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DESIGNING A COMPETENCE MANAGEMENT SYSTEM WITH AGILE METHODS: CASE SIILI SOLUTIONS PLC

*Completed Research
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Abstract

Most of the world population works in the service sector, which stresses the importance of knowledge-intensive organizations and, consequently, strategic competence management. Knowledge management and the supporting enterprise systems (ESs) have received a lot of researcher attention, but the deployment success rate is not flattering. Therefore, in this 33-month long Action Design Research (ADR) program we designed and implemented Competence Management System (CMS) with agile methods in a professional services company Siili Solutions PLC. The contribution of this paper is to provide rich insight and understanding on technological aspect of CMS design and implementation as well as on agile software development practices of agile experts.

Keywords: Competence management system, Action design research, Design principles, Knowledge management, Enterprise system, Agile development.

1 Introduction

Most of the world population works in the service sector, which results in a huge impact on the economic prosperity (ILO 2015). Castells (2010) argues that knowledge-based occupations contribute most to the growth and productivity whereas Vargo and Lusch (2008) consider all economies as service economies. Therefore, leading the knowledge workers (Drucker 1999) and data resources (Dav-enport 2007, Goodhue et al 1988) in a contemporary organization might be the best source of competitive advantage.

The professional services firms need to estimate and forecast the customer demand in order to be able to match it with the consultants having the correct competences. Consequently, the firms need in depth data and knowledge regarding individual and organizational competences so that they can guide the competence development. Knowledge management and the supporting enterprise systems (ESs) have received a lot of researcher attention, but the deployment success rate is not flattering. Moreover, earlier research has identified a need for more empirical research on agile development practices by experienced practitioners.

In this action design research (ADR) I aim at: 1) increasing understanding of the technological aspect of the design of competence management systems (CMS) and 2) gaining more understanding about CMS development by software engineers with expertise in agile methodologies.

The paper is structured as follows. (1) I have discussed the purpose and scope as well as theoretical and practical relevance in this introduction. (2) In the next section I position the research by looking into existing literature and (3) proceed to describing the research methodology including description of the case organization Siili Solutions PLC. (4) I then describe the design of the CMS artefact with agile practices in Siili Solutions PLC. (5) In the evaluation section I analyse the success and usage of the artifact. (6) Finally, I conclude the paper with the contribution of the research.

2 Positioning of the Research

In this paper I continue the information systems (IS) tradition regarding the term ‘competence’ as in competence management systems (Lindgren 2004). Therefore, I am not using the human resources (HR) trend regarding the term ‘capability’ when the HR scholars refer to a person’s work competence (Lester 2014). CEN (2010) defines *competence* as ‘a demonstrated ability to apply knowledge, skills, and attitudes for achieving observable results’.

2.1 Evolutionary approach to strategic management

The business environment changes nowadays so rapidly that conventional market-based view (Porter 1979) to strategic management is not agile enough. As a result, according to Wade and Hulland (2004), IS scholars have often applied Penrose’s (1959) resource-based view (RBV), which emphasizes firms’ internal resources and not external industry or market situation (Wernerfelt 1984).

Minzberg (1998) argues that RBV should be a good match in high-speed industries, but the challengers claim that evolutionary approaches are needed above all when firms seek to commercialize latest advances in technology development. For example, Haeckel (1992) suggested Sense and Respond approach for firms seeking for a more adaptive strategy, Teece et al (1997, 2009) combined RBV with modern organizational theories and came up with Dynamic Capability Framework (DCF), and Collins (2001) introduced Level 5 Leadership as well as Hedgehog Concept to demonstrate how great leadership can lift a company from mediocrity to excellence. All the evolutionary approaches stress the importance of understanding market dynamics and utilizing firm resources via, for instance, knowledge and competence management in order to gain competitive advantage.

2.2 Competence management systems and agile development

Knowledge-management researchers have stressed the importance of studying the connection of strategic competitive advantage and organizational knowledge (Alavi and Leidner 2001). Moreover, IS researchers have pinpointed that the deployment of ESs often fail even though they are expected to result in significant benefits (Momoh et al 2010, Pekkola et al 2013) due to the enterprise-wide utilization of same applications for the most important operational and analytical functions (Brown and Vessey 2003).

The ES research focusing on competence management has been scarce after the seminal work of Lindgren et al (2004), who introduced CMS design principles (DPs) and competence typology. Hustad and Munkvold (2005) analysed the challenges in developing IT-enabled competence management. Corallo (2010) focused on the maximization of competence management benefits. Simon (2010) utilized design theory as a lens to CMS. Chae et al (2011) scrutinized information flows in HR IS. Mattila (2012) discussed ES implementation for resource allocation. The author has studied the design and implementation of CMSs in real business environment (Niemi and Laine 2016a, 2016b).

