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MSc Information & Library Management

*Developing new information
system for NORDIP*

Final report

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Executive summary

The purpose of this report is to research, assess and provide final recommendations for NORDIP to develop a new electronic system in order to improve information management, storage and discovery.

Our insight into organizational context of NORDIP, current information management setting and great opportunities presented by Horizon2020, allowed to define the key functional requirements for the new system:

- Centralization of information management
- Security and scalability
- Easy discovery of information
- User-centred approach

Also, further examination of the ways other organizations improved their IP (Intellectual Property) management provided a better insight into possible solutions for NORDIP.

Therefore, our final recommendations include:

- Phasing the project following Systems Development Life Cycle (SDLC) method.
- Outsourcing software with an option to customize it for NORDIP needs, instead of developing it “in-house”.
- Using cloud computing services to facilitate resource and software sharing among regional offices.
- Adopting user centred approach, i.e. collect data and feedback during various stages of the project to achieve “best fit” for organization.
- Setting up separate networks for NORDIP staff, research organizations, general public and industry partners in order to provide varying access to IP.
- Implementing a robust network security system (firewalls, encryption, scannable badges to access physical NORDIP facilities)
- Acquiring open source operating software in order to cut costs, support overall Norwegian “open government” approach and avoid commercial vendor “lock-in”.
- Estimated costs - € 80 000 (cost breakdown provided in section 8.2)
- Proposed time frame – 11 months.

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1. Introduction

NORDIP, as an intermediary in IP and research promotion and commercialization process, takes a very important position in R&D progress in Norway. After all, research information can be considered as the “transmitter between Science and Society” and is used by a variety of bodies with differing interests:

- researchers - to find partners, to track competitors, to form collaborations,
- research managers - to assess performance and research outputs and to find reviewers for research proposals,
- research strategists - to decide on priorities and resourcing compared with other countries,
- publication editors - to find reviewers and potential authors,
- intermediaries/brokers - to find research products and ideas that can be carried forward with knowledge/technology transfer to wealth creation,
- the media (to communicate results of R&D in a socio-economic context,
- the general public - for interest (EuroHORCS, 2008; cited in Jörg, 2010, p.25).

As a result of thorough investigation into the issues and needs of NORDIP, this report presents a synopsis of current situation, overview of best practices in the field of information systems for management of the Intellectual Property and discussion of possible solutions for NORDIP. Lastly, we will present proposed project schedule and final recommendations that best support organizational goals.

The following section will present organizational context and arising issues of information management in NORDIP.

2. Current situation

2.1 Organizational context

NORDIP gathers and promotes research projects, innovations and other types of intellectual property. Also, it acts as an intermediary in the cycle of IP commercialization. Figure 1 illustrates the cycle of IP commercialization, while Figure 2 presents NORDIP position within the cycle.

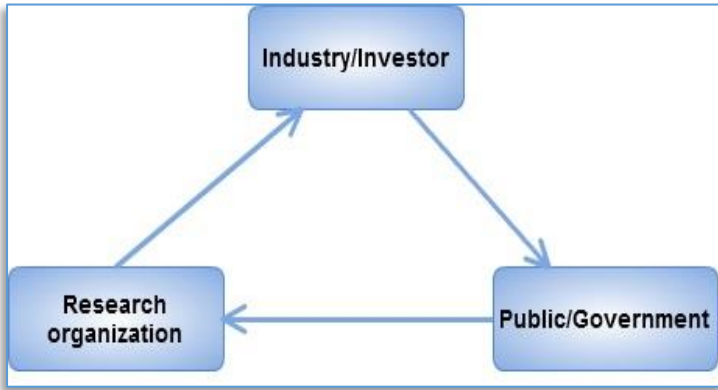


Figure 1. Research commercialization cycle.

NORDIP has several regional offices that operate their own information management systems and a mixture of both manual filing and cataloguing electronic documents. The organization manages large body of Intellectual property,

e.g. research, designs, patents, copyrights and inventions.

Also, as NORDIP has a wide range of users and stakeholders, the current systems have to fulfil their needs and allow perform various functions that are characteristic for each group of stakeholders. Table 1 presents key stakeholder groups and their functions.

