Computers (PCs) and workstations lead to the fast development of the internet. The internet was spreading like wildfire and new developments were accomplished constantly as limitations of growth were stumbled upon, which further enhanced the quick growth. Already by 1985, the internet was already well established and supported a broad range of different communities,

mainly researchers and developers, in their daily communication. E-mail could be used by different mail systems. Eventually the WWW concept was created in 1989, everyone with an access and a browser could access the global collection of text documents and other resources linked by hyperlinks and URLs. (Leiner et al. 2016)

Commercialization of the internet lead to the development of competitive, private network services as well as the development of commercial products utilizing the technologies for internet usage. The internet has not finished changing, new applications and services spawn constantly. Now, the internet has become a commodity service that could be accessed globally through the WWW. “The Internet is as much a collection of communities as a collection of technologies”. Important services of the internet were and still are communication, data transfer and the WWW. (Leiner et al. 2016)

Digital and telecommunication technologies have converged the traditional newspapers, TV and radio channels as well as opened up new possibilities for services and products in the digital communication media. (Elitas 2015) Emerging social technologies provide economical development possibilities for business purposes. Social media technologies have had a longer lasting impact on communications on a personal level for a while already, but most recently they have become a support platform for businesses as well. (Nord et al. 2016)

Media proliferation, market globalization and new emerging information and communication technologies have changed the dynamics of modern marketing. The most prominent information and communication technology seems to be the internet. (Constantinides 2014) The internet makes it possible to deliver content such as picture and sound to anyone anywhere. Information is instantaneous without the need of time and space. Two-way and simultaneous information sharing has emerged along with traditional one-way information sharing, like news as an example. The new generations are utilizing social media to meet their personal, social and academic needs. (Elitas 2015) Social media has changed the power structure: customers are powerful and sophisticated, difficult to influence, persuade and retain (Constantinides 2014).

2.1.2 Social Media Platforms

Defining the term *social media* is challenging due rapid development of it and technologies utilizing it in the free and open access environment. By Merriam-Webster dictionary, social media is described as "forms of electronic communications through which people create online communities to share content like information, ideas, personal messages, etc." (Meyers 2012).

The definition of social media platforms is even more challenging to define unambiguously. (Denardis & Hackl 2015) Social media platforms are complex and interconnected (Felix et al. 2016). Some definitions define platforms as applications that allow user generated content (UGC) to be shared, others define them by their ability to exchange information interactively. In some cases, platforms are used to describe the frame a social media site is built on and in some cases they refer to the actual social media sites. (Denardis & Hackl 2015)

However, from a technical perspective, social media platforms offer different functionalities. Yanbo et al. (2016), summarize these functionalities as follows: conversations, sharing, relationships, identity, presence, reputation and groups. By combining these different types of occurring definitions, social media platforms have different functionalities and facilitate different types of actions. They are an intermediation of UGC, a platform that offers individuals networking connections with each other, and a platform that offers direct interactions between users and content. (Denardis & Hackl 2015, Yanbo et al. 2106)

In this thesis, social media platforms describe the type of means on which social media sites can be built upon. In Table 1, an example listing of different types of social media platforms are presented with examples of each platform based social media sites are. (Meyers 2012)

Table 1. An example list of social media platforms and social media site (Meyers 2012, Penni 2016).

Social Media Platforms	Social Media Sites
Social Networking sites	Facebook, Google+
Microblogging sites	Twitter, Tumblr, Posterous
Blogging sites	Blogger, Tumblr, Penzu
Publishing tools	WordPress, ResearchGate
Collaboration tools	Wikipedia, WikiBooks, WikiTravel
Rating/Review sites	Amazon's rating, IMDB
Photo Sharing sites	Flikr, Instagram, Pinterest
Video Sharing sites	YouTube, Vimeo, Viddler
Personal Broadcasting tools	Livestream, Podcast, Ustream
Virtual worlds	World of Warcraft, Farmville
Widgets	Like buttons, Share buttons
Social Bookmarking and News Aggregation	Digg, Delicious
Group buying	Amazon, eBay, tori.fi, Groupon

For maximum exploitation of social media platforms, it should be understood that different platforms have different functions and forms, how to engage in them and to take inconsideration their transient nature. (Yanbo et al. 2106)

For improved utilization of social media, it is important to understand how social media platforms can be accessed. They can be divided into two categories; web based and mobile based platforms. Websites are typically used via PCs, which is generally fixed to a certain physical location. In many cases, applications are being created for website based platforms. Accessing social media via mobile devices like smart phones or tablets is popular and can be done anywhere. Mobile applications have a higher sensitivity to time and location. (Gikas & Grant 2013, Kaplan 2012) Businesses engaging in mobile social media are offered more knowledge of the user like geological position of the user in time or space. (Kaplan 2012)

2.1.3 Social Media Sites

Social media sites, like Facebook and Google+, are generated constantly. In Figure 1, statistical information on active users of the leading social media sites is presented.

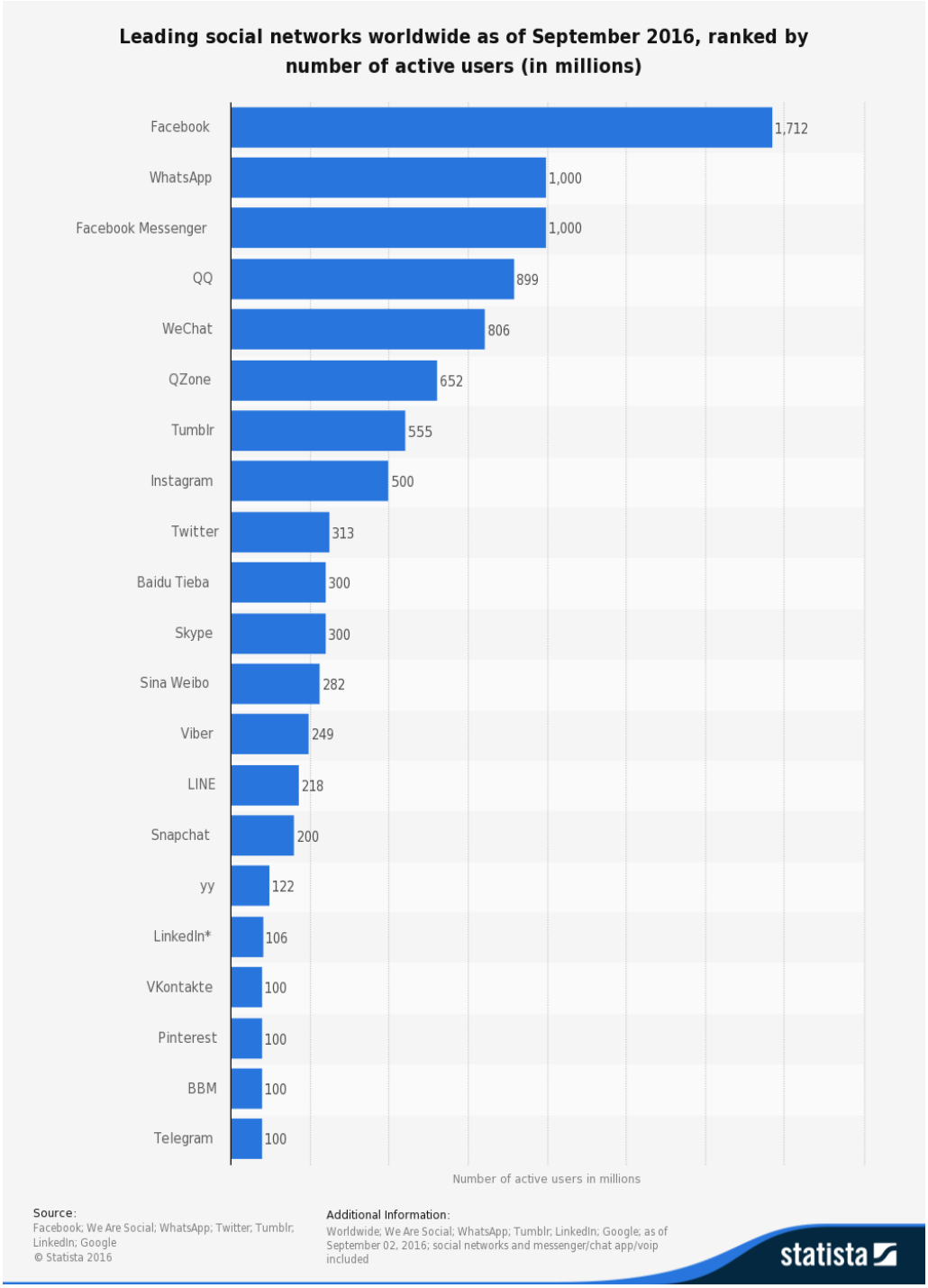


Figure 1. Statistics on the leading social network sites worldwide in September 2016 (Statista 2016).

Communication platforms are generally instant messaging clients like Whatsapp, Facebook Messenger, WeChat, popular among Chinese are QQ and Baidu Tieba, Skype, Viber, Line, BlackBerry Messenger (BBM) and Telegram. Instant message types of platforms will not be examined further in this thesis.

From the Statista statistics (Figure 1) the following social networks will not be discussed in more depth: QZone, Sina, YY, VKontakte, Pinterest. QZone is a Chinese social networking website, which allows its users to write blogs, keep diaries, send photos, listen to music and watch videos (Qzone 2016). Sina Weibo is also a Chinese microblogging site and it has a similar penetration to Twitter in the USA (Weibo 2016). Snapchat is an image and video sharing application (Snapchat 2016). YY is a major Chinese video based social network (YY 2016). VKontakte is a Russian social networking service similar to Facebook (VKontakte 2016). Pinterest is a photo sharing website that catalogs pins (media content, mainly photos and videos) to collections under ideas (Pinterest 2016).

In Figure 2, statistics on the usage of social media sites for content marketing in Finland is presented based on the report of Content marketing trends in Finland in 2014.

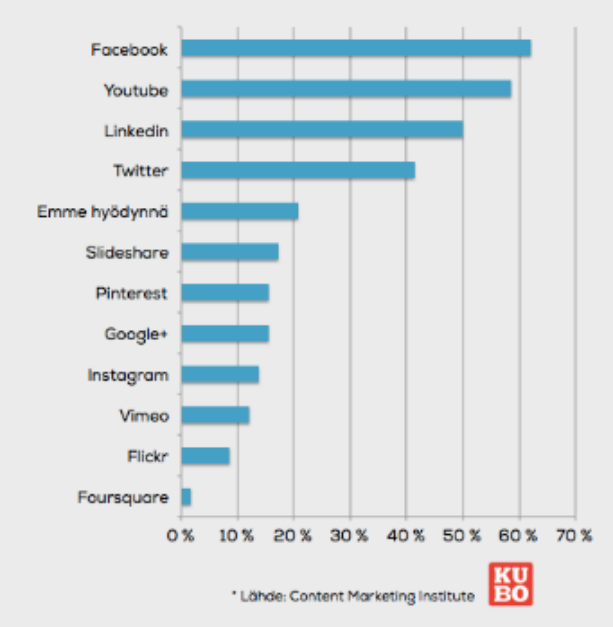


Figure 2. Used social media sites in content marketing in Finland in 2014 (Lintulahti 2014b).

The report states that the most used social media sites are Facebook (61 %), YouTube (59 %), and LinkedIn (50 %,). Twitter is the 4th popular social media site, 41 % of companies use it in their content marketing. In the USA, LinkedIn is the most used at 91 %, Facebook at 81 % and YouTube is the 3rd most popular. LinkedIn is considered to be the most efficient social media site in Finland and around the world. Twitter is ranked higher worldwide, but it is also gaining more users in Finland. (Lintulahti 2014b)

From the leading social networking sites worldwide, Facebook, Twitter, LinkedIn, Google+, YouTube, Instagram and Tumblr will be discussed more next. Also ImpactStory, ResearchGate, Academia.edu, MyScienceWork, ScienceOpen, Zenodo, Mendeley, Flickr, and Reddit will be looked into as possible networking sites. At the end of site specific details is a summary of all the described networking sites.

Facebook

Facebook is the biggest and most popular social networking site based on global reach and total active users. It has the greatest number of users. In October 2016, Facebook had 1.71 billion users worldwide of which 1.55 billion were active. Active users are users that have logged in during the last 30 days. Facebook has over 1 million advertising small-medium enterprises (SME) and estimations show that bigger enterprises are using annually up to 100 million dollars in Facebook advertising. Facebook has become an innovation playground for advertisers and marketers. Marketing seems to be the primary business approach of Facebook. (Nord et al. 2016)

Facebook is mainly used for personal contacts. It generally reveals fun and nonprofessional insights like hobbies and free time interests about the user. The main focus is not in academic and professional background. However, universities, corporations and research groups have public Facebook pages. Facebook acts as a platform for conversations by its groups function. (Tachibana 2014) Facebook has been long the most efficient social media channel in content marketing, but its importance has recently decreased some (Lintulahti 2015b). The recent development in Facebook users' posts is that the content shared is less personal than before. News and interesting articles are shared more as content. Sharing personal anecdotes has decreased as much as by 21 % since mid-2015. (Talouselämä 2016)

Twitter

Twitter is an online and social networking service. Twitter has created a characteristic post called tweet, which is limited to 140 characters. Tweets have revolutionized microblogging in social media. Twitter has 313 million users of which 304 million are active users. Twitter's primary business approach is spreading the word quickly. (Nord et al. 2016) Twitter utilizes hashtags (#), which are used to categorize what tweets are about. Hashtags can be searched. Tweets can be retweeted, quoted or responded to. A public reference of "@" can be used in tweets. Twitter is especially a popular platform for sharing links. (Twitter 2016)

LinkedIn

LinkedIn is a professional networking site, where users can create profiles for personal use and for their companies. LinkedIn's primary business purpose is professional networking and it can be used by enterprises as well as general users. Enterprises can engage with their stakeholders by actively creating content and developing their digital profile. User profiles can connect with colleagues and friends, creating their own professional network. LinkedIn has over 332 million users and it grows at a rate of 2 new members per second. This makes LinkedIn very attractive to marketers. (Nord et al. 2016)

Google+

Google+ is Google owned application. It is a social networking site, where users can create circles and join different communities. (Google+ 2016) Google+ is a popular site in Latin America. It has over 300 million users. Google+ 's primary business purpose is marketing and it has over 53 % positive interaction rate between users and brands. (Nord et al. 2016)

YouTube

YouTube is a social media site where users can upload video material. Monthly, over 6 billion hours of video is being watched. Each day, 1 billion hours of videos are played over mobile phones. Only in the United States, over 63 % of the population has used the site to listen to music or watch music videos. It's primary business purpose is marketing. (Nord et al. 2016)

Instagram

Instagram is a mobile photo and video sharing social networking service. Instagram photos and videos can be also shared through to other social media sites like Facebook, Twitter, Tumblr and Flickr. Instagram is known for providing digital filters for users to use in their images. (Instagram 2016)

Tumblr

Tumblr is a Yahoo! owned blogging and social networking website. It allows to create different types of blogs by allowing its users to upload different types of content to their blogs: photos, GIFs, links, Spotify tracks, etc. (Tumblr 2016).

ImpactStory

ImpactStory is an online website, which can be used as a tool for exploring and understanding the impact of one's work. It is similar to Google Scholar. It tracks the impact of one's publications in Twitter, blogs, news outlets, etc. (ImpactStory 2016)

ResearchGate

ResearchGate is a networking site for scientist and researchers, where publications can be shared. Currently, it offers over 100 million publications, with over 11 million researchers. It can also be used for discussions and to find collaborations. (ResearchGate 2016)

Academia.edu

Academia.edu is research paper sharing site, where academics can share their work. It has almost 46 million registered academics that have uploaded almost 17 million papers to Academia.edu. (Academia.edu 2016)

Zenodo

Zenodo is a scientific networking and sharing site. It has research field based communities which can be generated by users. Zenodo accepts all kinds of research, from sciences to humanities. (Zenodo 2016)

MyScienceWork

MyScienceWork is a scientific networking site, where individual members can access and share research. It has 0.5 million users and over 30 million publications. It has a digital promotion platform for research institutes and R&D companies, which helps increase international visibility and exposure of research work. (MyScienceWork 2016)

ScienceOpen

ScienceOpen is a research networking site. It has over 26 million articles and its users can publish, collaborate and give peer reviews. It utilizes smart filters, topical collections and input from the academic community to contextualize content. (ScienceOpen 2016)

Mendeley

Mendeley is a networking site, where its users can showcase their publications to other researchers. It also measures article performance with authoritative metrics like downloads and citations. It can also be used for generating citations and bibliographies during writing processes. Networking possibilities include also the possibility of creating and collaborating in groups. (Mendeley 2016)

Flickr

Flickr is a photo management and sharing site. It allows publishing photos and organizing the photos in a new way. User can give permission to other users to help categorize, tag, note and comment on their photos. (Flickr 2016)

Reddit

Reddit is a discussion website, where content is submitted for review by the users. It has subcommunities that focus on specific subjects for example science or music. (Reddit 2016)

Periscope

Periscope is a live video sharing social media site. It is owned by Twitter and allows its users to live stream. (Periscope 2016)

Summary of Social Media Sites

The discussed social media sites are collected in Table 2. A conclusion on whether the social media site is relevant to Renewable Energy Processes is also presented. The relevant social media sites for the team are Facebook, Twitter, LinkedIn, YouTube. Also the following sites are useful and relevant to active researchers ImpactStory, ResearchGate, Academia.edu, MyScienceWork, ScienceOpen, Mendeley and Periscope.

Table 2. A summary of researched social media sites in relevance to the Renewable Energy Processes team. The most important ones for researchers are bolded.

Site	Type of Site	Pros	Relevance to Renewable Energy Processes
Facebook	Social Networking	Free. Popular.	Relevant: channel for publishing content and to network.
Twitter	Microblogging	Free. Popular.	Relevant: channel for showcasing researcher profiles.
LinkedIn	Professional and social Networking	Free. Popular. Important for companies.	Relevant: channel to showcase company's and researchers' expertise.
YouTube	Video sharing	Free. Popular.	Relevant: a place to upload videos for sharing them further.
Google+	Social Networking	Free. Somewhat popular.	Not currently: main users not in target audiences.
Instagram	Photo Sharing	Free.	No: no need to upload photos to a certain channel for sharing.
Tumblr	Blogging and Mircoblogging.	Free. Popular.	Not currently: no great scientific impact.
ImpactStory	For exploring and sharing online impact of one's research.	Open data and communication. Free.	Relevant: tool for researchers.
ResearchGate	Social and Scientific Networking, and Sharing.	Open data and communication. Free. Popular.	Relevant: site for active researchers.
Academia.edu	Scientific Networking and Sharing.	Open data and communication. Free. Popular.	Relevant: site for active researchers.
Zenodo	Scientific Networking and Sharing.	Open data and communication. Free.	Not currently: no great scientific impact.
MyScience Work	Scientific Networking and Sharing.	Free for individual users.	Relevant: site for active researchers. Possibilities for the team too

ScienceOpen	Scientific Networking and Sharing.	Free. Publishing, collaborating and peer reviews.	Relevant: site for active researchers.
Mendeley	Scientific Networking and Sharing.	Free. Tools for citation and bibliographies. Groups.	Relevant: site for active researchers and other tools.
Flickr	Photo Sharing	Free.	Non relevant: no need for a photo sharing site.
Reddit	Social Networking	Free. Discussions in science subcommunity.	Not currently: no great scientific impact.
Periscope	Live Video Sharing	Free. Twitter based.	Relevant: tool for active researchers.

2.1.4 Scientific Use of Social Media

Social media has enabled a new way of communicating about research work. Researchers have several platforms to share research, review and communicate with other researchers around the world. Currently popular social media sites specifically targeted to share research work are ResearchGate, MyScienceWork, ScienceOpen, Academia.edu, etc. It is common that these scientific networking sites are free and open for all. The ability to communicate scientific research to the general public is essential these days. The social media sites used depend on the branch of science and personal preference. Generally though, mainstream sites like Facebook, LinkedIn and Twitter are well used too. (Van Eperen & Marincola 2011)

In the early 21st century, mainstream sites like Facebook and Twitter, were and still somewhat are perceived as unprofessional sites by scientists. This led to the creation of closed web communities with a specific theme, like Surgytec, which is for medical employees, or Sciatble, which is a genetics and cell biology professional network. Social media was viewed merely as tool that distracted people from real life like realtime events and discussions. (Van Eperen & Marincola 2011) Social media networks, like the specific closed communities, emerge, evolve and go extinct.

(Tachibana 2014) They do not generally communicate with the general public. A shift has occurred towards more of an open minded view on social media: it is a powerful communication advancement that allows successful communication with the general public at the channels that the masses are using. (Van Eperen & Marincola 2011)

Networking sites help scientists stay current, keep track of colleagues and other enterprises in the field, build a community of advisors and collaborators, participate in seminars and conferences remotely (webinars), interact internationally, etc. Everyone has an online presence, whether they wanted and built it themselves or not. This can be checked by just doing an online search in one's name. To start managing one's online presence, it is recommended by Karen Peterson, a director of Scientific Career Development, for researchers to start with a LinkedIn profile. A thoroughly made profile that is regularly updated portraits one's background information, education, experience and accomplishments to potential customers, employers and other users. Networks can be increased and enhanced by engaging in conversations and setting up meetings. (Tachibana 2014)

Social media users are commonly assumed to be young and early career scientists, but research shows that established researchers are also active online (Tachibana 2014). It is reported that research workers spend up to 28 hours each week writing e-mails, searching for information and collaborating internally (Chui et al. 2012). The scientific conversations are moving online which grows the online communities. Users of all ages, work experience history and careers are utilizing online sites and tools. Because the users are so heterogeneous, the social media sites create genuine and interactive communities that are far reaching. Social media is accessible to all globally, making it a great equalizer. (Tachibana 2014)

2.2 Digital Marketing

The consumer behavior has changed and forced companies to review their digital marketing strategies Tiago & Verissimo 2014. Recent research suggests that not only do many consumers and social media users expect the companies to participate in social media, but some even purposely pull companies into the social media by mentioning the brand or hashtagging them in a post (Felix et al. 2016). The role of social media has

become an integral element of 21st century business: to survive the age of empowered customer, engaging in the social media is a strategic imperative (Constantinides 2014, Felix et al. 2016). The importance of utilizing digital marketing in the industrial sector is growing constantly. By 2013, the industrial sector's businesses were already using 26 % of their total marketing budgets towards digital marketing. (Järvinen & Karjaluoto 2015) In 2014, based on a survey of marketing managers, majority of companies had internal and external pressure to adopt a digital presence in different social media platforms Tiago & Verissimo 2014. Main drivers for enhancing digital marketing are its cost effective nature, changes in customer behavior, and the fact that its results are easier to see and measure than traditional marketing (Järvinen & Karjaluoto 2015). The Web 2.0 based applications allow the implementation of innovative forms of communications with the customers as well as to create content closely with them Tiago & Verissimo 2014 b

2.2.1 Structure of a Digital Marketing Plan

There are several ways to produce a digital marketing plan. Digital marketing businesses have commercialized different frameworks and templates. By combining the different approaches and taking into consideration the outline of this thesis, a digital marketing plan containing strategies for content and social media marketing can be constructed based on the principles presented in Figure 3. (LePage 2016)

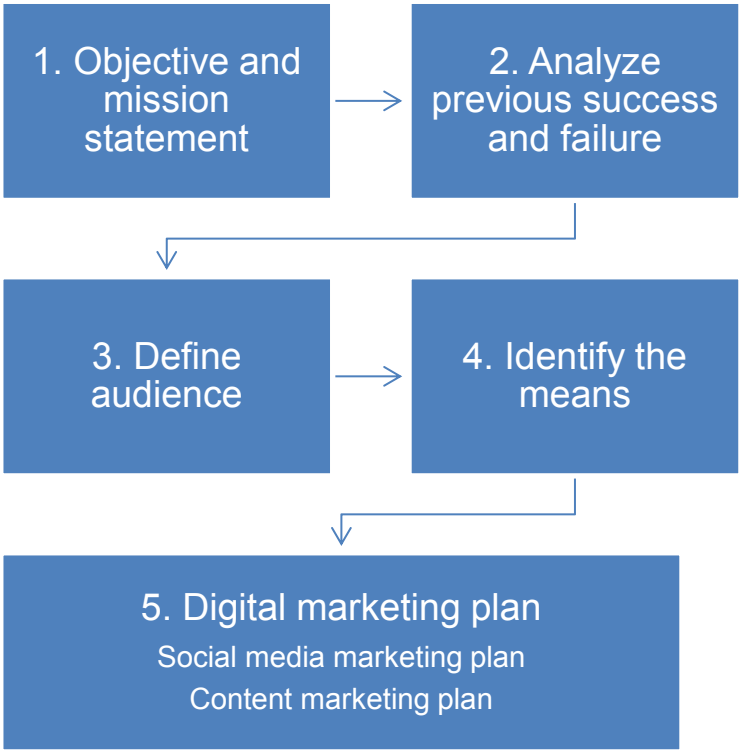


Figure 3. Basic structure for creating a digital marketing plan.

The first phase of creating the plan is to establish a mission, then to define more specific goals and objectives. Having concrete objectives helps analyzing the success of social media activities and campaigns. Goals are used to measure success and for example, a tool to measure return of investment. Digital marketing goals should be aligned with the broader marketing strategy. One commercialized framework for goals is the SMART framework: specific, measurable, attainable, relevant and time bound. (LePage 2016) By setting specific and realistic key performance indicators (KPIs), it is easier to reach the set targets but also to measure the success. A realistic and specific KPI would include the goal and a measurable figure that is reached by a target date or a timeframe. For example: "increase traffic (= goal) by 10 % (= figure) in 2 months (= target)". (Burke 2016)

The second phase is to audit the current social media presence and its previous success. It is important to analyze who is the target audience for each social site, what type of content has been posted, who is in charge, etc. (LePage 2016) To analyze the current social media status, analytics like Google Analytics can be utilized. This is also the phase to analyze the competition. (Burke 2016)

An important part of the plan is to define target audience: audience need to be the heart of the strategy and their needs should be met. The defining process should include key characteristics like demographic information such as gender, location and age, but also information about their career or job title, and the type of problems they might need solving. Also identifying what kind of goals, desires, aspirations and fears they might have is important. At this point, it is good to start evaluating the capabilities and strengths of the team: who could help or influence customers, etc. (Burke 2016)

The fourth section includes identifying the means: budget, team members or employees, and the chosen social media channels. Digital marketing budget should include any costs chosen sites might have, whether paid promotion will be used, if commercial analytical programs are going to be used, etc. Analyzing the team members should include an overview of what could be realistically achieved, what are the capabilities, and identify the level of personal digital marketing activity. Also it needs to be identified whether there is a need to outsource something or if more employees need to be hired. The current digital marketing channels need to be analyzed as well, and make a decision on whether to keep them or even invest in them. Burke 2016)

For the fifth phase, the actual digital marketing plan is created. Social media marketing plan consists of the chosen social media sites, creating profiles there as well as improving them and the profiles already existing. For the content marketing plan, an editorial calendar should be taken into use to help the creation and curation process of contents. (Burke 2016, LePage 2016)

2.2.2 Barriers, Challenges and Risks

It is established that the one of the main factors contributing to inadequate digital marketing is the lack of an actual plan (Chui et al. 2012). One other major contributor is the slow adaptation of technologies, mainly because of lack of funding, time, training, and management and technical support, being unaccustomed to the social media technologies as well as personal opinions on the matter. Successful digital marketing requires innovation inside the organization. Based on studies, smaller enterprises tend to be more innovative and open for adaptation of new technologies. (Michaelidou et al.

