

NETworked POWER

Innovation by social software

Part 1: The research project

1. Objectives

The mass use of Internet in both professional and consumer markets started in the mid 1990s, with applications such as e-mail, web-portals, and file transfer. At present, there is an emerging mass use of Internet as enabling infrastructure for networked communities where the key user-centric technology is *social software*, i.e. solutions that enable networked processes such as social interaction, information exchange, and creating and sharing of content. Social software encourages people to meet, interact and co-create within an extended web of employees, customers, and stakeholders (Brandtzæg & Heim, 2008). Social software solutions will change how companies and nonprofits innovate, tap talent, lower costs and realize new opportunities (Weber, 2008).

The impact of social software for professional purposes is predicted to be considerable, both for the industry (Tapscott et al., 2007), and for non-profit organisations (Brandtzæg & Lüders, 2008). Social software will be a key enabler of novel *innovation chains and networks*, which will emerge both commercially in the industry and at the level of societal improvement through non-profit organisations (NPOs¹).

The overall objective of NETPOWER is:

To develop social software solutions that support networked innovation in the industry and non-profit organisations (NPOs).

To achieve this, NETPOWER has the following objectives:

- Design social software for networked innovation, on basis of consumer market technologies.
- Refine methods to be used in the development and evaluation of professional-purpose social software, including the use of Living Labs.
- Apply real-world industrial and NPO use cases, to support validation and re-design.
- Acquire new knowledge about the impact of social software for networked innovation in the context of the industry and NPOs.
- Establish best-practices for the use of social software for innovation with regard to diversified user participation, intellectual property rights, privacy and security.

NETPOWER's objectives are well founded in recent research. The networked value-creating potential of social software has been clearly demonstrated by consumer market successes such as MySpace and YouTube (Shirky, 2008). Also, networked innovation is supported by theories on open innovation (Chesbrough, 2006) and user-oriented innovation (Von Hippel,

¹ In this project "non-profit organisations" is used to account for a great variety of non-profit organisations, such as charitable organisations, religious organisations and political organisations.

1986). Users and customers are in this perspective not only knowledgeable, but also able to innovate, facilitated by the use of social software (Füller et al, 2006).

Still, social software for innovation in the industry and NPOs face important challenges, mainly related to developing solutions that adequately respond to the requirements of the industry and NPOs in a professional context. These challenges will be taken up by the NETPOWER project, by project partners who already develop, deploy, or use social software. The project consortium includes social software providers (Induct software, Bengler), industrial and NPO social software users (Devotam daVinci, Innoco, The Norwegian Labour Party (DNA), Seniornett), and researchers in the field of social software, user-centred development and innovation (SINTEF, BI).

The additionality of the project is significant. Individually, the project partners hold expertise on user-requirements, technology, innovation, organisational culture and implementation of social software. However, the planned individual activities of the industry partners only target sub-problems of the project. By a close co-operation between the partners and a user-centred and Living Lab-oriented approach, NETPOWER significantly increases innovation and enables the development of more and better integrated social software solutions targeting the real needs and requirements of users, industry, and NPOs.

1.1 Results: Commercial and societal innovation

The following results are expected by the industry and NPO partners:

Devotam daVinci: Increased internal innovation capabilities, as well as expertise on social software as facilitator of networked innovation processes, business development and employee contentment. This will strengthen the partner in their core business as advisor in the fields of e.g. ICT and process management.

Induct Software: New social software solutions for innovation management and networked innovation in leading organisations. A commercial success of this software is dependent up on how these solutions fit the requirements of the industry.

Innoco: New knowledge about how to apply and make use of networked tools for improving organisational culture and innovation processes. This knowledge will be important for the partner's customers; mainly established public and private enterprises.

Bengler: New social software services targeting citizens in general and NPOs in particular. The services will contribute to increase traffic to the existing Bengler service Origo, being highly important for Bengler in order to reach their business goals.

The Norwegian Labour Party (DNA): Increased citizen involvement in policy-making processes, making policy more compliant with citizen-needs and contexts.

Seniornett: Increased digital competence among elderly in Norway by enabling senior-to-senior help and support, and by expanding the quality of their learning environments by harvesting ideas from key users.

