



**RESEARCH PAPERS FOR  
EUROFM'S 15<sup>TH</sup> RESEARCH SYMPOSIUM  
AT EFMC2016**

**8-9 JUNE 2016 IN MILAN, ITALY**

SUSANNE BALSLEY NIELSEN AND PER ANKER JENSEN (EDITORS)



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## PREFACE

The general conference theme for EFMC 2016 is “*FM - enhancing people and business*” and this is also the theme of the 15<sup>th</sup> EuroFM Research Symposium Research, which is organized as part of the conference. The objective of the research symposium is to present original research that contributes to the understanding of the role of FM in organisations and to encourage discussions and the development of new knowledge amongst researchers and FM professionals and educationalists on this important topic.

This year the research symposium is integrated with the business conference. The last 14 years there have been separate parallel tracks for research presentations and business presentations. Recently there have been various attempts to support a stronger cross-fertilisation between research and practice for instance with joint workshops and panel debates during the conference. However, this year the research and business tracks are fully integrated, so that most sessions include a combination of research and business presentations. The main difference between the presentations is that the research presentations are based on research papers, which have been through the same rigorous review process that was used for earlier EuroFM research symposia, and the papers are published in this scientific publication.

This publication includes all the research papers accepted for the research symposium independent on whether they are presented at a conference session or as posters. All together 40 abstracts was received and after the review process 22 papers has been accepted and are included in this publication. One half of the papers will be presented orally and the other half as posters.

A further new development is that EuroFM has agreed an open access mandate. This ensure that the full text of all published research papers and conference proceedings arising from EuroFM sponsored work should be deposited in an open access institutional repository, or if that isn't available, on the ResearchGate database after the conference.

We thank all authors and the scientific committee for great work. We wish the reader an enjoyable lecture and a lot of inspirations for further research and the application into education and practice.

May the 15<sup>th</sup> Research Symposium at EFMC 2016 in Milan become a successful event that will help FM in enhancing people and business!

Susanne Balslev Nielsen  
Chair of the Scientific Committee and  
EuroFM's Research Network Group

Per Anker Jensen  
Member of the Scientific Committee and  
Head of CFM

**A warm thank you to the scientific committee**

- Assoc. Prof. Susanne Balslev Nielsen, Technical University of Denmark (chair)
- Assoc. Prof. Knut Boge, Oslo and Akershus University College of Applied Sciences
- Assoc. Prof. Brenda H. Groen, Saxion University of Applied Sciences
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# **1 DISRUPTION AND CHANGE MANAGEMENT**

## **1.1 SUSTAINING CHANGE IN FACILITIES MANAGEMENT**

PAUL WYTON

## **1.2 REDUCING STUDENTS' LITTERING BEHAVIOUR BY APPLICATION OF PERSUASIVE TECHNIQUES**

RIANDA MULDER

## 1.1 Sustaining change in Facilities Management

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### ABSTRACT

**Purpose:** Facilities Managers (FMs) are managers of change and managers within change, this paper draws upon a study utilizing practice theory to provide an understanding of the barriers to the sustainability of intentional change. Change is constrained by the perceptions of that change held by those involved. Viewing a change 'as if' it is a system can provide a gestalt appreciation of that change and enable the barriers to that change to emerge, be understood and addressed.

**Method:** A participative action research enabled the embeddedness required of a method of change as practice and the appreciation of the practice, praxis and practitioners within 2 cases of intentional change within FM. In each case a longitudinal study of the introduction of systems thinking inspired methods to facilities management was completed. Data was gathered through observation, outputs of developmental workshops and reflective discussions and interviews, and analyzed through the general inductive approach.

**Findings:** Sustainability of a change is compromised by an inadequate practical reason that fails to accommodate the inherent complexity in change. Intentional change in facilities management is complex and challenging, and made harder by a combination of the failure to appreciate the nature of the change, decision makers committing the environmental fallacy, intervention design that fails to accommodate purposeful planning processes and consciously address the sweep in required for a gestalt understanding.

**Originality/value:** Viewing an intentional change 'as if' it is a system enables an appreciation of the barrier inducing separations that exist within a change intervention, understanding of a change, its context and those involved to support practicing FMs in the management of a change.

### Keywords

Facilities Management, Change management, Systems thinking, Sustaining change

## 1 INTRODUCTION

Facilities Management (FM) as a function is engaged in delivering change, is expected to respond to and support change throughout an organisation and is impacted by a rapidly changing wider environment. Facilities managers (FMs) have to manage change and manage within change. Success in this context can be argued as coping effectively with the ubiquity of change in the general but also delivering specific change in the particular (Jansson 2013). Sustainability of change is defined as '*new working methods and performance levels persist for a period appropriate to the setting*' (Buchanan *et al* 2005) and the sustainability of change is difficult (Fillingham 2007, Burnes 2011), Beer and Nohria (2000) state that '*the brutal fact is that about 70% of all change initiatives fail*'. Whether the



statistics of failure are correct or not, the challenge of achieving something new as intended, of sustaining an intentional change is great. By (2005:369) to defines change management as the '*process of continually renewing an organizations direction, structure, and capabilities*' and is seen as integral to the strategy process (Burnes 2004). McDeavitt *et al* (2012:142) take a more pragmatic view '*it is an effort to get individuals and groups ready, willing, and able to implement and sustain new ways of working*', these definitions recognize that change management involves the expression of power to achieve the sustainability of something new. The purpose of this paper is to explore sustaining change and how systems thinking methods might aid the FM in recognizing, understanding and addressing emergent barriers to intentional change. The paper draws upon two longitudinal studies of the introduction of systems thinking methodologies to an FM department within a large organization.