2012) It also has to be noted, that new tools, approaches and technologies emerge all the time, so it is important to stay current (Felix et al. 2016).

As denoted by Felix et al. (2016), engaging in digital marketing communications, like discussions, in social media, also increases the risk of "moderations and consequences arising from participation in social media". A challenge for digital marketing is that management, employees and customers conceptualize and use social media differently. Also identifying and managing employees' responsibilities is an important factor. Identifying the individuals responsible for social media marketing can be challenging. (Felix et al. 2016)

2.2.3 Social Media Marketing

Social technologies have changed the trend of internet being the connection between computers to it actually connecting people. Social media has become a way of life in socializing and business. Social media makes it possible for individuals and businesses to get their messages across to large audiences. (Cross 2014). Globally, over 1.5 billion people are utilizing social media platforms to find and share information. By tapping into the conversations in social media, companies can use different social media platforms to reach consumers and gather information. However, there is still a lot of untapped potential. Approximately 72 % of companies use social technologies in some way, but only a few are even close to utilizing the full potential. (Chui et al. 2012)

Social networks are created between individuals, groups of people, organizational organizations and associations and corporations. The social networks vary in size and heterogeneity. (Michaelidou et al. 2012) Typically SME or work group based social networks are smaller in size and more homogenous than in larger corporations. Based on studies on competitiveness of businesses, it is critical to have social networks for bigger enterprises, but essential for the survival for smaller businesses. (Michaelidou et al. 2012)

Michaelidou et al. (2012) state that social media marketing is an appreciated value adding tool, that makes it possible for enterprises to provide information, to accommodate connectivity, community and transactions, and to share cost reductions.

How companies should utilize social media depends on the marketing objectives and challenges set based on the type of industry and product. For example, whether the business is business-to-business (B2B), which is typically the case for industry, or business-to-customer (B2C) is a factor. (Felix et al. 2016) B2B marketing utilizes the social media to generate value for brand through information, knowledge, conversations, relationships and e-commerce. Social media has become the most important resource in global commerce of B2B. (Michaelidou et al. 2012)

The role of social media marketing is important to be understood by researchers as well. Currently, studies have been mostly focused on isolated social media marketing issues that benefit B2C enterprises. Studies have been conducted on issues like effective communication, purchase behavior, customer relationship and brand management, innovation management, traffic generation to online platforms, reducing marketing costs and employee recruitment. There are several advancements in these specialized areas, but a more of a holistic approach to strategic social media marketing has yet been produced. By Felix et al. (2016), strategic social media marketing needs a holistic framework so that it is no longer an untested user interaction paradigm with little published academic research. (Felix et al. 2016)

There are several benefits in engaging in social media marketing. Market research report that businesses use social media for several purposes. These purposes are divided into goals. Michaelidou et al. (2012) categorized social media marketing goals:

- increase traffic to website and others sites,
- identify new business opportunities,
- create communities,
- distribute content,
- collect feedback from customers, and
- support brand.

These goals can be achieved by collecting information from and about the customers, collect feedback from the customers, utilize two-way conversations, and constantly develop and improve on the customer relationship with communication and interaction (Michaelidou et al. 2012).

Strategies

There are several approaches for different social media marketing strategies: customer relationship management, marketing organization, marketing problems, customers and communications, etc. (Felix et al. 2016). Michaelidou et al. (2012) summarized three value adding strategies for branding that focus on building a customer relationship in B2B context: information rich strategy, relation exchange strategy and joint learning strategy. These strategies examine the relationship between internet characteristics, like interactivity and information availability, and key customer variables, such as trust, satisfaction and commitment. (Michaelidou et al. 2012)

In the study of Kietzmann et al. (2011), seven functional building blocks were found to be in common with all forms of social media. These building blocks are presented in Figure 4. By having different emphasis on these building blocks, different types of value can be created for users. In the study of Felix et al. (2016), research was conducted to define the critical decisions of social media marketing and how to integrate them into a holistic framework. (Felix et al. 2016)

Figure 4. Seven functional building blocks of all forms of social media (Modified from Kietzmann et al. 2011).

Another way to look at marketing strategies is characterizing it to be proactive or passive. Proactive enterprises are involved in conversations, have relationships with customers, and engage in activities like sharing. Companies that have a passive approach can monitor and analyze conversations in social media channels to gain an understanding of how customers discuss, react or view certain matters. An important passive approach is setting guidelines for employees on work related social media activity. However, it is difficult to set exact ground rules since the social media platforms are complex and interconnected. (Felix et al. 2016) In research conducted by Rokka et al. (2014), they stated that management, employees and customers construct the meaning of social media differently. This makes establishing guidelines more difficult. (Rokka et al. 2014)

2.2.4 Social Media Analytics

To enhance digital marketing efforts different kinds of analytic tools can be used. Data analyzed is typically attribute data or network data. User analysis provide information based on attribute data of individuals and their attributes like gender, age, demographics, movement or location, preferences, answers to surveys, etc. Network analyses provide information on the users and their connections. (Hansen et al. 2011)

Every time a post is made, or something is shared or liked, it creates a digital footprint in the social media site. Further activities based on this digital footprint, like viewing or resharing the content, data is added to the digital footprint creating a data trail. (Bradbury 2013) Social media analytics is about gathering data from social platforms to help improve on one's digital marketing strategy. (Järvinen & Karjaluoto 2015) This data lets businesses access all the conversations about their business and their competition. The type of data that is interesting depends on the digital marketing goals of each business. (Bradbury 2013) The KPIs can be identified based on the marketing goals. In most cases, social media KPIs are based on engagement statistics. They are generally divided into likes and shares a post receives, replies and comments and most importantly the clicks the links and content gain. (Järvinen & Karjaluoto 2015)

For non-profit organizations, governments and other similar enterprises, the goal is likely to be able to provide information that gets shared. Other typical focuses of B2B

enterprises are increasing brand awareness and brand trust, increasing customer satisfaction or just gaining information on customer behavior and interests. Also understanding key words and concepts from discussions help to create content that will be more relevant and reachable to customers. (Bradbury 2013) Studies show that companies using web analytics to demonstrate their digital marketing activities benefit their business. (Järvinen & Karjaluoto 2015)

Outsourcing a focus group or market survey does not only create expenses, but is also produced with a delay making it impossible to adjust one's marketing strategy in real time. There are several available analytical tools that can be accessed instantly. There are free tools, but also ones that are subject to charge. Generally, there are built in analytics in the social media sites, which focus on only that social media site and might provide less information than other analytical tools. Some available tools, like HootSuite, gather information from various channels. More advanced analytical tools provide information on what is being said online about a certain topic, creating a sentiment analysis, also known as an "opinion mining". Best analytics are viewed to be attribute based: they provide information about the customer history like location and behavior. Gained analysis should be compared to other data to find relations, e.g. what was the user reach for certain campaigns. (Bradbury 2013)

One free, widely used and an informative analytic tool is Google Analytics: it provides information on how users found the site and what happened afterwards. This way, for example, the effectiveness of social media campaigns or created content can be analyzed. (Bradbury 2013)

2.2.5 Content Marketing

By the definition of Content Marketing Institute (2016), content marketing is a marketing technique of creating and distributing valuable, relevant and consistent content to attract and acquire a clearly defined audience with the objective of driving profitable customer action. With great quality and consistent content, search engines reward businesses by bumping up search results. Good content is also a key to drive user traffic to one's sites. (Content Marketing Institute 2016)

The most important goals for content marketing are to increase brand awareness, increase customer commitment, enhance sales, acquire new customers, increase customer satisfaction rates, increase traffic at own sites and enhance and upkeep market dominance. (Lintulahti 2016) The biggest obstacle seems to be measuring the accomplishments of these goals. Without proper analytics, measuring can be insufficient and therefore, it is hard to assure professionals and researchers of the effectiveness of social media and content marketing (Lintulahti 2015a, Michaelidou et al. 2012). The biggest workload seems to be at producing interesting content and being able to publish content at a continuous and a systematic way, and to focus on organizing the contents better in different channels. (Lintulahti 2015a)

Based on Lintulahti's (2016) review of the Research's Survey on Content Marketing Trends in Finland in 2016, companies that have produced a content marketing plan produce more efficient content marketing and are more successful at it, than companies without a documented marketing plan. Without an actual documented marketing plan, issues with time, resources and the ability to produce content arise more often. Utilizing content marketing in Finland is behind other countries, where comparative studies are made. (Lintulahti 2014a, Lintulahti 2016)

Based on the Content Marketing Trends in Finland in 2014 survey, the companies revealed what kind of challenges they have with digital marketing. Below, the challenges are listed from the biggest to smallest issues.

- Lack of time to create content,
- resource inefficiency,
- being able to produce interesting content,
- understanding the customers and what is recent,
- how to find the best focus on target audience,
- internal coordination to produce content,
- budgeting and costs,
- how to measure the success rate of content marketing,
- technical issues, and
- lack of professional help in the field.

Content marketing plan is designed closely with the social media marketing plan. Content is always created for the audience, which in turn affect the chosen social media sites and goals. Strategies for creating and curating contents are included in the content marketing plan. An essential tool for curation is an editorial calendar. Important happenings, events and occasions are plotted in the calendar. Then a developing and posting/publication plan for contents can be created. Having an actual time table for posts helps to be meticulous with the digital marketing plan. (Lintulahti 2014a)

Content Marketing Strategy

Content is imperative in creating traffic for social media sites and further actions. Content can be categorized into user-generated (UGC) and marketer-generated content (MGC). (Choi & Lee 2016) UGC is generally categorized to be user reviews or comments, social tags, also known as 'electronic word of mouth'. (Choi & Lee 2016, Xu & Yin 2015) MGC is targeted for advertising and providing product information. In Choi and Lee's research (2016), UGC had a stronger effect on customers' cognitive trust and MGC on emotional trust. Majority of research has focused on UGC and cognitive trust. The terms UGC and MGC cannot be so simply separated, in many cases the content created is a combination of both. (Choi & Lee 2016)

The most efficient contents are visual such as videos, infographics, presentations, photos, etc. In fact, videos are actually the most viewed content at the moment. Especially *How To* videos seem to be more popular than for example an article on the same issue. Visualization tells a better story driving more traffic to website or creating more likes and shares. (Holmes 2014) It is important to utilize multiple channels. (Lintulahti 2015a)

There are many ways to engage in creating content. One way is to utilize a content matrix created by SmartInsights (Figure 5). The content matrix can be used to brainstorm content ideas based on identified and specific customer profiles. When creating content, it is important to be innovative and think outside the box. (Bosomworth 2014, SmartInsights 2016)

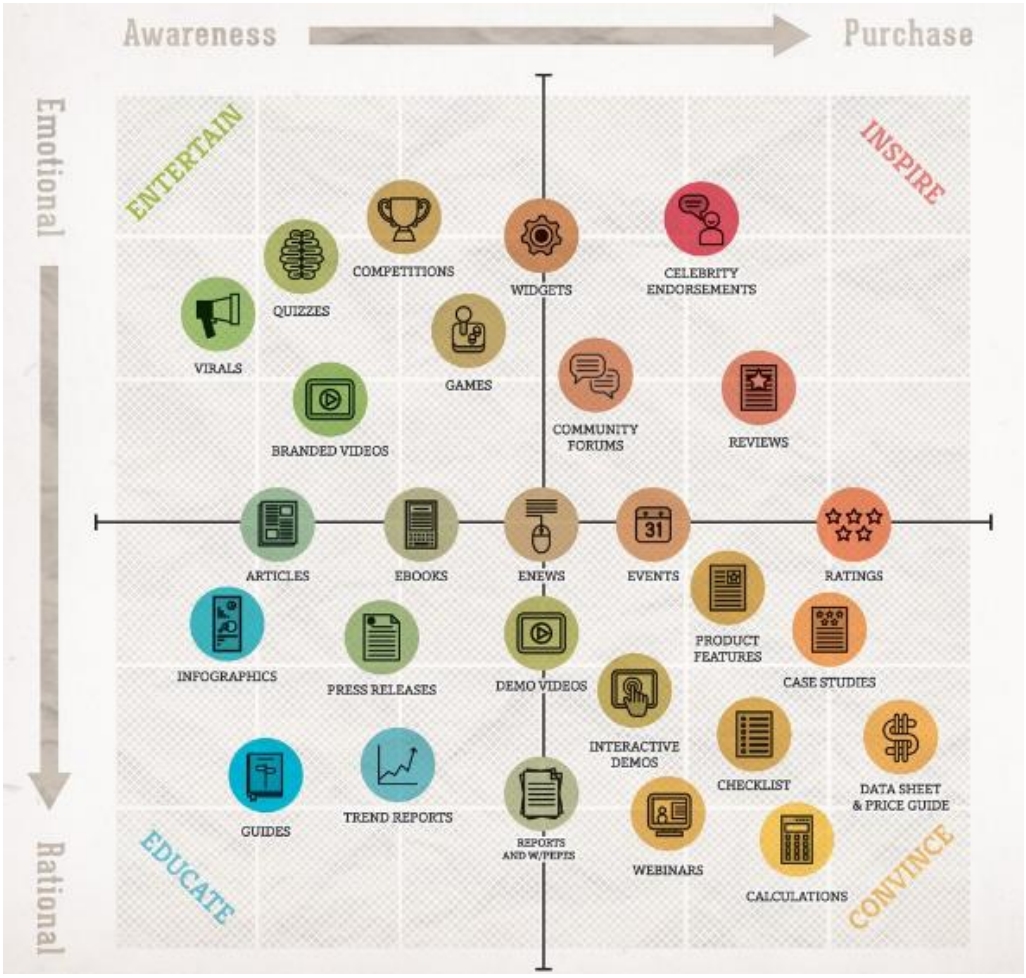


Figure 5. The content matrix (SmartInsights 2016).

There are two axes and four quadrants in the content matrix. The emotional-rational axis describes content that are used to attract and engage customers. For example, guides (on the end of rational axis) appeal to the rational side of customers. The other axis, awareness-purchase, reflects on the buying process. The buying process is about first creating awareness and providing information that leads to maybe a review or a discussion on forums, which leads towards a sales transaction. The four quadrants of the matrix categorize the content types: entertainment, education, inspiring and convincing. The entertainment quadrant includes games, videos, quizzes, etc. The education quadrant includes articles, infographics, press releases, etc. The inspiring quadrant creates impact with reviews, quotes, forums, etc. The convincing quadrant includes case studies, checklists, demos, calculation, etc. Convincing types of content can also be viewed as converting type of content since the goal is to drive the user towards sales transactions. Education especially is important for the industrial sector. (Cooler Insights

2016) Ideas for blog posts will be discussed more after this Content Marketing Strategy section.

An idea on the work load involved in creating contents is described in Figure 6. Engaging in social media is the easiest to implement and requires the least amount of attention. Press releases and blogs, articles and images are considered easy to implement. Interactive games and applications, animations and webinars are most difficult to produce and require more attention. (MyBlackBean 2016)

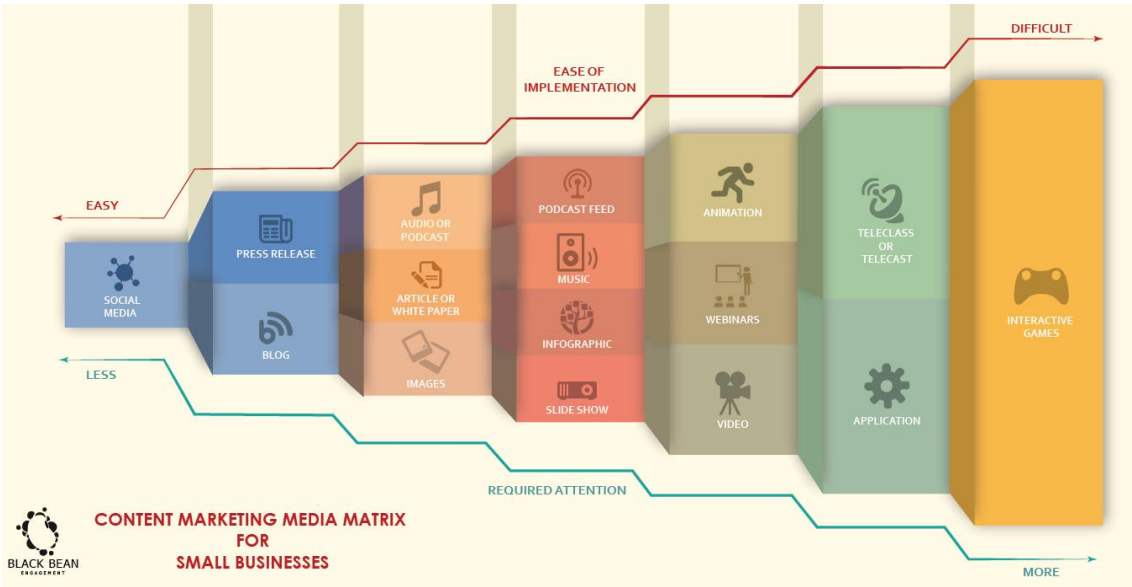


Figure 6. Work load analysis of creating content (MyBlackBean 2016).

Another important tool for creating content is the content marketing calendar (Cooler Insights 2016). There are several commercial calendars that can be used, but even with a Google Calendar, a calendar can be created. Google Calendar is easy to share among team members and allows editing. It is a good idea to high light key campaigns and their specific time frames to help promoting and content creation. (Burke 2016) It is important to document what kind of content is to be created and when it is to be published. (Cooler Insights 2016) For Renewable Energy Processes, an editorial calendar was created in the Outlook application.

Blogs

Blogs can be created in many ways and some ideas for Renewable Energy Processes are listed in Table 3. Maryan Jan (2016) listed 8 types of blog posts that are popular in 2016.

Table 3. Blog types (Jan 2016).

Type of Blog	Goal	Ideas
How to, solve a problem	Educational, convincing	Use expertise and simplify problems
Listing	Educational, entertaining	Easily shared content, "5 ways to cut down your energy consumption"
Myth busting	Educational, entertaining, convincing	-
Behind the scenes	Entertaining, inspiring, convincing, creates trust	"People behind the business", "Equipment and facilities"
Client/customer spotlight	Educational, inspiring, convincing	Case studies
Visual	Educational, inspiring, convincing	Infographics, Live stream, Slide Share presentation, Video, Animated GIF
Share a story	Inspiring, educational	Share results, personal insights, researcher's own journey
User-generated content	Entertaining, educational	Guest post, interview, summarize responses from a questionnaire, survey audience

2.3 Thermochemical Processes

In this section, combustion, pyrolysis and gasification will be looked into more technically. First, a revision of fuels for energy production purposes is made with a

main focus in biomass. After that, an overview of typical reactor technology used in thermochemical processes is made.

2.3.1 Fuels

The evolving of civilization has resulted in the development of new energy sources and conversion technologies. Industrial revolution started when the utilization of stationary wind and water mills began. As the demand for energy increased, the mills were replaced by the use of coal. New fossil fuels have been introduced as time has passed. From the 19th century's coal dependent civilizations, oil has shifted the dynamics of 20th century and today. Current rapid global industrialization and motorization require immense amounts of fuels: fossil fuels remain the primary source for heat and power production. (Lecksiwilai et al. 2016, Kataki et al. 2015)

Fossil fuels are hydrocarbons that have formed over millions of years from buried organisms. By burning the fossil fuels, the captured carbon is released back into the atmosphere. Carbon is naturally cycled between the ocean, bio- and atmosphere at a stable atmospheric concentrations of CO_2 and CH_4. (Solomon et al. 2007) However, fossil fuel combustion and industrial processes contribute to about 78 % increase in GHG emissions from 1970 to 2010 (IPCC 2014 p. 5). The increase in GHG has resulted in climate change causing several global problems: the atmosphere and ocean have warmed, Antarctic and Greenland's ice sheets have melt and due to this, sea levels have risen, atmospheric GHG concentrations have increased, heat waves occur more frequently and intensively, etc. (Moreira & Pires 2016, Kataki et al. 2015 p. 32) Due to the environmental concerns, there is a special interest towards renewable resources and subsequent development of biomass, hydroelectric, solar, wave, geothermal and wind power (Kataki et al. 2015, p. 31).

By the IPCC Guidelines for National Greenhouse Gas Inventory program in 2006, fuels were classified into six main categories: liquid, solid, gas, other fossil fuels, peat and biomass (IPCC 2006). The main categories, their subclasses and examples are presented in Figure 7.

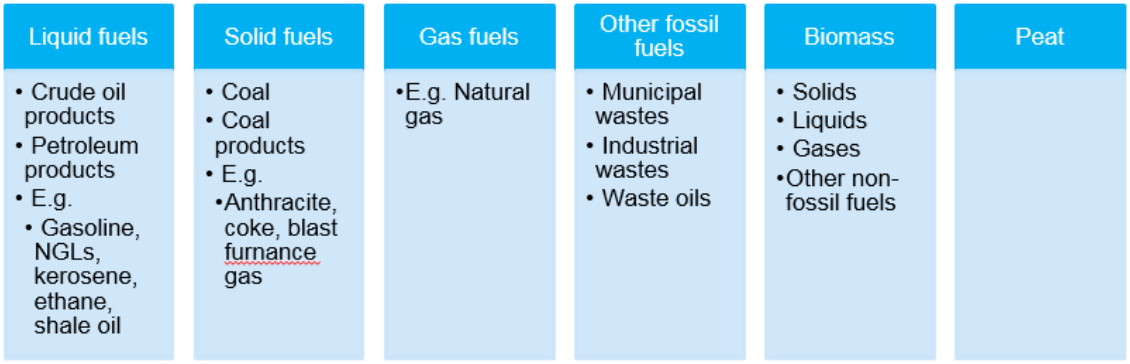


Figure 7. IPCC's categorization of fuel types.

Peat was categorized as a fossil fuel in 1996 IPPC Guidelines, but not anymore in 2006 guidelines. Peat is not strictly speaking a fossil fuel, however, it contributes to greenhouse gas emissions through its life cycle similar to traditional fossil fuels. Biomasses can be further classified into solids, liquids, gases and other non-fossil fuels. More on the classifications under "Biomass". (IPCC 2006)

Because biomass is an important fuel for renewable thermochemical energy processes, it will be further discussed in this theory section. Other types of fuels are further outlined from this thesis. Secondary fuels like pyrolysis oil and syngas are discussed in pyrolysis and gasification sections.

Biomass

Biomass is a carbon neutral, abundant and well available resource. Due to this, economies globally are aiming towards biobased economy based on bioenergy, biofuels and bioproducts. Biofuels have the potential to offset the effects of global warming. However, there is a conflict with biofuels when they are produced from edible sources or if they are produced on land that could be used for crops. A classification system of first, second and third generation fuels is used to analyze the sustainability of biomass. First generation fuels are produced from edible feedstock like corn, rice, wheat or sugarcane and oilseeds. They generally have a high carbohydrate or oil content and are valuable in the production of biodiesel, alcohols and biogas. Second generation fuels are nonedible and produced from lignocellulosic biomass and crop waste residues. Third generation fuels are still under development, but they are derived from fermentative and

photosynthetic bacteria as well as algae. Common trait for third generation fuels is that they have high contents of oil, carbohydrates or proteins. (Kataki et al. 2015, p. 31-37)

Biomass is a feedstock from which fuels, materials and chemicals can be produced via conversion processes. Biomass can be converted into heat by combustion, into fuel gas by partial oxidation, biogas through anaerobic digestion, bioalcohol by fermentation, into biodiesel by transesterification, pyrolyzed into bio oil or be processed into syngas, which is a platform gas for other fuels and chemicals. Fuel composition and fuel characteristics, like ash content and moisture, affect the processing option for each type of biomass. It is important that the used biomass is uniform in quality. Biomasses can be in solid, liquid and gas state. Solid fuels' energy content is contained in the form of fixed carbon (FC) and volatile matter (VM). VM describes the vaporized or devolatilized components, other than water, that are liberated when heated. Fuel types can be evaluated by examining these indexes. (Kataki et al. 2015, p. 34-7)

There is a tremendous diversity in biomass feedstock and therefore, several ways to classify biomasses. In the IPCC Guidelines for National Greenhouse Gas Inventory program in 2006, biomass was one of the main six categories of fuels. Biomasses were further classified into solid biofuels, liquid biofuels, gaseous biofuels and non-fossil biofuels. (IPCC 2006) Another way to categorize biofuels is by the origin of the biomass. Kataki et al. (2015), categorized the biofuels into eight origins presented in Table 4. (Kataki et al. 2015 p. 34-36)

Table 4. Biomass characterization groups (Modified from Kataki et al. 2015, p. 36).

Group of Origin	Biomass
Forest products	Wood, logging residues, trees, shrubs and wood residues, sawdust, bark
Energy crops	Short rotation woody crops, herbaceous woody crops, grasses, starch crops, sugar crops, forage crops, oilseed crops
Biorenewable waste	Agricultural wastes, crop residues, mill wood wastes, urban wood wastes, urban organic wastes
Sugar crops	Sugarcane, sugar beets, molasses, sorghum
Food crops	Grains, oil crops
Industrial organic wastes	Organic wastes
Aquatic plants	Algae, water weed, water hyacinth, reed, rushes
Others	Algae, kelps, lichens, mosses

Biomasses are composed of carbohydrates, protein or lipids (Chen et al. 2016). Due to the fact that wood is well available and attainable, wood based fuels are used and researched a lot. Woody biomass consists of carbohydrates cellulose and hemicellulose, and lignin, which is a non-sugar type of macromolecule. (Bridgwater 2011; Kataki et al. 2015, p. 37; Younan et al. 2016) Agricultural wastes like straw, manure, olive pits and nut shells, energy crops such as miscanthus or sorghum, forestry wastes such as bark and stumps, and solid wastes, sewage sludge and leather waste are an example of interest. (Bridgwater 2011) Even though homogenous fuels are preferred, coprocessing several fuel that consists of several biomasses, like municipal solid wastes, refuse-derived fuels or contaminated soil, makes the biofuel heterogeneous. Therefore, fuel characterization for different processes is important for optimal process conditions. (Al Chami et al. 2014, Younan et al. 2016)

2.3.2 Reactor Technology

The reactors used for combustion, pyrolysis and gasification are comparable. The basic operational principals for the most used reactors will be described in this section. Fluidized bed reactors like circulating fluidized bed (CFB) reactor and bubbling fluidized bed (BFB) reactors will be discussed in more detail, other reactors like

advanced fluidized beds, annular, flash and mechanical reactors, etc., and will be outlined from this thesis.