1.2 Relevance to the VERDIKT programme

NETPOWER directly addresses the VERDIKT topic “communicating organisations” by examining how to utilize the potentials for mass collaboration emerging as a consequence of the networked society. This approach will generate new knowledge in how social software can facilitate innovations in industry by exploiting networked information exchange and information management. The solutions will improve the industrial and NPO ability to reach and communicate with their users.

The project has high societal impact, through its aim to provide both industry and NPOs with improved innovation capacities. In particular, the project's aim to support NPO innovation represents a research goal that until now has not been sufficiently prioritized. Also, the project addresses the challenge of participation (e.g. across the age groups) in networked innovation; solutions for networked innovation need to transcend existing digital divides in order to enable a sufficiently open innovation.

The NETPOWER interdisciplinary team of researchers are grounded both in the humanistic and technological tradition, including researchers from the fields of human-computer interaction (HCI), media and communications, and innovation research.

2. Frontiers of knowledge and technology

The frontiers of knowledge for this project are identified within four areas: 1) The benefit of networks; 2) Social Software; 3) Innovation in social networks; and 4) Developing social software through online Living Labs. These areas are elaborated in the following.

2.1 The benefit of networks

Metcalf points out that: "*The network effect is expanding the collective intelligence of the human race*" (2007: 56). This is true in both professional and personal life, where we form groups based on affinities and expertise (Weber, 2008). Also, networks improve the ability for people to advance professionally through connecting and co-creating. Organisations of any type may use social networks to their advantage, providing they learn how the networks operate.

The vice president of Google (Cerft, 2007) argues that social networks on the Internet allows thinly distributed groups to discover one another and to make common causes, and explains how e.g. politicians have discovered that the Internet is a two-way street for communication. Fundraising, political co-ordination and citizen involvement have been raised to new levels of precision through social software and are playing a visible role in US election campaigns (Smith & Rainie 2008). This gives high expectations as to how NPOs in Norway can use social software to involve their members and achieve innovation and service improvement.

2.2 Social software

Social software implies a potential revolution in the way we communicate, create and innovate, providing we know how to make the technical innovations drive societal, political and business changes. Steven A. Ballmer, Microsoft CEO, talking on the future of software, stated: "*I think one pervasive change is the increasing importance of community*" (Webster, 2008).

Shirky (2002) defines social software as "software that supports group interaction", indicating that social software is more a matter of social interactive solutions than a limited set of technologies. In this proposal we understand social software to be systems and applications supporting content sharing and co-creation in sociable online environments. This includes solutions for media sharing (e.g. YouTube, Flickr), self presentation, social interaction and debate (e.g. MySpace, blogs, Facebook, LinkedIn), virtual 3D environments (SecondLife) referencing and recommendation services (e.g. Digg, Del.icio.us) and co-created knowledge resources (e.g. Wikipedia). Social software may have an important role to improve digital competence and reduce digital divides, e.g. for elderly users (Karahasanovic et al., 2008).

Advanced Norwegian social software solutions include Underskog and Origo; both developed by the NETPOWER partner Bengler. Origo was launched in 2007 and currently has 56 000

community users from all age groups. Origo has in a short time span become an important communication channel for Norwegian NPOs, and will extend its use to facilitate networked innovation.

State of the art knowledge on social media are continuously being published by SINTEF researchers Brandtzæg and Lüders, who will be working on NETPOWER (see e.g. Brandtzæg & Heim, 2008; Heim et al., 2007; Kaare et al., 2007; Brandtzæg & Lüders, 2008; Lüders 2008a; Lüders 2008b), both being part of one of Norway's leading research team on social media.

2.3 Innovation in social networks

The industry and NPOs need innovation in order to meet their short and long term goals (Radjou, 2004), and social software can be utilized throughout all stages of the innovation process (Prahalad & Ramaswamy 2000). Moreover, user-oriented innovation processes offer great advantages; inviting consumers, and particularly lead-users, into the innovation process increases the opportunities to develop the right services and products (Von Hippel, 1986).

