

### Are SonarQube Rules Inducing Bugs?

The popularity of tools for analyzing Technical Debt, and particularly the popularity of SonarQube, is increasing rapidly. SonarQube proposes a set of coding rules, which represent something wrong in the code that will soon be reflected in a fault or will increase maintenance effort. However, our local companies were not confident in the usefulness of the rules proposed by SonarQube and contracted us to investigate the fault-proneness of these rules. In this work we aim at understanding which SonarQube rules are actually fault-prone and to understand which machine learning models can be adopted to accurately identify fault-prone rules. We designed and conducted an empirical study on 21 well-known mature open-source projects. We applied the SZZ algorithm to label the fault-inducing commits. We analyzed the fault-proneness by comparing the classification power of seven machine learning models. Among the 202 rules defined for Java by SonarQube, only 25 can be considered to have relatively low fault-proneness. Moreover, violations considered as 'bugs' by SonarQube were generally not fault-prone and, consequently, the fault-prediction power of the model proposed by SonarQube is extremely low. The rules applied by SonarQube for calculating technical debt should be thoroughly investigated and their harmfulness needs to be further confirmed. Therefore, companies should carefully consider which rules they really need to apply, especially if their goal is to reduce fault-proneness.

#### General information

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Organisations: Computing Sciences, Lappeenranta University of Technology

Contributors: Lenarduzzi, V., Lomio, F., Huttunen, H., Taibi, D.

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ISBN (Electronic): 9781728151434

ASJC Scopus subject areas: Organizational Behavior and Human Resource Management, Hardware and Architecture, Software, Safety, Risk, Reliability and Quality, Computer Networks and Communications

Keywords: architectural smells, code smells, coding style, machine learning, SonarQube, static analysis, Technical Debt

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#### Bibliographical note

EXT="Lenarduzzi, Valentina"

Source: Scopus

Source ID: 85083565109

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#### What matters for knowledge work productivity?

Purpose: Knowledge work productivity is a well-studied topic in the existing literature, but it has focussed mainly on two things. First, there are many theoretical models lacking empirical research, and second, there is a very specific research regarding how something impacts productivity. The purpose of this paper is to collect empirical data and test the conceptual model of knowledge work productivity in practice. The paper also provides information on how different drivers of knowledge work productivity have an impact on productivity. Design/methodology/approach: Through the survey method, data were collected from 998 knowledge workers from Finland. Then, confirmatory factor analysis was conducted to confirm the knowledge work productivity dimensions of the conceptual model. Later, regression analysis was used to analyse the impacts of knowledge factors on productivity. Findings: This paper increases the understanding of what matters for knowledge work productivity, with statistical analysis. The conceptual model of knowledge work productivity consists of two major elements: the knowledge worker and the work environment. The study results showed that the knowledge worker has the biggest impact on productivity through his or her well-being and work practices. The social environment was also found to be a significant driver. The results could not confirm or refute the role of the physical or virtual environment in knowledge work productivity. Practical implications: The practical value of the study lies in the analysis results. The information generated about the factors impacting productivity can be used to improve knowledge work productivity. In addition, the limited resources available for organisational development will have the greatest return if they are used to increase intangible assets, i.e., management and work practices. Originality/value: While it is well known that many factors are essential for knowledge work productivity, relatively few studies have examined it from as many dimensions at the same time as this study. This study adds value to the literature by providing information on which factors have the greatest influence on productivity.

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MoE publication type: A1 Journal article-refereed  
Organisations: Industrial and Information Management, Research group: Knowledge and Learning Research Center  
Contributors: Palvalin, M.  
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Pages: 209-227  
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Original language: English

ASJC Scopus subject areas: Industrial relations, Organizational Behavior and Human Resource Management

Keywords: Knowledge work, Measurement, Performance management, Productivity, Work environment, Performance

Electronic versions:

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Source: Scopus

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Research output: Contribution to journal › Article › Scientific › peer-review

### Social capital characteristics in RD project networks

Network research has multiple approaches that offer knowledge related to multiple network types. This article identifies and discusses social capital characteristics in the context of government-funded RD project networks. Previous literature on this context has typically focused on collaboration between universities and firms while our interest is solely on interfirm relationships. Secondly, the previous literature on interfirm collaboration concerns typically other types of networks such as strategic alliances. We argue, that to understand the dynamics of inter firm collaboration in RD project networks, the research needs to be conducted in coherent environment. Data for this qualitative research was collected by interviewing 18 firm representatives who had experience on participating government-funded RD projects. We recognized social capital characteristics in RD projects and organized these findings under structural, cognitive and relational dimensions of social capital. Results indicate that project networks' social capital characteristics differ in many parts from strategic alliances and thus support our argument. The results can be exploited by project coordinators, innovation officers and project network members to facilitate the interfirm collaboration in RD project networks.