Reactors can be classified by the way the fuel is moved. Excluding special reactors, fuel is typically moved either mechanically, fluidically or self-moved. An example of mechanically moved fuel reactors is a screw conveyor or a rotary drum. Fixed beds are an example of self-moved reactors. Fixed beds have a wide temperature range; therefore, possibility for hotspots with ash fusion occur, there is a rather low specific capacity, heat up can be time consuming and scale up possibilities are limited. Also the requirements for fuel is homogenous, otherwise channeling of feedstock might occur. (Warnecke 2000)

Fluidized bed reactors utilize fluidization of the fuel. For biomasses, typically fixed and fluidized beds are used. Another way to examine reactors is by their mass flow direction. Fixed beds are typically counter or cocurrent, rarely crosscurrent. In counter current flow, feedstock and the reactive material, like steam or air or oxygen, are fed in at the opposite directions. (Warnecke 2000)

Fluidized Bed Reactors

Fluidized beds have good heat and mass transfer capabilities, good temperature distribution, good conversion efficiency, high specific capacity as well as fast heat up. They are popular due to their fuel flexibility, they can tolerate well variations in fuel quality and in particle size distribution. There are no hot spots, they have high carbon convergency, residence times are short, the technology is easily scaled up, they can be operated at partial load, etc. Typical fluidized bed reactor types are circulating and bubbling fluidized bed reactors. (Warnecke 2000)

Bubbling beds utilize relatively low gas velocities to fluidize the solid fuel. The low gas velocities create bubbles that rise to the surface mixing the fuel. Bubbling fluidized bed has recirculating hot sand that is fluidized by a carrier gas, typically the product gas, air, steam or oxygen. Fuel is fed into the hot sand bed. Bubbling fluidized bed technique is used a lot, because it is simple to construct, it is scalable and has very efficient heat

transferring capacity at small particle sizes, which yields in high pyrolytic liquids. It is well studied, which makes the technology well understood. (Jones et al. 2013)

As the gas velocities are increased, bubbling bed turns into a turbulent bed. Circulated fluidized beds utilize high gas velocities and are also referred to as fast beds. (Basu 2015, p. 22-23; Warnecke 2000) Circulating fluidized beds utilize turbulent mixing of fluidizing gas and solid fuels, this creates fluid like behaviour for the solid. Higher air flows mobilize the bed material. Fluidized beds utilizes preheated fluidized air, which is blown from air distribution nozzles at the bottom of the furnace (Figure 8). This results in fast heat transfer and chemical reactions with the bed material. (Hirvonen 2016; Warnecke 2000)

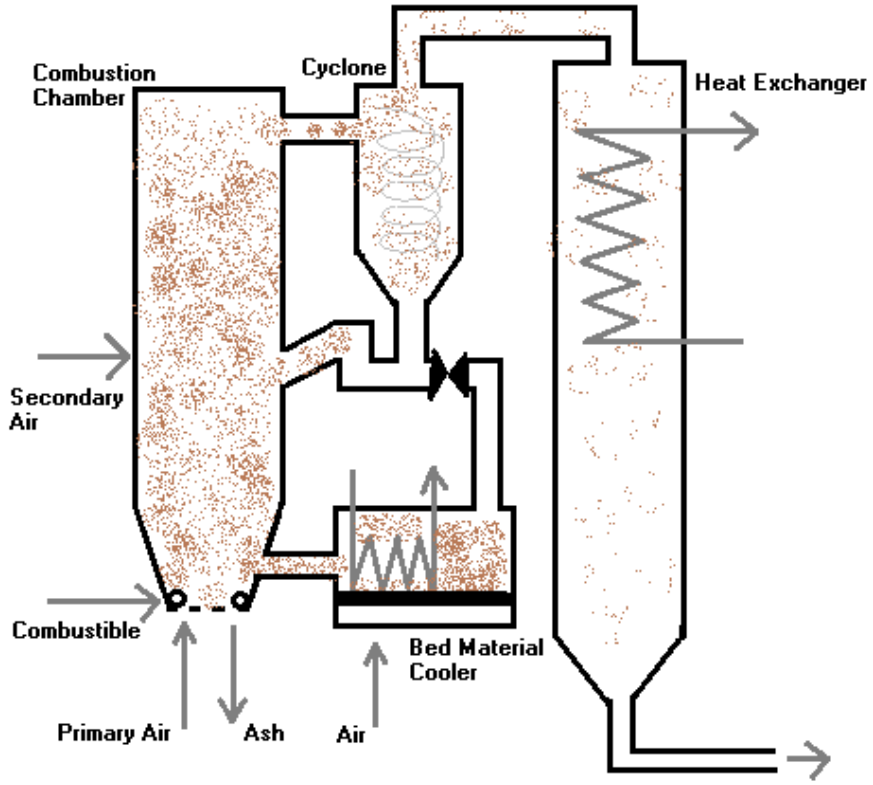


Figure 8. Typical circulating fluidized bed combustion configuration with a heat exchanger (Modified from Gazo Generator 2013).

Fluidization air acts as a primary combustion air. Primary air is used to control the heat transfer phenomena. Secondary combustion air is introduced to the secondary combustion zone and it controls the oxygen level of flue gas. Typical process temperature is at 800-900 ºC, where different hindrances can be controlled efficiently;

low thermal NO_x emissions, sulphur capture is efficient and fuel ash fusing can be prevented. (Hirvonen 2016)

Circulating fluidized bed pyrolysis is most used technology in the industry. It is similar to bubbling fluidized bed pyrolysis reactor, but in the circulating fluidized bed pyrolysis, the hot sand is circulated between the pyrolysis reactor and reheater. This enhances the heat transfer. (Basu 2015, p. 22-23; Hirvonen 2016)

2.3.3 Combustion

Combustion process's primary function is to transform chemical energy in a fuel to steam in the present of oxygen. (Basu 2015, p. 158) The global combustion reaction for hydrocarbons used in reaction calculation is presented in equation 1 (Basu 2015, p. 348).

$$C_xH_y + (x + \frac{y}{4} O_2) \rightarrow xCO_2 + \frac{y}{2} H_2O + Heat \quad (1)$$

Reaction Mechanisms

As fuel is combusted, it goes through a sequence of events presented in Figure 9. Those events are heating and drying, devolatilization and volatile combustion, swelling and primary fragmentation and combustion of char with secondary fragmentation. (Basu 2015, p. 92-94) As the fuel is heated, moisture evaporates causing it to dry and also release volatiles (Hirvonen 2016).

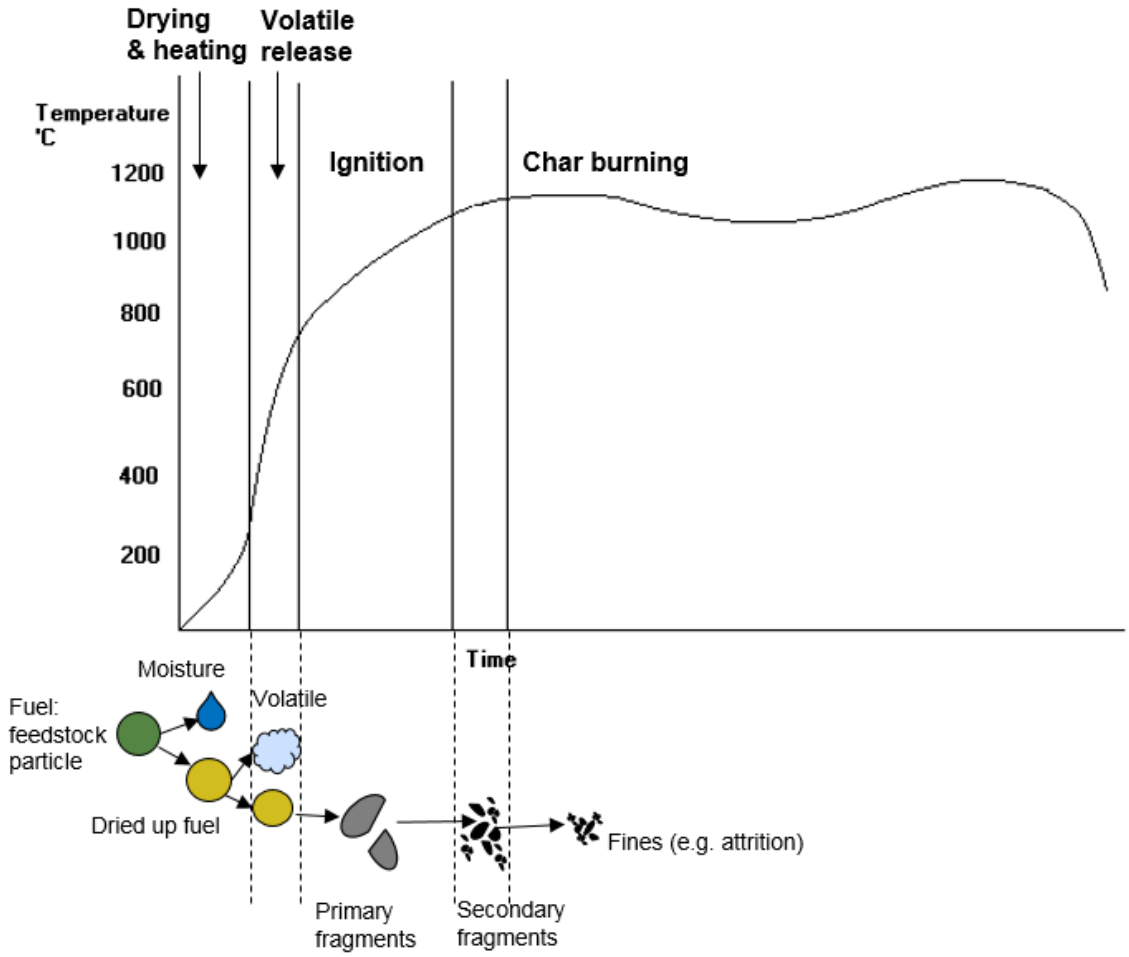


Figure 9. Combustion events (Modified from Basu 2015, p. 92).

Devolatilization is also called pyrolysis and in this process phase, condensable and non-condensable gases are formed. Volatile matter consists of different hydrocarbons that are released in stages based on the temperature. The volatile contents burn in diffusion or turbulent flame, which is affected by the oxygen diffusion rate. After the volatiles have been released, the combustion of char, devolatilized mass of the fuel, begins. Provided oxygen oxidates the carbon on the char surface to CO_2 and CO (equation 2). (Basu 2015, p. 92-96)

$$C + O_2 \rightarrow CO_2 \quad (2)$$

The fuel particle decreases and goes through other physical processes, like fragmentation and attrition, during the combustion process. Fragmentation occurs in primary and secondary phases. In primary phase, the rapid heating of the particle

increases the internal pressure causing the fuel particle to fragment into several smaller pieces. Secondary fragmentation occurs after the devolatilization process when carbon wall bridge between particle's pores is broken. In attrition, fines are produced through rather coarse coal particles being abrased together. The formed fines generally escape from the furnace and constitute to major combustibles loss. (Basu 2015, p. 104-106)

Emissions

Combustion of fossil fuels in power generation and transportation is the main source of manmade air pollution (e.g. SO_2, NO_X, CO, CO_2), volatile organic compounds (VOC) and fly ash, that contribute to health problems and climate change. Air pollution causes local problems such as smog, regional problems like acid rain and ground level ozone formation. (Basu 2015, p. 121-124)

For combustion processes, it is important to minimize the emissions. Sulfur can be captured with a use of limestone sorbent. Process parameters and other factors can be adjusted to lower emissions. Important variables are combustion temperature, pressure, fly-ash circulation rate, gas residence time/furnace height, solid residence time, pore characteristics and limestone sorbent size. (Basu 2015, p. 134-138)

Nitrogen oxides are NO, NO_2 and N_2O. Nitrogen oxide emissions can be reduced through combustion process modifications, like lowering the combustion temperature, staging the air feed, injecting ammonia and using lower excess air. (Basu 2015, p. 142-148)

Carbon dioxide emissions can be controlled via carbon capture and storage (CCS). For CCS, there are three promising and available technologies: pre-combustion, post-combustion and oxyfuel combustion. Oxyfuel combustion is a process, where oxidation reduction occurs in fuel and air reactors. CO_2 purification unit (CPU) captures the CO_2 from the gas. Conventional combustion plants can be retrofitted to oxy combustion. (Lappalainen et al. 2014) Chemical looping utilizes a metal oxide as an oxygen carrier in fluidized bed, that minimizes the mixing of nitrogen in combustion air with the flue gas. Due to this, the flue gases consist of carbon dioxide and moisture. Calcium looping is a post-combustion process, where flue gases are passed through a calcium oxide

absorber. Also conventional means like adding a scrubber to capture CO_2 is possible, but would add to consumption of electricity even up to 80 %. (Basu 2015, p. 150)

2.3.4 Pyrolysis

Pyrolysis is a thermochemical decompositioning process, where fuel is being treated in anaerobic conditions at elevated temperatures varying from 300 to 1100℃ to produce pyrolytic liquids and gas, and solid products (Burcu 2016, Chen et al. 2016, Schulkez 2016, Onay & Kockar 2003).

Reaction Mechanisms

Combustion wise, pyrolysis is the first phase of it. If oxygen were introduced to the process, combustion would occur. The fuel is heated, which begins the decompositioning reactions and mass transfer out of the fuel. (Jones 2011) The temperature range is broad. It varies based on the wanted product yield, but also there are fuel specific optimum operation temperatures. Particle characteristics effect the optimum temperature since particle size has a large role in heat and mass transfer. (Younan et al. 2016) The smaller the particle size, the better the heat and mass transfer. To obtain a small enough particle size, grinding is required, which is an energy intensive process. (Bridgwater et al. 2002)

Pyrolysis modelling is a complex process. There are several possible reaction pathways, because pyrolysis involves a great deal of physical and chemical transformations and produce a wide range of different product species. (Kim 2014, Younan et al. 2016) Even though extensive research has been conducted, there is still considerable debate over which reaction mechanism is controlling the distribution of pyrolysis products. The reaction mechanism depends on the process conditions and fuel. To be able to produce reliable models, proximate analysis of the raw fuel is essential. It consists of moisture, ash, volatile matter and fixed carbon contents. (Kim 2014)

Generally though, the pyrolysis process can be divided into three phases. The phases are drying, primary pyrolysis and secondary pyrolysis, which are shown in Figure 10. Distinguishing the primary and secondary reactions from each other is however rather

difficult due to the close coupling of these multiphase pyrolysis phases (Patwardhan et al. 2011).

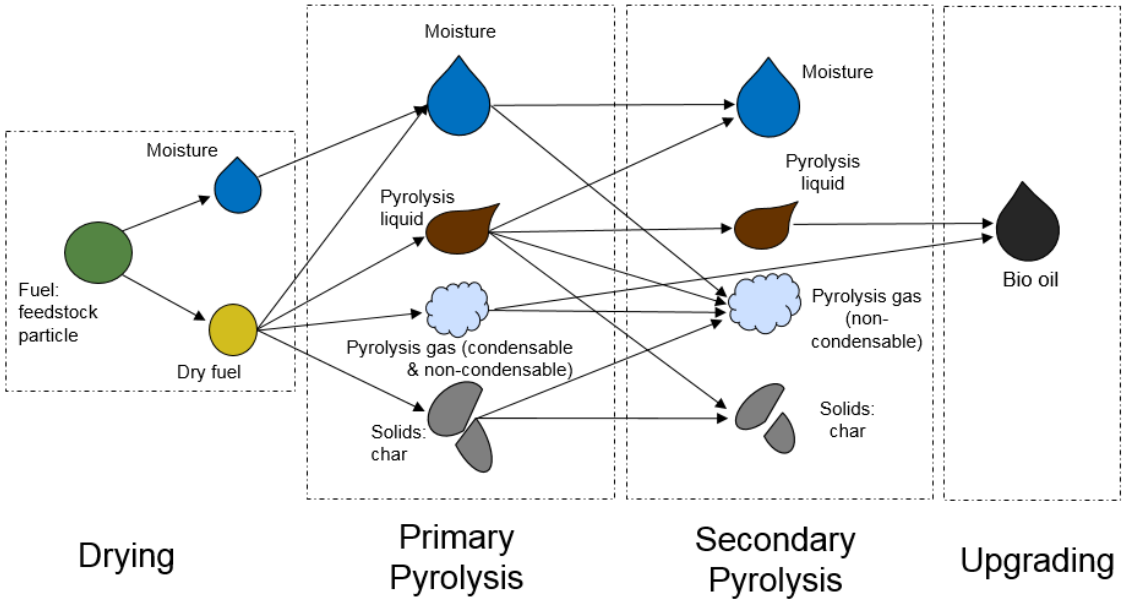


Figure 10. Generalization of reaction mechanics of pyrolysis.

In the drying phase, the fuel dries up whilst creating moisture and dry fuel. Primary pyrolysis consists of fragmentation and shrinkage; dry fuel breaks into pyrolytic liquid and non-condensable and condensable gases, as well as into solids like char. Secondary pyrolysis consists of multiple reactions: reforming, cracking, dehydration, polymerization, gasification, oxidation and water-gas shift. Secondary pyrolysis produces pyrolysis liquid, permanent non-condensable gas and solids. (Jones 2011)

Products

The fuel is processed into pyrolytic liquids also known as pyrolytic oil or bio oil or tar, gases and solids (Jones 2011). The yield fractioning depends largely on the fuel composition, ash content, volatile fraction, fixed carbon and the process conditions Jones et al. 2013).

Char is primarily composed of carbon, but contains also hydrogen and various inorganic compounds. Char is mainly used as fuel and soil amendment. Negative carbon cycle can be achieved by using char as a soil amendment. Formed non-condensable gases include

CO_2, CO, CH_4, H_2 and other light hydrocarbon compounds such as propane, propylene, butane, butenes, ethane, etc. (Burcu 2016) Non-condensable gases are collected during vapour condensation. The gas is generally used as a fluidizing gas in the reactor, but it is also collected for fuel purposes. (Jones et al. 2013)

Condensable gases are condensed to bio oil. Bio oil is brown or black, and free flowing at room temperature. Just the bio oil can contain over 300 compounds, such as highly oxygenated components. Bio oil is not compatible as a liquid transportation fuel without a catalytical upgrade. It can, however, be combusted directly in boilers, gas turbines and slow and medium speed diesel engines. (Burcu 2016, Jones et al. 2013, Carlson et al. 2008)

In Table 5, general properties of pyrolytic liquid, diesel and heavy fuel oil are presented for comparison. Bio oil can be used as an alternative to fossil oils, but due to rather high water content, approximately 20 %, the heating value is lower compared to fossil fuels. (Chen et al. 2016, Schulzke et al. 2016) Pyrolytic oil's calorific value is around 17.5 MJ/kg, which is approximately half of diesel’s and heavy fuel oil’s calorific value/lower heating value LHV (Table 5). It has similar properties to fossil oil in the handling, storage, transportation stages and in its utilization possibilities. (Bridgwater et al. 2002, Burcu 2016, Onay & Kockar 2003)

Table 5. Conventional fuel oils compared to pyrolysis liquid (Bridgwater 2002, Lehto et al. 2014).

Attribute	Pyrolysis liquid	Diesel	Heavy fuel oil
Density (kg/m^3 at 15 ºC)	1 220	854	963
Typical composition (%)			
C	48.5	86.3	86.1
H	6.4	12.8	11.8
O	42.5	-	-
S	-	0.9	2.1
N	< 0.4	0.02	0.4
Viscosity (cSt at 50 ºC)	13	2.5	351
Flash point (ºC)	66	70	100
Pour point (ºC)	- 27	- 20	21
Ash (wt%)	0.13	< 0.01	0.03
Sulphur (wt%)	0	0.15	2.5
Water (wt%)	20.5	0.1	0.1
Acidity (pH)	3	-	-
LHV (MJ/kg)	17.5	42.9	40.7

The product fractioning depends on the pyrolysis process conditions. Pyrolysis subclasses are slow, fast and flash pyrolysis. In Table 6, general information on these subclasses is presented. The heating rate and maximum temperature increase from slow to flash. Residence time acts the opposite being the shortest on flash pyrolysis and longest in slow pyrolysis. (Chen et al. 2016)

Table 6. Pyrolysis process types and their operational parameters (Burcu 2016, Chen et al. 2016, Schulkez 2016, Onay & Kockar 2003).

Attribute	Slow pyrolysis	Fast pyrolysis	Flash pyrolysis
Heating rate (℃/s)	< 1	10 – 300	> 1000
Temperature (℃)	300 – 700	550 – 1 000	800 – 1 100
Residence time (s)	< 450	0.5 – 10	< 0.5
Main product	Char [~35 %]	Liquids [~50-70 %]	Gases
Side products	Gas [~35 %] Liquids [~30 %]	Char [~10-30 %] Gas [~15-20 %]	Liquids Char

Slow pyrolysis is the original pyrolysis technique and its mainly used to produce charcoal; 25-40 % of char, 20 % gas, 25-40 % liquids. The fuel does not vaporize rapidly. This increases the residence time and allows the vapour components to have more time to react. Due to the process conditions, much of the solids remain in solid char creating charcoal. (Chen et al. 2016)

In fast pyrolysis, the fuel is heated to 550-1100 °C at a short residence time and after decomposition products are rapidly cooled (Carlson et al. 2008). After cooling and condensation, homogenous brown liquid is formed. Flash pyrolysis is similar to fast pyrolysis, they both aim to utilize rapid cooling of the product vapours and to shorten the residence time to avoid secondary vapour reactions. Flash pyrolysis also shortens the contact time between product soils and vapour to limit cracking. (Bridgwater 2011)

2.3.5 Gasification

Gasification is partial oxidation at elevated temperatures. Fuel is processed into the synthetic gas (syngas). Syngas consists of permanent non-condensable gases that are H_2, CO, CO_2, CH_4, N_2. (Bridgwater 2002) Further processing of syngas offers an environmentally friendly platform to produce fuels and chemicals. (Wender 1996) Carbonaceous compounds are applicable to gasification. Typical fuel is biomass, natural gas, wastes, oil and coal. Gasification is highly endothermic. (Bridgwater et al. 2002)

Reaction Mechanisms

In Figure 11, ideal process reaction mechanism for gasification process is demonstrated. The temperature changes in the reactor, which facilitates the conditions for the different phases. The first phase is drying, where fuel is dried creating moisture and dried up fuel particles. For successful gasification, it is optimum to remove moisture content as much as possible in the drying phase. The second phase is pyrolysis, where further moisture, pyrolysis liquids and gas, and char are formed in the absence of air. (AllPowerLabs 2016, Bridgwater et al. 2002)

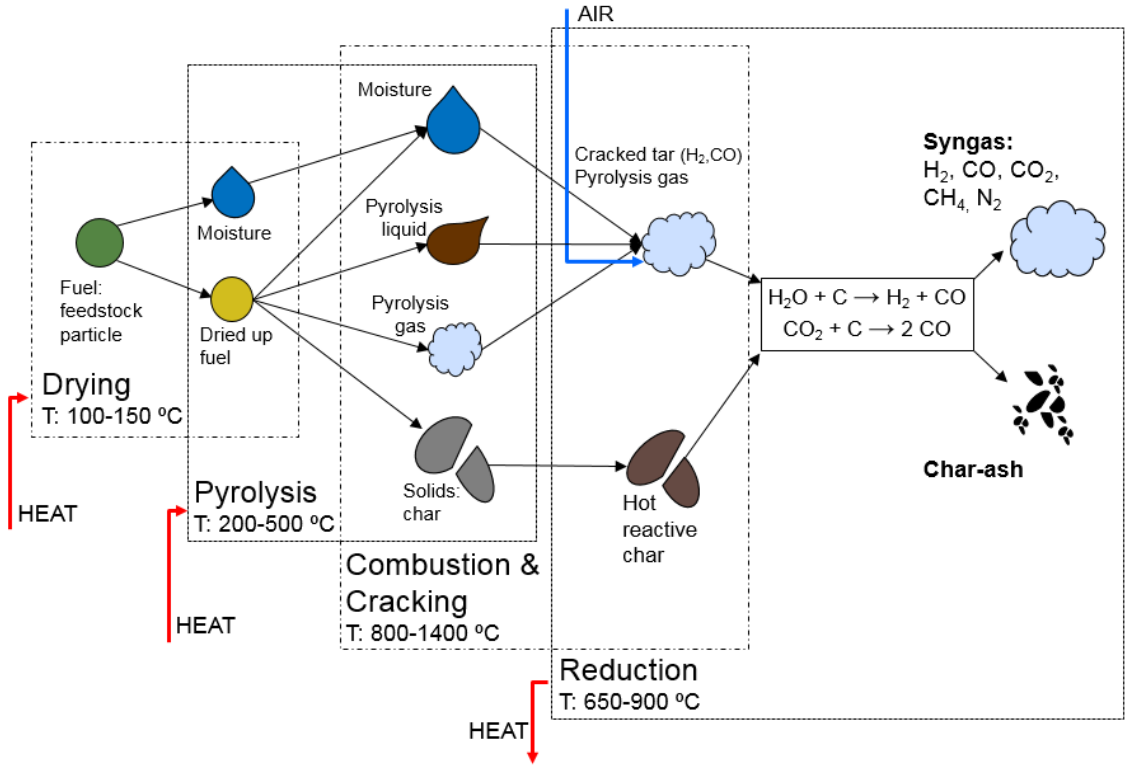


Figure 11. Ideal gasification process.

Combustion reactions provide heat for the whole gasification process. Depending on the gasification method, the combustion temperature can be up to 1400 °C. Tar cracking occurs as the temperature increases. In cracking, larger molecules are broken down into smaller and lighter molecules. Tar cracking provides mainly H_2, CO and other flammable gases. In an ideal case, all the tar transforms into combustible gases. It is important to aim production towards maximum cracking, because sticky tar in the production gas is harmful. (AllPowerLabs 2016, Bridgwater et al. 2002)

The reduction reactions are demonstrated in reaction 3 and 4,

$$C + CO_2 \rightarrow 2CO \quad (3)$$

$$C + H_2O \rightarrow H_2 + CO \quad (4)$$

Flue gas and water vapour are passed through hot reactive charcoal. Due to the high oxygen affinity of the hot char, it reacts with oxygen with the water vapour and carbon dioxide. This produces carbon monoxide and hydrogen, depending on the reaction path (Figure 11). (All Power Labs 2016, Bridgwater et al. 2002)

Products

The main product in gasification is syngas. Its composition and the type and level of impurities vary on the used reactor type and its operating parameters. The data in Table 7 reflects on the syngas characteristics produced by different reactors. As it can be seen, fluidized bed reactors produce higher heating value, HHV, syngas. In addition, if O_2 is used, better HHV values can be reached and the gas quality is better due to the low contamination level of tars and dust. For fluidised bed gasifiers, which are the main industrial reactors used, the gas quality is poorer when compared to the downdraft gasifiers. However, NO_X emissions are low. (Bridgwater et al. 2002)

Table 7. Product gas characteristics of different types of gasifiers (Modified from Bridgwater 2002).

	Gas composition (v-%/v dry)					HHV (MJ/Nm^3)	Gas quality	
	H_2	CO	CO_2	CH_4	N_2		*Tars*	*Dust*
Fluid bed, air-blown	9	14	20	7	50	5.4	Fair	Poor
Updraft, air-blown	11	24	9	3	23	5.5	Poor	Good
Downdraft, air-blown	17	21	13	1	48	5.7	Good	Fair
Downdraft, oxygen-blown	32	48	15	2	3	10.4	Good	Good
Multi-solid fluid bed	15	47	15	23	0	16.1	Fair	Poor
Twin fluidised bed gasification	31	48	0	21	0	17.4	Fair	Poor

Syngas can be utilized in power production. To be able to use it for the production of steam or electricity, cleaning the gas from contaminants is an important issue. It needs to be noted, however, that the heating value is rather low and this affects the range of usable gas turbines. Syngas can also be further developed into different chemicals and fuels; mainly hydrogen, synthetic fuels, methanol and ammonia. Utilizing water-gas-shift reaction, hydrogen and ammonia can be produced. Fischer-Tropsch synthesis can be used to generate synthetic hydrocarbon fuels. Via methanol synthesis, dimethylether can be produced. (Bridgwater et al. 2002)

Emissions

Syngas can contain many impurities such as tars, nitrogen compounds, particulates, alkali- and heavy metals. Tars cause clogging and fouling of surfaces and nitrogen compounds cause NO_X emissions. Cleaning the syngas before use is essential in other utilization methods than direct combustion. Challenges in developing advanced gasification are in creating efficient gas clean up processes. Typically, gases are cleaned via cyclones, filtering, scrubbing, catalytic decomposition, ultra-clean up and directly in the gasifier. Tars can be catalytically decomposed utilising limestone or dolomite

additives directly in the gasifier. Ammonia can be reduced by acid scrubbing. Particulates, alkali, chlorine and heavy metals can be removed with a ceramic or bag filter. Sulphur can be captured in the gasifier but also removed via ultra-clean up. (Bridgwater et al. 2002)

2.4 Solar Power

Solar power is one of the most promising technological options for energy production. (Green 2000) Typically, technologies utilize either direct or indirect capture technologies. Photovoltaics (PV) utilize direct capturing and concentrated solar power (CSP) indirect methods. (Hakkarainen 2014)

In PV, the silicon semiconductors convert sunlight directly into electricity. Solar cells make up modules, which are linked together to form panels. The light enters the cell through gaps between the top contact metals. Due to potential difference, electric current is formed as electrons are temporarily released. An individual PV solar cell can produce about 1-2 W of power. Current commercial PV cell materials are mostly made out of silicon. (Green 2000) Between 2004 and 2013, installed PV capacity has increased 53-fold making it the fastest growing energy technology (Hakkarainen 2014).