There has been an increasing interest in the research on agile software development (Abrahamsson et al 2009) since the creation of Agile Manifesto (2001). It means a set of principles guiding iterative development of software in self-organizing teams (Fowler and Highsmith 2001). However, earlier research has identified a need for more empirical research focusing on experienced agile teams and organizations giving more attention to management oriented approaches (Dingsøyr et al 2012).

3 Methodology

3.1 Research approach: action design research

Sein et al (2011) introduced action design research (ADR) method, which calls for starting from a practically relevant business problem and through iterative design cycles end up in an artifact rooted in scientific theories. Accordingly, this study includes four iterative stages (see Figure 1), which the researchers utilized to create and deploy a competence management system with organizational and technological interventions. The researchers reflected the first stage (problem formulation) in Niemi and Laine (2016a). The results of the last stage (formalization of learning) have been published in Niemi and Laine (2016b) and in this current article.

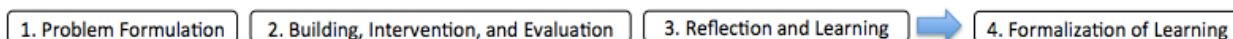


Figure 1. Applied Action Design Research Method, adapted from (Sein et al 2011).

3.2 Competence Management System at Siili Solutions PLC

The case organization in this research is Siili Solutions PLC, which is a professional services firm specializing in agile development of business critical solutions to globally operating customers. Siili operates in Finland, Germany, and Poland with over 400 consultants. It was established in 2005, listed on Nasdaq in 2012 with 2,33 euros per share, and reached all-time high price 9,20 euros in spring 2016. Siili aims at exceeding €50M revenue with 10% EBITDA in 2016, which would continue the historical track record of 40% average annual growth since 2010.

Siili Solutions PLC has spent over €2M in the R&D program focusing on competence management from January 2013 to June 2016. The program consists of three organizational interventions and five technological interventions with the largest releases during 2014-2015.

The author kicked off the scientific ADR program when he started as R&D director in Siili Solutions PLC in October 2013. Consequently he has been heavily involved in the planning and leading of the CMS program. Therefore, the author is an ‘involved researcher’ and, in addition, there has been an ‘outside researcher’ contributing to the scientific research, but not involved in the actual development (Walsham 1995, 2006). In the ADR team there has also been three service development employees and several software developers implementing the changes in ‘KnoMe’ competence management software solution.

The author started the research with ‘problem formulation’ stage by interviewing 40 employees, customers, and partners in October – December 2013 and analysed the findings utilizing dynamic capability framework (Teece 2009). The author formulated the scientific problem and reflected the current state of the research in the second quarter of 2015 with 20 semi-structured interviews. However, the actual CMS was designed utilizing several exploratory workshops exploiting the expertise of the researchers and the Siili employees and openly collecting ideas via company-wide collaboration tool and email. The researchers also collected secondary research material, such as management documents, reports, and instructions on the intranet, the version control and documentation tool, the project and requirement management tool, the collaboration tool, and the emails of Siili Solutions PLC, as well as publicly available information such as stock exchange releases and semi-annual financial statements.

The next stage of the ADR was ‘building, intervention, and evaluation’ (see Fig. 2). The CMS KnoMe was designed in a real business context in Siili Solutions PLC and included both organizational and technological artifacts, which are further elaborated in section 4 of this article. The ‘reflection and learning’ stage was formally done in five confirmatory workshops with Siili employees representing cross-disciplinary expertise from August 2015 to June 2016. The results are discussed in section 5 of this article. The ‘formalization of learning’ stage consists of this (and several other) scientific articles.