### General information

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Organisations: Mechanical Engineering and Industrial Systems, Research area: Manufacturing and Automation

Contributors: Majuri, M., Lanz, M.

Publication date: 4 Oct 2018

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ISBN (Electronic): 9781890843373

ASJC Scopus subject areas: Strategy and Management, Communication, Engineering (miscellaneous), Management of Technology and Innovation, Organizational Behavior and Human Resource Management, Computer Networks and Communications, Decision Sciences (miscellaneous)

DOIs:

10.23919/PICMET.2018.8481775

### Bibliographical note

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Source: Scopus

Source ID: 85056486979

### **360-Degree video streaming and its subjective quality**

Traditional challenges for deploying end-to-end streaming systems are made harder when considering 360-degree media content. One of these challenges relates to the lack of commonly accepted standardized methodologies for subjective 360-degree video quality assessment, especially oriented towards streaming services. The contribution of this paper falls in the area of subjective assessment of 360-degree video. - From traditional standardized test methodologies originally designed for 2D/3D video, we tailored a methodology more oriented towards Virtual Reality (VR) streaming services. The methodology inherits a lot from existing ITU standards for video subjective quality evaluation. The additions incorporate the special properties of 360-degree video, namely omnidirectionality, as opposed to traditional video. - With this goal in mind, a new metric called Similarity Ring Metric (SRM) is introduced. It measures the degree of similarity in watching patterns of a single subject or between different subjects for several subjective assessment tests. This metric enables an inclusion or rejection criteria for test results in subjective assessment sessions. We also present visual fatigue results related to a subjective quality experiment of 360-degree video.

#### **General information**

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MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Nokia Technologies

Contributors: Curcio, I. D., Toukoma, H., Naik, D.

Number of pages: 23

Pages: 1-23

Publication date: 5 Feb 2018

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ISBN (Electronic): 9781614829591

ASJC Scopus subject areas: Organizational Behavior and Human Resource Management, Computer Networks and Communications, Signal Processing, Information Systems and Management, Media Technology

Keywords: 360 degrees video, Omnidirectional video, subjective assessment, subjective quality evaluation, test methodology, virtual reality streaming

DOIs:

10.5594/M001758

#### **Bibliographical note**

EXT="Curcio, Igor D.D."

Source: Scopus

Source ID: 85050404607

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **A Dual Perspective of Value in a Bundle of Product and Service**

Focusing on value creation in marketing has always been the key to success for companies. As a result, the definition, analysis and communication of value has gained importance. Companies are making an attempt to make a value proposition that is not only lucrative for the customer, but also has great returns for the company itself. Although this might sound simple on paper, since it is the basis for business logic, it is much more complicated in real life situations. With the service elements in the offering and the emergence of technologies such as smart and connected phenomenon, the business models become more innovative and more complexity is added to the analysis of value. The objective of this paper is to introduce a method for the dual perspective of value in a bundle of product and service in a smart and connected context. This method draws from the customer value and customer lifetime value concepts to offer an all-inclusive study on value. This assists companies in crafting an appealing value proposition in a cost-saving offering for a client that offers value to the company over its lifetime. This study specifically deals with the state of the arts smart and connected phenomenon and provides a view on how value works in that context. The framework created through this study serves to help the company choose a client that is of most value to the firm over the time of their cooperation. It then leads the company towards a better fabrication of the offering that is not only an attractive proposition to the client but also for the company. It gives a close insight onto where the benefit comes from and how a smart and connected bundle of products, services and relationships must be put together for maximum results in the modern age.

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Organisations: Industrial and Information Management, University of Vaasa (UVA)

Contributors: Safarpour, N., Sillanpää, I.