Photovoltaics will not be further discussed in this thesis as the main focus of VTT is in CSP technology.

Concentrated Solar Power

The first utility-scale concentrated solar power systems date back to the 20th century as the first commercial plants were installed in 1984 in the United States. At the time when oil and gas prices began to peak, interest towards CSP increased. Since 2004, the installed capacity has increased by almost 10-fold. (Hakkarainen 2014)

Concentrated solar power technology is a fast growing renewable energy technology, even though it is capital intensive. It is an attractive production method, because of its storage capabilities and integration to current energy production infrastructure like conventional power plants, combined cycle power plants and concentrated solar fuel

production. This provides flexibility and energy security. (Bijarniya et al. 2016, Hakkarainen 2014) An advantage of CSP is that it is scalable from residential use to medium capacity hybrid facilities, but also to large scale standalone CSP plants. They are also easily set up as the materials used are common industrial materials like steel, glass, etc. As manufacturing techniques improve and solar energy continues to gain popularity, the capital and operation costs are expected to come down. (Bijarniya et al. 2016)

A variety of CSP technologies exist. Generally though, CSP uses lenses or mirrors to collect the otherwise low density solar energy. The collected solar energy is focused onto a receiver, which heats the heat transfer liquid. The heat transfer liquids' temperatures range from 200-1100 °C. The heat is used to produce steam or hot air, which is further used in electricity generation. (Bijarniya et al. 2016, Hakkarainen 2014)

Direct normal irradiance (DNI) describes the intensity of solar energy received on a plane perpendicular to the sun light. DNI value of under 200 kWh/m^2/a is the required cut in value. Annually, a DNI value of 1800 kWh/m^2/a is used as a limit value when a production area becomes economically feasible for CSP production. (Bijarniya et al. 2016) The best production circumstances are located in sun-belt areas, including southern Europe and USA, northern Africa and Chile, the Middle East, parts of India, China and Australia. In best areas, the DNI value can be 2,800 kWh/m^2/a. At an area with an optimum DNI value, 1 km^2 can annually produce up to 100-130 GWh of solar electricity. For the same amount to be produced by 50 MW coal or gas fired mid load power plant, it would have to have an annual production time of 2000-2600 hours. (Hakkarainen 2014)

3 VTT'S EXPERTISE

VTT’s advantage is in dynamic modelling and co-developed simulation software Apros as well as other modelling and simulation methods. There are several references from combustion, and gasification and pyrolysis processes. In this section, VTT's process analytical expertise is showcased with a closer look at Apros (Section 3.1), VTT's facilities for thermochemical conversion are presented in Section 3.2, and VTT's new strategy is shortly analysed for the digital marketing plan.

3.1 Process Analysis

VTT has created together with Fortum the Apros simulation software, which can be used to create more efficient processes by simulating fast transients and different system states, but also by simulating different automation scenarios with the process design. As Apros is the main software used by Renewable Energy Processes, it will be discussed more detailed in section 3.1.1.

Also comprehensive knowledge and expertise lie in Computational Fluid Dynamics (CFD) modelling. Aspen plus is also used to design and optimize processes. CFD modelling can be used to study fluid flow and related phenome, such as mass and heat transfer as well as chemical reactions in process industry equipment. Especially furnace operations, different load conditions, NO_x emission control and emission reduction, co-firing and slagging are of interest at VTT. VTT has intensive expertise in utilizing CFD in simulating and modelling combustion processes. Likewise, other industrial processes, such as pyrolysis and gasification are simulated, and there are also applications in 3D CFD for nuclear safety analysis.

Aspen plus is also used to design and optimize processes at VTT. Aspen plus is a chemical process optimization software, which is used for design, operation and optimization. (VTT 2016b)

3.1.1 Apros

Apros is a commercial simulation software developed together with Fortum and VTT, which allows configuring and running simulation models for industrial process systems, controls and binary automation and electrical systems. (Lappalainen et al. 2014, (Mikkonen et al. 2016) Its main applications are combustion power plants, nuclear power plants and distributed energy systems. (Mikkonen et al. 2016) Apros was initially developed for simulating combustion processes, but it has many other applications as well due to its many useful features. For example, for solar power production, Apros is an efficient tool since it can "simulate complex dynamic processes affected by the inherent transient nature of solar irradiation, combined by the existing process components in Apros used for conventional power plant simulation and VTT's know-how about combustion processes" (Hakkarainen 2014)

Dynamic simulation is used for the whole life cycle of a plant, from predesigning to operations. To find the optimal operation parameters for each plant, operation and maintenance, engineering and research and development aspects are taken into consideration as a whole. (Mikkonen et al. 2016) An overview of Apros's interface is presented in Figure 12.

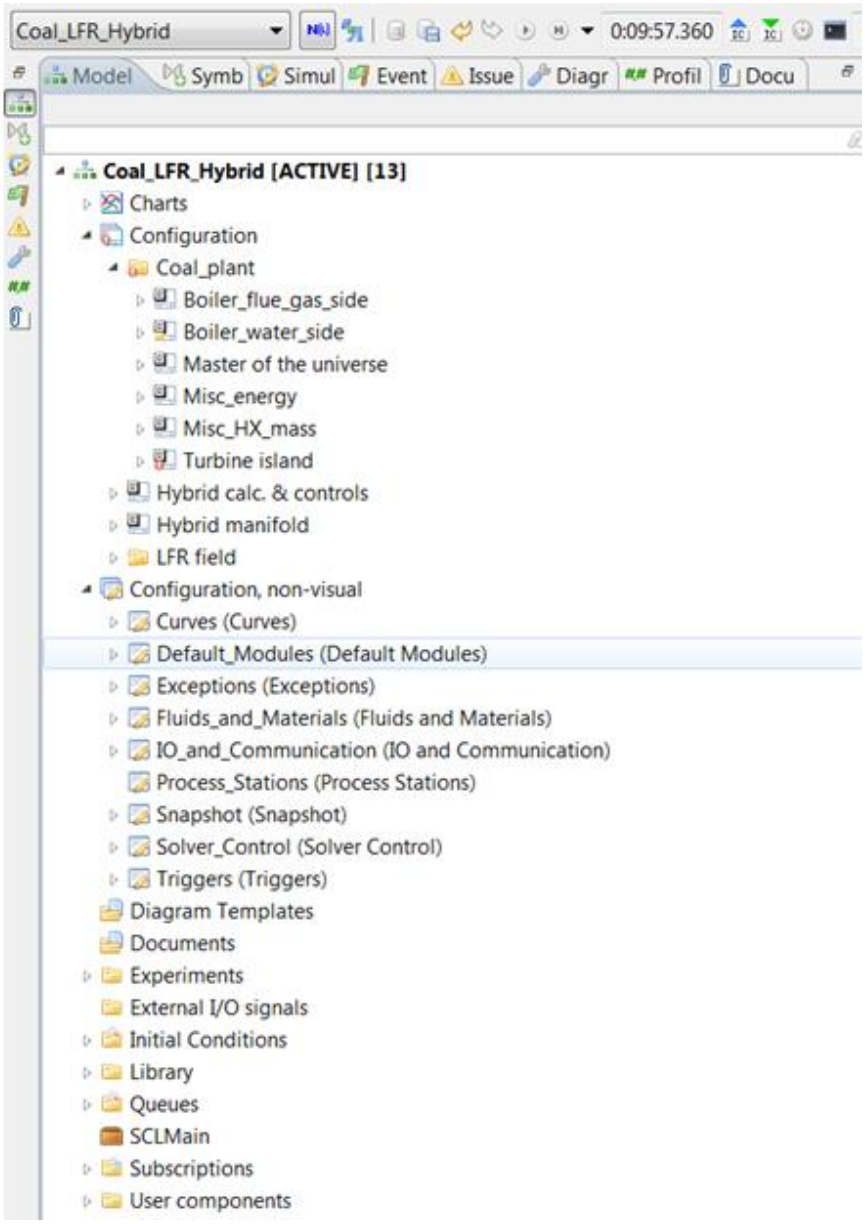


Figure 12. An overview of Apros's interface (Mikkonen 2016).

The simulation engine contains solvers and model libraries: it is possible to model gas and liquid flow networks, automation and electrical systems. The libraries consist of predefined and validated process component models. User friendly system offers process components, such as heat exchangers, vessels, pumps, valves, tanks, etc., to choose from and connect together. To form a complete process, process related input data is also needed. The Apros program hides all the solution algorithms, making it possible to operate without the need for knowledge in programming or differential equations. Designs for the state and structure can be modified in between as well as during simulations. Users can also save complete or parts of a model in the library for

future use. Optimal model structures can be created since the fidelity of components can be chosen for each component. Simulation speeds can be modified by choosing the fidelity accordingly: both simple and high fidelity models can be created. Analysis simulator gives information for startup and emergency procedure designs. With short time steps, transient phenomena can be also studied. (Mikkonen et al. 2016)

Apros Modeller Interface is the design user interface, which allows an online access for easy configuration and modification of simulation models as well as managing and monitoring simulation experiments. The interface is built on Simantics platform. The interface configures a CAD-like graphical presentation of different diagrams and dialogs of component properties of the simulation model. The simulation model contains unlimited number of diagrams which can be interconnected by a connection flag. They are organized in a folder tree for quick access. Simulation experiments and their dynamic behavior can be monitored via numerical values and trend graphs based. Data can be viewed both in long term as well as instantaneous values of the most essential properties of the components. (Mikkonen et al. 2016)

3.2 Thermochemical Conversion Facilities

VTT's gasification and pyrolysis technology research is focused to Otaniemi Espoo, where a Bioruukki concept has been created. Bioruukki offers research and development for low carbon energy solutions, efficient biomass refining, new biomass based products, recycling and waste utilization as well as sustainable chemical development. Bioruukki integrates techno-economic and concept studies with raw material pre-processing and fuel conversion processes with process, chemistry and CFD modelling. (VTT 2016c)

VTT has different bench and pilot scale analytical facilities for combustion, fast pyrolysis and gasification. VTT's pilot plants can be used for technical research services and process development projects. In Tables 8-10, properties of combustion, pyrolysis and gasification facilities are presented.

3.2.1 Combustion

With VTT's several pilot and bench scale combustion reactors, experimental work is easy to conduct and then furthermore combined with modelling and simulation tools. VTT's combustion unit has a long track record and a deep understanding of the combustion phenomena, which include material behaviour in the furnace, furnace chemistry, heat transfer phenomena, ash chemistry, emission formation and fuel specific effects on process dynamics. VTT has a new approach of integrating concentrated solar power with boilers to enhance the competitiveness of combustion processes. (VTT 2016d) This reduces the carbon dioxide emissions in power generation and creates stability around otherwise uncertain production volumes of weather dependant solar energy (Tietjen et al. 2016).

The combustion facilities are mainly located in the city of Jyväskylä. In addition to the different boiler types, the combustion organization also include facilities for feedstock analysis as well as pre-treatment. Combustion facilities are presented in Table 8. (VTT 2016d)

Table 8. Properties of combustion facilities at VTT.

Reactor	Capacity	Scale
CFB	50 kW	Pilot
BFB	30 kW	Pilot
FB test rig	-	Bench
Grate firing combustion unit	500 kW	-

3.2.2 Biohybrids

Weather dependent renewable energies, RES, such as wind and solar energy, have high capital intensity and uncertain production volumes (Tietjen et al. 2016). To integrate solar energy with conventional energy production methods like combustion, the formed hybrid reduces the problem of uncertain production of weather dependent energy production methods.

Biohybrid systems are studied at VTT as well. They are also studied at Jyväskylä; solar collectors are combined and modelled together with CHP production. Renewable Energy Processes team's expertise in combustion processes made combining the technology with solar power an interesting approach. By configuring a solar field, which would not need a separate power block, to a Rankine cycle, a biohybrid concept was created. (Hakkarinen 2014)

3.2.3 Pyrolysis

VTT offers pyrolysis research services that cover the whole value chain: from procuring and characterizing the biomass raw material to extensive analysis studies on the produced bio oil. Pyrolysis facilities include different reactors for slow, intermediate and fast pyrolysis and they are located in Espoo. They are presented in Table 9.

Table 9. Properties of pyrolysis facilities at VTT.

	Reactor type	Capacity	Scale
Slow pyrolysis	Batch	20 kg/batch	-
Intermediate pyrolysis	Screw	5 kg/h	Bench
Fast pyrolysis	Fluidized Bed	1 kg/h	Bench
	Unique integrated fast pyrolysis unit (thermal and catalytic)	0.5 tons/d	Pilot
	Moving Bed	2 kg/h	Bench

Bio oil production can be studied in either bench scale, feed of 1 kg/h, or pilot scale, feed of 20 kg/h in either catalytic or non-catalytic conditions. Extensive bio oil analyses include determining physical and chemical properties, and based on those properties an assessment on the suitable end use applications and upgrade possibilities is made. Bio oil upgrading tests can be made with continuous laboratory scale catalytic upgrading unit. Hydrothermal liquefactioning (HTL) experiments are carried out in a 1 litre batch unit at 350℃ and maximum pressure of 250 bars. (VTT 2016d)

VTT's integrated fast pyrolysis technology was first implemented in 2014. By integrating a fast pyrolysis unit into Fortum's power plant, annually 50 000 tons of produced bio oil replaced fossil fuels in district heating. (VTT 2016d)

3.2.4 Gasification

VTT's gasification research and development focus is in drying, gasification reforming and initial gas cleaning processes. VTT has experience in coal, oil and natural gas processing. Gasification facilities include a dual fluidized bed gasification pilot plant for syngas at capacity of 200 kW, bubbling bed gasification with gas cleaning units at fuel capacity of 25 kW, pressurized fixed bed gasification pilot plant with a fuel capacity of 500 kW and laboratory reactors for catalytic gas cleaning units and fuel synthesis. (VTT 2016d)

Table 10. Properties of gasification facilities at VTT.

Reactor type	Capacity	Scale
Pressurized fixed-bed	500 kW	Pilot
Dual FB	200 kW	Pilot
BB + gas cleaning	25 kW	-

3.3 Strategy

VTT published its new strategy for 2016-2020 in August 2016. The company has focused on six areas of expertise, called lighthouses. Those six lighthouses are arctic extremes, digital habitats, valuable health, energy in transition, digitalizing industry and bioresource efficiency. VTT has identified these as the future markets that have growth opportunities. (Kallio et al. 2016)

VTT has a special focus on its employees, the VTTPeople. The employees and their development are at the core of creating the next generation VTT. The expertise in science and technology creates the impact of VTT. The target for 2016-2020 is to increase that impact and expertise. (Kallio et al. 2016)

4 METHODS

To gain concrete data for the creation of the digital marketing plan, a trial social media profile and a questionnaire for SONE employees were created. The trial social media profile is explained in section 4.1 and the questionnaire in section 4.2. The questionnaire can be found in the appendix (Appendix 1).

4.1 Trial Social Media Profile

In the beginning of this master's thesis project, a trial social media profile was created on Facebook and named VTTEnergySolutions. The trial profile was published in 4.7.2016. The trial profile is analyzed based on the analytical information provided by Facebook.

The purpose of the trial profile was to have a low key test ground for publishing different types of content. Information on how different type of content was received, what and how content could be further shared in different types of Facebook groups and pages was focused on. Trial also provided an insight into what kind of work loads are connected to different types of content.

4.2 Questionnaire

A questionnaire on the use of social media was sent out to the VTT's Solutions for Natural and Environment organization (SONE) employees by e-mail. Renewable Energy Processes is a team in the SONE organization. The questionnaire was sent out to the whole organization to get a wider sampling. The questionnaire was open for responses 21.11-28.11.2016. The questionnaire was created and analyzed by Google Forms. The questionnaire is attached as an appendix (Appendix 1).

The purpose of the questionnaire was to gain insight on the current use of social media sites of SONE employees, as well as to get an understanding of possible barriers regarding the use of social media for professional purposes. It was also important to recognize what kind of interest employees had towards utilization of social media for

work as well as creating content. For the digital marketing plan to be as successful and practical as possible, it was essential to understand the factors preventing active utilization of social media and creating content.

5 RESULTS

In Sections 5.1 and 5.2, analyses of the trial social media profile and questionnaire are presented. Based on these analyses, conducted energy survey and the theory review, the digital marketing plan has been formed. The digital marketing plan is in Section 5.3.

5.1 Trial Social Media Profile

The results of the trial social media profile in Facebook is analyzed in this section. The site was published in 4.7.2016 and has been operational at the time of analyzes for 19 weeks (17.11.2016). The profile was administered only by the writer.

5.1.1 Page Analysis

In Figure 13, the visitation rates of the fans of the Facebook page are presented. Throughout the week, VTTEnergySolutions fans were visiting the page steadily. On the top of the figure, weekdays are presented from Monday to Sunday. Visitation data based on the time of the day is below the weekday representation. VTTEnergySolution fans tend to visit the page between 8-23 with peaks at 9-11, 16-17 and 20-22. The peaks correlate with morning coffee break, end of workday and before bedtime. The time frame is fixed according to the local time zone of Finland.

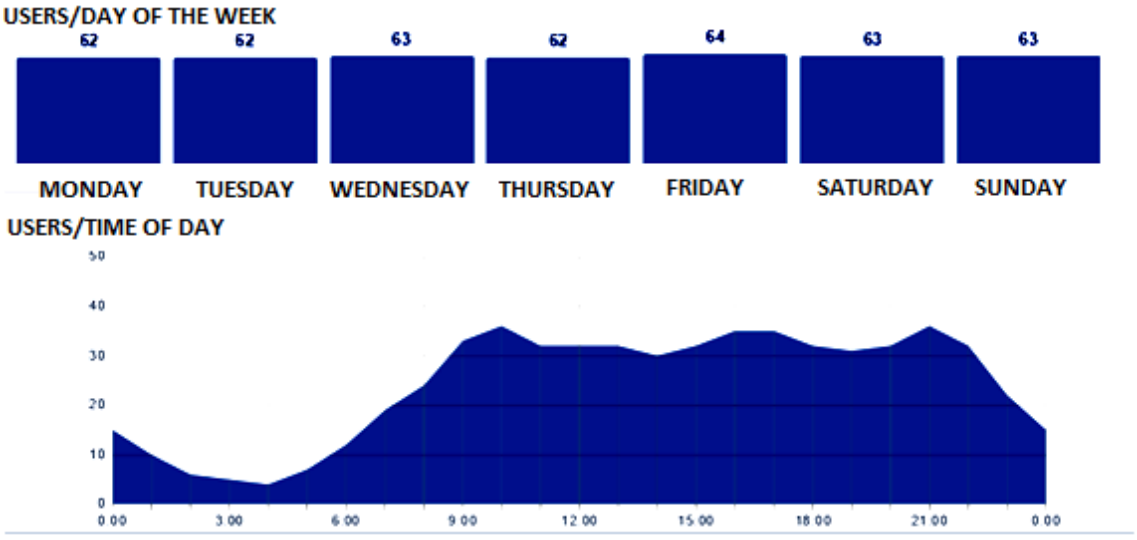


Figure 13. Visitation data of VTTEnergySolutions Facebook page fans.

The amount of total likes is presented in Figure 14. The beginning of the VTTEnergySolutions page took off slowly, most likely due to summer vacations. The likes have increased steadily.

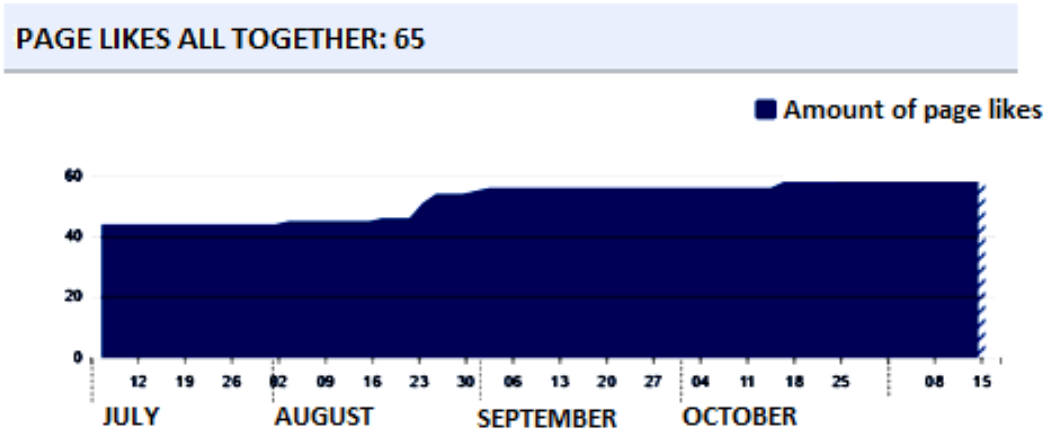


Figure 14. Page likes by November 17th 2016 on the VTTEnergySolutions Facebook page.

Figure 15 presents, the used devices for viewing the VTTEnergySolutions page. People viewed the page via computer twice as much as with mobile devices.

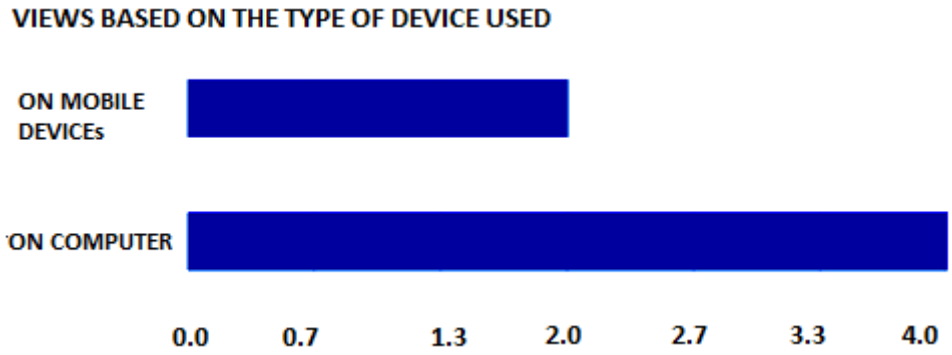


Figure 15. The used device for viewing the VTTEnergySolutions Facebook page.

In Figure 16, an overview of the page during a 28-day period (20.10.-17.11.2016) is presented. The page likes had increased by 300 %. Coverage of posts was 366 people with an increase of 16 %. Commitment to the posts was 46 with an increase of 18 %. Video material on the page was viewed for at least 3 seconds 8 times, with an increase of 100 %.

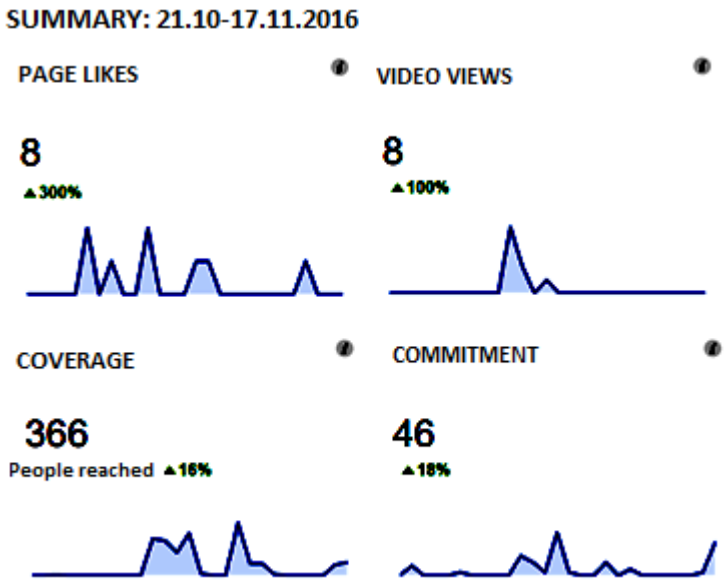


Figure 16. An overview of the VTTEnergySolutions Facebook page during the last 28 days (20.10.-17.11.2016).

5.1.2 User Analysis

In Figure 17, a gender and age division is shown. The gender division is close to a 50 % division between women and men in both reached users and committed users (fans). The main age group reached is between 25-34, but also the age group 35-44 was well represented. The target was to reach users over 18 years of age. No users under 18 years were reached.

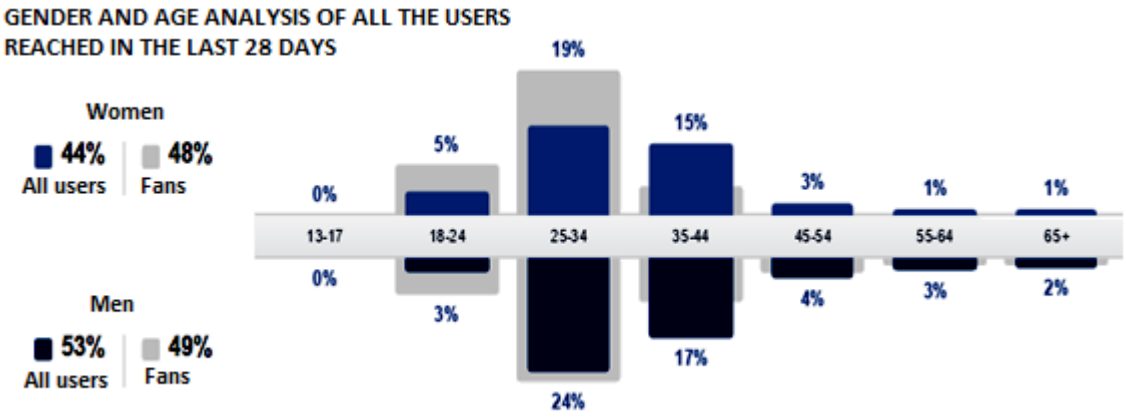


Figure 17. Gender and age division of users that published content was shown in the last 28 days (20.10-17.11.2016) on the VTTEnergySolutions Facebook page.

The range of countries where visits were made from was broad (Table 11). Altogether, 20 countries were represented. Europe was represented the strongest, but visits from North and South America, and Asia were made as well.

Table 11. Reached users' nationalities and languages on the VTTEnergySolutions Facebook page.

Europe (impact)	North America (impact)	South America (impact)	Asia (impact)
Finland (193)	Canada (5)	Peru (2)	Arab Emirates (1)
Germany (8)	USA (5)	Mexico (1)	South Korea (1)
Sweden (4)		Brazil (1)	
Spain (2)			
France (2)			
UK (2)			
Norway (2)			
Hungary (2)			
Austria (1)			
Italy (1)			
Slovakia (1)			
Luxemburg(1)			
Poland (1)			

Majority of users were from Finland and used Finnish. After Finnish, most users use English as their language, approximately 36 %. Also German, Swedish and Spanish and Chinese were detected. It should be considered what kind of languages should be used in posts. Now the main language was English, but also posts about news and blogs written in Finnish were made. A short summary was made in English of posts that were otherwise in Finnish.