The novelty of utilizing social software in networked innovation processes, as compared to conventional market research, is that users are not only asked about their opinions, wants and needs; they are invited to contribute with their creativity and problem solving skills. As an example Peugeot initiated an online design contest where nearly 2800 design enthusiasts from 90 countries proposed car designs on the theme of "Retrofuturism" (www.peugeot-avenue.com) (Füller et al, 2006). Other examples include how enterprises and NPOs such as IBM, Adidas, Reebok, Mazda, Sun, Reef Ball Foundation, Creative Commons and American Cancer Society, all use SecondLife to gain benefit from networked innovations (see also http://en.wikipedia.org/wiki/Businesses_and_organizations_in_Second_Life). In Norway, the state broadcaster, NRK, have successfully involved their users in discussions on the future of NRK service through the blog NRK Beta.

Social software may be utilized to involve a broad range of users in the innovation process, providing the solutions support the needs of all users – avoiding the digital divide challenge. Successful solutions for open innovation in a steadily older population (+ 1.200.000 Norwegians above the age of 55 in 2007) need to support the needs also of the elderly users in order to benefit from the insights and experience of this group.

NETPOWER partner Induct Software has developed state-of-the-art prototypes of social software supporting innovation in larger professional organisations. Based on a research driven knowledge on how users act and use social software for networked innovation, these solutions will be further improved.

2.4 Developing social software through the online Living Lab approach

Living Labs represent new kinds of environments to involve users in innovation and development processes. In these labs, user research and design activities are conducted in the every-day context of the user. In a comprehensive review of Living Lab state of the art, Følstad (2008a), who will be working on NETPOWER, accentuated the current trend that Living Labs are used to engage users in co-creative or networked innovation processes.

In consumer market solutions such as Facebook and MySpace, users serve the roles of information providers, designers, and co-developers. However, at present the development of social software typically seems to follow the pattern of "launch and learn", where an abundance of services and service concepts are put to the market and only a few survive (Følstad, 2008b).

In the RECORD project (www.recordproject.org) the SINTEF researchers participating in NETPOWER have established an online Living Lab² supporting design-feedback and co-creating processes between designers and users of consumer market social software. The RECORD Living Lab is, together with Owela of VTT (Finland) and Botnia (Sweden), one of the few Living Labs where users mainly are involved in the development through online environments. In NETPOWER the online Living Lab will facilitate networked innovations among community members.

3. R&D challenges

State of the art research emphasizes the optimism towards innovation through social software solutions, but also challenges in creating solutions that sufficiently meet user requirements, as well as general challenges with regard to user-created content (e.g. participation/digital divides, privacy, IPR, and security). The following challenges are regarded as central in order to meet the project objective:

3.1 Understand the innovation context

Successful development of social software for innovation depends on a thorough understanding of the context for innovation in the industry and NPOs. This is not trivial, since the context will be changed by the implementation of online tools for networked innovation, which accentuates the need for experience gathering in real-world trials and frequent involvement of the users. Sub-challenges include:

- Specify and maintain requirements from (1) industry/NPO and (2) employees/citizens
- Identify ways to handle challenges of participation/digital divides, intellectual property rights (IPR), privacy, and security specific to social software solutions for the professional market.

3.2 Social software solutions tailored for the innovation context

The main challenge of NETPOWER is not the development of social software components per se, but the development of comprehensive solutions meeting the needs and requirements of the users and innovation context. Important user requirements are related to participation across the digital divides, in order to include a sufficiently wide range of citizens and employees in the innovation process. In particular the solutions will target three main innovation contexts:

- Networked innovation within professional organisations
- Open innovation involving enterprise employees and external users/citizens
- Ideation and requirements identification in open networked discussion forums

3.3 Efficient design-feedback and evaluation

The novelty of the solutions to be developed, requires a development process where user-based design-feedback and evaluations are conducted frequently and efficiently. Also, the prototype implementation should allow the establishment of new general knowledge on effects of social software for innovation. There are two main challenges:

- Collecting efficient design-feedback and evaluation of prototype solutions, for iterative improvement of the proposed solutions
- Collecting data providing best-practices for-, and reliable and valid knowledge on innovations through social software.

² The RECORD Living Lab has applied for membership in the European Network of Living Labs.