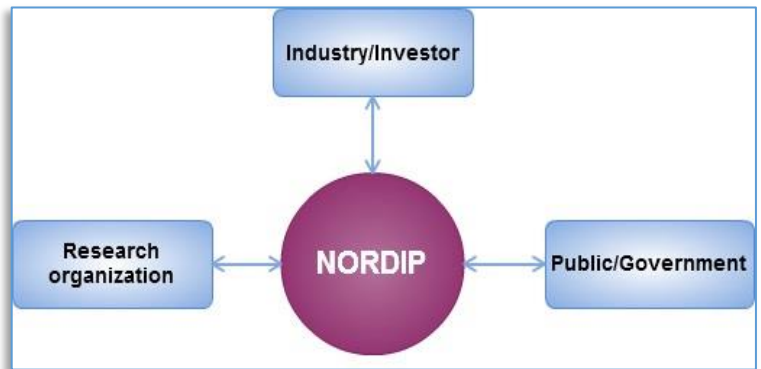


Figure 2. NORDIP position in Research commercialization cycle.

Stakeholder group	Functions
<i>Internal NORDIP staff</i>	<ul style="list-style-type: none"> • Accepting applications • Approval of permits • Storing documents • Cataloguing and tagging documents
<i>General public</i>	<ul style="list-style-type: none"> • High level search for intellectual property (IP) • Limited access to the results (abstracts, summaries, descriptions, etc.) • Submitting general inquiries
<i>Research institutes</i>	<ul style="list-style-type: none"> • Detailed search of research database • Full access to the content of the

	<p>documents</p> <ul style="list-style-type: none"> • Submission of research
<i>Industry partners</i>	<ul style="list-style-type: none"> • Apply for funding • Express interest in commercializing research project • Access information about existing research

Table 1. *NORDIP stakeholder groups and their functions.*

As we can see, NORDIP stakeholders perform different functions and, therefore, have varying needs. Therefore, current and future information system has to facilitate smooth user experience.

Lastly, EU initiative *Horizon2020* highlights the role of NORDIP in national and European context, i.e. the organization is facing great opportunities to improve the current state of R&D in Norway.

2.2.1 NORDIP and *Horizon2020*

In general, Norway’s R&D (Research and Development) output is lower than EU average, partially due to the fact that traditional Norwegian industrial activities, like petroleum and natural gas extraction, fish farming, etc., are “less R&D intensive” (European Commission, 2014b).

Moreover, Arvid Hallén, general director of The Research Council of Norway has expressed his concerns that Norway is not involved enough in research activities at European level (Horizon 2020 Projects, 2013).

Supporting this statement, Appendix 1 presents a chart illustrating Norway’s position among other European countries and European average in relation to innovative enterprises.

Therefore, *Horizon 2020* - “the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020)” provides the opportunity to contribute in improving existent Norway’s position (European Commission,

2014a). As the Research Council of Norway (2013) affirms, “Norwegian participation in the EU Framework Programmes has been of critical importance to Norwegian research, enabling Norwegian researchers, research institutions and companies to take part in larger international networks”.

Thus, as *Horizon2020* raises higher expectations for NORDIP performance, shortcomings of the current information system in NORDIP are becoming more evident.

Thus, the following section will discuss current deficiencies of existing information management system.

2.2 Current issues

Currently, existing information management systems operate at regional levels, therefore, with increasing applications for funding and other research-related intellectual property, **lack of centralization** is becoming more evident.

Also, documentation is being processed in two ways: by manual filing and storing it in electronic databases. This two-folded medium of documents, i.e. paper and electronic format, is causing **issues in management, visibility and retrieval of documents**.

In addition, active participation in Horizon 2020 sets high standards for data management and retrieval, thus its **access** has to be managed appropriately, taking in consideration **sensitive nature of intellectual property**.

As a result, **high level search function** and **intuitive interface** of intranet or extranet is becoming increasingly important in order general public, academic institutions, Government departments, industry experts, etc. could discover relevant content successfully. To date, existing information systems in NORDIP cannot effectively perform this function, mainly due to earlier mentioned lack of centralization and non-uniform medium of documentation storage format.