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Original language: English

ASJC Scopus subject areas: Business and International Management, Management Science and Operations Research, Organizational Behavior and Human Resource Management, Industrial and Manufacturing Engineering, Management of Technology and Innovation

Keywords: customer life-time value, customer value, service, smart and connected, value proposition

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### Bibliographical note

INT=tj,"Safarpour, Niusha"

Source: Scopus

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Research output: Contribution to journal › Article › Scientific › peer-review

### Business Model Innovation of Startups Developing Multisided Digital Platforms

Platforms are defined as multisided marketplaces with business models that enable producers and users to create value together by interacting with each other. In recent years, platforms have benefited from the advances of digitalization. Hence, digital platforms continue to triumph, and continue to be attractive for companies, also for startups. In this paper, we first explore the research of platforms compared to digital platforms. We then proceed to analyze digital platforms as business models, in the context of startups looking for business model innovation. Based on interviews conducted at a technology startup event in Finland, we analyzed how 34 startups viewed their business model innovations. Using the 10 sub-constructs from the business model innovation scale by Clauss in 2016, we found out that the idea of business model innovation resonated with startups, as all of them were able to identify the source of their business model innovation. Furthermore, the results indicated the complexity of business model innovation as 79 percent of the respondents explained it with more than one sub-construct. New technology/equipment, new processes and new customers and markets got the most mentions as sources of business model innovation. Overall, the emphasis at startups is on the value creation innovation, with new proposition innovation getting less, and value capture innovation even less emphasis as the source of business model innovation.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research group: Business Ecosystems, Networks and Innovations, Industrial and Information Management , VTT Technical Research Centre of Finland

Contributors: Still, K., Seppänen, M., Korhonen, H., Valkokari, K., Suominen, A., Kumpulainen, M.

Number of pages: 6

Pages: 70-75

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### Host publication information

Title of host publication: Proceedings - 2017 IEEE 19th Conference on Business Informatics, CBI 2017

Publisher: IEEE

ISBN (Electronic): 9781538630341

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Keywords: Business model, Business model innovation, Digital platforms, Platform, Startups

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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **DevOps in regulated software development: Case medical devices**

DevOps and continuous development are getting popular in the software industry. Adopting these modern approaches in regulatory environments, such as medical device software, is not straightforward because of the demand for regulatory compliance. While DevOps relies on continuous deployment and integration, regulated environments require strict audits and approvals before releases. Therefore, the use of modern development approaches in regulatory environments is rare, as is the research on the topic. However, as software is more and more predominant in medical devices, modern software development approaches become attractive. This paper discusses the fit of DevOps for regulated medical device software development. We examine two related standards, IEC 62304 and IEC 82304-1, for obstacles and benefits of using DevOps for medical device software development. We found these standards to set obstacles for continuous delivery and integration. Respectively, development tools can help fulfilling the requirements of traceability and documentation of these standards.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, University of Central Lancashire, University of Helsinki

Contributors: Laukkarinen, T., Kuusinen, K., Mikkonen, T.

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Pages: 15-18

Publication date: 30 Jun 2017

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ASJC Scopus subject areas: Organizational Behavior and Human Resource Management, Software, Management of Technology and Innovation

Keywords: agile development, DevOps, medical software development standards, Regulated software

DOIs:

10.1109/ICSE-NIER.2017.20

#### **Bibliographical note**

EXT="Kuusinen, Kati"

Source: Scopus

Source ID: 85026751442

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Organizational effects of digitalization: A literature review**

The effect of digitalization on organizations has been studied separately but there has been very little research done on the overall "big" picture of the effects. However, the digitalization of society and business is marching forward at an ever increasing speed, calling for more converged research on the phenomenon. The main areas of effects elicited from the literature are organizational learning, digital innovations, organizational agility, business ecosystems, and organizational structures. More minor influences have been gathered in the framework of digitalization presented in this article. It can be seen as a tool for managers to explore their organizations capabilities on the digitalization front.

#### **General information**

Publication status: Published

MoE publication type: A2 Review article in a scientific journal

Organisations: Research group: Software Engineering and Intelligent Systems, Industrial and Information Management

Contributors: Kuusisto, M.