In Figures 18-21, demographic information of users within the last month is presented. The demographics is based on a 150 m radius of VTT's headquarters at Vuorimiehentie 3, Espoo Finland. In Figure 18, it can be seen that the gender division is 60 % of men and 40 % of women. The overall worldwide gender division was approximately 50 % of men and women.

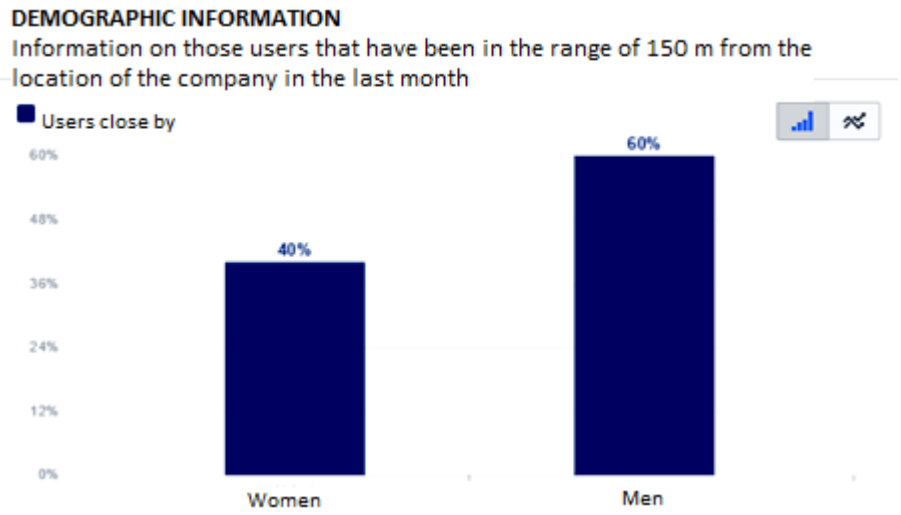


Figure 18. Gender division of the demographic users on the VTTEnergySolutions Facebook page.

In Figure 19, the age division of the demographic users is presented. When comparing the demographic user base to the general users, younger people from the age group 18-24 were reached. The majority age group is still the same for demographic and general users, 25-34. The reach of younger users could be explained by the existing student facilities around the headquarters of VTT. This presents a targeted marketing possibility for students.

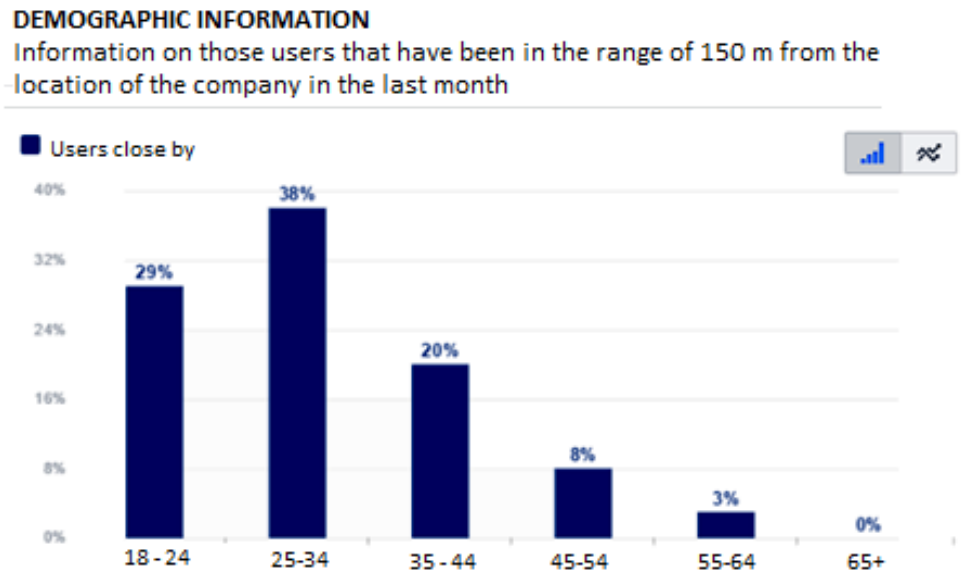


Figure 19. Age division of the demographic users on the VTTEnergySolutions Facebook page.

In Figure 20, a comparison gender division is made for each age group. Overall, men seem to better represented in all the age groups except for the older age group of 55-64, where women were represented more.

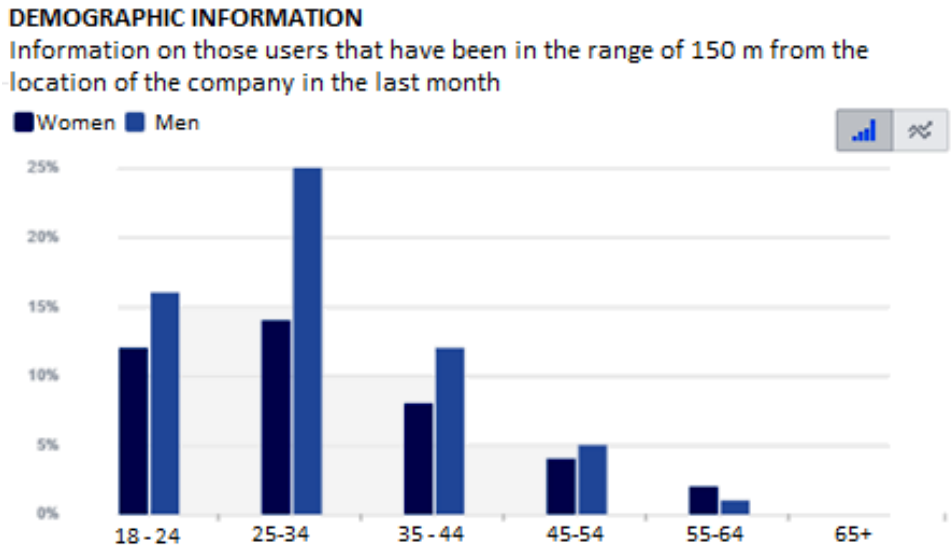


Figure 20. Gender division of each age group of the demographic users (Darker color: women, lighter color: men) on the VTTEnergySolutions Facebook page.

In Figure 21, a division of the demographic users is made based on whether they were travelling or local. Majority of the demographic users were local, but 4 % were travelers.

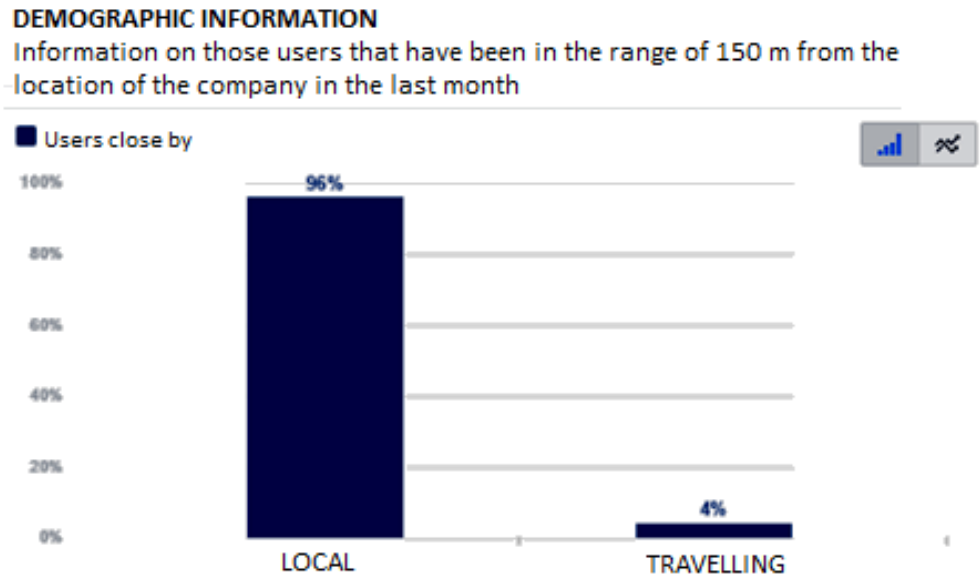


Figure 21. Origin of the demographic users on the VTTEnergySolutions Facebook page.

5.1.3 Content Analysis

By November 17th, 76 posts were made in the VTTEnergySolutions page. Page has been operational since 4.7.2016. In the 19 week period, approximately 4 posts were made per week. In Figure 22, the reachability and commitment received by different types of contents posted on the page is presented. Most reachable contents were pictures, then links, status posts and shared videos. Visual material and calls to action like clicking a link seem to reach more users.

Figure 22. Reachability/coverage and commitment to different types of contents posted on the VTTEnergySolutions Facebook page.

In Table 12, an overview of the posts reaching over 50 in coverage are presented. Approximately 15 % of all the posts received more than 50 in coverage. Compared to the current amount of likes, it is approximately 75 % of all committed users. The largest coverage was received by sharing an outside article on creating food from electricity first on the VTTEnergySolutions page, and then further shared to a Uusi Energiapolitiikka discussion group (3717 members, 17.11.2016).

Table 12. An overview of all the posts that reached coverage of over 50 on the VTTEnergySolutions Facebook page.

Date	Post	Type	Coverage
24.8.2016	Creating food from electricity: outside news article	Link, shared to discussion groups	599
14.10.2016	Cell pod: outside news article	Link	120
3.8.2016	Circular economy: Frame work for Sustainable circular business model (VTT written article posted elsewhere)	Link	95
7.11.2016	Circular Economy: utilizing autumn leaves	Link	95
13.7.2016	VTT Bioruukki introduction	Picture	91
16.9.2016	VTT Publication: Properties of Indigenous Fuels in Finland	Link through LinkedIn	88
11.7.2016	VTT web page: Replacing critical raw materials	Link	81
17.10.2016	Advertisement: Free thermochemical investments webinar	Link	68
1.11.2016	Circular economy: steel industry's side streams	Link	64
1.11.2016	Publication: bio oil	Picture and link	63
31.10.2016	Advertisement: Seminar on Bioenergy RES hybrids	Link	51

Some video material from VTT's YouTube account were shared. Published videos relating to VTT were:

- Ice formation on wind turbine blades,
- European Research Infrastructure for Circular Forest Bioeconomy (ERIFORE).
- Bioruukki bioeconomy piloting animation, and
- Relooping Fashion - Closed-loop Textile Recycling.

Also a video on Tesla's Powerwall 2 and solar roof tiles for homes was published. The best video material that was viewed the longest and watched at least over 3 seconds, was the Tesla Powerwall 2 and Solar Roof Tiles for Homes video.

In Figure 23, the reactions, comments and shares of published contents by the users of VTTEnergySolutions is graphed.

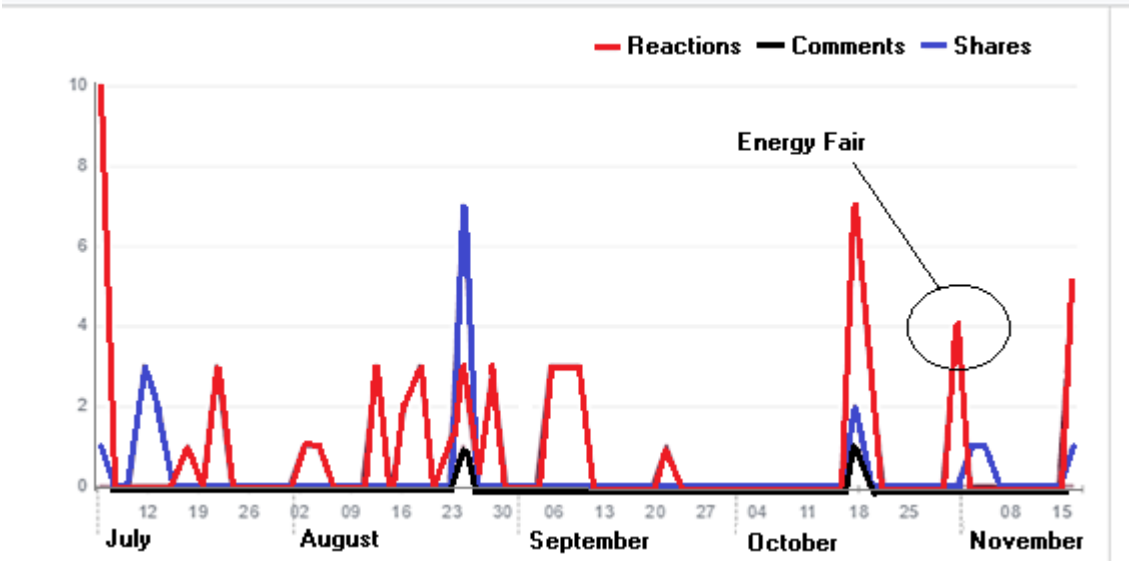


Figure 23. Reactions, comments and shares of published contents on the VTTEnergySolutions Facebook page.

There was an interesting correlation between the increase in page traffic and the Energy Fair held in Tampere at 25.10.-27.10. VTT had a stand at the fair for promoting its energy know-how. The VTTEnergySolutions page was not advertised at the fair; however, users seemed to search Facebook for VTT's energy know-how. No posts were made during the fair either. The closest posts to the time of the fair were made in 17.10.2016 and 31.10.2016. Also a peak can be seen around the end of August. At this time, the post on creating food from electricity (Table 9), which received the largest coverage, was created. In addition, a VTT job opportunity was posted around that time.

5.1.4 Discussion

Most interesting posts seem to be posts that have visual content like pictures and video. Longer videos, over 1 minute, are not viewed as long as short ones. Facebook categorizes views by over 3 and over 10 second views. Short videos should be favored and for Facebook, it is important to add subtitles to the video since videos are automatically muted. Infographics were the most interesting type of pictures. Links for blog posts, news articles and publications were also popular.

There was a clear correlation between a big energy event, the Tampere Energy Fair where VTT had presence, and visits to the VTTEnergySolutions page. The page was not advertised at the fair. An editorial calendar will be used to administer creating and publishing content. It is important to map events VTT is participating or organizing there. Around these dates, audience targeted content and general marketing content should be published. Also strategies to advertise social media profiles at these events should be considered.

By sharing content to energy discussion groups and energy events groups, more users were reached. Also tagging event organizers and other associates related to the post, like newspaper that originally published the content, reachability can be increased.

When looking at the posts published, if too many posts were made directly from VTT sites (website news, YouTube, VTT publications, VTTBlog), the interest and commitment towards VTTEnergySolutions Facebook page decreased. By adding outside articles and VTT's researchers' posts, like blog posts from LinkedIn, as well as content related to the energy sector but not directly to VTT, commitments spiked. A balance should be found with external and VTT related content.

5.2 Questionnaire

The SOME at SONE questionnaire was sent out to gain insight on the employees' current use of social media, and interests and barriers related to the future use of social media. The questionnaire was open for responds for a week, from 21.11-28.11.2017. In total, 60 responses were received. A total of 20 responses from the team members in Renewable Energy Processes were received. The questionnaire is analyzed in the following sections for the digital marketing plan.

5.2.1 Current Usage of Social Media Sites

The current status of employees presence in social media is presented in Figure 24. Of the employees who answered, 80 % had profiles in LinkedIn. The percentage for Renewable Energy Processes team was 70 %. Facebook and ResearchGate ranked also quite high in the social media sites where employees had profiles in. Over 13 % did not

use social media at all. Majority, over 73 %, used social media for personal use, but over 63 % used social media for work purposes as well.

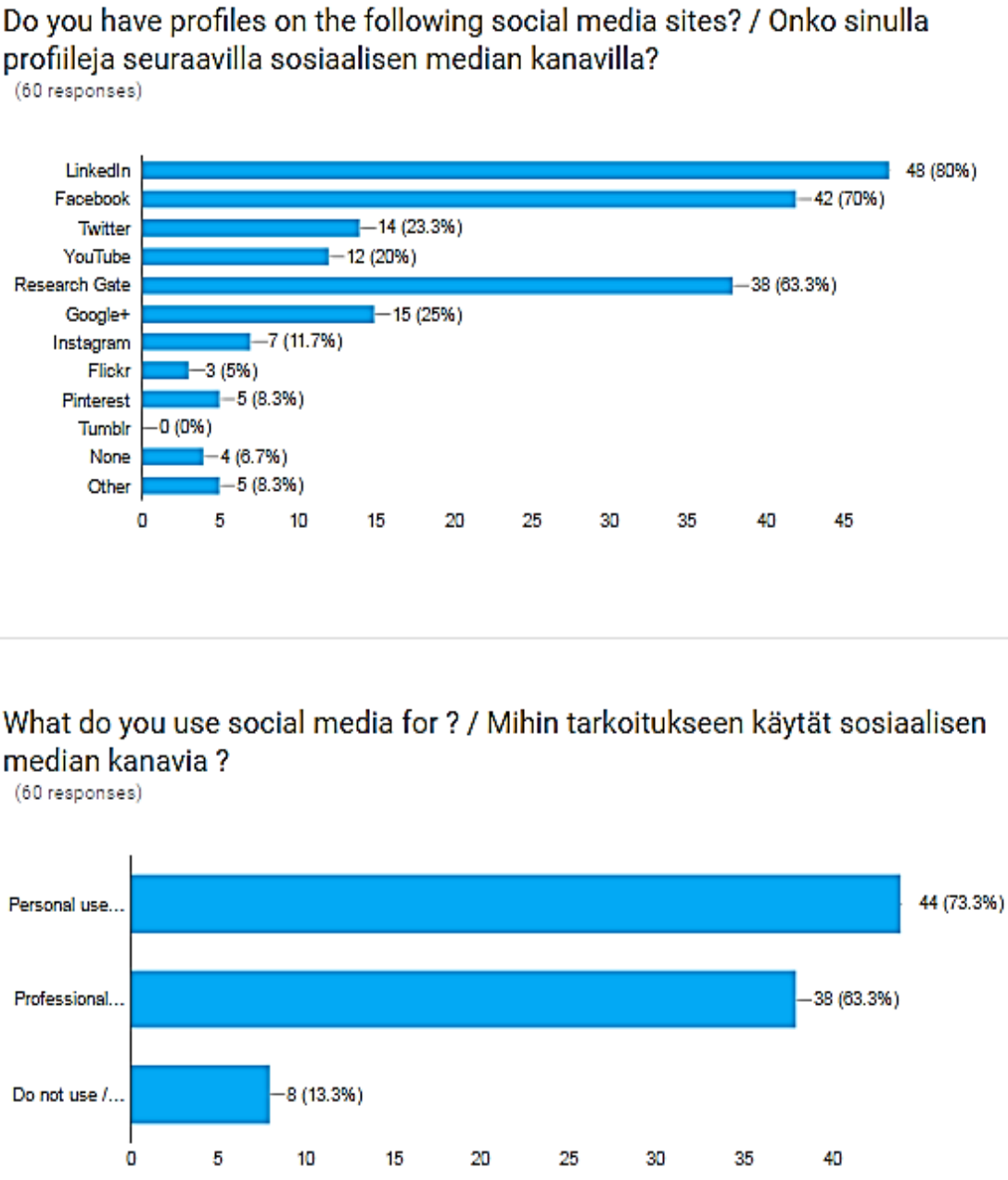


Figure 24. Current usage of social media of SONE employees.

5.2.2 Barriers for the Professional Use of Social Media

It was important to establish an understanding of what kind of barriers employees have considering the professional use of social media. In Figure 25, those barriers towards the professional use of social media are presented.

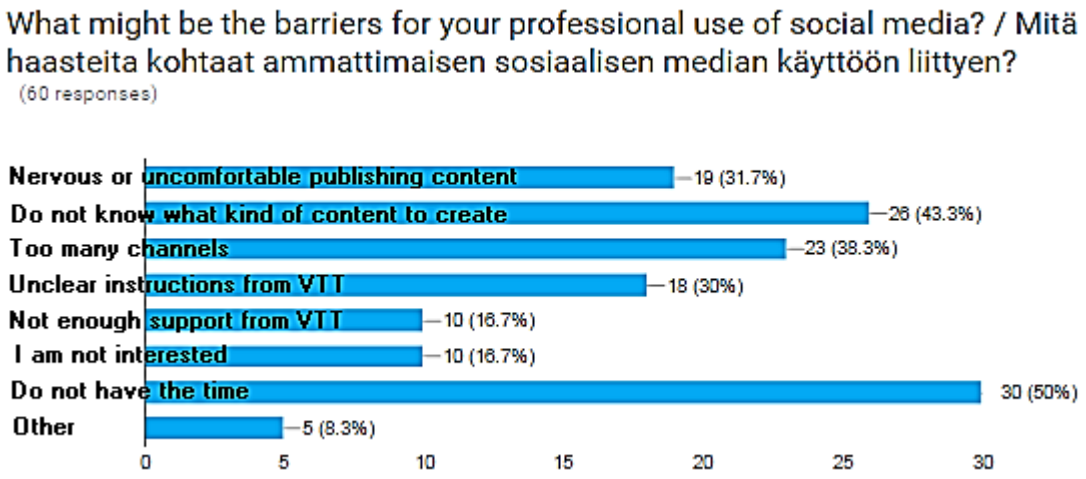


Figure 25. Barriers related to the use of social media for professional purposes.

The main reasons listed were insufficient time resources (50 %), the fact that employees do not know what kind of content to create (over 43 %) and they are confused with the number of channels (over 38 %). Almost 32 % felt that they were nervous or uncomfortable publishing content, and 30 % felt that the instructions from VTT are unclear. Minority (over 16 %) felt that VTT should be more supportive towards the use of social media by employees. Over 16 % stated that they were not interested in using social media for professional purposes. Over 8 % answered *Other*. It could be that this option was chosen because there was no option for not wanting to use personal profiles for professional purposes.

5.2.3 Interest Towards the Utilization of Social Media

Majority of the respondents were interested in using social media to communicate about their work. In Figure 26, employees ranked from 1-5 how important they felt utilizing social media for professional purposes is.

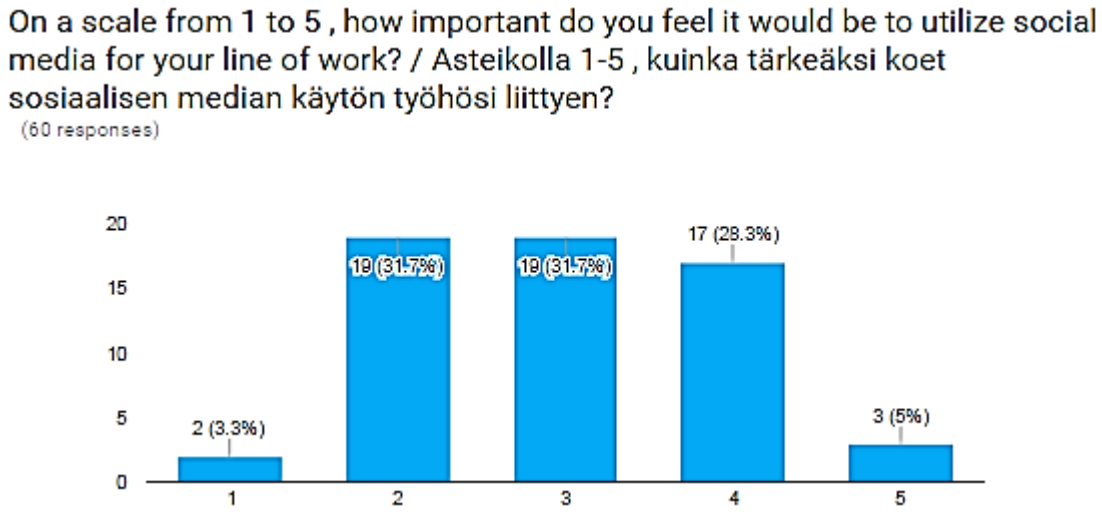


Figure 26. How important SONE employees felt about utilizing social media for professional purposes.

Approximately 3 percent felt that it is not important at all (1 on the scale). Over 30 % felt that it is not that important (2). Approximately 60 % ranked the utilization of social media for professional purposes as quite important (3) or important (4). A few, 5 %, felt that it was very important.

In Figure 27, the employees ranked how interested they were about utilizing social media to enhance their work.

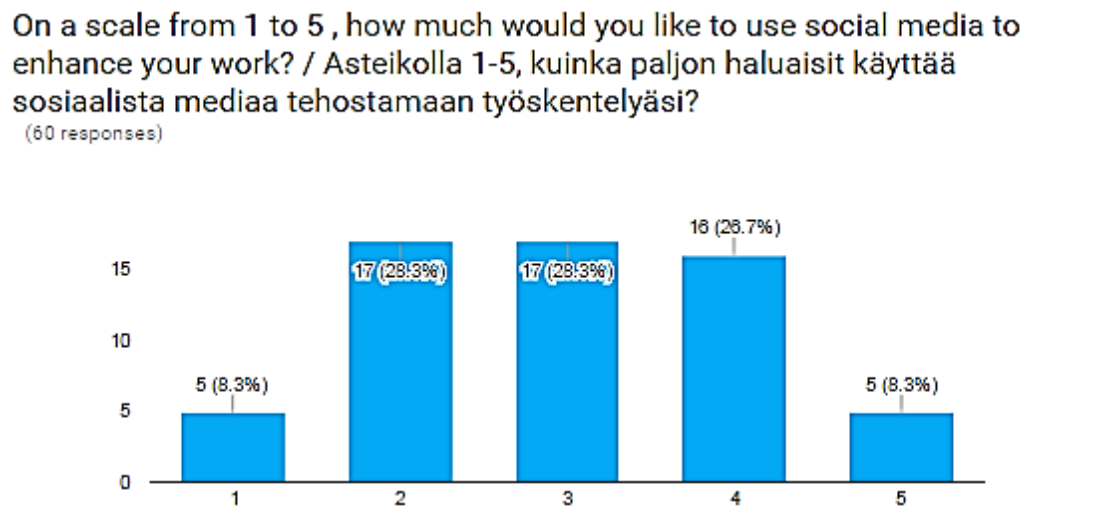


Figure 27. How interested SONE employees were about utilizing social media to enhance their work.

When comparing Figure 26 and Figure 27, the rating of importance does not correlate with interests towards utilization. Some employees ranked the importance of utilizing social media somewhat more important, but personally were not as interested in the utilization.

In Figure 28, a summary of where the employees would like to create social media profiles and their interests towards the purpose of the use is presented.