In order to better understand the need for a new information system for NORDIP, we have to explore some of the examples in literature of the importance of and the ways how a new information system can improve day-to-day and overall functioning of the organization.

3. Literature review

First of all, in an era of global knowledge, management of intellectual property (IP) can become increasingly difficult if we do not facilitate available information technologies to tackle this issue (Grassman et al., 2012, p. 1).

In addition, as universities and research institutes are involved in numerous research projects, to make the most of their IP output, robust IP management systems cannot be underestimated. Therefore, to drive R&D networking further, concerned organizations need to adapt and implement appropriate measures to facilitate centralized IP storage and discovery for its effective promotion and commercialization.

As Joerg et al. (2012, p.3) expressed, IP goes beyond research publications and, when planning effective ways to manage it, we must acknowledge other entities such as “funding, organization, project, person, data, patent, impact <...> and their changing relations through time”. Also, throughout the literature, the role of government initiatives to connect research and industry is emphasized. For example, as Mohan (2012, p.92) states, “strategic research relationships between industry and research institutes that get facilitated by government, are an effective means to create a platform for scientific research for industrial use”.

Taking into consideration the role NORDIP plays in R&D field and a variety of its stakeholders, we have to be aware of some of the best practices of effective intellectual property management systems.

First of all, the report on information systems of European research organizations, produced by EuroHORCS (European Heads of Research Councils) (2008), provides a comprehensive list of information systems used by 17 EuroHORCS members, including their key functions.

The key aspect of these information systems is that they all facilitate a robust searchable database where a variety of search criteria (full text/abstract, research institution, person, etc.) allows the user to find the information needed. Also, the implications is that, to achieve highest benefits, the systems must facilitate collaboration between research-funding and research-performing organizations and, as recommended by the report, would be interoperable enough to merge with other IP management systems (ibid. p.17).

In addition, few examples of such initiatives can be found locally and in neighbouring country Sweden.

First of all, ScienceNet, a national platform in Sweden collecting data about research projects in Sweden and various funding agencies, is a solution for previous unsuccessful initiatives to gather research from universities more or less manually (Johansson and Ottosson, 2012, p.1). The solution was automation of information gathering and providing “one-stop shop” for research institutes producing IP and funding organizations.

Overall, we can draw a lot of similarities between the issues that ScienceNet solved and the ones NORDIP is trying to address.

Another example proving the importance of centralization of information management within the organization is found locally, in Norway: restructuring former research documentation system FRIDA in Norway into CRISTin – Current Research Information System, joining approximately 150 institutions, delivered immense benefits, e.g. one interface to view national data of Norway (Sidselrud and Lingjærde, 2012, p.1).

These examples emphasize two key features essential for the success of adopting a new information management system: **centralization of local systems** and **high-end search function**. Therefore, apart from many other system aspects, NORDIP needs to focus on achieving excellence in these key features.

To sum up, it is evident that, similarly to NORDIP, other organizations sought change as a result for increasing need of bringing all data together for its improved management, storage and discovery.

The following section will assess feasibility of developing a new information system for NORDIP.

4. Systems investigation and analysis

4.1 Feasibility study

Feasibility study is conducted in order to assess how attainable the new system is in terms of **technical, economic, legal, operational** and **schedule** aspects (Reynolds and Stair, 2001, p. 503). Our current feasibility study indicates that the project is feasible in all four aspects.

For example, **economic** (cost saving) feasibility can be assured as there are several cost saving options for operating system acquisition. Although, in later stages of the project it might be re-assessed if, for example, services providers require higher fees or some emergency expenses occur.

In addition, the project is **technically** feasible as, as a result of thorough planning, hardware and software will be acquired and modified to suit NORDIP needs.

Operational feasibility will be achieved by employing highly competent IT specialists to set up hardware, networks and software. Also, change management, e.g. user training programme, is a very important stage of the project and will help to ensure operational success of the system.

We determine our project as **legally** feasible as the system will be developed to facilitate ethical handling of IP, i.e. adherence to Data Protection laws and ensuring IP security in the system.

Lastly, **schedule** feasibility of the project was re-assessed since the release of our interim report and, as a result, the project time frame was extended (proposed time schedule is provided together with final recommendations in section 8.1).