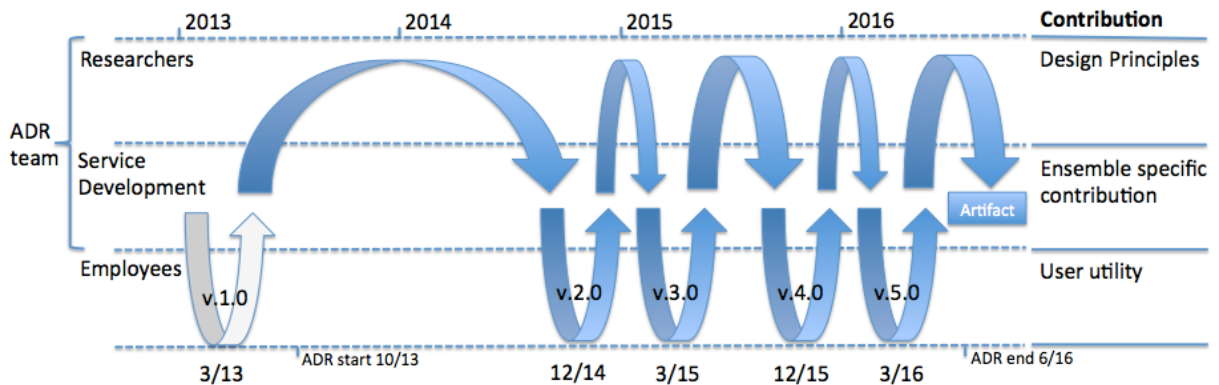


Figure 2. The BIE stage and release versions of CMS KnoMe at Siili Solutions PLC.

4 Design of the KnoMe Artifact

In 2013 Siili Solutions PLC had no formal framework, process, or technology for competence management. The CMS development program was initiated to systematize competence management and to create a software application accessible to all employees. During the CMS development program, there have been three major organizational changes and five major releases of the CMS (see table 1). The following descriptions are based on real-life situations in a knowledge-intensive project organization Siili Solutions PLC from January 2013 to June 2016 (formal scientific ADR since October 2013).

Release	Main goal of the release	Time
1.0	Complete transparency on the stored data for all employees.	Mar 2013
2.0	The first true competence catalogue including information on the ongoing and latest projects and a more structured data model.	Dec 2014
3.0	Supports the new organization launched in Jan 2015 and the management of recruits and partners with LinkedIn login.	Mar 2015
4.0	Supports the new organization launched in Oct 2015 and includes completely renewed user interface as well an early release of customer and project management.	Dec 2015
5.0	Integration with the ERP system, which contained the master data and realized hours of each customer and project.	Mar 2016

Table 1. The major releases of KnoMe in Siili Solutions PLC. In addition, there have been smaller releases almost on weekly basis.

4.1 Agile development with Kanban

The ADR team decided to design and implement KnoMe following agile development principles aiming at functioning software with high end-user satisfaction. In other words, the team wanted to avoid a big project with a massive requirement backlog and complex processes. Instead they created a service vision to guide the prioritization and empower the team to autonomously organize the work.

The team chose Kanban as a development method resulting in short incremental development cycles. The development and requirements were managed in Trello Kanban board (see Fig. 3) having different states, which every work item had to pass through. There were practically no any other management criteria and the team members themselves were responsible for choosing the implementation order of the approved requirements as well as for the scope and timing of each release. The Trello board

was complemented with Flowdock collaboration (see Fig. 4), version control was done in Gitlab (see Fig. 5), and software builds & testing in Jenkins (see Fig. 6).

Moreover, the same team took full responsibility of development and operations (i.e. DevOps) meaning that the same people managed the design, implementation, testing, publishing to production, as well as end-user “helpdesk” and bug fixing. The code was integrated into a shared repository several times a day and automatically tested and verified (i.e. Continuous Integration) meaning that the developers were able to publish new releases on a daily basis without any downtime for the end-users. Moreover, the developers first split new requirements into specific test cases and only then wrote new code that was required to pass the tests (i.e. Test Driven Development) aiming at proactively creating clean code from the beginning without a need for reactive testing and debugging.

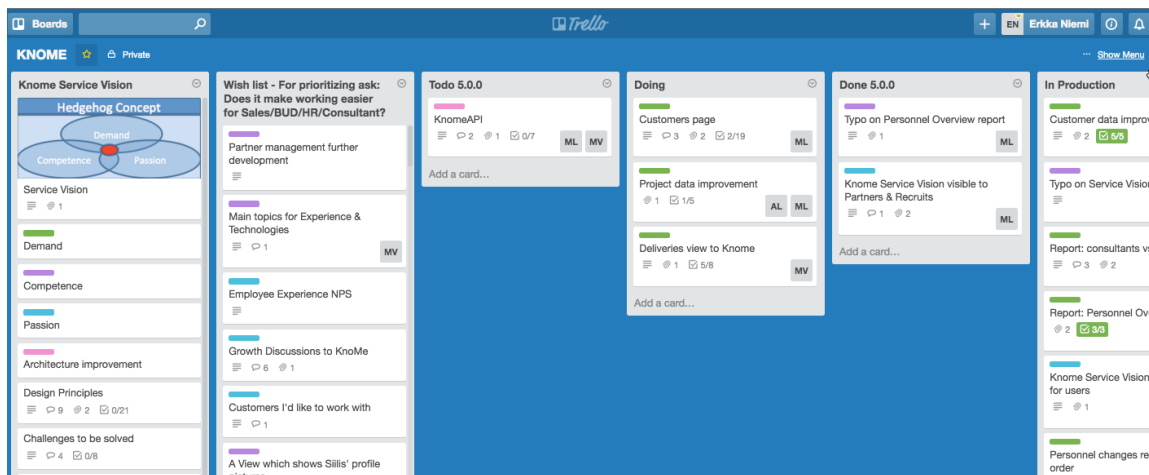


Figure 3. Online Kanban board Trello is used for requirement management and documentation. The developers themselves drag the cards forward as the work progresses.