The characteristics of systems thinking, such as a striving for holism (Checkland 1981,) allowing for emergence (Flood 2010), a focus upon purpose and the participatory idea (Ulrich 2012) would appear to benefit a cross organizational function such as FM providing what Davies (2011) would describe as a gestalt view. Systems thinking as an approach appears to be gathering momentum within FM as such approaches as lean management are applied in an FM context, as the publication of papers by Jylha and Junnila (2013) and Price *et al* (2007) illustrates. Yet Dawidowicz (2012:3) states that '*there remains little research about the understanding of, learning of and use of systems thinking*, and Taylor *et al* (2013:6628) recognize the challenge of introducing lean stating that '*it seems difficult to sustain*'. Systems thinking has tended to be focussed within academic and consultancy / practitioner circles that are separated from practice (Harbig and Stevens 2012). This is aptly illustrated by the language used, often cited as a barrier to understanding and acceptance, a danger of maintaining a separation of theory and practice what Reynolds (2011) sees as the trap of dogmatism of practitioners.

Tools associated with systems thinking such as value mapping, visualization, and customer voice provide the means to better understand the operating context within FM, yet the conditions of a systems approach to management such as the participatory idea, the challenge to established hierarchies, and value defined by customer, do appear to be challenging to the established order generating rules and resources operating within the FM context.

The findings presented within this paper indicate that sustainability of an intentional change is compromised by the initial and ongoing decision making, and this is explained by insufficient practical inquiry in context. This weakness in inquiry inevitably fails to identify, understand and address barriers to the sustainability of change. Theoretically, this weakness can be aligned to the inadequacies of practical reasoning of those brining about the change. Inadequate practical reason compromises understanding of '*what one is to do*' (Wallace 2014) and '*how to put a problem well*' Ulrich (2012: 1308) through a limitation in the appreciation of the freedom to act. The methods of planning and implementing a change fail to address significant emergent barriers and so the conditions of failure are unwittingly embedded within the design of a change process.

Taking the systems thinking perspective of viewing a change '*as if*' it is a system (Stacey 2011) would enable a process of inquiry that strives for the unachievable holistic understanding (Ulrich 2012), accommodates emergence and purposeful planning process (Reynolds 2004), and avoids the environmental fallacy (Churchman 1967), providing a means to an enhanced practical reason.

## 2 METHOD

Combining the principles of pragmatism, in particular praxis, with social construction leads to a methodology that should allow emergence, for both the researcher and within the research context. This leads to practice theory, which '*allows researchers to engage in direct dialogue with practitioners*' (Golsokhi et al 2010:1). That Balogun *et al* (2003) argue requires a range of theoretical and methodological tools to get close to the practice whilst being aware of the wider world within which the practice is occurring through the study of practices, praxis and practitioners (Vaara and Whittington 2012). Organizational research has tended to address either issues of individualism and '*understanding how practice is done*' or the social and '*how social systems define practices*' (Whittington 2006:614), creating a dualism of individualism against societism, or '*agency versus structure*' (Caldwell 2012:159). A practice driven methodology can be seen to bridge the gap and address both the individual and the social (Simpson 2009). Whittington (2010:109) stated that '*understanding peoples activity is the central purpose of social analysis*' and argued the concept of strategy as practice as a full spectrum research that through the analysis of institution and praxis enables understanding of social practice that bridges between methodological individualism and social structure. The study aimed to explore the process of change, with a focus upon the how and the why of emergence, growth and termination over time (Langley, Smallman, Tsoukas and Van de Ven (2013).

Whittington (2010:123) links particularly to and draws from the philosophical perspective of Giddens and structuration theory, recognizing structuration as a view that enables the particular approach of studying '*episodes of strategic conduct*' from the inside to bring '*conduct and institution together*'. Central to practice theory as a methodology is the practice turn, enabling a research approach that addresses the micro of individual action and also the macro of intra and extra organizational constraints and enablers (Whittington 2010) whilst avoiding methodological individualism (Tsoukas 2010). Simpson (2009) explains practice turn as a need to take a practice view that enables appreciation of temporality and social agency where social agency is the capacity to influence the meaning of social action and enable the transcending of boundaries between individual and social. Golden Biddle *et al* (2010:81) discuss the practice turn and its use within strategy as practice, justifying as a micro analysis of action with a focus on the doing rather than the types of change. Strategy as practice '*refocuses research on the actions and interactions of the strategy practitioners and situated practices they draw upon*'. Janssen (2013) reinterpreted this approach into the specific strategic context of change to propose a methodology of change as practice. What emerged was a research methodology that addresses praxis, as the '*actual activity*', practice as the '*shared routines of behaviour*' and practitioners as '*those impacted*' (Whittington 2006:619). To accommodate such a methodological viewpoint required a participative, democratic, reflexive method to generate data and enable analysis, conceptualization and theorization. Action research was adopted to gain the required embeddedness in order to appreciate the developing practice, praxis and practitioners over time with the introduction of the intended changes.

The study concerned embedded involvement within two related but independent interventions to introduce lean management techniques to the facilities management function of a large multinational organisation.

Case 1 was an internally designed and delivered intervention involving a variety of activities to support a decision taken by the European head of facilities to bring the FM function into line with operations, manufacturing and R&D functions in being lean. Activities included a two day introductory workshop for those who voluntarily engaged. Ongoing support was provided through a series of activities that were designed around the principles of Kolb's learning cycle (1984) and involved abstract conceptualization, active experimentation, concrete experience and reflective observation. Central to these activities were a series of action learning sets established to provide a safe environment to explore ideas, address learning needs, discuss practical experimentation and emergent barriers and reflect upon progress. Other supporting activities included coaching and sharing activities such as a knowledge market. The intervention continued for approximately 9 months and whilst achieving some significant localized successes was not seen to achieve sustained use of lean across the FM function.