4.2 Tangible and intangible benefits

Literature review and current situation suggest that implementation of a new information system will bring some tangible and intangible benefits for NORDIP. Table 2 summarizes the projected benefits.

Tangible benefits	Intangible benefits
<ul style="list-style-type: none"> • Increased speed of document processing. 	<ul style="list-style-type: none"> • Input towards national and European R&D growth.
<ul style="list-style-type: none"> • New markets for IP commercialization. 	<ul style="list-style-type: none"> • Timely and accurate information.
<ul style="list-style-type: none"> • Long term cost reduction. 	<ul style="list-style-type: none"> • Improved morale.
<ul style="list-style-type: none"> • Improved networking with stakeholders. 	<ul style="list-style-type: none"> • Improved promotion of Norwegian research. • Improved status.

- Established example for other similar organizations.

Table 2. Tangible and intangible benefits for NORDIP

4.3 System development methodology

There are several approaches to the development of an information system: **Prototyping**, **Agile development** and **Systems Development Life Cycle (SDLC)**. While the first two focus mainly on user requirements and communications, their drawbacks include lack of finite goals definition, setting of unrealistic expectations and difficult management of the project (Pearlson and Saunders, 2013, p.308). Therefore, we propose **Systems Development Life Cycle (SDLC)** the main approach for the developing the system and phasing the project. SDLC is a “multistep, iterative process” where each phase within the SDLC is interconnected and can be repeated until the “best fit” is achieved (O'Brien and Marakas, 2013, p. 521). Figure 3 illustrates the main phases of SDLC.

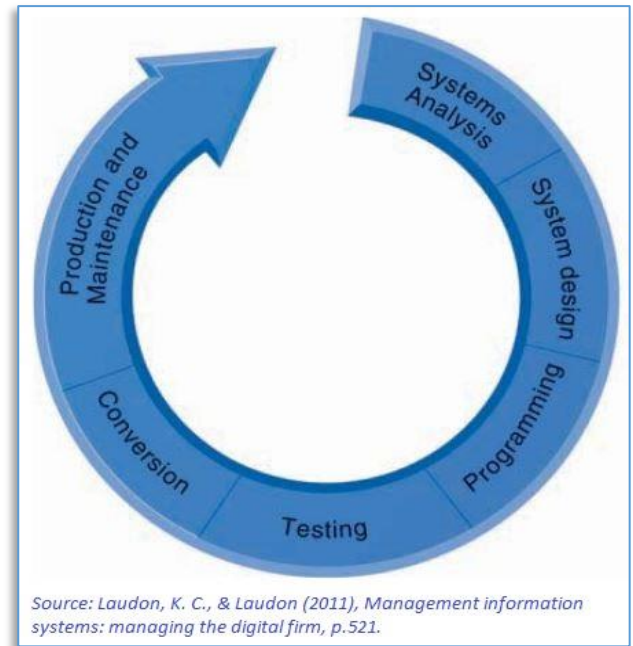


Figure 3. Systems Development Life Cycle (SDLC.)

Although, some prototyping will be used to visualize the system interface and test its usability and acceptance from its users.

4.4 Functional requirements of a new system

In order to define new system requirements and set project priorities, we have to gain an in-depth insight into the existent system and the needs of various stakeholder groups. Therefore, the project will start with extensive data and user feedback collection and analysis.

At present moment, the functional requirements for the new system are based on our preliminary investigation into current situation of NORDIP and the examples explored in the literature review.

Therefore, the key requirements of the new information management system are:

- Centralization of information management
- Security and scalability
- Easy discovery of information

Lastly, the system, while providing tools for information management, has to be appealing for the user, i.e. **intuitive interface**, **fast response time** and **support/help** when needed.

The following section will present system acquisition considerations.

5. System acquisition considerations

Any organization considering acquiring a new information management system is facing two options: **build** or **buy**.

Our analysis provided in Interim report considered benefits and risks associated with both methods of system acquisition, and concluded that buying the system is a viable option for NORDIP.

In short, regardless of possible issues (loss of strategic focus and technological innovations, risks associated with reliability of services provider), by outsourcing information system, NORDIP would benefit in multiple ways: cut costs, focus on other important activities, free internal resources for other purposes, be able to adapt the system easier when needed, consolidate data centres, etc. (O'Brien and Marakas, 2013, p.637).