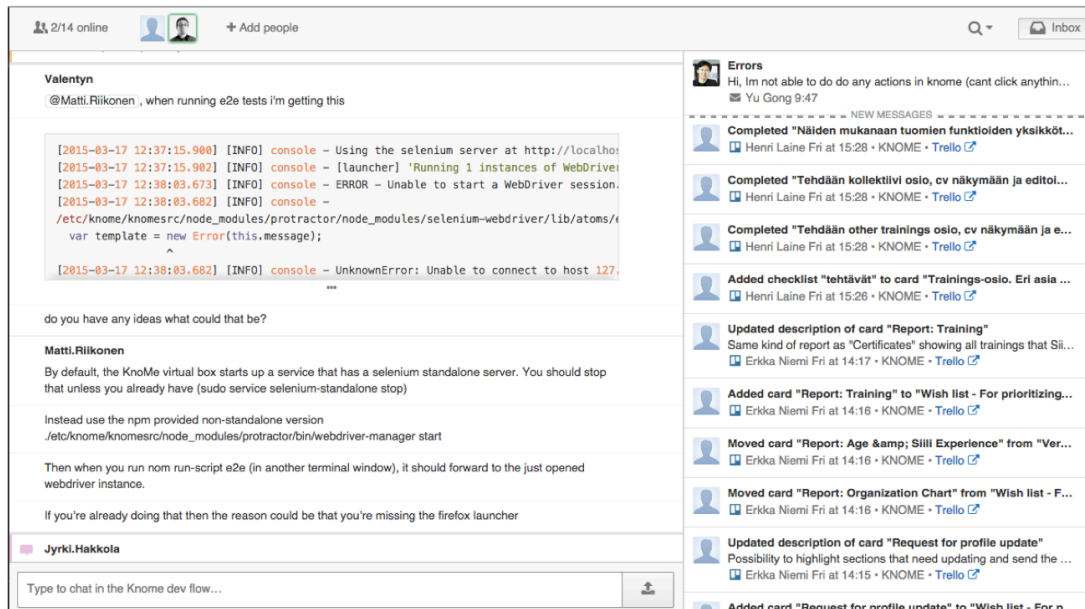


Figure 4. Online collaboration tool Flowdock is integrated with the Kanban board and allows the team members to discuss the changes and ask for help.

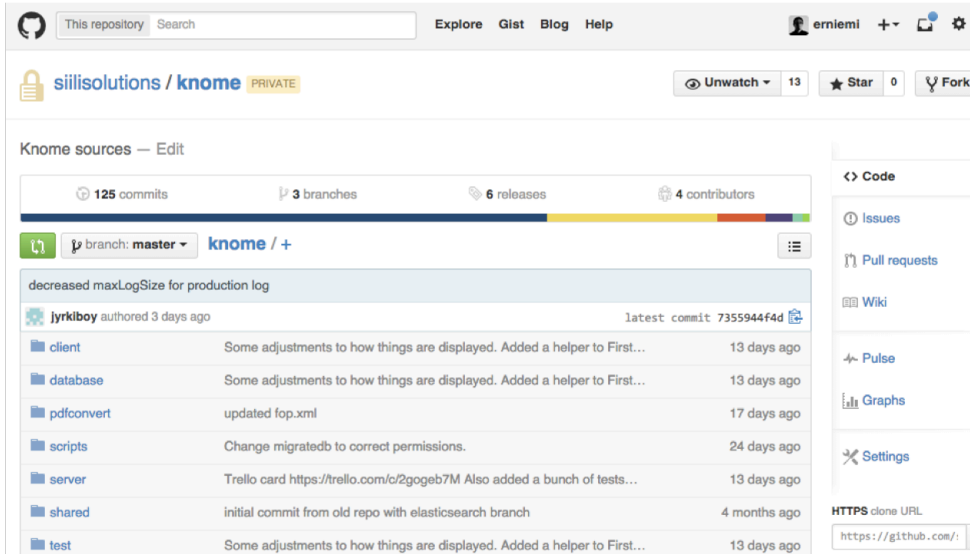


Figure 5. Online version control tool Gitlab stores the code including changes in the central repository. The developers issue pull requests to publish their code into the repository.