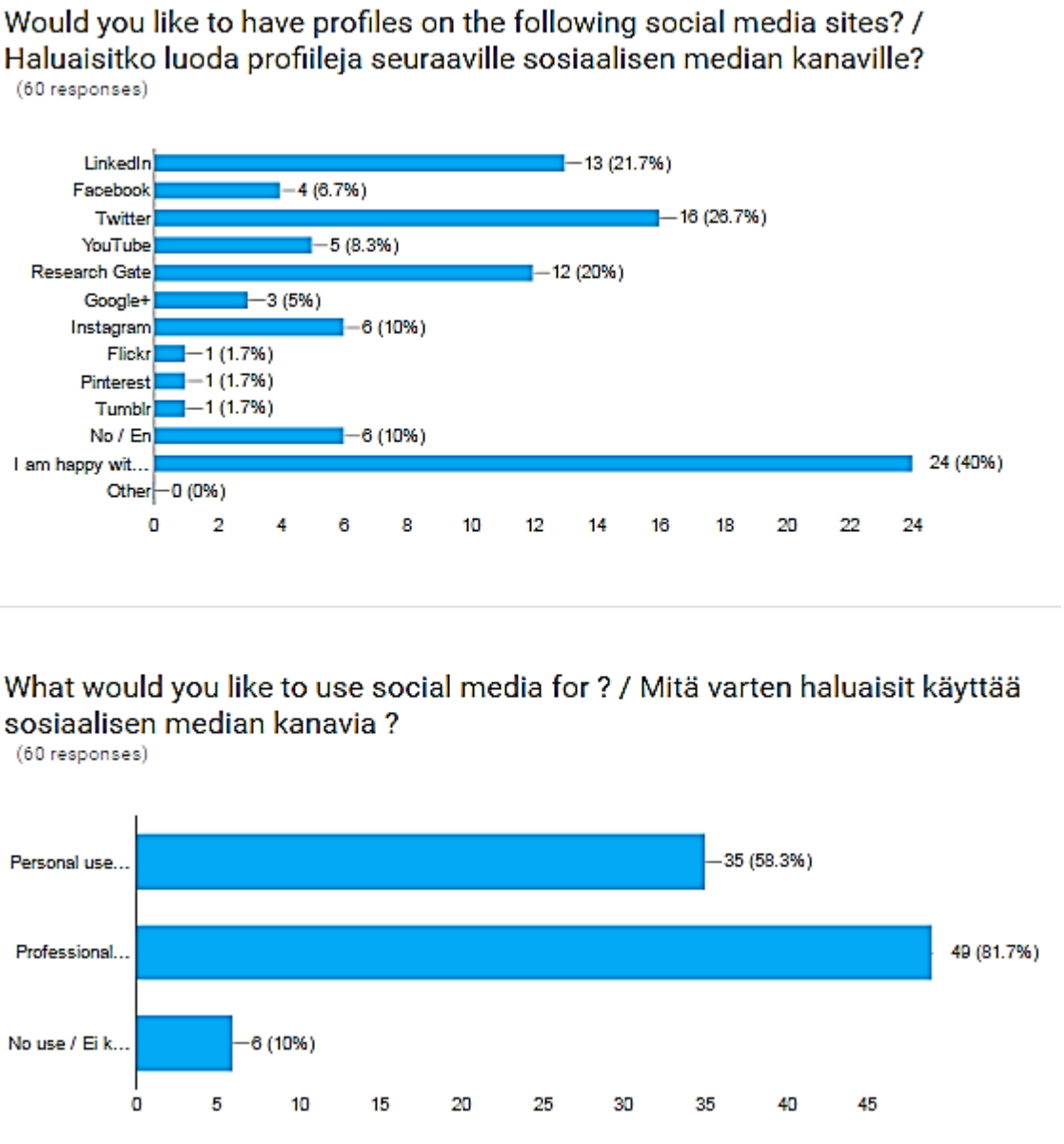


Figure 28. Employees' interests towards creating profiles in social media.

Of the respondents, 80 % had LinkedIn profiles. The rest 20 % answered that they would like to create profiles in LinkedIn. Twitter ranked the highest (27 %) for social media sites where employees would like to create profiles. Many of the respondents (40 %), were, however, content with the current profiles they had.

5.2.4 Discussion

Other ideas and comments given by the respondents are summarized based on opinions and thoughts employees had of social media and VTT, questions or themes that emerged, and content and workshop ideas. Generally, the respondents felt that there are not enough social media communicators in the research field. Some of the respondents felt that businesses use social media, but individuals rarely.

Employees felt that the VTT website needed updating and that VTT research should be systematically more visible in social media. Many respondents wanted marketing and communication experts that could be used to support the showcasing of researchers' expertise and the infrastructure. Employees do want to improve their skills and be more active in social media, but feel that VTT's guidelines for social media and support system need to be more organized if VTT wants employees to be active.

Some felt that it is most important to do well in search results of search engines like Google, and that social media does not feel to be that important to gain publicity and increase reachability. It needs to be recognized, that social media popularity and activity affect the results on search engines. For VTT website, if material is shared over social media sites, it will be viewed higher by search engines. High quality research publications were felt to be the best way to increase awareness and popularity in own field of science.

The biggest controversy related to whether or not the employee felt comfortable to use their personal profiles for the good of the company. Some felt that they do not want to use any personal profiles to promote VTT, some felt that LinkedIn and ResearchGate can be used to some extent. Many however, did not seem to have a problem in using their personal profiles to promote VTT since they felt that they promote themselves as well.

Main questions that rise from the questionnaire were:

- how to popularize science,
- how to communicate research results to the general public,
- how to stimulate conversation,
- how to create marketing material on the expertise and research facilities of VTT, and
- how to stay current.

Content ideas:

- videos:
    - demo videos on facilities, programs, etc, and
    - modern way to showcase abstracts,
- webinars,
- Statistics,
- news on current and upcoming projects,
- research highlights,
- sales material, and
- blog series:
    - life of dissertation worker, and
    - future of new discoveries and their possible applications.

Workshop ideas:

- creating and improving profiles and creating content,
- how to use social media,
- how to visualize research results for social media, and
- how to make your data and results more marketable.

5.3 Digital Marketing Plan

The digital marketing plan is constructed from social media and content marketing point of views. For these specific plans, a mission statement, analysis of VTT's and competitors' social media sites, and a review of audience and resources have been compiled. The plan is constructed based on the literature review, results from the trial social media profile and SOME at SONE questionnaire, and analysis of VTT's and its competing research centers' social media presence. There are separate approaches for the organization and employees since creating and utilizing personal profiles for work purposes is optional.

It is important to create strong social media profiles for Renewable Energy Processes. Social media posts can be used to drive targeted traffic towards website, which helps generate leads. Social media activity boosts search engine optimization. Strong profiles help to build relationships important to Renewable Energy Processes, and create networks. Users view social media sites more as social networks rather than marketing channels and therefore, are more receptive to the messages portrayed in posts or discussions. By creating and following the digital marketing plan, targeted audience can be reached and engaged with. Also, social media is an excellent tool to help generate interest towards events and even get Renewable Energy Processes noticed at them. Strong social media presence contributes to brand awareness as well. It needs to be noted, that the competitors do have a presence in the social media. (The Content Factory 2016)

Energy related discussions can be viewed a bit risky, since the field is well opinionated. This should not however, effect the communication of energy related research work. By following set guidelines and publishing results rather than personal opinions, controversy can be diverted. The current VTT guidelines for social media are:

- make sure there are no copyright issues before publishing. A good way around this is by posting and resharing links.
- Publish only public content, no confidential material should be uploaded, and
- do not publish pictures of others without their permission.

A good posting principle is to post about research work and results, and not personal opinions in the VTT related social media sites.

5.3.1 Mission Statement

The mission is to make VTT's Renewable Energy Processes the go-to center for conventional and renewable energy related research work (Figure 29). To make the mission realistic, different goals are set. The two major goals are to generate leads and increase sales for Renewable Energy Processes, as well as to increase brand awareness and acknowledgement. Site specific goals and objectives for different social media sites are listed in the social media marketing plan section.

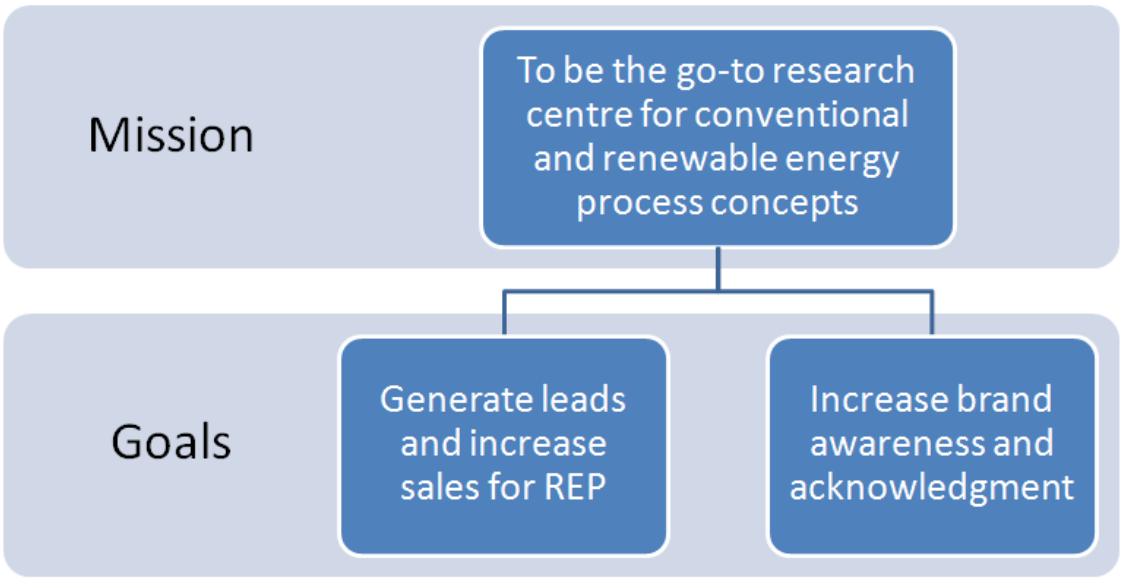


Figure 29. Mission statement for Renewable Energy Processes organization

5.3.2 Analysis of VTT's and Competitors' Current Social Media Profiles

VTT has several profiles in each of the chosen social media sites, i.e. LinkedIn, Facebook, Twitter. In addition to the official sites, there are subsidiary sites and specific research related organizational sites. Analyses for each of the chosen platforms are presented in this section. VTT related sites as well as six other research institutes ranked by the European Research Ranking 2015 are analyzed in the following. VTT placed 11th on this ranking. Ranking of the top 11 is presented below. The bolded institutions were chosen for comparisons.

1. **Centre National de la Recherche Scientifique (CNRS), France.**
2. **Fraunhofer Gesellschaft, Germany.**
3. **Comissariat a L'Energie Atomique (CEA), France.**
4. **Max Planck Geselleschaft, Germany.**
5. Consiglio Nazionale, Italy.
6. **University College London (UCL), UK.**
7. University of Cambridge, UK.
8. University of Oxford, UK.
9. Agencia Estatal Consejo Superior de Investigaciones Cientificas, Spain.
10. **Imperial College of Science, Technology and Medicine, UK.**
11. VTT Technical Research Centre of Finland.

LinkedIn, Facebook and Twitter are analyzed by searching for profiles related to VTT and its competitors in each of the platforms.

LinkedIn

Data from LinkedIn is collected in Table 13. VTT has two profiles in LinkedIn; the official company page and a page for a subsidiary company VTT Expert Services. VTT's company page utilizes Showcase pages for different research areas.

Table 13. Data on VTT's and its competitors' LinkedIn profiles.

Current Profile Names	Employees	Employees in LinkedIn	Followers	Showcase Pages (followers)
VTT	1000-5000	1909	12 930	Cell factory (82) Healthy food and beverages (57) Biomaterial products (47) Bioruukki Pilot Centre (10)
VTT Expert Services	51-200	80	198	-
CNRS (1)	10 001+	10 814	35 920	-
Fraunhofer-Gesellschaft (2)	10 001+	8385	33 127	-
Max-Planck-Society (4) **(Several small sites)**	-	-	-	-
UCL Union (6)	10 001+	11 771	177 147	UCL TRO Drug Discovery Group (129)
Imperial College London	5001-10 000	9717	142 600	Imperial College London Program Management Office (59)

UCL and Imperial College London also utilized Showcase pages. They have the most followers, but it needs to be noted that they are also educational institutes. CNRS and CEA are research centers, so it is sensible to do further comparisons between them and VTT. The CNRS and CEA company pages are rather active, but their operating language is French.

All other competitors were easily found except for Max Planck Society since it had many different profiles in LinkedIn. For this reason, it is suggested that Renewable Energy Solutions does not create its own LinkedIn page, but utilizes the Showcase possibilities under VTT’s official page.

Facebook

The importance of Facebook for businesses is increasing. Facebook and LinkedIn are very similar in popularity when comparing the likes and followers of LinkedIn, Twitter and Facebook. In Table 14, the data on Facebook is presented. In Facebook, there are three VTT related profiles: the official VTT profile and two research related pages: protein production and energy solutions.

Table 14. Data on VTT's and its competitors' Facebook profiles.

Current Profile Names	Public Reference	Likes
VTT Technical Research Centre of Finland	@VTTFinland	2179
VTT Technical Research Centre of Finland - Protein Production	@VTTProteinProduction	170
VTT Technical Research Centre of Finland - EnergySolutions	@VTTEnergySolutions	67
CNRS (1)	@cnrs.fr	99 319
Fraunhofer Gesellschaft (2)	@Fraunhoferde	8021
Comissariat á l'énergie atomique et aux énergies alternatives (3)	-	829
Max Planck Society (4)	@maxplancksociety	150 745
UCL Union (6)	@ULCUnion	19 471
Imperial College London	@imperialcollegelondon	142 574

The official VTT page has the most likes of the VTT related profiles. However, when compared to the competitors' pages, VTT falls quite behind in likes. Max Planck Society and Imperial College London had the strongest Facebook profiles. From research institutes, CNRS had a strong profile as well. Again, the operational language for CNRS and CEA was French.

Twitter

Twitter based profiles are analyzed in Table 15. In Twitter, VTT has three related profiles: official site, Cyber-Physical and Expert Services. The most active one is the official profile. VTT has two main hashtags that are been used: #VTTFinland and #VTTPeople. They are used very well and show up in Twitter searches.

Table 15. Data on VTT's and its competitors' Twitter profiles.

Current Profile Names	Public Reference	Tweets	Follows	Followers	Likes
VTT	@VTTFinland	3 330	1 997	9 243	868
VTT Cyber-Physical	@VTT_CPS	194	14	54	-
VTT Expert Services	@VTTExpert	17	29	24	-
CNRS (1)	@NRS	13 200	2 840	77 300	8 335
Fraunhofer Presse (2)	@Fraunhofer	4 818	899	16 700	390
CEA Recherche (3)	@CEA_Recherche	1 841	471	7 382	-
Max Planck Society (4)	@maxplanckpress	15 200	1 075	65 700	3956
UCL (6)	@ucl	1 501	827	24 100	249
Imperial College	@imperialcollege	6 525	2 959	53 600	1633

VTT has a few thousand more followers than CEA, but otherwise, it falls quite behind from the other institutes. Tweet wise VTT is active and the VTT related hashtags are very well and widely used. Majority of the competitors did not have a designated hashtag. Since VTT has established well with its hashtags, a #VTTEnergy hashtag would be a smart move to introduce to the VTT hashtag family. This would collect and enhance the awareness of VTT energy know-how.

5.3.3 Audience

The targeted audience consists of decision makers and the general public. Figure 30 present different profiles divided into different audience groups. For VTT, primary

audience are the decision makers. Especially the information providers are important to be reached via social media. Based on a VTT customer need and buying process workshop, providing easily attainable and informative material on expertise and capabilities, the purchase process can be shortened and improved already at the research phase of the potential customer. (Customer Need and Buying Process Workshop 2016)

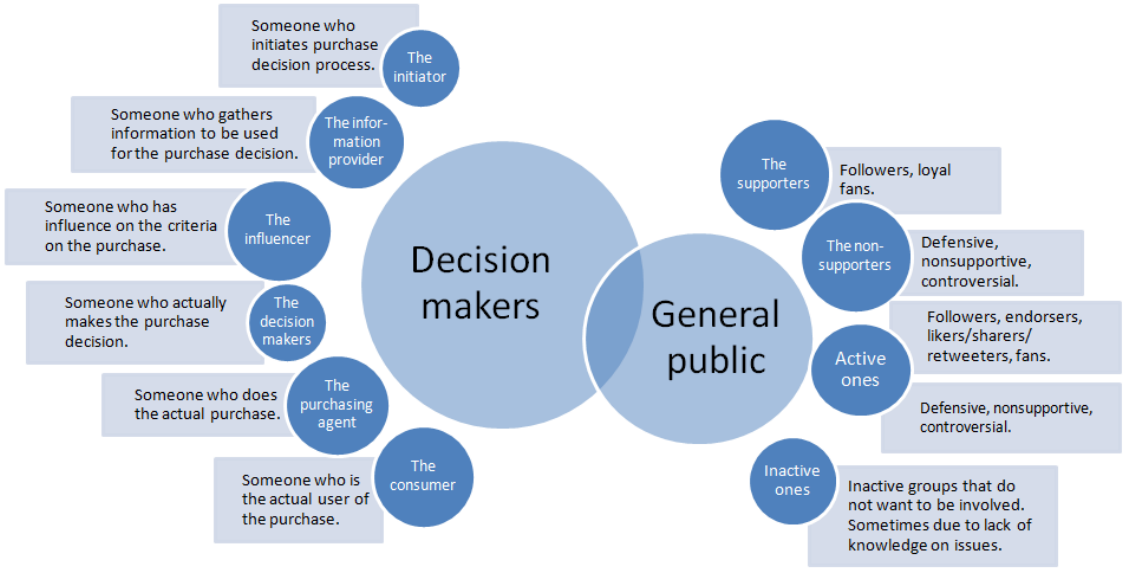


Figure 30. General audience profile for targeted audience for VTT.

The secondary audience, general public, needs to be considered as well since they can have an effect on the decision makers. Communicating about research work is imperative to educate the general public. The general public is also a force to be reckoned with; with the masses as supporters, VTT's energy research will be able to build a popular network around its work. Students and graduates are generally active and supportive. Connecting with the next generation is an asset when hiring the future engineers and leaders of tomorrow. For this, student specific strategies are provided in section 3.5.6. on the content marketing plan.

Of the general public, the active and supportive ones hardly cause quarrels, but non-supportive ones can debate and argue on issues. Based on the energy network survey conducted (Section 5.2.3.), the energy field is talked about a lot. Discussions can consist misleading and untrue statements presented as facts, and heated up conversations due to the different views on energy policies and production methods. These discussions

present a good opportunity to display the expertise of VTT. It is important to identify what kind of audience is the target, but also to identify possibly controversial discussions and actions that may rise from a certain post.

5.3.4 Resources

An overview of the resources is presented in Figure 31. The digital marketing plan is designed in this work without a dedicated budget. The resources of employees, work hours, are of course required. However, steps to minimize used time for creating content have been identified in the content marketing plan section. Efficient use of the editorial calendar tool is important to minimize the work load created. Small scale marketing ranging from 0.50-10 €/promotion, for improving reachability in Facebook can be considered.

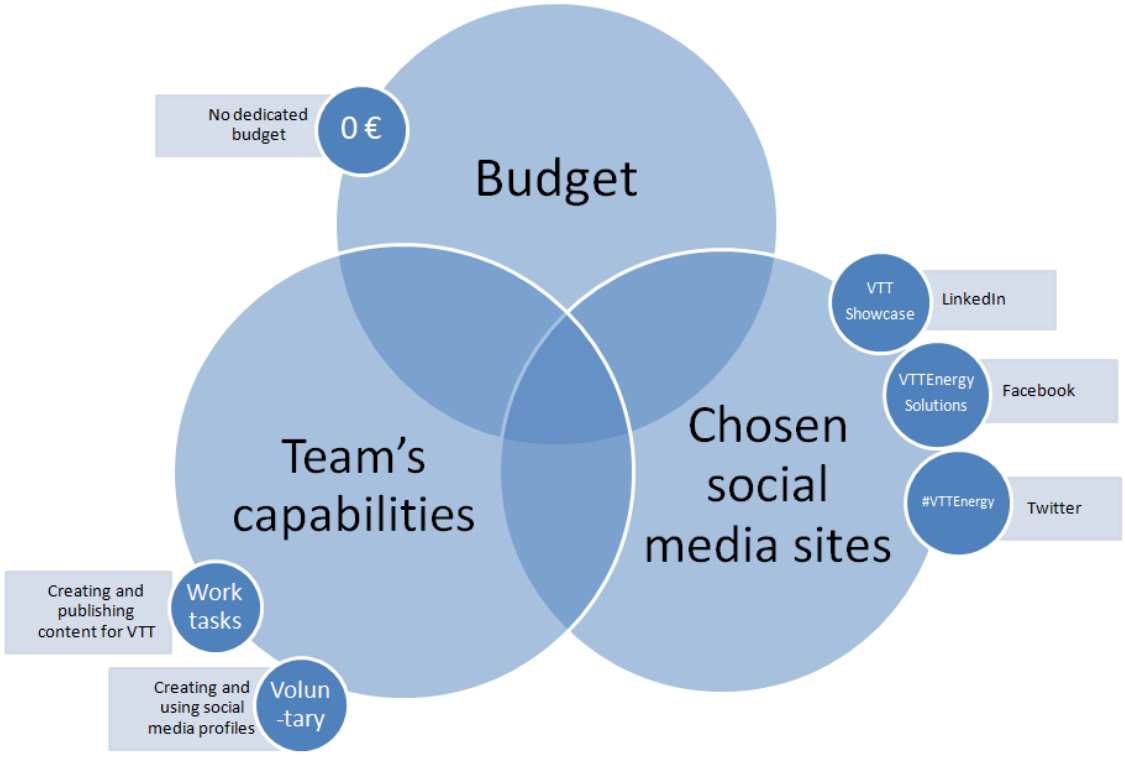


Figure 31. An overview of Renewable Energy Processes' resources.

The team's capabilities include the social media know-how and enthusiasm towards digital marketing. The team can be tasked with creating content, but cannot be forced to create personal profiles or use them for the good of the organization. Based on the

questionnaire, 72 % of the Renewable Energy Processes team replied and 20 % of those, were initially interested in being part of creating content. One of the major barriers being the lack of time, work hours towards creating content should be dedicated. Also providing enough information, guidance and ideas to the team helps to break down the barriers.

The Renewable Energy Processes know-how is divided into three substance areas. These areas have designated team leaders. Through this digital marketing plan, the substance area team leaders and the whole team's team leader are designated with roles and tasks.

5.3.5 Social Media Marketing Plan

Social media sites studied in this work were chosen based on global popularity, cost, usability and suitability for industrial and research work related field, customer and competitor analysis, and by the existing social media profiles of VTT. For Renewable Energy Processes, LinkedIn, Facebook and Twitter will be the major channels for creating impact. Other social media sites are to be used as well, but they have more of a supportive role for the main sites. For example, YouTube, which can be used to upload content that is then shared on the main sites.

VTT has a social media strategy for employees. Guidance videos for creating a Twitter and LinkedIn profile can be found from VTT's intranet under social media section "VTT in Social Media". In the following section, videos on how to create a Twitter and LinkedIn profile are provided.

LinkedIn

LinkedIn is currently the most important professional social media site for VTT. In

Table 16, goals and objectives for the year 2017 are presented. The main goals are to increase the awareness of researchers, and the brand by increasing credibility and presence, as well as continuously build a network.

Table 16. LinkedIn Goals and Objectives for Renewable Energy Processes and its Employees.

Renewable Energy Processes			
Goal	1) Increase the awareness of researchers	2) Increase credibility and presence: Communicate about research work	3) Continuously build a network around team members and customers and associates
Objective	i. Motivate researchers lecturing abroad to create and improve LinkedIn profiles by 1st quarter of 2017 ii. Increase researchers' LinkedIn profiles from 70 % to 100 % by the end of year 2017	i. Find or create an appropriate Showcase page to project team's research work by the 1st quarter of 2017 ii. Encourage team members to add a link to the Showcase page once it is operational and has content	i. By 1st quarter, make sure the team members are connected with each other ii. By 2nd quarter, encourage the team members to connect with personnel in ongoing, recent and upcoming projects iii. By the 2nd quarter, encourage teams to follow associate and customer companies
Tools	Organize a photo shoot.	Editorial Calendar. *See content marketing plan.*	Create monthly customer and associate company lists for continuous network updating
Employees			
Goal	1) Improve own digital profile	2) Take part in communicating about own research work	
Objective	i. Create and improve LinkedIn profile by 1st quarter of 2017 ii. Improve networking by building relationships and connecting with co-workers, customers and other connections iii. Follow associate and customer companies, starting from VTT iv. Endorse skills of colleagues	*See content marketing plan.*	
Tools	Utilize trade unions' resume services (E.g.: TEK's CV-clinic also checks LinkedIn profiles) Always connect with ongoing projects, take part in a photo shoot		

Currently, 70 % of Renewable Energy Processes' team members have LinkedIn profiles. The percentage needs to be increased, at least to cover all the researchers lecturing and visiting customers abroad. The social media trend is more plausible abroad than in

Finland and lecturers are generally researched on. If the researcher does not have a strong social media profile, the next one sure does. Many team members' profiles need to be refined as well.

The VTT company page in LinkedIn is informative and generally covers topics that are researched at VTT. However, specific information on energy related research cannot be found collectively. An appropriate Showcase page should be established for publishing energy related content in LinkedIn. The Bioruukki showcase shows potential, but it is still without content. A joint Showcase page under the Bioruukki shares the publishing responsibilities. Also, Renewable Energy Processes can benefit from the publicity of Bioruukki.

In LinkedIn, there are other functions as well. SlideShare is a LinkedIn based site, where presentations can be uploaded. VTT has its own SlideShare account, where researchers should upload their presentations. Personal profiles can share updates, which is generally used for short and simple messages, like sharing a link with a brief comment. A short visual message can be created by uploading a photo and just including commentary to it. The publishing articles function can be used for many purposes; to publish a full blog post or just a bit longer message than the update. Articles can be created with titles, images and videos can be uploaded to it as well.

Another function of LinkedIn is the groups. Interesting groups are produced all the time. Groups should be followed as they tend to have discussions that present opportunities for Renewable Energy Processes to showcase their expertise and share created content. Some currently interesting groups for Renewable Energy Processes are listed below in

Table 17. Potential Discussion Groups in LinkedIn.

Potential LinkedIn Groups	Members (4.12.2016)
Linked: Energy (Energy Industry Expertise)	255 017
Renewable Energy World	160 040
Horison 2020: Framework Program for Research & Innovation	195 193
Boiler Engineering	5 965
Power Generation Engineers	7 164
Waste to Energy	17 606
Sustainable Energy Development	11 724
Renewable Energy Industry	4 486
Cool Heating	60
ISES (International Solar Energy Society) Discussion Forum	613
Solar Energy	6 197
Energy University	15 380
Energy Industry Professionals	18 050
Sustainability Professionals	150 397

Facebook

Facebook is sometimes viewed as somewhat of a less serious social media site, but its users are sharing news and articles on their personal profiles, and also displaying more interests that are more professional. Facebook is under transition, and it is becoming more and more important for businesses to be a part of.

In Facebook, VTT has the official Facebook page and two team specific pages: Energy Solutions and Protein Production. The VTT's official page seems to have less of energy related posts when compared to other research topics. Renewable Energy Processes is represented in Facebook under the VTTEnergySolutions page. The VTTEnergySolutions is a public page and therefore, it is currently the only VTT energy related profile that can be viewed without having a profile on Facebook.

Facebook related goals and objectives are presented in Table 18. The goal for the page is to provide a comprehensive platform for communicating about VTT's research work

and new developments in the energy field as well as present what kind of a workplace VTT is.

Table 18. Facebook Goals and Objectives for Renewable Energy Processes and its Employees.

Renewable Energy Processes			
Goal	1) Increase credibility and presence: Communicate about research work	2) Create a comprehensive Facebook-page since it is one of the only sites that can be viewed without having a profile	
Objective	i. Increase the amount of likes from 68 (30.11.2016) to 100 by the end of 2nd quarter of 2017 ii. Increase the amount of likes from 100 to 200 by then end of 4th quarter of 2017 iii. Continue to administrate the VTTEnergySolutions Facebook page iv. Find collaborative administratives from other VTT energy related research teams by the end of 1st quarter of 2017 v. Encourage team members to like the page by the end of 1st quarter		
Tools	*See content marketing plan.*		
Employees			
Goal	1) Take part in communicating about own research work	2) Take part in creating content about own work	3) Consider liking the VTTEnergySolutions page
Objective	*See content marketing plan.*		Like the VTTEnergySolutions page by 1st quarter
Tools	*See content marketing plan.*		

The plan is to keep on administrating the VTTEnergySolutions page. Since "Energy Solutions" cover more than just the Renewable Energy Processes, it would be good to seek out other interested VTT energy related teams to join in up keeping of the page.