Case 2 built upon the work of case 1, a small international consultancy specializing in lean were employed to design and deliver a development programme to integrate lean into the FM function. In this case the resources provided were far greater in financial terms but also seen in the commitment of time by those involved and the ongoing participation by the European head and his executive team. A series of 8, 2 day workshops were delivered over approximately 5 months, and involved participation in activities designed to promote understanding of methods and tools, that supported the underlying principles and provided opportunities for personal reflection on active experimentation expected of the participants between workshops. The intervention was designed on the principle of a cascade with lean coaches identified in case 1 supported in becoming subject experts and developing presentation skills to be able to deliver to further waves of participants as the intervention proceeded down the hierarchy of the organisation. The intervention consisted of two fully supported waves each of approximately 50 managers, the programme was then to continue with adapted local delivery to waves three and four on the discretion of the local senior managers. The intervention came to a premature end after approximately 8 months owing to the impending outsourcing of the FM function. Again significant localized successes were reported, substantial savings identified and changes in behavior and process, but lean was not sustained across the FM function.

Through the action learning sets within case 1 and the workshop programme within case 2 action research cycles were established and were assessed for content, process and impact (McKay and Marshal 2001).

Through involvement in these cases data was collected through participant observation, outputs of the various activities and 19 informal interviews with those involved within the intervention, these supported through reflective discussions with the change leaders. Significant data was collected, transcribed, coded and analysed through the general inductive approach (Thomas 2006).

### 3 DISCUSSION OF RESULTS

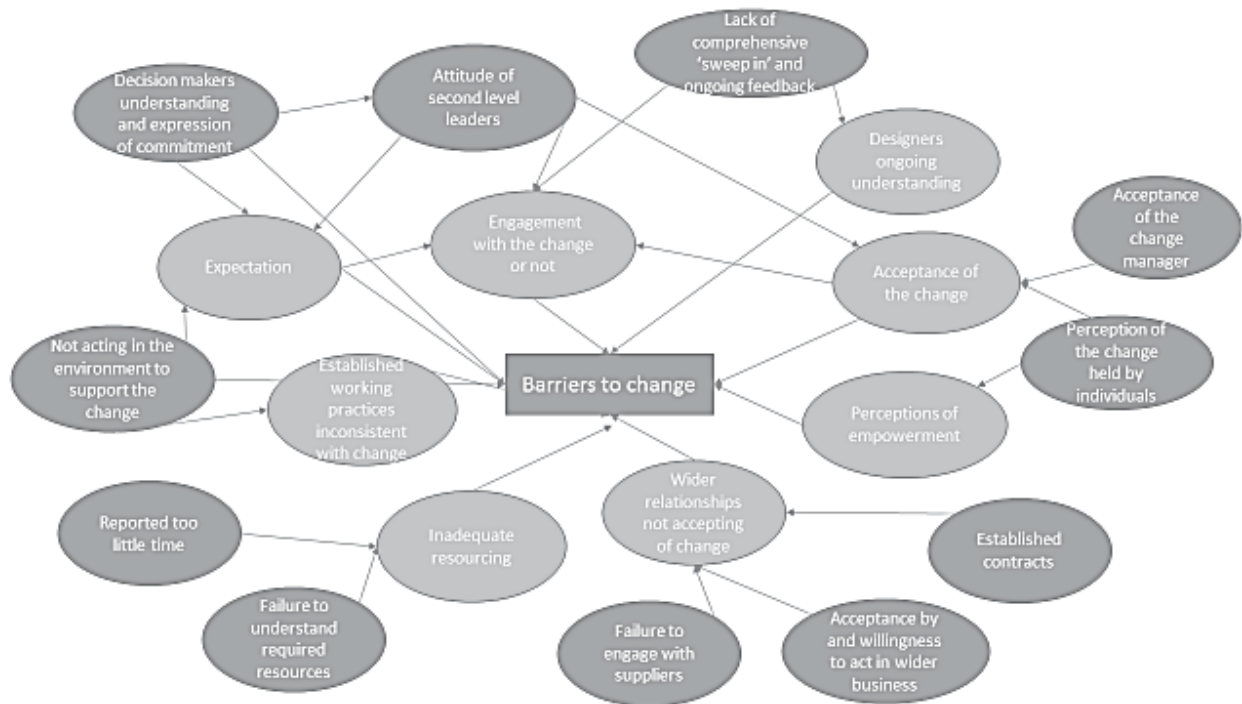
In each of the cases the workshops, development activities, support from the change manager received strong feedback from those involved. It appeared that the intervention was successful in developing the understanding of and reported competency in lean. Despite this

lean was not fully executed, did not become part of the order generating rules and resources of the FM function (Tsoukas 2010). At the end of the intervention lean was not seen as a natural way of working, a manager summed up the situation *'it is a bit like Monday oh lean today it is a deliberate process as opposed to this is how we work and I don't know how large a step that actually is'*. A member of SLT recognized the time and emergent nature of behavioural change when asked if the programme had achieved the desired change *'no not at the moment'*. The final statement is important, for each of the interventions those instigating the change did not fully define what the intended meant in practice, there was a lack clarity over what success looked and felt like, this resulted in managers adopting their own, often quite different interpretations. Ulrich (2012) stresses the importance of a process to put the problem well, the lack of clear definition suggests the senior managers were not clear in their own minds what the problem context was and therefore did not *'put the problem well'*.