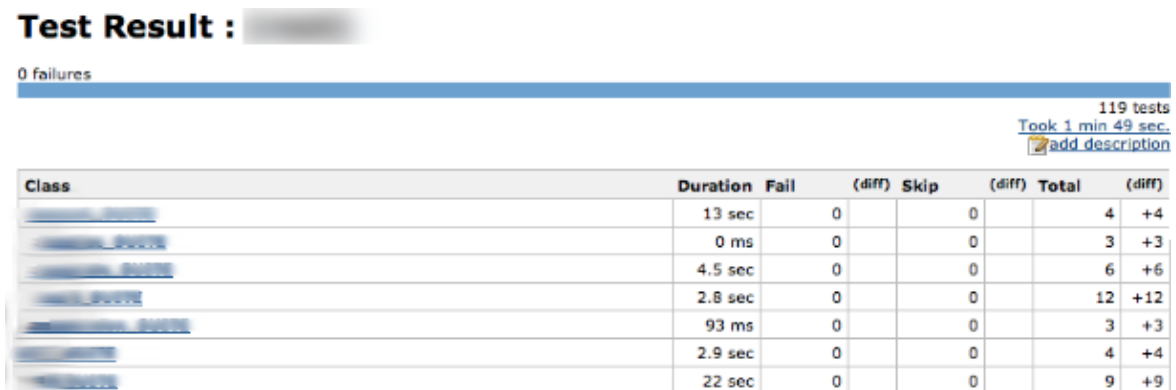


Figure 6. Online continuous integration tool Jenkins is used for managing the software builds and test automation.

4.2 Architecture: processes, data, applications, technology

The Siili Solutions PLC CMS Knome is open for all its employees, partners, and recruitment candidates. They are able to input data on their current competences and aspirations for the future development as well as see the same information regarding their colleagues, which is expected to help in networking. However, the CMS supports several other important business processes: sales people are able to use it for searching competences needed for customer assignments, human resources development people are able to use it when evaluating and managing the competence needs on different organizational levels, and recruitment people are able to use it in talent attraction process. The most essential system functionalities are: 1) input and edit competence data, 2) search for individuals or competences, 3) visualize the data on different levels.

The CMS contains several master data entities: people, tribes (competence pools), customer and partner organizations, and projects. This data can be supplemented by different kind of categorizations and, most importantly, with competence-related data, which has been designed applying Lindgren et al (2004) competence typology (in-stock, in-use, in-the-making).

All of Siili Solutions PLC enterprise systems are implemented on cloud and integrated with each other (see Fig. 7). They help to run the core business processes in many ways: 1) KnoMe contains information on persons (employees, recruits, partners) and their competences, 2) Severa is the commercial resource management and invoicing service containing data on customers and projects, 3) Office365 includes customer relationship management (CRM), reporting and analytics (PowerBI), as well as document & content management, 4) data warehouse, master data management, and active directory federation services all help to maintain the integrity and security of the data.

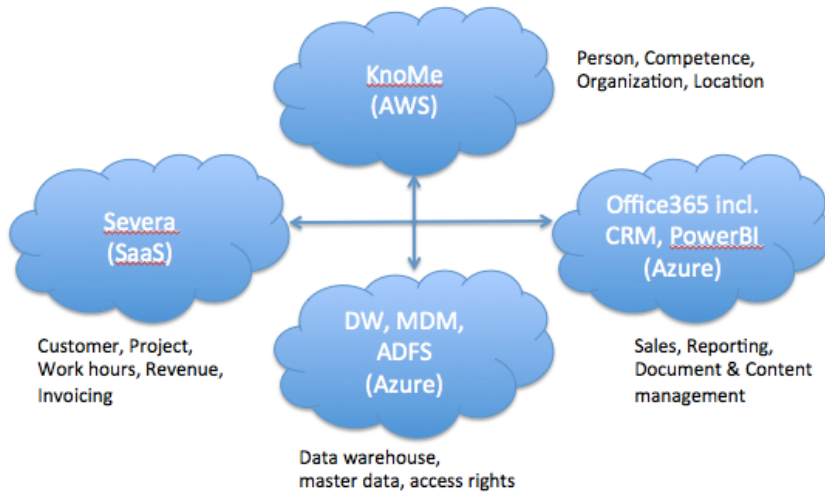


Figure 7. Siili's ESs are all implemented on cloud and integrated with each other.