Number of pages: 22

Pages: 341-362

Publication date: 2017

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#### **Publication information**

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Original language: English

ASJC Scopus subject areas: Applied Psychology, Public Administration, Organizational Behavior and Human Resource Management

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Research output: Contribution to journal › Review Article › Scientific › peer-review

### **A Customer's Possibilities to Increase the Performance of a Service Provider by Adding Value and Deepening the Partnership in Facility Management Service**

Reliable and good suppliers are an important competitive advantage for a customer and that is why the development of suppliers, improvement of performance and enhancement of customership are also in the interest of the customer. The purpose of this study is to clarify a customer's possibilities to increase the performance of a service provider and to develop the service process in FM services and thus help to improve partnership development. This research is a qualitative research. The research complements the existing generic model of supplier development towards partnership development by customer and clarifies the special features that facility management services bring to this model. The data has been gathered from interviews of customers and service providers in the facility management service sector. The result is a model of customers' possibilities to develop the performance of service providers from the viewpoint of value addition and relationship development and in that way ensure added value to the customer and the development of a long-term relationship. The results can be beneficial to customers when they develop the cooperation between the customer and the service provider toward being more strategic and more partnership focused.

#### **General information**

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MoE publication type: A1 Journal article-refereed

Organisations: Department of Civil Engineering, Research group: Capacity Development of Water and Environmental Services CADWES, University of Vaasa

Contributors: Sillanpää, E., Junnonen, J., Sillanpää, I., Saari, A.

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Peer-reviewed: Yes

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Original language: English

ASJC Scopus subject areas: Industrial and Manufacturing Engineering, Management Science and Operations Research, Business and International Management, Management of Technology and Innovation, Organizational Behavior and Human Resource Management

Keywords: facility management, performance increase, relationship development, service development, value addition

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#### **Bibliographical note**

INT=rak,"Sillanpää, Elina"

Source: Scopus

Source ID: 84977538557

Research output: Contribution to journal › Article › Scientific › peer-review

### **Collaboration change in enterprise software development**

Enterprise software development is a complex effort that may last years. Enterprise software is often developed by a systems integrator that makes modifications to a pre-made package or builds tailored software for the specific purpose. The development may include many developer organizations, the user organization, and their different departments and sub-units. Their collaboration evolves through project incidents, phases and even crises. The practices of project management, communication, contracts, and ultimately personal relationships change intentionally or unintentionally. These changes may cause uncertainties and discontinuities for the development. This study observes changes during enterprise software development and their influence on collaboration practices in different situations. During twenty years of development both internal and external crises and changes in the business environment triggered changes in collaboration. The collaboration practices are classified with four modes of collaboration (contract, cooperation, personified, and process) that illustrate emphasis in collaboration in different circumstances.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication  
Organisations: Department of Information Management and Logistics, Research group: Novi, Aalto University  
Contributors: Smolander, K., Rossi, M., Pekkola, S.  
Number of pages: 7  
Pages: 68-74  
Publication date: 14 May 2016

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Publisher: ACM  
ISBN (Print): 9781450341554  
ASJC Scopus subject areas: Organizational Behavior and Human Resource Management, Social Psychology, Software  
Keywords: Collaboration, Collaboration change, Enterprise software, Project management  
DOIs:  
10.1145/2897586.2897590  
Source: Scopus  
Source ID: 84974527974  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Benchmarking supplier development: An empirical case study of validating a framework to improve buyer-supplier relationship

In today's dynamic business environment, firms are required to utilize efficiently and effectively all the useful resources to gain competitive advantage. Supplier development has evolved as an important strategic instrument to improve buyer-supplier relationships. For that reason, this study focuses on providing the strategic significance of supplier development approaches to improve business relationships. By using qualitative research method, an integrated framework of supplier development and buyer-supplier relationship development has been tested and validated in a Finnish case company to provide empirical evidence. It particularly investigates how supplier development approaches can develop buyer-supplier relationships. The study presents a set of propositions that identify significant supplier development approaches critical for the development of buyer-supplier relationships and develop a theoretical framework that specifies how these different supplier development approaches support in order to strengthen the relationships. The results are produced from an in-depth case study by implementing the proposed research framework. The findings reveal that supplier development strategies i.e., supplier incentives and direct involvements strongly effect in developing buyer-supplier relationships. Further research may focus on considering in-depth investigation of trust and communication factors along with propositions developed in the study to find out general applicability in dynamic business environment. Proposed integrated framework along with propositions is a unique combination of useful solutions for tactical and strategic management's decision making and also valid for academic researchers to develop supplier development theories.