The impact observed was of a change process design compromised by its definition and consequential resource allocation, the conditions of failure enfolded within the process. In particular the change activities focused upon the development of capability in tools, but that focus was at the expense of understanding the wider environment, the process designers committed what Churchman (1967) would describe as the environmental fallacy. This had the impact of both creating and hiding barriers to the change that emerged, these were not fully recognized, understood or addressed, compromising the likelihood of sustained change. The change process became separated and isolated from the wider organisation and those involved failed to fully appreciate the constantly evolving conditions within which the change might apply. Reynolds (2010) recognized the difference between purposeful and purposive process, the former accepting purpose can change and develop, but fixed in the latter, purposeful accommodating both design and emergence. The design of the change interventions whilst not fixed were not fully purposeful, they could not adapt to the needs of the developing nature of the purpose in context of the changing environment.

Viewing the change *'as if'* it is a system (Stacey 2011) provides a viewpoint that enables a gestalt, along with the acceptance and recognition of the significance of emergence. Techniques that force such a view provide a boundary critique (Ulrich 2012) and drives towards the unachievable but desired holistic appreciation of the change and its context and avoid the environmental fallacy. Through taking this viewpoint analysis of the intentional change of the introduction of lean as a systemic approach (Jackson, Johnston, and Seddon, 2008, Seddon and Caulkin, 2007) numerous barriers emerged that compromised the sustainability of that change, many of these barriers were not addressed within the change intervention design.

Figure 1 A systemic illustration of observed barriers to the introduction of lean into FM



The illustration Figure 1 is intended to demonstrate the complexity involved within a change intervention through identification of emergent barriers to the change. What emerged was a ‘mess’ of interacting conditions that impacted upon and affected the change, the environment and those involved. The consequence was of a change process that was not designed or resourced to fully engage with the wider environment to which the change was intended. This resulted in a lack of understanding of the environment, acceptance of the change and the attitudes of those involved. These conditions compromise the ability to take informed decisions in support of the intervention, there was an inadequate practical reason (Churchman 1967, Wallace 2014).

Within the FM context a number of specific barriers emerged that compromised sustainability of the change including acceptance of the change, engagement with the process, perceptions of empowerment to act, perceptions of inadequate resourcing, established working practices that contradicted the intended new that were not challenged and the impact of contract as a limiter of change. To illustrate the impact of emergent barriers a couple of examples of contexts that compromised sustainability:

The role of the senior leaders in establishing expectation was evident and in their actions can create or compromise acceptance and engagement. In particular the power of the second level leaders through their actions to influence those within their sections was evident in either promoting support or compromising that support. Within an FM wide change inconsistent engagement was seen to compromise the likelihood of the change sustaining. Senior leaders acting as sponsors to an intentional change make decisions based upon their own understanding of the problem and the change. A variety of resources are allocated on the basis of that understanding resulting in inadequate resources in terms of time, finance and challenge, this resulted in interventions that were believed to be well resourced but were actually under resourced for the scope and change required.

The change involved a number of well received learning activities, those who engaged reported their understanding was developed, however they also felt a lack of empowerment to express this learning. They did not feel fully supported and felt that those who were not directly involved who would need to go through the change would not accept the change as their expectations had not been addressed. This view was contrasted by the belief within the senior management that those involved within the intervention were empowered to act, a difference between the espoused values and the values in use (Argyris and Schon 1978) within the order generating rules and resources operating within the organisation (Whittington 2006).

The change was expressed as a long term intervention to promote a way of thinking and acting, however there were a number of existing structures and ways of being within the organization that directly contrasted the principles proposed. As an example the organization utilized a short term, cost focused and highly individual reward structure that promoted behaviours directly opposite to those proposed, yet this was not addressed within the intervention design and delivery.

Churchman (1967) originally coined the term sweep in to describe the attempt to address all relevant values and Reynolds (2004) the process of unfolding the necessary boundary judgements. Drawing upon Ulrich's (2102) concept of participatory idea supports the need for a whole system participation for acceptance, engagement, and to achieve a suitable practical reason for decision making. A significant missing from the introduction of lean was engagement with contractors who were responsible for delivery of a significant range of services, they were not 'swept in', and with their absence many ideas for improvement would cut across contractual barriers and were prevented from progressing. Similar socially constructed boundaries within the wider organizational structure prevented progress where responsibilities were seen to cross into area outside of the control of FM, again there was no mechanism to adapt and sweep in those from outside the FM function.

Analysis identified many issues, and in so doing demonstrated that there is no single thing, no silver bullet to ensure successful introduction of systems thinking into Facilities Management. Churchman (1997:9) notes the '*systems approach is designed to avoid the environmental fallacy*'; interventions with the objective of improving problem solving through a way of thinking that emphasize addressing the environmental fallacy, are themselves not sustained as a result of just such an environmental fallacy.

#### 4 CONCLUSION

The introduction of systems thinking is challenging, takes a great deal of resource and time, and requires a widespread disconfirmation, movement and new behaviours and structure sustained (Schein 2010). The intentional introduction of systems thinking to FM within the cases required far more understanding and resources to achieve that understanding than was allocated. The role of the decision maker in its widest sense (Churchman 1979) and the intervention decision process appears crucial to the structural and behavioural change required. The process, in failing to enable boundary critique failed to achieve a holistic understanding of the problem context, and led to decisions based upon those flawed understandings, the problem was not put well (Ulrich 2012). This led directly to misunderstanding of resource requirements for the intervention activity, miss-appreciation of

the structural and behavioural changes required, and a lack of understanding of what success meant. Such misunderstanding is represented in the ongoing behaviour of the decision makers in the way that the interventions were supported, and the actions that were taken or not taken that supported or contradicted the desired ends.

The changes suffered from an inadequate practical reason, in order to achieve a more holistic understanding of a change context it is proposed that the intervention design should accommodate the view of the change 'as if' it is a system, incorporate techniques that support a boundary critique and the participative idea and are purposeful in nature.