In addition, further literature review supported our interim recommendation.

For example, in order to increase its competitiveness among other research institutions and improve information management, Karlsruhe Institute of Technology (Germany), one of the largest research and higher education organisations in the world focusing on engineering and natural sciences, has chosen “off the shelf” commercial software and then, with the help of its vendor, adjusted it to better suit the needs of the organisation (Scholze and Maier, 2012).

Also, extensive research of information system adoption in higher education institutions in the UK suggests, that “off the shelf” software is a prevalent solution (Russel, 2012; JISC, 2010, p.19). The implication is that, if organization is not unique in its functions and procedures, “off the shelf” customizable system might be the optimum solution for NORDIP that can address all needs of the organization.

Having selected the method of system acquisition, we need to consider the ways it will be delivered to NORDIP offices.

One of the ways is cloud computing, i.e. obtaining various services (storage, software, etc.) “as a pool of virtualized resources over a network, primarily the Internet” (Laudon and Laudon, 2011, p.213). Our interim recommendations favoured the possibility for NORDIP to secure network, storage and servers using cloud computing. Although, we conducted a more in-depth literature review to explore this option in-depth.

[Cloud computing] enables companies to focus on what they do best and leave the technology to outside specialists (Turner, 2013, p. 1)

Cloud computing

Chorafas (2011, p.4) intentionally calls cloud computing “onDemand solution” as this term implies key advantages of cloud computing over “onPremises”, i.e. in-house, IT structure: **scalability** and **extendibility**. In NORDIP case, these features become relevant in the light of *Horizon2020*, i.e. increased research activity and funding might demand higher capability of the system.

In addition, as cloud computing is able to facilitate location independent resource pooling, it is an important deciding factor for NORDIP to achieve centralization of resources among its several regional offices.

Also, cloud computing enables three types of services:

- **IaaS** (infrastructure as a service),
- **PaaS** (platform-as-a-service),

- **SaaS** (software-as-a-service) (Pearlson and Saunders, 2004, p.273).

These services differ by increasing level of provider's control over applications and virtualization, respectively (ibid.).

Even though cloud computing seems like a cheaper, easier and faster acquired solution, the risks associates with this type of service delivery include about possible technology failure or the risk of vendor going out of business and "the cloud" virtually disappearing (Turner, 2013, p.1). Therefore, it is essential to ensure the cloud provider is reliable and trustworthy.

It has to be noted, that organisations considering cloud computing need an in-depth **security risk assessment**. For NORDIP, an organization that manages large body of IP, this aspect is of great importance.

Therefore, we examined an extensive report on cloud computing risk assessment published by ENISA (European Union Agency for Network and Information Security) that concludes that "cloud's economies of scale and flexibility are both a friend and a foe from a security point of view", i.e. large pools or resources may attract hackers, although "cloud-based defences" are able to provide a robust shield and minimize security risks (ENISA, 2009, p. 4). The following section will discuss and justify our priorities for system design.

6. System design

6.1 User centred approach

First of all, the system must address its user needs. Therefore, it is essential to investigate their expectations and priorities. This can be achieved by continuous feedback collection, interviews, etc. during planning, design and testing stages of the project.

Secondly, in addition to system functionality, graphical interface is very important for the success and usability of the system. Therefore, interface and navigation functions must address the requirements identified from user feedback collection.

Lastly, cataloguing, tagging and indexing of information managed by NORDIP will greatly affect overall user experience of the system as it will have a direct impact on resource discovery for external users.

6.2 Network infrastructure

In order to establish connection among various user/stakeholder groups and address their needs and functions, NORDIP will need to set up several types of networks.

First of all, an **intranet**, a network that allows internal users to share information and collaboratively manage resources, will be set up. It will provide the same interface and functions for all regional offices of NORDIP.

Secondly, several **extranets** will be needed in order to provide varying access to external stakeholders, e.g. research institutions and industry bodies. Access to these networks will be provided by setting up a log in function.

In addition, **wireless local area networks (WLANs)** will provide centralized local sharing of office equipment, e.g. printers, fax machines, scanners, etc.