#### General information

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Organisations: Department of Civil Engineering, University of Vaasa (UVA), High Level Training Institute  
Contributors: Shahzad, K., Sillanpaa, I., Sillanpää, E., Imeri, S.  
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Keywords: Buyer-supplier relationship, Case study, Strategic competitive advantage, Supplier development, Supplier management, Supply chain management  
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10.1515/mper-2016-0007  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84965052640&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84965052640

Research output: Contribution to journal › Article › Scientific › peer-review

### **Asymmetric luminance based filtering for stereoscopic video compression**

Asymmetric stereo video coding is a well-known enhancement technique for efficient 3D video rate scaling, taking advantage from the binocular suppression theory. Usually in asymmetric video coding one view is encoded in a higher spatial/ temporal resolution or quality, while the auxiliary view is encoded with a lower resolution or quality. In this paper a novel asymmetric video coding approach is proposed to enhance the stereoscopic video compression efficiency. A regionally adaptive smoothing filter is applied to dark pixels of one view while the same filter is only applied to the light pixels of the other view. The location and the strength of the smoothing filters are determined according to the texture characteristics and the degree of the brightness of each individual pixel within the image. A series of systematic subjective tests were conducted, confirming that no quality degradation is perceptible by application of such filters. This is while the objective measurements show a Bjontegaard delta bitrate reduction of up to 26.6% and with an average of 16.8%.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research group: Video, Research Community on Data-to-Decision (D2D), Nokia

Contributors: Homayouni, M., Aflaki, P., Hannuksela, M. M., Gabbouj, M.

Publication date: 5 Feb 2015

#### **Host publication information**

Title of host publication: 2014 International Conference on 3D Imaging (IC3D)

Publisher: IEEE

ISBN (Print): 9781479980239

ASJC Scopus subject areas: Organizational Behavior and Human Resource Management, Computer Vision and Pattern Recognition

Keywords: Asymmetric, low-pass filter, MVC, Stereoscopic video, subjective quality assessment

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10.1109/IC3D.2014.7032577

Source: Scopus

Source ID: 84930446866

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Designing a performance measurement system to support outsourcing decisions in a Finnish university**

In recent years, the role and importance of performance measurement in public organisations has been much emphasised. However, the discussion on the issue so far has been on a rather general level. This paper aims to understand the challenges faced by public organisations in developing performance measurement systems (PMSs) for a specific managerial purpose, to support outsourcing decisions. The objective of the paper is approached with a literature review and a single qualitative case study carried out as an action research. The case study introduces a detailed description of a PMS development project carried out in the support services of a Finnish university. A framework developed in prior research is utilised to analyse the impacts of two typical characteristics (conflicting stakeholder needs and undefined objectives) of public organisations in a PMS design project. The contribution of the paper is to extend the existing understanding about public sector PMS especially regarding two key points: 1) to understand the impact of different purposes for measurement (in this case the outsourcing context) on the PMS development process; 2) to understand the need to align the PMS system with the organisational culture and other managerial control systems in order to achieve desired performance outcomes.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Industrial Management, Research group: Center for Research on Operations Projects and Services, Department of Information Management and Logistics, Managing digital industrial transformation (mDIT), Lappeenranta University of Technology

Contributors: Jääskeläinen, A., Lönnqvist, A., Kulmala, H. I.

Number of pages: 16

Pages: 237-252

Publication date: 3 Jan 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: International Journal of Public Sector Performance Management

Volume: 2



Issue number: 3  
ISSN (Print): 1741-1041  
Ratings:

Scopus rating (2015): CiteScore 0.3 SJR 0.125 SNIP 1.03

Original language: English

ASJC Scopus subject areas: Strategy and Management, Organizational Behavior and Human Resource Management, Public Administration

Keywords: Decision-making, Finland, Outsourcing, Performance management, Performance measurement system, PMS, Productivity, Public sector, Support services, University

DOIs:

10.1504/IJPSPM.2015.067814

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#### **Bibliographical note**

ORG=tta,0.6

ORG=tlo,0.4

EXT="Kulmala, Harri I."

Source: Scopus

Source ID: 84924369881

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Perceived Impacts as User Experience Components in Mobile News Making with Smartphones**

This chapter discusses users' perceptions of system impacts as one of the user experience components. Findings from twelve case studies on mobile news making with smartphones are summarized, focusing on the perceived impacts of system use and system characteristics that can contribute to user's perception of system quality. The findings indicate that the perceived impacts of system, i.e., the benefits and costs, for the mobile user, activity, outcome (news and news content), and journalism are important for understanding user experience and therefore the overall evaluative judgments of the system.