4. Research approach and methods

In order to benefit from requirements and experiences with varying contexts for innovation, the NETPOWER research approach is based on a close interaction with two cases:

1. **Industry and commerce:** Induct Software and the research partners will co-operate on the development of social software solutions for industrial innovation. The solutions will be applied and evaluated in co-operation with NETPOWER-partners: Devoteam daVinci and Innoco.
2. **NPOs and society:** Bengler and the research partners will co-operate on the development of social software solutions to support value-creation in non-commercial organisations. The solutions will be applied and evaluated in co-operation with NETPOWER-partners: The Norwegian Labour Party and Seniornett.

The variation introduced with the two cases will strengthen the generality of new knowledge, and serve as a stronger validation of the developed solutions. Also, the cases provide complementary insights. In particular, we expect that the NPO innovation culture to be closer to the concept of open innovation than the industry innovation culture. At the same time, the industry innovation culture should provide increased focus on issues such as security and IPR.

The research challenges presented in Section 4 are met in the following work packages (WP). Each WP addresses the specific contexts of the two cases (see section 4.1 for details).

Work package	Methodological approach
WP 1: Requirements	User and stakeholder interviews, field studies, surveys, and textual analysis.
WP 2: Challenges	Stakeholder and expert workshops, risk-analysis
WP 3: Software solutions	Iterative user-centred development
WP 4: Design feedback and evaluation	Living Lab and real-world trials on basis of case implementations. Online observations and textual analysis
WP 5: Innovation theory	Field studies, interviews
WP 6: Best practices	Stakeholder and expert workshops
WP7: Living Lab and real-world trials management	Re-design of Living Lab and real-world approach on basis of experiences with development of professional software

Table 1: Overall NETPOWER work package structure

4.1 Iterative design combined with methodological innovation and theory building

The project includes three main user-centred development iterations, all with online Living Lab user-involvement or real-world trials for both the industry case and the NPO case. The online Living Lab user involvement will be used for early phase prototypes to support design-feedback and collaborative redesign of early designs, whereas real-world trials, conducted within the context of Devoteam daVinci, Innoco, DNA and Seniornett, will be used for running prototypes enabling more comprehensive field studies.

Each of the iterations will result in new versions of the developed software (WP3) on basis of the evaluation results (WP4), in addition to updated user requirements (WP1) and theory (WP5), as well as improved approaches to Living Lab and real-world trials (WP7).

The three iterations will be preceded by the establishment of initial requirements (WP1) and challenges to professional software (WP2) as well as initial adaptation of the Living Lab to

the NETPOWER application domain, and followed by the establishment of best practices for professional social software (WP7).

The research approach is selected to provide comprehensive and interdisciplinary data, relevant for fulfilling the research objectives and securing methodological triangulation.

The relations and interdependences between the different work-packages are illustrated in the following figure, together with relations to associated national and international activities.

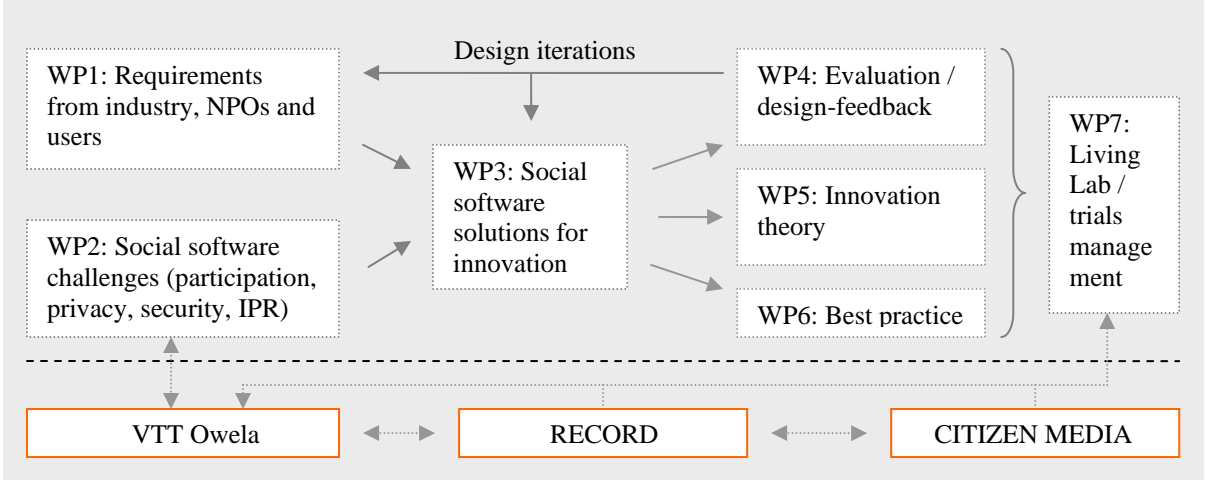


Figure 1: Relations between work packages and associated activities.