The software development utilized CoachDB and ElasticSearch for the database layer, Node.js and REST for the application layer, and Angular.js for the user interface. The development infrastructure was implemented using Amazon's cloud (AWS) with an automated Chef environment. Authentication is done with Active Directory for internal users and with LinkedIn for external users. KnoMe is fully responsive and scales automatically for all common devices, including web and mobile.

4.3 Realization of the CMS service vision

There has been a clear service vision guiding the KnoMe requirements and development since the very beginning in 2013. It was inspired by the Collins' (2001) hedgehog concept meaning that a firm aspiring to rise to excellence should aim at the focal point of Competence, Customer demand, and Passion.

Competence should focus on what you can be the best in the world at. The corresponding data in KnoMe is stored as profiles of every individual employee, recruit, and many partners (see Fig. 8). The profile includes, for example, personal details, certificates, training, and, most importantly, methodology and technological skills.

Customer demand should focus on how your economies work best. The corresponding data in KnoMe covers all historical and ongoing customer and internal projects (see Fig. 9). The data includes a description of each customer as well as ongoing and implemented projects. The projects are linked with each participating employee including his/her role in the project as well as the required technological skills.

Passion should focus on what most interests your employees. The corresponding data in KnoMe is implemented on profiles by providing each employee with the possibility to rate each unique skill on two scales: *skill level* and *interest to use it*. These ratings are used to generate many reports and visualizations, such as skill clouds on both tribe and company levels (see Fig. 10).

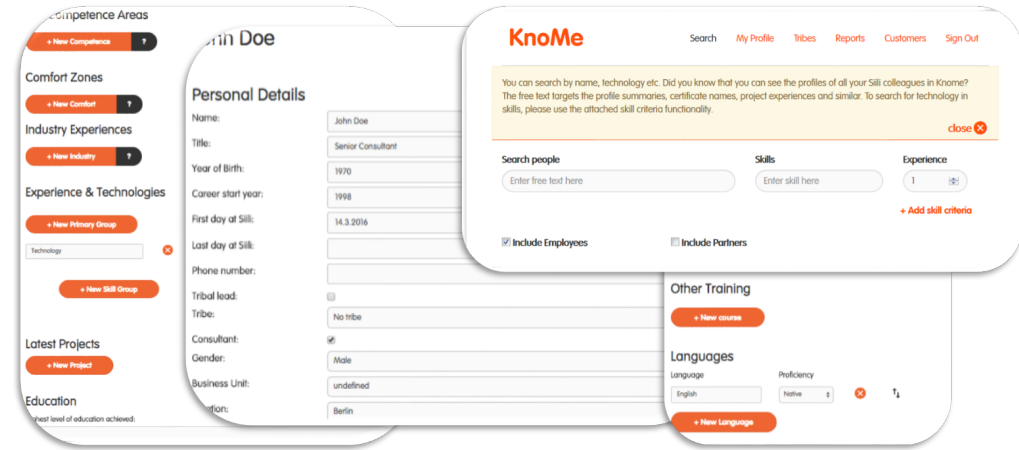


Figure 8. COMPETENCE: Profile content screenshots.

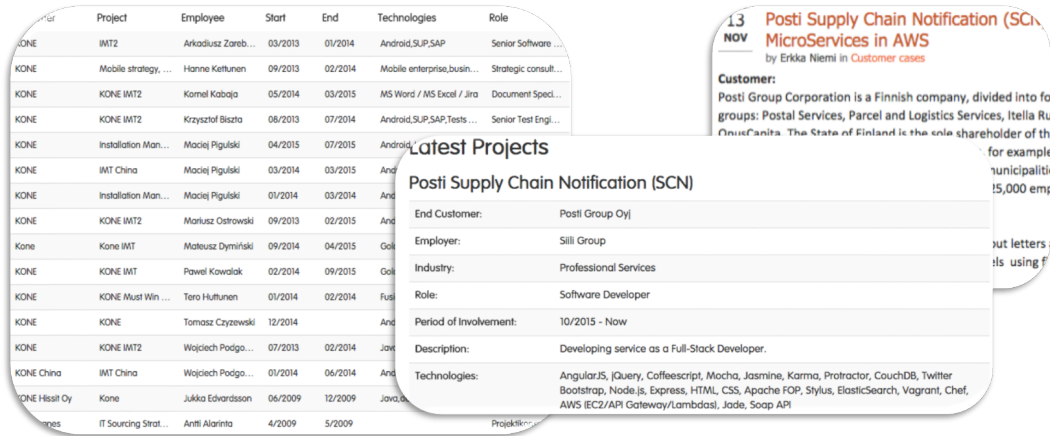


Figure 9. DEMAND: Ongoing and historical customer and internal projects.