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## 1.2 Reducing Students' Littering Behaviour by Application of Persuasive Techniques

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### ABSTRACT

**Purpose:** This research aims to investigate the effectiveness of persuasive techniques to reduce littering behaviour of students at Dutch Universities of Applied Sciences (UAS). It hovers on the interface of several domains, involving Facility Management (FM), cleaning services, behavioural sciences and persuasive design. The research aims to develop a holistic, integral approach to reduce litter, based on knowledge of habitual behaviour of students. This contributes to both the educational environment, the effectivity of FM and cleaning services and a sustainable environment.

**Theory:** Least Effort Principle (Kingsley, 1949); Cognitive Dissonance Theory (Festinger, 1962); Theory of Normative Conduct (Cialdini et al., 1990); Theory of Planned Behaviour (Ajzen, 1991); Fogg Behavioural Model (Fogg, 2009); Conceptual Framework of the Human-Technology Interaction Group (Broeders et al., 2010); Limitless Generation (Spangenberg and Lampert, 2013).

**Design/methodology/approach:** Theoretical research was carried out on the field of FM and behavioural sciences. Empirical research was done by means of interviews, experiments and observations at the Utrecht UAS in Amersfoort ('HUA') in the Netherlands.

**Findings:** Awareness and positive intentions do not automatically lead to non-littering behaviour, because littering is habitual and hard to refrain of. Therefore, the best approach is to a) disturb the wrong behaviour by unconscious norm-activating interventions and b) by making the desirable behaviour easy by simplifying the target behaviour. Measures should be adjusted to the target group in the context of the built environment.

**Originality/value:** Scientific research on indoor littering behaviour in educational environments is scarce. Behavioural change by persuasive interventions is an innovative topic, which beholds interesting possibilities for the FM field.

### Keywords

FM, Cleaning services, Littering, Behavioural sciences, Persuasive design.

### Abbreviations

FM Facility Management

CC Cleaning Company

UAS University of Applied Sciences

HUA UAS Hogeschool Utrecht in Amersfoort

## 1 INTRODUCTION

Litter is a social and environmental problem with undesirable consequences. In the Netherlands, annual litter removal amounts to an average of €250 million per year (Hoppe et al, 2013).

Littering has been researched especially in public spaces (Cialdini et al., 1990; Newhouse, 2009; Goldstein et al., 2010; Payne, 2012). Though there are many examples of anti-litter campaigns, these are primarily focussed on either public areas or secondary schools (The Inspiration Room, 2008; The Fun Theory Campaign, 2009; OVAM, 2013; GemeenteSchoon, 2015; NederlandSchoon, 2015; ROVA, 2015).

Littering by youngsters between 12 and 18 years has been topic of research. Van de Water en Lent (2008) have shown that littering is influenced by context: feeling involved as well as the risk to get caught, determine the amount of littering. Unfortunately, schools score rather low on both variables, resulting in a substantial amount of littering by pupils. As students enter a UAS at the age of 17, it is quite likely that their behaviour is comparable to that of secondary school pupils.

There is demonstrably a lack of research on littering in universities (SenterNovem, 2009). Even though Dutch UAS educate approximately 700.000 students, there is hardly any research on (prevention of) littering behaviour of students. This papers aims to fulfil this need.

Littering requires cleaning, and therefore prevention is relevant for both facility managers (FMs) and cleaning companies (CCs). Field research for this paper through interviews amongst eight FMs and CCs has shown that litter inside buildings of professional organisations is considered a hot topic. Cleaning costs are a substantial part of the facility budget and littering increases the costs considerably. Furthermore, the interviews showed that measures are primarily taken on an operational level and are mainly based on previous experiences and common sense. However, the solution may lie beyond an approach of preventing and solving symptoms only. When an organization seriously aims to reduce litter in buildings and on premises, the behaviour of the user should be the starting point.

Someone who litters throws rubbish onto the floor and leaves it indefinitely or for others to dispose (Reference Encyclopedia, 2014). Approximately 95% of behaviour is habitual and so is littering behaviour in most cases (Ouellette and Wood, 1998; Ruitenburg, 2015). In the past, researchers tended to explain habitual behaviour by focusing on a person's intentions, considering this to be a predictable indicator for behaviour. Creating awareness was thought to be an effective way to change intentions and thereby the behaviour (Ajzen, 1991; Sheeran, 2002; Fishbein and Ajzen, 2011). This approach is currently visible in many anti-litter projects (Kenrick et al., 2005; McKenzie-Mohr, 2013). However, research showed that awareness projects are less effective because the habitual behaviour is insufficiently taken into account. Despite awareness and positive intentions, people find it hard to change habitual behaviour (Aarts et al., 1998; Constanzo et al., 1986). Therefore, interventions aimed at changing littering behaviour should be based on knowledge about automatic behaviour instead of changing the intentions and creating awareness (Bargh, 1994; Aarts and Dijksterhuis, 2000a-b; Holland et al., 2005). This insight is an important input for this research paper.

Another input comes from insights in social sciences. Several behavioural change models promote environmental sustainability, such as the Enabling Change Model of Robinson (2009), the Community Based Social Marketing of McKenzie-Mohr (2013) and the Mindspace Model from the United Kingdom Institute for Government (2014). Still, despite the presence of these conceptual frameworks, designers of behaviour change interventions often view cognitive psychology research as ‘impenetrable’ and hard to understand and to apply (Fogg, 2009; Hermsen et al., 2014). As a result, many attempts to design persuasive interventions aimed on behavioural change fail or even result in the opposite effect, because designers have neglected and/or misinterpreted the factors that drive human behaviour. Ineffective techniques continue to be used, while effective techniques are underused, difficult to replicate and their mechanisms of action remain poorly understood (McKee et al., 2011; Michie and Johnston, 2012). Hence, a divide exists between the fields of design research and service design on one hand, and psychology on the other. Several behavioural scientists strive to bridge this gap. They state that evidence-based research, aimed at the specific features of the target group within their unique context, is a suitable way to find out whether interventions are effective or not (Fogg, 2009; Hermsen et al., 2014; Hoekstra et al. 2015).