4.2 Planned publications

- NETPOWER will result in the following scientific results:
- 8 articles in international peer-reviewed journals; at least three of these at Level 2.
 - 12 contributions on international peer-reviewed conferences.
 - 1 PhD targeting the innovation potentials of social software in enterprises. The PhD student will follow the doctoral programme at the Norwegian School of Management (BI), and will be supervised by a professor at the Department of Innovation and Economic Organization.

5. Project organisation and management

The consortium-partners represent a combination of knowledge from research, technological development and organizational culture. SINTEF and BI will conduct the core research activities, having comprehensive experience with studying social media, user requirements, interface evaluation and organizational culture and innovation processes. Bengler and Induct Software will be the technology partners. They are both leading suppliers in Norway on social software tools.

Devotam daVinci and Innoco are the industrial users of the solutions. They are end-users as well as consultants for how to implement social software in organisational innovation processes with their customers. DNA and Seniornett are typical end-users for Bengler’s social software solution. These partners will be instrumental in the experimental phase of the project, and therefore an important prerequisite for success. They also include a diversified user mass with younger and older users that are important to involve in order to fully benefit from social software.

Devoteam daVinci is the applicant/project owner and will be the administrative leader of the project. Devoteam daVincy is highly suited for this role through its extensive competency on the organizational requirements for innovation solutions, based on its business as advisors in the fields of ICT and process management. Devoteam daVinci will report to the Norwegian

research council. SINTEF will be the project leader, and responsible for managing and coordinate the day-to-day R&D activities, and also support Devoteam daVinci in the project management process.

NETPOWER will have a *steering committee* (SC), consisting of a representative from each partner. The SC will be chaired by Devoteam daVinci. The SC has superior responsibility for project plans and agreements on co-operations, as well as for possible conflict negotiations. Decisions in SC are made with simple majority and are binding for all partners.

NETPOWER will follow SINTEF's ethical guidelines (SINTEF, 2008). SINTEF is an equal opportunities employer, and women will hence be given precedence in the case of equal qualifications when the PhD-position is filled.

6. International cooperation

Work on professional social software challenges and the adaptation of the Living Lab for the development of professional purpose solutions will be conducted in co-operation with Owela (Open Web Lab), an online community for user-driven innovation and participatory design hosted by the VTT Technical Research Centre of Finland. Owela's aim is to study how social media can be used to support user- and community-driven innovations and media products. Contact person: *Pirjo Näkki, VTT*.

Näkki and guest researcher *Professor William H. Dutton, Director at Oxford Internet Institute (oii)* will attend research workshops and dissemination seminars. Dutton's competence within Collaborative Networked Organizations challenges resonates strongly with the R&D focus of NETPOWER. See <http://people.oii.ox.ac.uk/dutton>.

SINTEF is part of The Online Community Research Network (OCRN), a collaborative effort of online community professionals to better understand the challenges of building and managing social software in a community context. (www.onlinecommunityresearch.com). OCRN, lead by Bill Johnston, arrange roundtable meetings 4 times a year to exchange particular ideas and challenges with other members such as Microsoft, Google, Sony, Nokia, AOL and IBM. This collaboration will ensure that NETPOWER will approach state-of-the art solutions and challenges in regard to social software.

The NETPOWER project is closely related to the EU IP CITIZEN MEDIA (2006-2009) lead by Alcatel Lucent within the IST-part of FP6 (IST 2.4.6 – Networked Audio Visual systems and home platforms). Volume: 15,6 M€ distributed on 16 partners. SINTEF is successfully leading the work-package about users and user-needs and is heavily involved in technology-evaluation in real-life testbed contexts. SINTEF and CITIZEN MEDIA-partners will submit an application for a new IP within FP7.