We also have to consider which type of network operating system (NOS) would be most beneficial for NORDIP. Therefore, the following section will explore several options.

6.2.1 Operating system considerations

Primary functions of an operating system (OS) are:

- User interface
- Resource management
- Task management
- File management
- Utilities and support services (O'Brien and Marakas, 2013, p.154).

The key consideration for NORDIP is whether to choose an **open source** or **proprietary OS**.

While proprietary OS, e.g. Microsoft Windows, might seem as an attractive choice due to its general popularity, it is a costly option mainly due to the restrictions on its use and copying of the software.

A very important aspect of choosing between open source and proprietary OS, is the national context, i.e. NORDIP, as a government body, needs to support and embrace national approach towards open source software. Literature shows that Norway is actively promoting adoption of open source tools and software:

- In 2006, Norway government initiated a program to increase use of open-source software in order to cut ICT costs reduce country's dependency on Microsoft (NBC News, 2008).
- Norwegian Open Source Competence Centre, founded by The Ministry of Local Government and Modernization, collaborates with private and public sector, universities, colleges and R&D representatives, in order to "increase knowledge that enables a profitable use of the software to meet the demands of tomorrow" (European Commission, 2014c).
- Over the years, a number of policies and reports have been released in support of OSS in order to reduce dependency on proprietary software in government and the public sector (Lewis, 2007).

As we can see, the national context suggests OSS to be a plausible option for NORDIP.

6.2.2 Security

As NORDIP manages large amounts of IP, it is essential to ensure effective security management. In this way, we can minimize errors, fraud and loss of sensitive information (O'Brien and Marakas, 2013, p.596).

As internet is the main method of connecting with external stakeholders, it will be necessary to implement properly configured **firewalls** and **encrypt** sensitive information.

Also, **authorized access** must be implemented for both internal and external system users in order to minimize the risk of leaking of sensitive information to unauthorized individuals.

In addition to network security, ensuring that physical system security is ensured is essential. This can be addressed by implementing scannable badge system to limit and monitor who is entering NORDIP offices.

Lastly, staff awareness of system security is an important objective as well. Therefore, security policy will need to be drafted and implemented.

7. Implementation strategy

Taking into consideration organizational structure and functions of NORDIP, we consider **phased implementation** method, i.e. introducing the new system office by office. It causes

least disruption throughout the organization and ensures smooth change-over. Moreover, it will allow to better monitor user acceptance and provide initial training and help when needed.

7.1 Change management

The examples explored in our literature review show that essential stage of system implementation is preparing its user, i.e. providing support and tools to adjust to the new system.

Therefore, in order to maximize user acceptance, it is essential to establish active communication with NORDIP stakeholders. This can be achieved by collecting user feedback during various stages of the project and providing adequate training and continuous support during implementation of the system.

8. Findings and recommendations

Our research suggests that, in order to increase performance and efficiency, it is essential for NORDIP to bring all of its resources together for their improved management, storage and discovery. Therefore, a centralized, searchable and robust database is one of the priority objectives of the project.

Also, as originally suggested in our interim report, we can conclude that outsourcing the system will be the most beneficial method of system acquisition.

In addition, cloud computing proved to be the most beneficial and feasible option for NORDIP, with **PaaS** (platform-as a-service) type approach that will provide storage solution but also allow NORDIP to run acquired software and applications.

Lastly, we strongly suggest acquiring an **open source software** as it is cost efficient and reliable. Also, it complements overall Norwegian government support of OSS and attempt to minimize dependability on proprietary software.

8.1. Proposed project schedule

Also, having conducted a more extensive literature review, we gained a better insight into the timescale of similar projects, e.g. a research by Russel (2012) looked into information

systems implementation experiences across UK universities and provided a good insight into practical issues of such projects.

Therefore, we reassessed our interim project duration recommendation and are proposing **11-month time frame**. Figure 4 presents proposed time frame of the project.