The effectiveness of experimental interventions is inconclusive and there is no full understanding yet of what accounts for this variability. Evidence about effectiveness, sources of variation and mechanisms of action are accumulating slowly (Michie and Johnston, 2012). Therefore, the second important directive for this research is awareness of the importance of an integral approach, with several disciplines collaborating together, aiming their interventions at a specific target group in its unique context.

This paper focuses on littering behaviour of students at a UAS. It aims to aid UAS’ in decreasing littering, by using appropriate persuasive techniques that influence habitual behaviour, based on insights in socio-psychological drivers.

## 2 METHODS

Qualitative research methods used were literature review, group-wise and individual interviews. Quantitative research methods were applied in a case study in the HUA building by means of experiments and observations.

Literature review was carried out in the field of FM and behavioural sciences. Nineteen semi-structured in-depth interviews were carried out with social psychologists, facility- and contract managers, managers of CCs and customers of the FM department. Respondents were chosen by purposive sampling, based on their profession or position, interest and involvement with the subject. Furthermore, seven focus-group interviews took place with 39 students to determine their beliefs and ideas concerning their own littering behaviour. Group-wise interviews increase conversation, thus yielding more information (Lindlof and Taylor, 2010). Alternate, probing questions were formulated in an impersonal manner in order to avoid egocentric bias (Mullen, 1983). To avoid mutual influencing, the students wrote down their individual answers first, then being inventoried and discussed together. The sample represented students with an average age of 20 years. 54% of the respondents were female and 46% male.

The results of literature research and interviews were used to substantiate the selection of several experiments, carried out at HUA to determine the effect of persuasive techniques on

the littering behaviour of students. Eight sections of the building were indicated as highly litter-intensive areas. Baseline measurements were carried out during three months. Then several consecutive experiments were executed in seven sections over a period of five months. One section was appointed as 'blank control section'. The effectiveness of the interventions was measured by counting pieces of waste disposed on floors and furniture, twice a week between 4:30-6:00 p.m. and through participative observations in an open setting. Data were analysed with SPSS version 21.

### 3 RESULTS

#### **The Relevancy of Reducing Litter**

Results from literature review and interviews show that reducing littering behaviour in university buildings and premises is relevant for several reasons. Less litter leads to cost reduction in multiple ways. Estimations of two CC's claim that clearing up litter takes approximately 8-10% of the total cleaning time. Reduction of litter will thus decrease exploitation costs. Furthermore, good cleaning maintenance elongates the functional lifetime of building and inventory, thereby decreasing the total life cycle costs. Less litter prevents vermin and thus investments for counter measures as well (De Zwart, 2004).

A clean and tidy building adds value in multiple ways: it improves the working climate and compliance to governmental regulations regarding working circumstances, hence contributing to customer satisfaction (De Zwart, 2004). Cleanliness is likely to have a significant influence on study success as well (Kok, 2015). Furthermore, a clean building supports the image of the organization (Bitner, 1992). The presence of litter in the physical surroundings negatively influences the beliefs of people towards the overall quality of the university, which is crucial for the recruitment of new students. The presence of litter harms the image of the FM department and CC as well. Although most interviewed students are aware that they are responsible for clearing up their own waste, litter annoys them and they expect the cleaners to clear it up.

Last of all, reducing littering behaviour will support strategic aims concerning sustainability, recycling and reusing waste. Reducing indoor litter is relevant because litter disables optimal recycling and reuse. Indirectly it can save costs as well, because organizations can re-earn money through recycling (Shah, 2007; Cotts et al., 2010).

#### **The Effectiveness of Current Anti-litter Approaches**

FMs and CCs have undertaken numerous attempts to fight litter, such as sufficient suitable receptacles on strategic positions, and result-driven cleaning whereby cleaners apply a flexible cleaning program so polluted areas are cleaned more often. This requires knowledge of the behaviour, of litter-patterns in the building, a pro-active attitude and partnership between facility and cleaning staff. Surveillance and enforcement of house rules are needed, as well as communicative measures by email and on banners. Furthermore, the research showed the positive effects of an underlying principle, 'keeping the environment clean' by means of day-cleaning (Cialdini et al., 1990).

Nevertheless these measures do not seem to be (entirely) effective. They do not get to the root of the problems: the behaviour.

### **Why do Students Litter?**

In the group-wise interviews students were questioned about their reasons for littering, whether they are bothered by litter in the school building, and whose responsibility it is to remove litter. Results show that students in general do not appreciate litter, using words like disgusting, annoying and appalling to describe their feelings. When asked who is responsible for cleaning up, the majority says they are supposed to do it themselves. However, their behaviour shows otherwise. The presence of cleaners does not keep them from littering. Students say: “You notice the cleaner walking around, so you think they will take care of it” and “If students see the cleaners clearing up litter, they will leave it behind more easily”. They call themselves lazy and forgetful: “If I do not see a waste bin, or the distance to the waste bin is too far, I don’t feel like walking” and “If you’re busy, you sometimes forget.” Some students mention their uprising and their mothers cleaning after them: “I don’t clean up at home either. I think a lot of people don’t.” Many mention that littering is automatic behaviour, that they intend to but simply forget, that ‘it just happens’ and that they don’t do it on purpose.