To increase Facebook reachability, it is good to tag other involved parties and associates to posts and use the sharing action as much as possible. In take place.

Table 19, some energy related Facebook groups are presented where content can be further shared and discussions take place.

Table 19. Potential Discussion Groups in Facebook.

Potential Facebook Groups	Members
Uusi Energiapolitiikka	3820
Suomen Ekomodernistit	1065
Energy Discussion Forum	2813

Especially the Uusi Energiapolitiikka Facebook group should be well utilized. It grows approximately by 8 members a day, and its members include politicians, company leaders, entrepreneurs and otherwise active members like students. During the content testing of the trial profile, best reachability was gained by sharing an innovative VTT related news article to the Uusi Energiapolitiikka group. All of the mentioned groups, but especially the Suomen Ekomodernistit and Energy Discussion groups tend to have discussion that present opportunities to show VTT energy expertise.

Twitter

Twitter related goals and objectives are presented in Table 20. In the results of SOME at SONE questionnaire, Twitter was the most popular social media site where responders would like to have social media profiles at. Therefore, the activity of employees should be utilized in Twitter. VTT has a strong Twitter profile and the VTT related hashtags are well used. A new hashtag of #VTTEnergy will be introduced to the hashtag family, and researchers should be encouraged to create profiles and start using it.

Table 20. Twitter Goals and Objectives for Renewable Energy Processes and its Employees.

Renewable Energy Processes		
Goal	1) Increase the awareness of researchers	2) Increase credibility and presence: Communicate about research work
Objective	i. Increase researchers' Twitter profiles from 20 % to 40 % by the end of year 2017	i. Encourage the use of "#VTTEnergy" to create more visibility and uniform database
Tools	See content marketing plan.	

Employees			
Goal	1) Create and improve own Twitter account	2) Be more active on Twitter	3) Take part in communicating about own research work
Objective	i. Create and improve Twitter profile by 2nd quarter of 2017 ii. Improve networking by following co-workers, customers, companies and other connections	i. Tweet and retweet actively ii. Use #VTTEnergy	*See content marketing plan.*

At the initial phase of creating a social media presence for Renewable Energy Processes, it is not suggested to create own profile in Twitter. This way there are less administrative responsibility in the beginning which ensures that the plan is executed on the long term. However, if there are resources, as in active employees, an energy related Twitter profile can be established at any point.

Other

In Table 21, other social media sites that active employees can utilize on their own preference are presented. Later on, if a social media site seems potential for Renewable Energy Processes, it can be added to the digital marketing plan. For now, to make sure

that the plan is not too complicated and time consuming in the beginning, the chosen three social media sites will have the main focus.

Table 21. Other Social Media Sites for Employees to Utilize.

Other social media sites to be used	What	How
VTTBlog	VTT's own blog platform	Contact communications department
SlideShare	Share presentations Formats: *PowerPoint* *PDF* *Keynote* *OpenDocument*	VTT has its own SlideShare page Join via own LinkedIn profile
ImpactStory	Way to measure impact of research outputs, *Traditional* (journal articles) *Alternative* (blog posts, datasets)	Create an account ImpactStory will find your publications based on your ORCID (if you do not have one, it will help you create it)
Scientific Networking sites	ResearchGate ScienceOpen MyScienceWork Mendeley Academia.edu	Create a profile Add publications
Reddit	Reddit community where science topics are discussed At r/science	Create a Reddit user account
Google+	Social networking site Communities, people & pages	Create Gmail account

5.3.6 Content Marketing Plan

Activities in social media can include publishing and sharing content, but also engaging in discussions. The type of contents that are created by researchers, an estimation on content type workload, and insight on where they should be uploaded and how can they be further shared are collected in Figure 32. The workload increases downwards.

Content Type	**Workload** "XS" (< 30 min) "S (0,5-2 h) "M" (2-8 h) "L" (Days or more)	**Where to Upload**	**Where to Share or What to Hashtag**
Microblogging or microposting	Comment + news, articles, publications, ideas, etc. ➢ XS-S	Twitter	#VTTEnergy #VTTPeople #VTTFinland
		Facebook • VTTEnergySolutions • Personal profile	• Facebook discussion groups (table 13)
Blogging	From article, abstract ➢ S From beginning / "scratch" ➢ M-L	LinkedIn • Showcase page • Personal profile	Facebook • VTTEnergySolutions • VTTFinland Twitter • #VTTEnergy • #VTTPeople • #VTTFinland LinkedIn • Showcase page • Personal profile
		VTTBlog	
Infographics	Based on information level and graphics ➢ S-L	Facebook • VTTEnergySolutions Twitter • #VTTEnergy • #VTTPeople • #VTTFinland LinkedIn • Showcase page • Personal profile	
Video	Short & "rough", mobile videos ➢ S-M Longer films ➢ M-L	VTT profile in YouTube	Facebook • VTTEnergySolutions • VTTFinland Twitter • #VTTEnergy • #VTTPeople • #VTTFinland LinkedIn • Showcase page • Personal profile
Animation / Games	Very time consuming ➢ L	• VTT profile in YouTube • Other platforms suitable to support games	Facebook • VTTEnergySolutions • VTTFinland Twitter • #VTTEnergy • #VTTPeople • #VTTFinland LinkedIn • Showcase page • Personal profile

Figure 32. Collection of information on creating content, workloads related to the creation process and where to upload and share created content.

Creating content is the most time consuming part. Time can be saved by sharing content already created by other users, like news, articles, publications, other user's tweets and posts. Interesting head titles or comments should be added to gain attention. By sharing content through several social media sites and profiles, content is categorized well by search engines. In addition to general type of contents, like news and articles, content that can be further shared and is engaging and different are listed in Figure 33.

Content Type	Examples	Where to Upload	Where to Share, What to Hashtag
Presentations	Power points, pdf	VTT's SharePoint	Facebook • VTTEnergySolutions • VTTFinland Twitter • #VTTEnergy • #VTTPeople • #VTTFinland LinkedIn • Showcase page
Live streaming	Live presentations, interviews, vlogging	Twitter • Periscope Facebook • Live stream	Facebook • VTTEnergySolutions • VTTFinland Twitter • #VTTEnergy • #VTTPeople • #VTTFinland LinkedIn • Showcase page
Events	Webinars, Seminars, Conferences	Facebook • @VTTEnergySolutions • @VTTFinland Twitter	Facebook • Energia-alan tilaisuuksien tiedotusryhmä Twitter • #VTTEnergy • #VTTPeople • #VTTFinland LinkedIn • Showcase page
Job posts	Published VTT website	Facebook • @VTTEnergySolutions	Student organizations at Facebook • Oulun yliopiston Ympäristörakentajakilta ry • Oulun yliopiston Prosessikilta ry • Vaasan yliopiston teknillinen ainejärjestö Tutti • Lappeenrannan yliopiston Armatuuri • Aaltoyliopiston Puunjalostajakilta • Tampereen ympäristöteekkarikilta YKI

Figure 33. Examples of what kind of engaging and different type of contents can be shared quickly.

Editorial Calendar

VTT uses Microsoft Office Outlook as a professional information manager, which offers applications for e-mail, calendar, etc. An editorial calendar named "Editorial Calendar" has been created in Outlook for the use of Renewable Energy Processes team.

The Renewable Energy Processes team is divided into three substance areas that meet once a month. All areas are designated with a substance team leader that should be also be assigned with the responsibility for creating content considering their substance area of expertise. In these meetings, the editorial calendar should be updated. Updating the calendar includes listing all upcoming field related events, and publication dates for articles, and other publications, etc. Based on these dates, a plan for publishing content should be made and uploaded to the calendar. The dates should be considered from the perspectives of before, during and after.

An example of updated calendar is presented in Figure 34. If there is an upcoming seminar where a team member is presenting results, a blog post could be made before that. It could be based on the submitted abstract with tags to the relevant parties like the organizer. During the seminar, a live stream of or a picture from the presentation could be posted. Then again, after the event, presentation materials can be shared in SlideShare, video material can be uploaded in YouTube and shared, or a blog post can be written on the event.

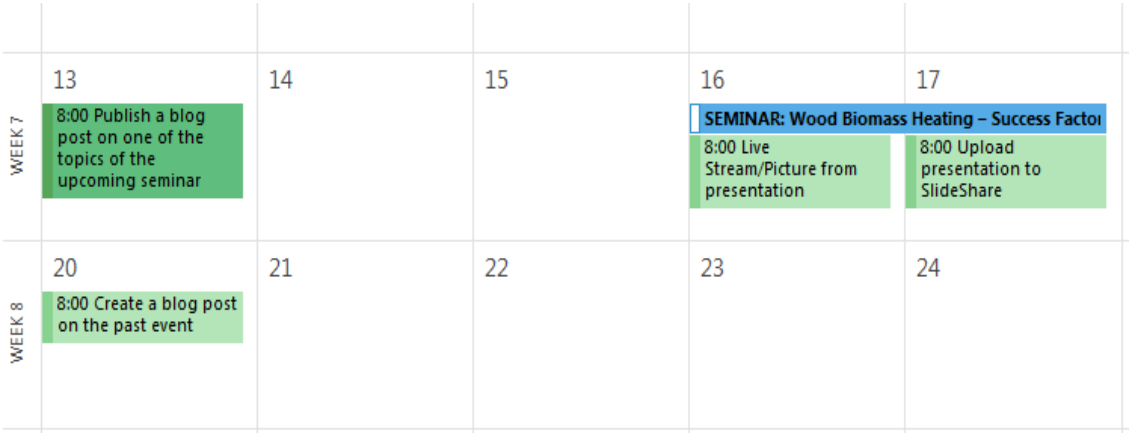


Figure 34. Example of updated Editorial Calendar.

Contents should be posted regularly and continuously. It is important to gain followers and likes, but it is essential to be able to retain them as well. Based on the findings of the trial profile, the interested users are active steadily throughout the week. The users seem to be active around 8:30-11, 16-17 and 20-22. It is essential to have something new to read at this point. The best times for publishing is therefore a bit before these time peaks: 6:30-7:30, 14-15 and 18-19.

In Table 22, the publication rates at which content should be published in LinkedIn and Facebook is presented. These rates are minimum suggestions. More can be shared if there is more relevant material. For Facebook, substance team leaders should be responsible or appoint responsible ones for uploading related news to the Facebook page. Related news can be quickly found at the bottom of the intranet homepage. If other VTT energy related teams join in on administrating the VTTEnergySolutions page, the publication rate can be adjusted higher.

Table 22. Content Publication Rates for LinkedIn and Facebook.

Social Media Site	Publication rate	Examples of Content
LinkedIn	At least twice a month	About VTT Energy: news, blogs, articles, reports, pictures, videos, events, job listings, presentations.
Facebook	3-6 / week	News (about VTT and also just about the energy field), articles, blogs, reports, pictures, videos, events, job listings, presentations and so on.

6 CONCLUDING REMARKS

For businesses and researchers, there is a growing need to increase their digital presence. Companies are not fully utilizing the marketing potential of social media and majority do not have a digital marketing plan. Social media is an integrate tool to enhance brand awareness and generate leads for business. VTT's Renewable Energy Processes team needs to increase awareness of its expertise in conventional and renewable energy solutions for customer and project acquisitioning. A digital marketing plan can be created to increase digital visibility.

The purpose of this master's thesis was to create a digital marketing plan for the use of Renewable Energy Processes team containing strategies for social media and content marketing. The technical review was conducted based on VTT's Renewable Energy Processes' area of expertise. Renewable Energy Processes conduct research around thermochemical processes, mainly about fuels and combustion, but also solar power. Renewable Energy Processes is a part of VTT's Bioruukki concept. Due to this, also pyrolysis and gasification were reviewed.

Social media is current; it offers many possibilities for businesses. Businesses and researchers no longer can choose whether or not they exist online. Majority of businesses and researchers show up on search engine results whether or not they had anything to do with the content. Second generation World Wide Web, referred to as Web 2.0, is an environment based on collaboration and information. Social media sites are based on Web 2.0. Most popular social media sites globally are Facebook, LinkedIn, Twitter, YouTube, etc. Profiles can be created on those social media sites, which can be used for different online social media activities. In this thesis, the most common social media sites were analyzed and relevant sites for VTT were collected for further evaluation.

For businesses, a digital marketing plan is integral to strategize and manage their online presence. There are many ways to create a digital marketing plan, many of which are commercial. Through literary review, it was conducted that a digital marketing plan can be made based on a mission statement, a review of own and competitors' current social

media presence, determining target audience, and assessing team resources. Digital marketing plan contains social media and content marketing plans. The social media marketing part includes the chosen social media sites, and the plan to create and refine the profiles on those sites. The content marketing plan needs to have strategies for creating and publishing content for the social media sites. An integrate part of the content marketing plan is creating an editorial calendar to be able to plan and manage the publishing and posting.

6.1 Digital Marketing Plan

The digital marketing plan was constructed based on the theoretical findings, results of the trial social media profile and SOME at SONE questionnaire, VTT's new strategy, and the research conducted around energy networks and social media. The digital marketing plan has strategies for social media and content marketing from both perspectives of Renewable Energy Processes and its employees. The plan was designed without a dedicated budget and its primary audience is decision makers, secondary audience is the general public like students and other interested users.

Social media site specific goals and objectives were aligned with VTT’s new strategy of creating impact through expertise and the researchers, VTTPeople. It is important to dismantle the possible barriers employees have that prevent the professional use of social media and content creation. The focus is to increase brand awareness by communicating about research, facilities and expertise, and to increase the digital presence of researchers. The mission is to make VTT the go-to research centre for conventional and renewable energy related research.

The first task for Renewable Energy Processes as an organization is to create a presence in three globally dominant social media sites: LinkedIn, Facebook and Twitter. In LinkedIn and Facebook, VTT’s Renewable Energy Processes should be represented as an organization by using channels of its own for presenting their expertise, research and facilities. During the thesis process, a trial social media profile VTTEnergySolutions was created in Facebook. For Facebook, VTTEnergySolutions should be continued to use. For LinkedIn, a Showcase under VTT’s official company page should be used. It needs to be decided whether the Renewable Energy Processes publishes under the

Bioruukki Showcase page or whether an own Showcase page should be created in LinkedIn. Later on, if there are necessary resources available, energy related Twitter page could be also created. For now, the plan for Twitter is to utilize active employees and start using the new hashtag #VTTEnergy.

Establishing social media presence requires profiles in the social media sites, but also captivating content. Creating content can be time consuming and challenging. Ideas to minimize the time used for planning and creating content were presented in the content marketing plan by content type. For example, an abstract can be easily turned into a blog post and presentation material uploaded into SharePoint and then further shared to the social media sites. Another way to facilitate the content creation process is to utilize an editorial calendar. There, important events and occasions, deadlines, etc. can be uploaded. The calendar provides information on what material will be created for work purposes. This content can be utilized as is or with minor modifications or additions as content for social media. Then, dates for publishing content can be added to the calendar as well. An editorial calendar has been created for the use of Renewable Energy Processes team in the e-mail and calendar application Outlook which is used by VTT.

The digital marketing plan should be refined constantly. Other VTT's energy related research teams should be invited to administer the Facebook page VTTEnergySolutions. When this occurs, the publication rate for Facebook should be increased. Interesting social media sites that could be added to the plan in the near future are the scientific networking sites and Google+. In addition, tools to measure impact of researchers' work, such as ImpactStory, are interesting applications to utilize in the future.

6.2 Future Research and Targets for Development

Based on the questionnaire conducted in this thesis, VTT’s social media guidelines should be revised. Employees require more accuracy and details to the guidelines. The current guidelines are brief and do not encourage employees to utilize social media for work purposes. Employees are not sure how they should represent VTT in social media. Employees also feel that VTT research should be more visible in social media. Energy discussions should be encouraged, not avoided. Help and support for creating captivating content about research work and facilities is also needed. To improve the

team's internal communications, an application that facilitates group discussion is needed. Currently, communication relies on e-mail, Skype and live meetings.

One of the main challenges is to inspire and advocate employees to participate in the continuous content creation process. Content created by employees is closer to UGC type of content, which is considered more relatable and evokes cognitive trust in audience when compared to MGC. Through researchers, audience can be reached and connected more on a personal level. Technology and tools helping the creation process should be researched upon and implemented into the digital marketing plan.

For further development of the digital marketing plan, paid marketing could be researched on. It would be interesting to see how a marketing budget to be used for advertising and analytics affects the success of digital marketing. In addition, potential associates should be sought out. What journals would enhance VTT's social media presence? Journals that are active in the same social media sites could be potential channels to publish articles and reports, since they can be tagged and posts shared.

For future research, LinkedIn groups should be further analyzed. A research trainee LinkedIn profile was insufficient for acceptation to many potential groups. Also analyzing the size of the groups and how it affects the nature of the discussions should be researched on. Another way to find potential conversations is from organizational and association sites that have private forums for members. Research on discussions taking place in those forums would also be interesting, but require memberships.

In addition, a deeper analysis of different scientific social media sites should be conducted. ResearchGate, MyScienceWork, ScienceOpen, Mendeley and Academia.edu should be compared to find the best sites for the researchers at VTT. ScienceOpen's platform for businesses should also be reviewed.

Through the research process of this thesis, it was noted that VTT’s profiles on different organization and association sites need reviewing. Some sites had insufficient contact and research facilities information. The employees and some customers feel that the VTT website needs to be updated as well.

7 REFRENCES

Academia.edu, 2016. Academia. [web document] Available at: www.academia.edu. [cited 8.12.2016]

AllPowerLabs, 2016. All Power Labs - Carbon Negative Power & Products 2016. How Gasification Works. [web document] Available at: http://www.allpowerlabs.com/gasification-explained [cited 10.7.2016]

Al Chami Z., Amer N., Smets K., Yperman J., Carleer R., Dumontet S., & Vangronsveld J., 2014. Evaluation of flash and slow pyrolysis applied on heavy metal contaminated Sorghum bicolor shoots resulting from phytoremedation. Biomass and Bioenergy, Vol. 63, p. 268-279.

Apăvăloaie E., 2014. The Impact of the Internet on the Business Environment. Procedia Economics and Finance, 15, p. 951-958.

Basu P., 2010. Biomass Gasification and Pyrolysis - Practical Design and Theory. 1st Edition. Burlington: Academic Press, 376 p. ISBN 9780123749888.

Bradbury D., 2013. Effective social media analytics. The Guardian. [web document] Available at: https://www.theguardian.com/technology/2013/jun/10/effective-social-media-analytics [cited 11.11.2016]

Bijarniya J., Sudhakar K., & Baredar P., 2016. Concentrated solar power technology in India: A review. Renewable and Sustainable Energy Reviews, 63, p. 593-603.

Bridgwater A., Toft A., & Brammer J., 2002. A techno-economic comparison of power production by biomass fast pyrolysis with gasification and combustion. Renewable and Sustainable Energy Reviews, 6, p. 181-246.

Bridgwater A., 2011. Review of fast pyrolysis of biomass and product upgrading. Biomass and Bioenergy, 38, p. 68-94.

Brengarth L., & Mujkic E., 2016. WEB 2.0: How social media applications leverage nonprofit responses during a wildfire crisis. Computers in Human Behavior, 54, p. 589-596.

Bosomworth D., 2014. The Content Marketing Matrix. [web document] Available at: http://www.smartinsights.com/content-management/content-marketing-strategy/the-content-marketing-matrix-new-infographic/ [cited 1.11.2016]

Burcu B., 2016. Pyrolysis: A sustainable way from Waste to Energy. FOREBIOM Potentials for realizing negative carbon emissions. Aadolu University. [Web document] Avaialable at: http://www.oeaw.ac.at/forebiom/WS1lectures/SessionII_Uzun.pdf [cited 14.7.2016]

Burke Z., 2016. 5 steps to a powerful digital marketing strategy. [web document] Available at: https://digitalmarketinginstitute.com/blog/5-steps-powerful-digital-marketing-strategy [cited 20.10.2016]

Carlson T., Vispute T., & Huber G., 2008. Green Gasoline by Catalytic Fast Pyrolysis of Solid Biomass Derived Compounds. ChemSusChem, 1, p. 369-470.

Chen P., Xie G., Addy M., Zhou W., Liu Y., Wang Y., Cheng Y., Li K., & Ruan R., 2016. Utilization of municipal solid and liquid wastes for bioenergy and bioproducts production. Bioresource Technology, 215, p. 163-172.

Choi B. & Lee I., 2016, DOI. Trust in Open Versus Closed Social Media: the Relative Influence of User- and Marketer-Generated Content in Social Network Services on Customer Trust. Telematics and Informatics.

Chui M., Manyika J., Bughin J., Dobbs R., Roxburgh C., Sazzarin H., Sands G., & Westergren M., 2012. The social economy: Unlocking value and productivity through social tecnhologies. McKinsey Global Institute. [web document] Available at: http://www.mckinsey.com/industries/high-tech/our-insights/the-social-economy [cited 12.11.2016]

Constantinides E., 2014. Foundations of Social Media Marketing. Procedia - Social and Behavioral Sciences, 148, p. 40-57.

Content Marketing Institute, 2016. What is Content Marketing? [web document] Available at: http://contentmarketinginstitute.com/what-is-content-marketing/ [cited 7.11.2016]

Cooler Insights, 2016. 6 Useful Content Marketing Tool and Templates. [web document] Available at: http://coolerinsights.com/2016/06/6-useful-content-marketing-tools-and-templates/ [cited 7.11.2016]

Cross M., 2014. Social Media Security - Leveraging Social Networking While Mitigating Risk. 1st Edition. Waltham: Syngress, 346 p. ISBN: 9781597499866.

DeNardis L. & Hackl A., 2015. Internet governance by social media platforms. Telecommunications Policy, 39, p. 761-770.

Elitas T., 2015. Social media usage by open education faculties: Atatürk University case. Procedia - Social and Behavioral Sciences, 176, p. 243-250.

European Research Ranking 2015. European Research Ranking. [web document] Available at: http://www.researchranking.org/?action=ranking. [cited 1.12.2016]

Felix R., Rauschnabel P., & Hinsch C., 2016. Elements of strategic social media marketing: A holistic framework. Journal of Business Research, 70, 118-126.

Flickr, 2016. Flickr. Find your inspiration. [web document] Available at: www.flickr.com. [cited 8.12.2016]

GazoGenerator 2013. Circulating Fluidized Bed. [web document] Available at: http://gazogenerator.com/boilers-for-power-and-process/circulating-fluidized-bed-combustion/ [cited 20.9.2016]

Gikas J. & Grant M., 2013. Mobile computing devices in higher education: Student perspectives on learning with cellphones, smartphones & social media. Internet and Higher Education, 19, p. 18-26.

Giuntoli J., Agostini A., Caserini S., Lugato E., Baxter D., & Marelli L., 2016. Biomass and Bioenergy, 89, p. 146-158.

Google+, 2016. Google+. [web document] Available at: http://plus.google.com. [cited 8.12.2016]

Green M., 2000. Photovoltaic: technology overview. Energy Policy, 28, p. 989-998.

Hakkarainen E., 2015. Comparison of Different Concentrated Solar Power Collector Designs and Development of a Linear Fresnel Solar Collector Model. [web document] Lappeenranta: Lappeenranta University of Technology.

Hansen D., Shneiderman B., & Smith M., 2011. Analyzing Social Media Networks with NodeXL - Insights from a Connected World. Burlington, USA: Elsevier Inc., 277 p. ISBN: 978-0-12-382229-1.

Hirvonen J., 2016. Dynamic modelling of circulating fluidized bed plant with gas turbine repowering. [web document] Lappeenranta: Lappeenranta University of Technology.

Holmes N., 2014. What is visual content? [web document] Available at: http://www.smartimage.com/visual-content/ [cited 10.11.2016]

ImpactStory, 2016. Impactstory. Let's add your publications. [web document] Available at: http://impactstory.org. [cited 8.12.2016]

Instagram, 2016. Instagram. [web document] Available at: www.instagram.com. [cited 8.12.2016]

InternetLiveStats, 2016. Internet Live Stats. [web document] Available at: http://www.internetlivestats.com/. [cited 10.12.2016]

IPCC, 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories - Volume 2 - Energy. [web document] Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html [cited 16.8.2016]

IPCC, 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland. (155)

Jan M., 2016. 8 Types of Blog Content You Should Publish in 2016. [web document] Available at: https://blog.getresponse.com/8-types-of-blog-content-you-should-publish-in-2016.html [cited 20.11.2016]

Jones S., Meyer P., Snowden-Swan L., Padmaperuma A., Dutta A., Tan E., Cafferty K., & Jacobsen J., 2013. Process Design and Economics for the Conversion of Lignocellulosic Biomass to Hydrocarbon Fuels - Fast Pyrolysis and Hydrotreating Bio oil Pathway. U.S. Organization of Energy Bioenergy Technologies Office. [web document] Available at: http://www.nrel.gov/docs/fy14osti/61178.pdf.

Jones J., 2011. Mechanisms of Pyrolysis. Massey University, New Zealand Biochar Research Centre. [web document] Available at: http://www.anzbiochar.org/2011%20Regional%20Meeting%20Presentations/JRJones%20-%20Mechanisms%20of%20Pyrolysis%20-%20Melb%2029%20Sept%202011.pdf

Järvinen J. & Karjaluoto H., 2015. The use of Web analytics for digital marketing performance measurement. Industrial Marketing Management, 50, p. 117-127.

Kallio K., Vasara A., Huomoo T., Kalliokoski P., Laitinen T., Nakari-Setälä T., Nuutinen M., Rikkola R., Salkari I., Still K., Sundqvist-Andberg H., & Turunen E., 2016. Growth partner through technology - VTT Strategy 2016-2020. [web document] VTT Technical Research Center of Finland Ltd.

Kataki R., Chutia R., Mishra M., Bordoloi N., Saikia R., & Bhaskar T., 2015. Recent Advances in Thermo-Chemical Conversion of Biomass. Section 2 - Feedstock

Suitability for Thermochemical Processes. Elsevier B.V., 491 p. ISBN: 978-0-444-63289-0.

Kaplan A., 2012. If you love something, let it go mobile: Mobile marketing and mobile social media 4x4. Business Horizons, 55, p. 129-139.

Kietzmann J., Hermkens K., McCartry I., & Silvestre B., 2011. Social Media? Get Serious! Understanding the functional building blocks of social media. Business Horizon, 54, p. 241-251.

Kim S., 2014. Prediction of product distribution in fine biomass pyrolysis in fluidized beds based on proximate analysis. Bioresource Technology, 175, p. 275-283.

Lecksiwilai N., Gheewala S., Sagisaka M., & Yamaguchi K., 2016. Net Energy Ratio and Life cycle greenhouse gases (GHG) assessment of bio-dimethyl ether (DME) produced from various agricultural residues in Thailand. Journal of Cleaner Production, 134, p. 523-531.

Lappalainen J., Touronen A., Mikkonen H., Hänninen M., & Kovacs J., 2014. Modelling and dynamic simulation of a supercritical, oxy combustion circulating fluifized bed power plant concept- Firing mode switching case. International Journal of Greenhouse Gas Control, 28, p. 11-24.