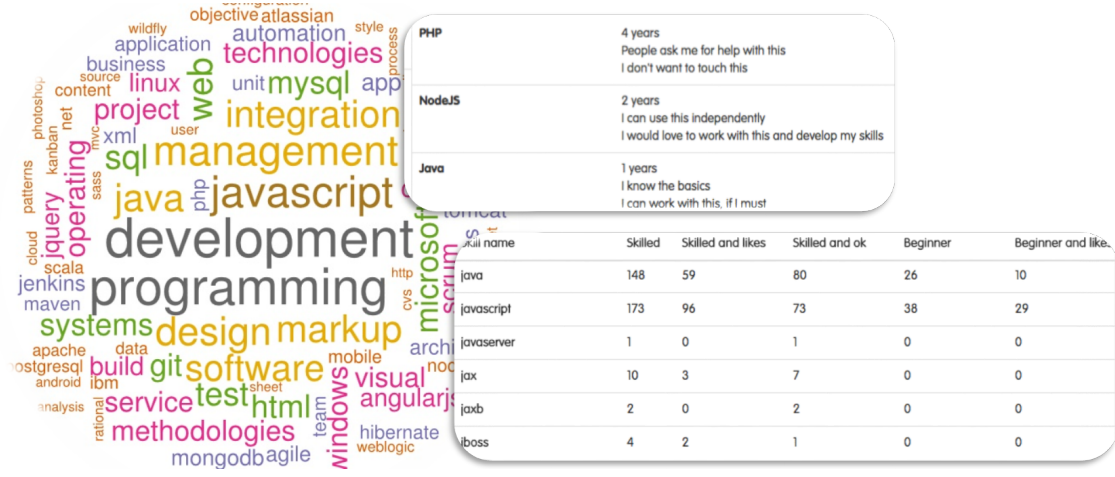


Figure 10. PASSION: Skills clouds derived from skill ratings on employee profiles.

5 Evaluation of the Artifact

'The competence management system we have implemented increases the utilization of our experts and improves our forecasting capabilities. According to my knowledge, it is the best system among competitors in Finland' stated Siili Solutions PLC CEO Seppo Kuula at an investor conference, Helsinki, Finland, Feb 25th, 2016.

The analyses presented in the researchers' articles were validated with Siili Solutions PLC involved executives, management, employees, and system developers in confirmatory workshops in August 2015 (Niemi and Laine 2016a) and April-June 2016 (this paper). The whole research program fulfils ADR principles (Sein et al 2011), as will be presented in a forthcoming paper focusing on revised design principles for competence management systems.

The KnoMe CMS was introduced to all employees in the beginning of 2013 and has 100% coverage, but some of the employees have not completed all the information on their personal profiles. The success and usefulness of the system is evident also on the usage statistics on table 2.

Month (2016)	Jan	Feb	Mar	Apr	May	Jun
Unique users	122	180	239	227	212	210
% of employees	31%	46%	58%	55%	50%	50%

Table 2. Unique users of CMS KnoMe (February extrapolated due to missing daily data)

Lindgren (2004) published **CMS DESIGN PRINCIPLES (DPs)** so in the following I use them to evaluate and reflect the KnoMe design:

DP 1. User-controlled transparency: "CMS should make *competence-in-stock* visible and accessible to the entire organization. This principle responds to the problem of CMS limiting the opportunities of knowledge sharing by restricting access to competence data."

In KnoMe the default setting is that everyone can see all the data on everyone and all the reports (recruits, skill matrix etc.) are available to all employees. On the other hand, the user controls all data about him/herself and it is always possible to personally decide how much and what data to input. Moreover, the users can mark some pieces of data confidential (e.g. birth date or a specific customer). However, even though the company values encourage to transparency different stakeholders can define confidentiality of data depending on personal, legal, or other reasons.

DP 2. Real-time capture with feedback loop: "CMS should track *competence-in-use* in real time. This principle addresses the problem of inaccurate competence data, which is caused by a CMS design focusing on past competence. The principle promises to generate data about competence as it emerges through knowledge work in action."

In KnoMe all the new employee master records and competence data are created already during the recruitment process according to this principle. In addition, customer, project and competence data are created in real-time when assignments start so it is easy to see which competences are in use and how widely they are utilized by looking, for example, at number of customers or employees. Many stakeholders (e.g. competence organization, business unit management, sales, human resources) continuously use the competence data and give feedback to individual employees who can edit the data any-time. As a result, the data quality and fit for use is considered good or excellent.