This behaviour can be explained by several unconscious drivers. First: the conflict between goals and pre-dominant self-interest. People are generally well aware of what is good and healthy, but they just lack the willpower to change it (Hermsen en Renes, 2014). To avoid conscientious objections, we apply cognitive dissonance to excuse ourselves when our attitudes conflict with our behaviour (Festinger, 1962). For instance, one student says: “Who cares if I leave just one piece of paper behind?”. Another explanation can be found in the power of the descriptive norm over the injunctive norm. This behavioural mechanism is related to normative social conformity: conformation to the peer group in order to be accepted, resulting in perceived social pressure (Cialdini et al., 1990; Reno et al., 1993). One student provides a fine example by saying: “If you notice others don’t clean up, you’ll feel stupid if you are the exception.”<sup>1</sup>

These results show that awareness and positive intentions towards clearing up waste do not automatically lead to non-littering behaviour. It is hard to refrain from habitual behaviour (Ajzen, 1991; Sheeran, 2002; Fishbein and Ajzen, 2011). The results also provide evidence for the limited effect of measures taken by FMs and CCs to decrease littering.

When linking these behavioural drivers to the students’ features (Spangenberg and Lampert, 2013), it becomes clear that the absence of a commonly shared feeling of responsibility for a clean environment reinforces the psychological mechanism of pre-dominant self-interest. Furthermore, the appraisal of small social networks increases the power of descriptive norms and informational social conformity. This can either have a positive or negative effect, depending of the social norm within the peer group. Behavioural changes should not be forced, because the average student dislikes too many rules and resistance will occur.

### **Applying Behavioural Insights to Design Persuasive Interventions**

Now the question arises how these behavioural insights can be applied to design persuasive interventions at HUA? Two developments within social psychology are relevant before this question can be answered. First, the insight that change of automatic behaviour should best be approached by unconscious norm-activating interventions. This is more effective than

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<sup>1</sup> A transcript of the students’ quotations is available on request.

trying to change the intentions by creating awareness. Second, knowledge of behaviour and research are needed to select and adjust the interventions to the target group and features of the building.

Several kinds of interventions can be applied (Broeders et al., 2010): social cues, whereby the influence of social signals on the behaviour is used. Second: norm activating environments, whereby adaptations in the environment are applied to activate the injunctive norm. Third: embodiment, stimulating the senses to influence the behaviour. Last: the usage of injunctive and descriptive norms.

### **Case Study at HUA**

The case building is part of the Utrecht UAS. It was built in 2010, is 18.000 m<sup>2</sup>, and seven stories high and located near the centre of Amersfoort, a mid-size provincial town in the centre of the Netherlands. Approximately 2.700 students study at HUA (Jaarverslag, 2013). The building is representative for management studies.

Several interventions were selected and applied at HUA (Figure 1).








#### *Interventions with social cues and descriptive norms:*

- Persuasive texts on posters, applied on waste bins and walls (a). Examples of the persuasive texts were: ‘89% of the students think that waste belongs in the waste bin’ (social proof), ‘Ready with lunch? Please throw your waste in the waste bin.’ (implementation intention), a picture of two eyes with the text ‘Please throw your waste in the waste bin’ (norm activation) and the same text, accompanied with a thumbs-up smiley face (prompting).
- Furthermore, lecturers were requested and reminded to ask students to clean up their waste after lectures (b).

#### *Interventions with norm activating environments:*

- Visual cues were applied by landscaping through nudges (Thaler and Sunstein, 2008). Trails of footprints led from the student workplaces to large waste bins (c).
- Gamification (Deterding et al., 2011): two gamification objects were placed. The ‘Puike Peuken Long’, two large bottles (‘lungs’) with a funnel on top in which students could throw their cigarette end and guess in which lung it would drop (d). The second object was a rubbish chute at the staircase between the 1st and 2nd floor, through which garbage could be thrown. A bin was placed underneath. When opening the lid of the chute, a triangle was moved and made a gong like sound (e).

Figure 1 Timeline with overview of interventions.

Timeline >	1-9-'14 (day 0)	3-12-'14 (day 99)	9-3-'15 (day 183)	1-4-'15 (day 220)
<b>1. Open workplaces ground floor</b>	Baseline measurements	Baseline measurements	Baseline measurements	Baseline measurements
<b>2. Open workplaces &amp; Staircase 2<sup>nd</sup> floor</b>	Baseline measurements			
<b>3. Open workplaces 4<sup>th</sup> floor</b>	Baseline measurements	Baseline measurements		
<b>4. Lecture halls A2.02 and C2.38</b>	Baseline measurements	Baseline measurements	Baseline measurements	
<b>6. Smoking area at entrance</b>	Baseline measurements	Baseline measurements	Baseline measurements	

Experiments based on the principle of embodiment were not carried out because of practical reasons. The experiments with persuasive posters on waste bins, nudges and reminders showed (a+b+c) some significant improvements. The gamification experiments (d+e) did not, there seemed to be a short term effect.

The HUA building has got a new, bright appearance. This might have influenced the outcome of the experiments. Research has shown a positive relation between cleanliness and littering behaviour (Cialdini et al., 1990).

#### 4 CONCLUSION

Indoor litter at UAS' is a relevant issue which should be taken serious. Current anti-litter approaches of FMs and CCs are mainly practical, preventing and solving symptoms. Some measures have a 'fit' with behaviour; however the behaviour should be the starting point. A recent trend to achieve sustainable behaviour is by applying persuasive interventions.

The implications of littering were explored to confirm the relevancy of the issue. The effectiveness of current anti-litter approaches was investigated. The littering behaviour and features of the students and scientific and evidence based findings of similar research were studied. This knowledge was used to select experimental interventions for a case study at HUA. The research methods were literature review, interviews, experiments and observations.

Littering is habitual behaviour. This asks for an approach by a) making the desirable behaviour easy by simplifying the target behaviour and b) disturbing the wrong behaviour by

unconscious norm-activating interventions. The right norm can be activated by social cues, norm activating environments, embodiment and applying injunctive and descriptive norms. The interventions should 'fit' the target group. Behavioural changes should be approached playfully and non-intrusive. An integral approach is needed for success.