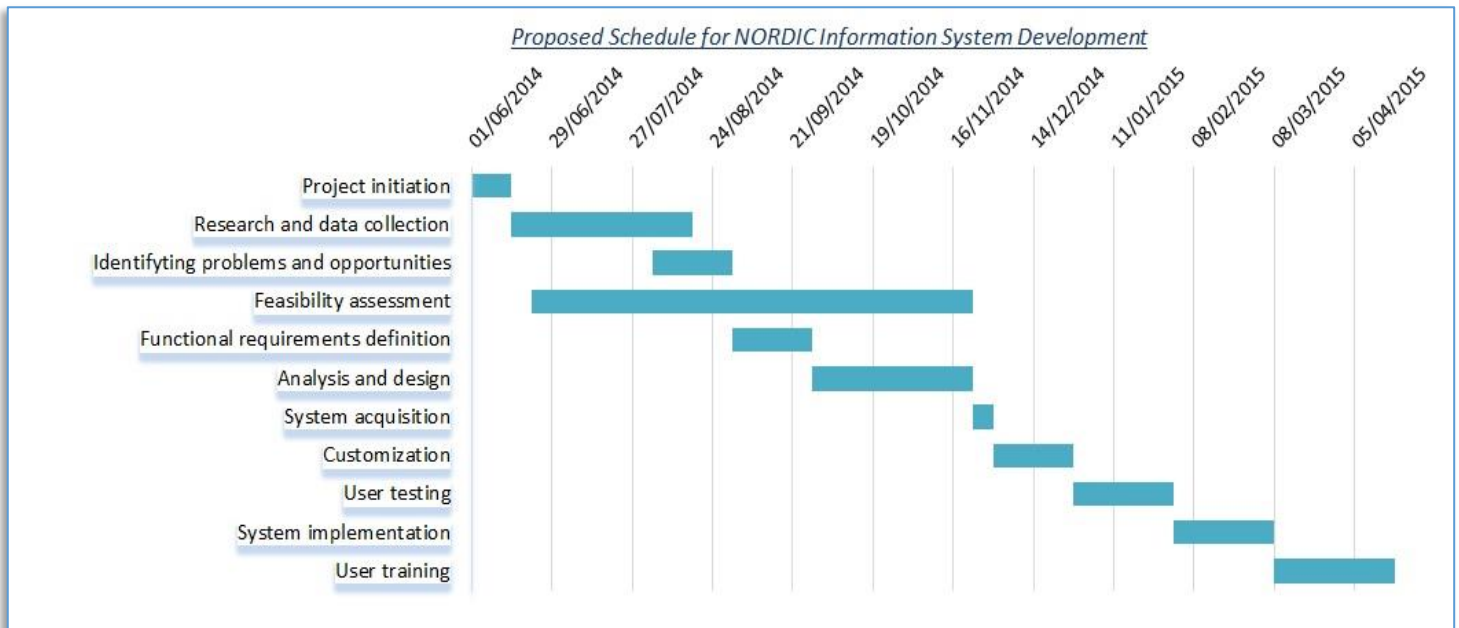


Figure 4. Proposed project time schedule.

8.2 Project costs

The project, inevitably, will inflict **intangible** and **tangible** costs. The former might include:

- Temporary disruption to NORDIP functions during implementation process.
- Loss of staff morale and possible resistance to change from user/employee perspective (this aspect is addressed in section 8.1 *Change management*).

Tangible costs are the costs of hardware, software, personnel and other services required. Based on our final recommendations, cost estimate is detailed in Table 3.

Category	Components	Estimated cost
Software	<ul style="list-style-type: none"> • OS • Office application • Database management system • Web server 	€ 8000

<i>Hardware</i>	<ul style="list-style-type: none"> • PCs, printers, scanners, etc. • Cables • Wireless equipment • Routers 	€ 4000
<i>Personnel</i>	<ul style="list-style-type: none"> • Project team • IT support • Training costs 	€ 68 000
Total		€ 80 000

Table 3. Estimated costs.

9. Conclusion

To sum up, considering the context and nature of NORDIP, we support Carr's (2003) approach to IT management:

- Spend less.
- Follow, don't lead.
- Focus on vulnerabilities, not opportunities.

As much as controversial this approach might be, for an organization like NORDIP, it can help achieve a robust, reliable and secure information system.