DP 3. Multi-perspective interest integration: "CMS should accommodate a definition of competence that includes individual knowledge workers' interests in addition to their existing competence. This principle facilitates the capture of *competence-in-the-making* by accommodating individuals' interests as an indication of the skills and knowledge that they are motivated to develop."

In KnoMe the Hedgehog Concept (i.e. service vision) is on the front page in order to remind all the users about the importance of personal interests when choosing customer assignments and planning for competence development. In addition, the users can themselves rate competences on two scales “skill” and “interest” (e.g. “I’d love to learn more”), which should enable and help to integrate the interests of several perspectives.

In the future the goal is to further develop KnoMe to even better take into account this principle. The system should be able to store the personal business model canvas (including competence career development plans) and to aggregate these on tribe-level and Siili Solutions PLC organization-level. Moreover, the intention is to integrate the current stand-alone employee satisfaction survey data with customers, employees and competence areas in KnoMe. As a result, I expect to even better understand the interests of the employees and the skills and knowledge they want to develop.

DP 4. Flexible reporting: “CMS should support ad hoc analyses of the organization's competencies, both with regard to different units of analysis (e.g., individual or group) and time frames (e.g., from-to dates). This principle addresses the rigidity in CMS reporting functionality. By providing managers with flexible reporting, CMS support strategic competence development by influencing competence-in-the-making.”

KnoMe is the single source for people and competence data (excluding salary data) in Siili Solutions PLC and it manages the whole data lifecycle across all processes from recruitment to exit. In addition to this operational usage, KnoMe is used for many analytical purposes. There are several reports on personnel, competencies, projects, and customers, which are available to all employees and not only managers. KnoMe utilizes modern flexible search technologies as well as advanced analytics capabilities and data mining techniques to transparently share the understanding of competences and to help guiding the competence development to desired direction.

6 Conclusion

Orlikowski and Iacono (2001) as well as Weber (2003) call for deeply engaging the IT artifact and taking technology seriously in IS research. Accordingly, in this paper I describe the technological aspect of our ADR program. This research provides new knowledge regarding CMS design principles by implementing an ES artefact with agile methods in a real business environment from 2013 to 2016. The complementing information governance organization (Niemi and Laine 2016b), as well the researchers’ proposal for improved design principles, are published in other papers. In the future, it would be interesting to study the wider adaption of the designed artifact and improved principles in other knowledge-intensive organizations.

6.1 Scientific significance

In order to stand out from ordinary application development, design science should recognizably point out the scientific significance (Hevner et al 2004). First, I apply the market based-validation by Kasanen et al (1993) to evaluate the scientific contribution of this constructive design research. This ADR conforms to principles of ‘weak market test’ meaning that a single firm has utilized the construct in an authentic business context and evaluated the advantages. Second, according to ADR method principles (Sein et al 2011), action design research should conclude in creating design principles (DPs). In this research program we created a CMS utilizing the DPs published by Lindgren et al (2004) and, therefore, I have provided more insight to gain more understanding on their suitability in an authentic business context. Third, earlier research (Dingsøyr et al 2012) has identified a need for more empirical research focusing on agile development practices by experienced developers. Therefore, in this paper I aimed at providing rich description of the utilized development practices and tools in order to contribute to scientific knowledge.

6.2 Practical significance

The published rich insight regarding competence management system design with agile methodologies is expected to be useful to other knowledge-intensive organizations. Therefore, it is important for them to understand the results of the implementation in this case organization. In this research I started from a practically relevant business problem and through iterative design cycles ended up in an artifact rooted in scientific theories (Sein et al 2011). The case organization in this research was Siili Solutions PLC, which spent over €2M in the R&D program focusing on competence management and resulting in three organizational interventions and five technological interventions from January 2013 to June 2016. The CMS Knome was available to all employees and used by ca 50% of them, which proves the usefulness of the technological artefact designed in this research. Moreover, during the researched period the Siili Solutions PLC sales revenue has increased from €18M to €50M and the market capitalization by 295% so the ADR has most likely partially helped in this success.

Acknowledgments. I would like to thank all the employees in Siili Solutions PLC for giving their time and sharing their ideas and experiences with us. This study was funded by the Academy of Finland (grant number 259454). The initial version of this paper was published as a short prototype paper in DESRIST 2016 conference.

Material. CMS Knome can be accessed from <https://knome.siilicloud.com> and Siili Solutions's website from <http://www.siili.com>. Please note that external users (partners and recruits) can only edit their own personal profiles, but employees can see the rest of the features and reports.

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