7. Progress plan and milestones

NETPOWER runs across 4 years. The project period is split into five phases. The finalizing of each of the four first phases represents a milestone. Phase 1 includes establishment of initial requirements and professional social software challenges, as well as initial adaptation of the Living Lab. Phase 2-4 are the projects three main development iterations, which all last one year. Phase 5 is the project wrap-up, with establishment of best practices and final exploitation and publication.

- M1 deliverables: Initial requirements, challenges
- M2-4 deliverables: Social software solutions (v1-3), innovation theory (v1-2), Living Lab / trial reports, case-specific evaluation reports
- Final deliverables: Innovation theory (v3), best practices

Due to the changing nature of the NETPOWER application domain, the project needs sufficient flexibility. To achieve this, the plans for each of the iterations will be detailed and accepted by the project SC at the end of the previous project phase.

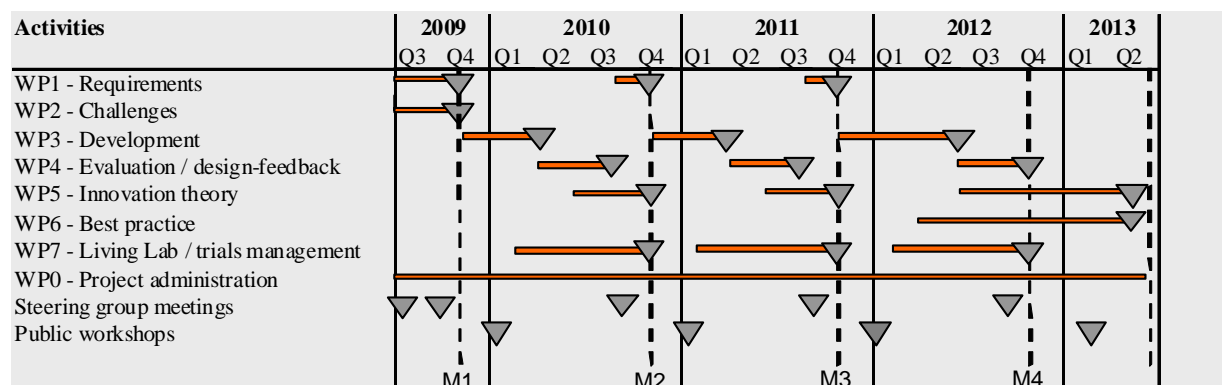


Figure 2: NETPOWER project GANNT with milestones

8. Costs incurred by each research-performing partner

Costs per year (KNOK)	2009	2010	2011	2012	2013	Sum
Payroll and indirect costs	3772	7786	7786	7786	1454	28584
Induct Software	1165	2310	2310	2310	605	8700
Bengler	1550	3150	3150	3150	450	11450
Arbeiderpartiet	250	500	500	500	90	1840
Seniornett	200	400	400	400	74	1474
Innoco	190	400	400	400	70	1460
Devoteam daVinci	417	1026	1026	1026	165	3660
Cost research-performing partners	850	1450	1450	1666	381	5797
BI	50	50	50	50	0	200
SINTEF	800	1400	1400	1616	381	5597
Other project costs	617	1249	1252	1054	30	4203
Project management	135	150	150	150	15	600
Guest researcher	47	49	52	54	0	203
Direct costs	235	250	250	250	15	1000
PhD	200	800	800	600	0	2400
Sum total costs (KNOK)	5239	10485	10488	10506	1865	38584
Sum total research (KNOK)	1467	2699	2702	2720	411	10000

9. Financial contribution by partners

Financing per year (KNOK)	2009	2010	2011	2012	2013	Sum
Own efforts	3772	7786	7786	7786	1454	28584
Induct Software	1165	2310	2310	2310	605	8700
Bengler	1550	3150	3150	3150	450	11450
Arbeiderpartiet	250	500	500	500	90	1840
Seniornett	200	400	400	400	74	1474
Innoco	190	400	400	400	70	1460
Devoteam daVinci	417	1026	1026	1026	165	3660
Applied from NFR	1467	2699	2702	2720	411	10000
Purchase of R&D	850	1450	1450	1666	381	5797
PhDs	200	800	800	600	0	2400
Other project costs	417	449	452	454	30	1803
Sum project financing	5239	10485	10488	10506	1865	38584