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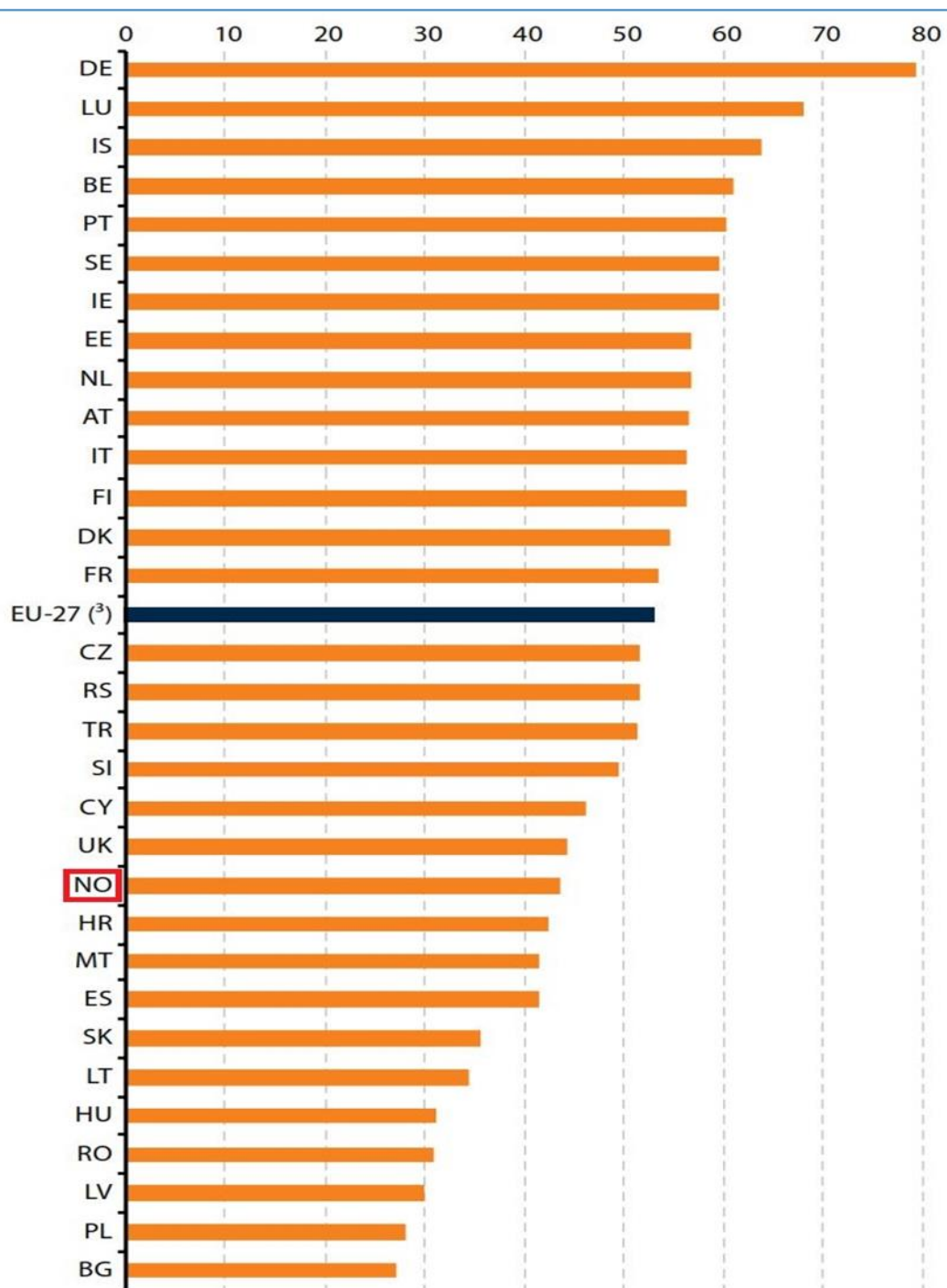
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Appendix 1 – Innovative enterprises 2008-2010



(1) Innovative enterprises i.e. enterprises that implemented any type of innovation (including enterprises with abandoned, suspended or ongoing innovation activities).

(2) EL, data not available.

(3) EU-27 excluding EL.

Source: Eurostat (online data code: inn_cis7_type).