#### **General information**

Publication status: Published

MoE publication type: A3 Part of a book or another research book

Organisations: Department of Pervasive Computing, Research area: User experience, Augmented Human Activities (AHA)

Contributors: Väättäjä, H.

Number of pages: 21

Pages: 218-238

Publication date: 2015

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Editor: Lumsden, J.

ISBN (Print): 9781466685833

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ASJC Scopus subject areas: Human-Computer Interaction, Information Systems, Organizational Behavior and Human Resource Management

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10.4018/978-1-4666-8583-3

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#### **Applications of fast-moving RFID tags in high-speed railway systems**

RFID technology has been widely utilized for the tracking and identification of numerous stationary and moving objects. One of the most challenging RFID applications has to do with the improvement in reliability, scheduling and efficiency of large-scale transportation infrastructure. As an example, Radio Frequency Identification (RFID) technology in Ultra High Frequency (UHF) frequencies (840-845MHz and 920-925MHz) is one of several technologies currently being utilized in China to monitor and regulate the railway system. Despite the very successful performance of ATIS RFID-based system for conventional trains with speeds up to 150kph, numerous challenges have to be resolved for the extension of this technology to modern high-speed and ultra high-speed railway systems with speeds up to 500kph. This paper identifies these issues, such as collision and insufficient reading time, and proposes various ways to alleviate their effect in UHF-RFID enabled railway systems.

### General information

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MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology

Contributors: Zhang, X., Tentzeris, M.

Number of pages: 5

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Publication date: 2011

Peer-reviewed: Yes

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Volume: 3

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ISSN (Print): 1847-9790

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Original language: English

ASJC Scopus subject areas: Management Science and Operations Research, Organizational Behavior and Human Resource Management

Keywords: Fast moving, RFID, Tracking systems, Train

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<http://www.scopus.com/inward/record.url?scp=84859823386&partnerID=8YFLogxK> (Link to publication in Scopus)

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Research output: Contribution to journal › Article › Scientific › peer-review

### The indoor condition guarantee procedure and associated lease contract model

Purpose - Numerous studies have shown that indoor environment affects health and performance, which in turn affect productivity. Property owners have not utilized Indoor Environment Quality (IEQ) as a value-added factor to market the office spaces. On the other hand, tenants have not had a tool to demand certain indoor conditions. The paper aims to present one market mechanism for including IEQ in office space supply: the office lease contract model entitled Indoor Environment Quality. Design/methodology/approach - The research included a constructive search for a lease contract model for the problems presented above. The need for this novel lease model is proved by the financial calculations. Findings - The lease contract procedure whereby a lessor issues a condition guarantee to a tenant consists of: technical building audit process; and entering the terms of the indoor condition guarantee in the lease contract. It makes sense for the owner to invest in a favourable indoor environment if the benefits are shared. An owner's monetary benefit from improved IEQ is also greatly related to longer lease periods. When tenants stay longer in the same facility there is less empty office space and less need for alterations by new tenants. Therefore, rental income is higher and alteration costs are lower, which in turn lead to higher profitability of the property owner's business. Originality/value - The lease model proposed forms guidelines for taking account of the indoor air quality in lease contracts.

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### **Flexibuild - a systematic flexibility management procedure for building projects**

**Purpose** - Nowadays it is typical that the precise use of a building becomes clear during construction. Current building processes do not support this in Finland. The objective of this study is to present a novel systematic management of the design process for flexible construction projects, from the project programming stage through to overall design, detailed designs, procurement, and handover, in a situation where the final use of the building becomes clear only during construction. **Design/methodology/approach** - The development work included a constructive search for solutions to the problems presented above. The process developed in this study is illustrated with two case projects analysed retrospectively. **Findings** - According to the open building principle, buildings should be divided into two parts: a permanent base building; and modifiable interior spaces. This division should apply throughout the building's entire life cycle, starting from the beginning of the construction project. The start of the project is the time when goals should be set for the flexibility of the building. The first step in this goal-setting procedure is to define the flexible modifiable spaces, and the second step is to dimension the permanent base building. A design procedure for this open building procedure has also been developed in the study. The study concludes that traditional boundaries and the content of design packages must be changed. These boundaries should be compatible with the appropriate bid packages and should support implementation of the construction work. The bid packages should follow the division to base building and spaces too. **Originality/value** - The procedure proposed forms guidelines for flexible programming, basic principles for design and procurement processes. In addition, it is the starting point to transforming the Finnish standard scope of work for design corresponding to the open building approach.

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