PART 2: Exploitation of results

10. Underlying idea

The NETPOWER results will be exploited at four levels:

Industrial exploitation: The developed social software for innovation purposes will be exploited by (1) innovation-oriented industrial actors who aim to utilize new tools for facilitating business development and organisational culture through new social software, and (2) software companies who aim to establish themselves in this emerging market. The exploitation depends on the NETPOWER research activities in order to develop solution prototypes according to the industry's emerging requirements, and to redesign and validate the solutions on basis of feedback from the online Living Lab and real world trials.

Societal exploitation: Establishing social software solution for the NPO context, as well as conducting the NPO case implementations, imply a significant improvement of the innovation abilities of NPOs. The research conducted in NETPOWER enables a structured development of such solutions, enabling faster development of adequate solutions for this context. This is important for NPOs ability to respond to their changing contexts in their societal value creation. The development of solutions supporting the involvement of user groups across the digital divide (e.g. the elderly) also strengthens the industry and NPOs' ability for open innovation.

Research exploitation: The knowledge and technological solutions developed in NETPOWER are highly demanded in a global perspective, and will ensure that Norwegian research within this area holds international standards.

International co-operation: The NETPOWER results are generated in co-operation with international actors. The link between NETPOWER and international initiatives will make sure that the project partners benefit from results generated internationally.

11. Innovation/degree of novelty

The innovation of NETPOWER is based on utilizing social software technologies for the consumer market for innovation purposes at the commercial level in the industry, and at the societal level in the NPOs. The novelty of NETPOWER is particularly related to:

- **New social software solutions for innovation.** The development and successful implementation of such solutions in the industrial and NPO contexts represent a significant innovation nationally as well as in an international context.
- **New knowledge on innovation through social software.** This knowledge is an important novelty, and will improve the ability of Norwegian industry to continue successful development of professional-purpose social software. This knowledge represents a contribution to the international state-of-the-art.
- **New knowledge on how to increase involvement of citizens** in policy-making processes, including the increased participation of users across digital divides.
- **New methods and processes supporting the development of professional purpose social software.** The systematic utilization of an online Living Lab for developing professional-purpose software solutions represents an advancement of the state-of-the-art on an international level.

12. Plan for exploitation of research results in the individual company

[This section has been removed from this version of the project description.]

13. Environmental impact

Not relevant.

14. Other value

14.1 Value for the research groups involved.

NETPOWER is of high value for the research groups at SINTEF and BI and will, as it represents new perspectives, take research on social media, user requirements, user experiences, evaluation, innovation-processes and organizational culture to the next level. Dissemination of results in internationally recognized publications will be a priority, and the project will enable the researchers to position their work on an internationally recognized level.

14.2 Value for non-participants in the project.

The value by the non-participants is expected to be significant. First, this is the first time social software for networked innovation is developed and deployed in Norway. We will engage thousands of users, and will get direct relevant feedback from users in developing solutions users themselves emphasise as value-added. Second, the solutions and new knowledge resulting from the project, will be of value to the industry and NPOs not participating in the project. The value for non-participants is a prioritized aspect of the project. In consequence, the project includes open seminars, presentations and publications targeting the industry, in addition to academic publication. Finally, the project aims to provide solutions that contribute to a lasting change in how businesses and organizations communicate and interact with citizens and other stakeholders.

15. Information and dissemination of results

The initial strategy and plans for dissemination of results is outlined below. The main goal of this strategy is to get most attention about the project, and share both theory and practise with other communities; in particular with research, industry, and users representative engaged in social software and networked innovation:

- Seminars - there will be at least one 1-day seminar per year for the Norwegian stakeholders.
- PhD and Master supervision within the projects and invite other students that are supervised by the project partners to project internal workshops.
- Extend Master and PhD university courses, held by the involved researchers, with NETPOWER results
- Public web-page to make available open deliverables, presentations, and publications in general.
- Presentation of 12 peer-reviewed papers at conferences, in addition to 8 academic journal papers.
- 10-15 non-peer-reviewed invited talks and publications for the public, industry and others.

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