Lehto J., Oasmaa A., Solantausta Y., Kytö M., & Chiaramonti D., 2014. Review of fuel oil quality and combustion of fast pyrolysis bio-oils from lignocellulosic biomass. Applied Energy, 116, p. 178-190.

Leijenhorst E., Wolters W., Van de Beld L., & Prins W., 2016. Inorganic element transfer from biomass to fast pyrolysis oil: Review and experiments. Fuel Processing Technology, 149, p. 96-111.

Leiner B., Cerf V., Clark D., Kahn R., Kleinrock L., Lynch D., Postel J., Roberts L., & Wollf S., 2016. What is the Internet. [web document] Available at: http://www.internetsociety.org/internet/what-internet [cited 21.9.2016]

LePage E., 2016. How to Create a Social Media Marketing Plan in 6 steps. [web document] Available at: https://blog.hootsuite.com/how-to-create-a-social-media-marketing-plan/ [cited 20.10.2016]

Lintulahti M., 2014a. Sisältömarkkinoinnin viisi yleisintä ongelmaa ja miten ratkaista ne [web document] Available at: http://www.kubo.fi/sisaltomarkkinoinnin-viisi-yleisinta-ongelmaa-ja-miten-ratkaista-ne/ [cited 7.7.2016]

Lintulahti M., 2014b. Facebook käytetyin, LinkedIn tehokkain sosiaalisen median kanava yritysten sisältömarkkinoinnissa [web document] Available at: http://www.kubo.fi/facebook-kaytetyin-linkedin-tehokkain-sosiaalisen-median-kanava-yritysten-sisaltomarkkinoinnissa/ [cited 7.7.2016]

Lintulahti M., 2016. Tulokset: Sisältömarkkinoinnin trendit Suomessa 2016 [web document] Available at: http://www.kubo.fi/tulokset-sisaltomarkkinoinnin-trendit-suomessa-2016/ [cited 7.7.2016]

Meyers A., 2012. 13 Types of Social Media Platforms and Counting. Decidedly Social. [web document] Available at: http://decidedlysocial.com/13-types-of-social-media-platforms-and-counting/ [cited 18.11.2016]

Mendeley, 2016. Mendeley. Empowering researchers. [web document] Available at: www.mendeley.com. [cited 8.12.2016]

Michaelidou N., Siamagka N., & Christodoulides G., 2011. Usage, Barriers and Measurement of Social Media Marketing: An Exploratory Investigation of Small and Medium B2B Brands. Industrial Marketing Management, 40, p. 1153-1159.

Mikkonen H., Suojanen S., Hakkarainen E., & Jegorff M., 2016. Control Method Development Platform for Hybrid Power Plants. VTT Technical Research Centre of Finland.

Moreira D. & Pires J., 2016. Atmospheric CO2 capture by algae: Negative carbon dioxide emission path. Bioresource Technology, 215, p. 371-379.

MyBlackBean, 2013. Content Marketing Media Matrix. [web document] Available at: http://visual.ly/content-marketing-media-matrix. [cited 17.11.2016]

MyScienceWork, 2016. MyScienceWork. Share and Promote Your Research. [web document] Available at: www.mysciencework.com. [cited 8.12.2016]

Nord J., Lee T., Cetin F., Atay Ö., & Paliszkiewicz J., 2016. Examining the impact of social technologies on empowerment and economic development. International Jouran of Information Management, 36, p. 1101-1110.

Onay O., & Kockar O., 2003. Slow, fast and flash pyrolysis of rapeseed. Renewable energy, 28, p. 2417-2433.

Oxley A., 2013. Security Risks in Social Media Technologies. Great Britain: Woodhead Publishing, 262 p. ISBN: 978-1-78063-380-0.

Patwardhan P., Dalluge D., Shanks B., & Brown R., 2011. Distinguishing primary and seconday reactions of cellulose pyrolysis. Bioresource Technology, 102, p. 5265-5269.

Penni J., 2016, DOI. The future of Online Social Networks (OSN): A Measurement Analysis using social media tools and applications. Telematics and Informatics.

Periscope, 2016. Periscope. [web document] Available at: www.periscope.tv. [cited 8.12.2016]

Pinterest, 2016. Pinterest. The world's catalog of ideas. [web document] Available at: www.pinterest.com. [cited 8.12.2016]

Reddit, 2016. Reddit. The front page of the internet. [web document] Available at: www.reddit.com. [cited 8.12.2016]

ResearchGate, 2016. ResearchGate - Share and discover research. [web document] Available at www.researchgate.net. [cited 8.12.2016]

Rokka J., Karlsson K., &Tienari J., 2014. Balancing acts: Managing employees and reputation in social media. Journal of Marketing Management, 30, p. 802-827.

Schulzke T., Conrad S., & Westermeyer J., 2016, DOI. Fractionation of flash pyrolysis condensates by staged condensation. Biomass & Bioenergy..

ScienceOpen, 2016. Scienceopen.com. Research+publishing network. [web document] Available at: about.scienceopen.com. [cited 8.12.2016]

Sareah F., 2015. Interesting Statistics for the Top 10 Social Media Sites. Small Business Trends. [web document] Available at: https://smallbiztrends.com/2015/07/social-media-sites-statistics.html [cited 16.11.2016]

SmartInsights, 2016. Digital marketing strategy advice [web document] Available at: http://www.smartinsights.com. [cited 20.11.2016]

Snapchat, 2016. Snapchat. [web document] Available at: www.snapchat.com. [cited 8.12.2016]

Solomon S., Qin M., Manning M., Chen Z., Marquis M., Averyt K.B, Tignor M., & Miller H.L, 2007. Contribution of Working Group I on the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. [web document] Available at: http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm [cited 20.10.2016]

Statista 2016. Statista - The Statistics Portal. [web document] Available at: https://www.statista.com/ [cited 23.11.2106]

Stevens 2016. Internet Stats & Facts for 2016. [web document] Available at: https://hostingfacts.com/internet-facts-stats-2016/ [cited 10.9.2016]

Szemmelveisz K., Scucs I., Palotas A., Winkler L., & Eddings E., 2009. Examination of the combustion conditions of herbaceous biomass. Fuel Processing Technology, 90, p. 839-847.

Tachibana C., 2014. A Scientist's Guide to Social Media. [web document] Available at: https://www.sciencemag.org/careers/features/2014/02/scientists-guide-social-media [cited 20.9.2016]

Talouselämät, 2016. Facebook huolestui ”romahduksesta”: Ihmiset eivät enää jaa henkilökohtaisia asioitaan [web document] Available at: http://www.talouselama.fi/uutiset/facebook-huolestui-romahduksesta-ihmiset-eivat-enaa-jaa-henkilokohtaisia-asioitaan-6539387#.VwcazR6Ms3Y.twitter [cited 7.7.2016]

The Content Factory, 2016. 16 Reasons Why Your Business Needs Social Media Marketing. [web document] Available at: http://www.contentfac.com/9-reasons-social-media-marketing-should-top-your-to-do-list/ [cited 4.12.2016]

Tiago M. & Verissimo J., 2014. Digital marketing and social media: Why bother? Business Horizons, 57, p. 703-708.

Tietjen O., Pahle M., & Fuss S., 2016. Investment risks in power generation: A comparison of fossil fuel and renewable energy dominated markets. Energy Economics, 58, p. 174-185.

Tumblr, 2016. Tumblr. [web document] Available at: www.tumblr.com. [cited 8.12.2016]

Twitter, 2016. Twitter. [web document] Available at: www.twitter.com. [cited 8.12.2016]

Van Eperen L. & Marincola F., 2011. How scientists use social media to communicate their research. Journal of Translational Medicine, 199(9).

Vonkantke, 2016. Vontake. [web document] Available at: www.vk.com. [cited 8.12.2016]

VTT, 2016a. VTT Technical Research Centre of Finland Ltd. [web document] Available at: http://www.vttresearch.com/about-us [cited 12.8.2016]

VTT 2016b. CFD modelling - A powerful and affordable tool. [web document] Available at: http://www.vttresearch.com/services/low-carbon-energy/combined-heat-and-power/boiler-operation-and-lifespan/cfd-modelling [cited 13.12.2016]

VTT 2016c. BIORUUKKI - Pilot Center. [web document] Available at: http://www.vttresearch.com/services/bioeconomy/key-technology-platforms-for-bioeconomy/bioruukki-piloting-centre [cited 13.12.2016]

VTT 2016d. Pilot plants and RD infra. [web document] Available at: http://www.vttresearch.com/services/business-essentials/pilot-plants-and-r-d-infra [cited 13.12.2016]

Warnecke R., 2000. Gasification of biomass: comparison of fixed bed and fluidized bed gasifiers. Biomass and Bioenergy, 18, p. 489-497.

Web Analytics Association 2008. Web Analytics Definitions. [web document] Available at: http://www.digitalanalyticsassociation.org/Files/PDF_standards/WebAnalyticsDefinitions.pdf [cited 6.9.2106]

Weibo, 2016. Weibo. [web document] Available at: www.weibo.com [cited 8.12.2016]

Wender I., 1996. Reactions of synthesis gas. Fuel Processing Technology, 48, p. 189-297.

Xu Y. & Yin J., 2015. Collaborative recommendation with user generated content. Engineering Applications of Artificial Intelligence, 45, p. 281-294.

Yadav M., Johsi Y., & Rahman Z., 2015. Mobile Social Media: The New Hybrid Element of Digital Marketing Communities. Procedia - Social and Behavioral Sciences, 189, p. 335-343.

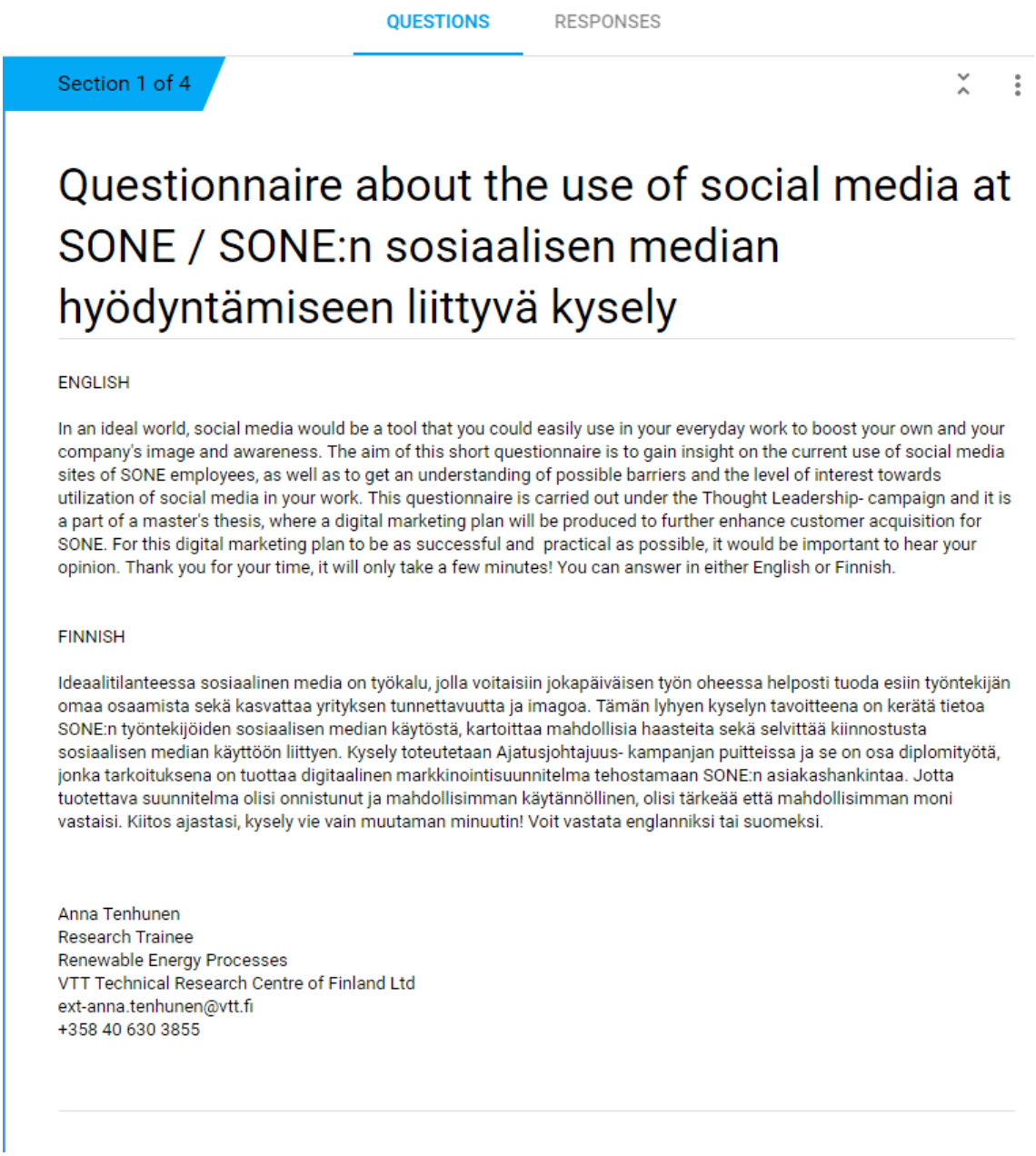
Yanbo W., Min Q., & Han S, 2016. Understanding the effects of trust and risk on individual behavior toward social media platforms: a meta-analysis of the empirical evidence. Computers in Human Behavior, 56, p. 34-44.

Younan Y., Van Goethem M., & Stefanidis G., 2016. A particle scale model for municipal solid waste and refuse-derived fuels pyrolysis. Computers & Chemical Engineering, 86, p. 148-159.

YY, 2016. YY Live. [web document] Available at: www.yy.com [8.12.2016]

Zenodo, 2016. Zenodo - Research. Shared. [web document] Available at: www.zenodo.com [cited 8.12.2016]

APPENDIX 1. Questionnaire: SOME at SONE



QUESTIONS RESPONSES

Section 1 of 4

Questionnaire about the use of social media at SONE / SONE:n sosiaalisen median hyödyntämiseen liittyvä kysely

ENGLISH

In an ideal world, social media would be a tool that you could easily use in your everyday work to boost your own and your company's image and awareness. The aim of this short questionnaire is to gain insight on the current use of social media sites of SONE employees, as well as to get an understanding of possible barriers and the level of interest towards utilization of social media in your work. This questionnaire is carried out under the Thought Leadership- campaign and it is a part of a master's thesis, where a digital marketing plan will be produced to further enhance customer acquisition for SONE. For this digital marketing plan to be as successful and practical as possible, it would be important to hear your opinion. Thank you for your time, it will only take a few minutes! You can answer in either English or Finnish.

FINNISH

Ideaalitilanteessa sosiaalinen media on työkalu, jolla voitaisiin jokapäiväisen työn oheessa helposti tuoda esiin työntekijän omaa osaamista sekä kasvattaa yrityksen tunnettavuutta ja imagoa. Tämän lyhyen kyselyn tavoitteena on kerätä tietoa SONE:n työntekijöiden sosiaalisen median käytöstä, kartoittaa mahdollisia haasteita sekä selvittää kiinnostusta sosiaalisen median käyttöön liittyen. Kysely toteutetaan Ajatusjohtajuus- kampanjan puitteissa ja se on osa diplomityötä, jonka tarkoituksena on tuottaa digitaalinen markkinointisuunnitelma tehostamaan SONE:n asiakashankintaa. Jotta tuotettava suunnitelma olisi onnistunut ja mahdollisimman käytännöllinen, olisi tärkeää että mahdollisimman moni vastaisi. Kiitos ajastasi, kysely vie vain muutaman minuutin! Voit vastata englanniksi tai suomeksi.

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Section 2 of 4

Background information / Taustatiedot

Description (optional)

Job Title / Työnimike *

Short-answer text

Organization / Organisaatio

- BA30
- BA32
- BA 34
- BA 3401
- BA 3402
- BA 3403
- BA 3404
- BA 3405
- BA 3406
- BA 3407
- BA 3408
- BA 35
- BA 3501
- BA 3502

QUESTIONS RESPONSES

- BA 3503
- BA 3504
- BA 3505
- BA 3506
- BA 36
- BA 3601
- BA 3602
- BA 3603
- BA 3604
- BA 3605
- BA 3606
- BA 3607
- BA 3608
- Other...

Age / Ikä *

- 18-25
- 26-35
- 36-45
- 46-55
- 56-65
- Other...

QUESTIONS RESPONSES

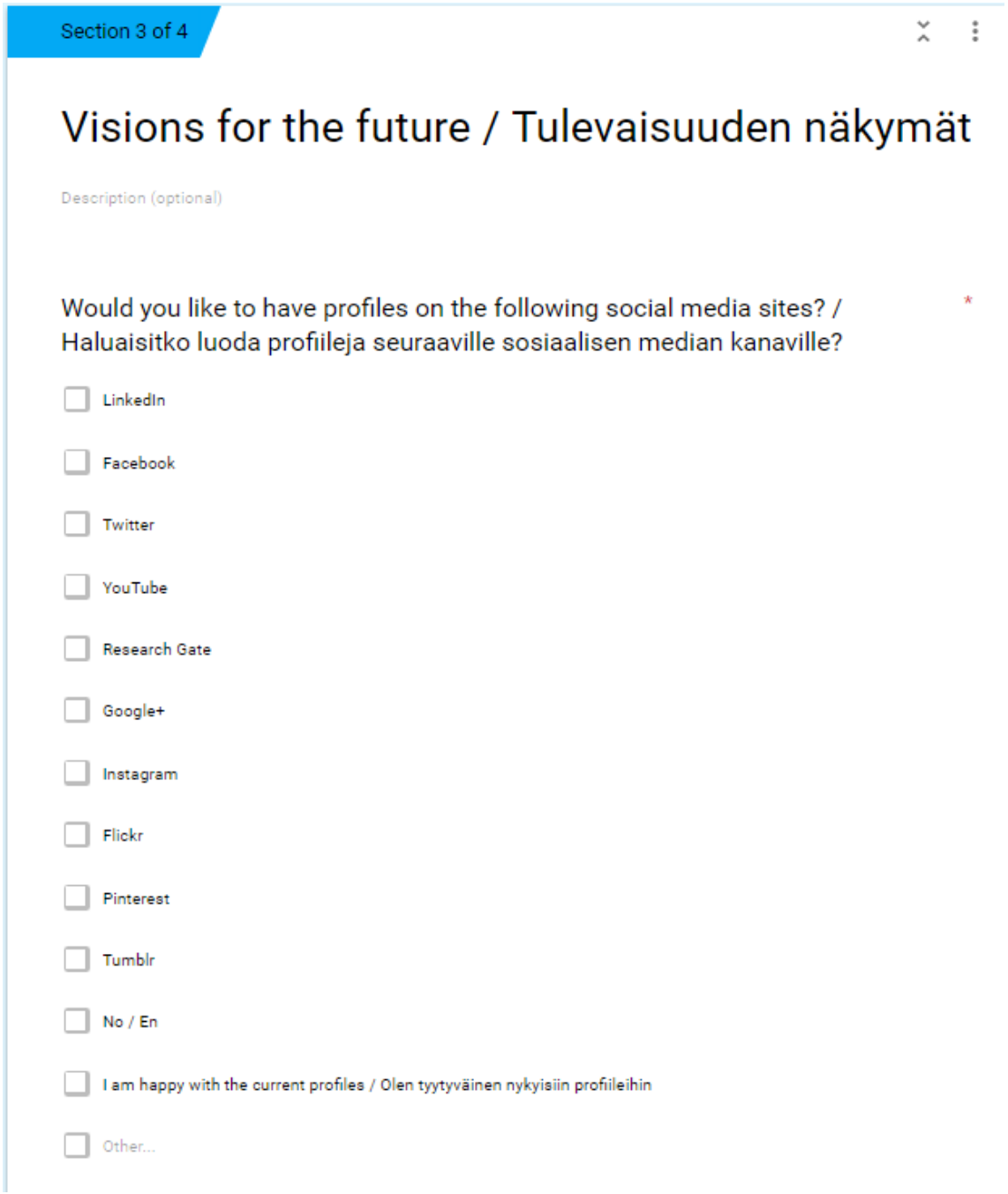
Do you have profiles on the following social media sites? / Onko sinulla profiileja seuraavilla sosiaalisen median kanavilla? *

- [ ] LinkedIn
- [ ] Facebook
- [ ] Twitter
- [ ] YouTube
- [ ] Research Gate
- [ ] Google+
- [ ] Instagram
- [ ] Flickr
- [ ] Pinterest
- [ ] Tumblr
- [ ] None
- [ ] Other...

What do you use social media for ? / Mihin tarkoitukseen käytät sosiaalisen median kanavia ? *

- [ ] Personal use / Henkilökohtainen käyttö
- [ ] Professional use / Ammattiin liittyen
- [ ] Do not use / En käytä

After section 2 Continue to next section



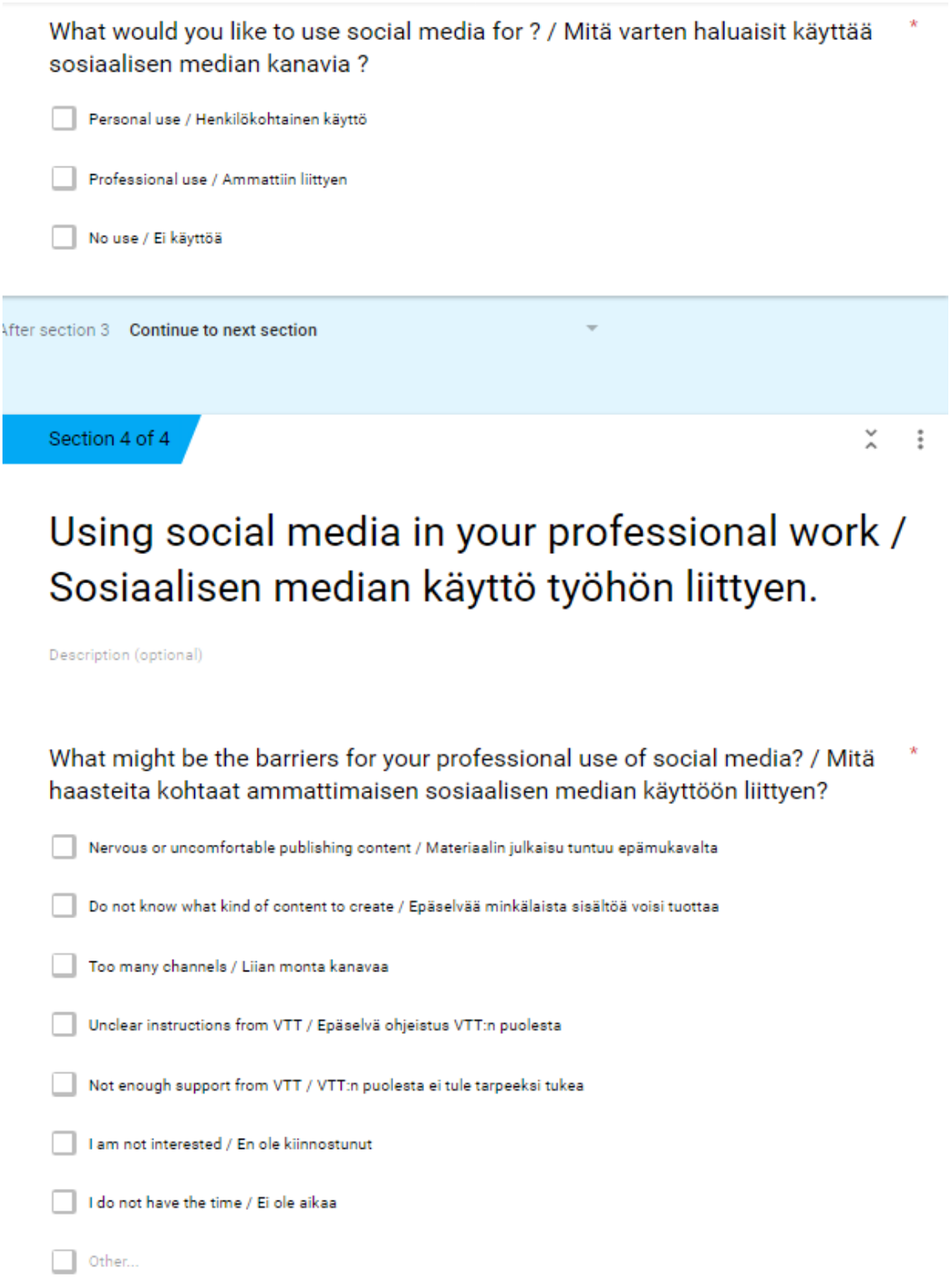
Section 3 of 4

Visions for the future / Tulevaisuuden näkymät

Description (optional)

Would you like to have profiles on the following social media sites? / Haluaisitko luoda profiileja seuraaville sosiaalisen median kanaville? *

- [ ] LinkedIn
- [ ] Facebook
- [ ] Twitter
- [ ] YouTube
- [ ] Research Gate
- [ ] Google+
- [ ] Instagram
- [ ] Flickr
- [ ] Pinterest
- [ ] Tumblr
- [ ] No / En
- [ ] I am happy with the current profiles / Olen tyytyväinen nykyisiin profiileihin
- [ ] Other...



What would you like to use social media for ? / Mitä varten haluaisit käyttää sosiaalisen median kanavia ? *

- [ ] Personal use / Henkilökohtainen käyttö
- [ ] Professional use / Ammattiin liittyen
- [ ] No use / Ei käyttöä

After section 3 Continue to next section

Section 4 of 4

Using social media in your professional work / Sosiaalisen median käyttö työhön liittyen.

Description (optional)

What might be the barriers for your professional use of social media? / Mitä haasteita kohtaat ammattimaisen sosiaalisen median käyttöön liittyen? *

- [ ] Nervous or uncomfortable publishing content / Materiaalin julkaisu tuntuu epämukavalta
- [ ] Do not know what kind of content to create / Epäselvää minkälaista sisältöä voisi tuottaa
- [ ] Too many channels / Liian monta kanavaa
- [ ] Unclear instructions from VTT / Epäselvä ohjeistus VTT:n puolesta
- [ ] Not enough support from VTT / VTT:n puolesta ei tule tarpeeksi tukea
- [ ] I am not interested / En ole kiinnostunut
- [ ] I do not have the time / Ei ole aikaa
- [ ] Other...

On a scale from 1 to 5 , how important do you feel it would be to utilize social media for your line of work? / Asteikolla 1-5 , kuinka tärkeäksi koet sosiaalisen median käytön työhösi liittyen? *

	1	2	3	4	5	
Not at all / Ei yhtään tärkeää	○	○	○	○	○	Very important / Erittäin tärkeää

On a scale from 1 to 5 , how much would you like to use social media to enhance your work? / Asteikolla 1-5, kuinka paljon haluaisit käyttää sosiaalista mediaa tehostamaan työskentelyäsi? *

	1	2	3	4	5	
Not at all / En yhtään	○	○	○	○	○	Very much / Hyvin paljon

What kind of material would you like to see or even create about your work? / Minkälaista materiaalia haluaisit nähdä tai jopa tuottaa työhösi liittyen?

Long-answer text

Other ideas and comments / Muut ideat ja kommentit.

Long-answer text

CALL TO ACTION! Do you want to get involved in creating content about your work? This also enhances your personal digital profile! Please leave your e-mail address. Your contact info will not be linked to your answers. /
Haluatko olla mukana tuottamassa sisältöä työhösi liittyen? Samalla tehostat henkilökohtaista digitaalista profiiliasi! Jätäthän sähköpostiosoitteesi. Yhteystietoja ei liitetä vastauksiin.

Short-answer text