Although the results of the experiments showed clear directives towards selection and appliance of the interventions, its' effectiveness remains uncertain. External variables influenced the validity of the experiments and findings were ambiguous. Nevertheless, the real-life characteristics of the experiments contributed to the external validity. Persuasive interventions should be tested in pilots first on a 'trial and error base', hence developing best practices.

### Recommendations

UAS' should take littering behaviour serious to prevent harmful effects. University Boards are advised to incorporate sustainability ambitions and goals in the business strategy, showing commitment by initiating anti-litter projects, eventually combined with/or embedded in sustainability or recycling projects. The impact on budget and perceived work pressure should be taken into account.

When universities aim on reducing littering behaviour, several directives should be taken into account:

- The desirable behaviour (clearing up) should be facilitated by decreasing the perceived effort through simplifying the target behaviour.
- The wrong habitual behaviour (littering) should be disturbed by unconscious norm-activating interventions in a playful, non-intrusive way.
- An integral approach: FMs and CC seeking collaboration with (student) designers and social psychologists.
- The interventions should be adjusted on the target group and features of the building.
- A holistic approach is recommended: combinations of several interventions should be applied, eventually supported by an awareness campaign. The persuasive interventions can be combined with current effective current anti-litter approaches.
- Best practices of experimental interventions will be discovered by the principle of trial and error.

Recommendations are given by combining behavioural insights with best practices of CCs. The interventions will be divided on a social cognitive-, physical- and organisational level.

**Social Cognitive Level:** awareness campaigns should no longer be the main approach however, they do not need to be banned either. Second: keeping a clean environment by result driven cleaning and through partnerships. Furthermore, senior students should be appointed to explain house rules to new students. Breaking house rules should be pointed out to students, preferably in a non-punishing and positive way, conducted by cleaning staff, janitors and lecturers.

Based on behavioural insights, the following 'new' approaches are recommended: dare to experiment with persuasive interventions, test them in pilots to investigate the 'fits' with target group and building. Second, involve students in anti-litter projects and make an appeal on their positive, transforming abilities. Last of all, modelling is important. Lecturers should be a role model by giving the right example.



Some don'ts will be given as well. Gamification is attractive, but likely to have a short-term effect. Instructing, threatening, so-called 'funny' messages, and punishment are dissuaded. Prohibiting eating and drinking in lecture halls is ineffective; it is better to remind students afterwards to clear up combined with communication by means.

**Physical Level:** communication by means: persuasive texts on waste bins, cleaners' clothes and larger cleaning materials. Place functional, clean, well maintained receptacles on visible places, positioned on walking routes on regular, mutual distances and use drop-pits at the entrances.

Smoking zones are ineffective because of the power of the descriptive norm over the injunctive norms. Unless the smoking zone complies exactly to the smokers' wishes, it is discouraged.

**Organisational Level:** FMs and CCs should regard the litter issue as a common problem. To avoid (financial) tensions, they should discuss mutual expectations concerning responsibilities and tasks in the tendering phase. Costs can be saved by investments aiming to decrease littering behaviour, instead of economizing on time norms and budget. Second, good employership towards cleaners is needed, because of social considerations and prevention of sickness leave. Satisfied employees show a better performance, which indirectly contributes to less litter.

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## **2 VALUE CO-CREATION**

### **2.1 THE ADDED VALUE OF INTEGRATED FACILITY MANAGEMENT FROM IFM-SUPPLIERS' PERSPECTIVE**

HESTER VAN SPRANG, JESSE GHUIJS AND BRENDA H. GROEN

### **2.2 A STEP-BY-STEP PLAN TO MANAGE AND MEASURE ADDING VALUE BY FM/CREM**

THEO VAN DER VOORDT, PER ANKER JENSEN, JAN GERARD HOENDERVANGER AND FEIKE BERGSMA

### **2.3 HOW REAL ESTATE AND FACILITIES MANAGEMENT CONTRIBUTE TO VALUE CREATION IN DIFFERENT ORGANIZATIONS**

KNUT BOGE AND ALENKA TEMELJOTOV SALAJ

## 2.1 The added value of Integrated Facility Management from IFM-suppliers' perspective

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### ABSTRACT

**Purpose:** Added value is measured at output level in the added value map. Given the extent of outsourcing of facilities services, it is relevant to determine how suppliers of integrated facility management (IFM), the most strategic of sourcing models, monitor and communicate their added value. The paper aims to identify the most important added values of IFM as perceived by the main IFM-suppliers active in the Netherlands, and to determine how these IFM-suppliers monitor and report results to the client on these key values.

**Theory:** This study builds upon previous added value research by Lindholm (2008), Jensen (2010), Van der Voordt (2012), and Gerritse et al. (2014).

**Design/Methodology/Approach:** Qualitative research, combining literature research, desk research, and semi-structured interviews with strategic managers/directors representing 6 out of 10 of the largest IFM-suppliers in the Netherlands. Interviews were analysed using open and axial coding.

**Findings:** This research shows the beginning of a broadening scope of suppliers towards other value domains than costs. However, this requires adequate quality of the supplier-client relationship. It is only after the IFM-supplier has proven to deliver up-to-promise that the client is willing to address other (softer) values. Being able to measure the results will contribute towards the paradigm shift. However, this study shows that IFM-suppliers are limited to measuring their strategic impact on costs, satisfaction, and sustainability.

**Originality/Value:** This study illustrates the market-need for a value based management dashboard. Further research is needed to operationalize the FM-values (especially productivity) into measurable, strategic indicators and to develop corresponding tools to monitor results.

### Keywords

Facilities Management, Added value, Integrated Facility Management (IFM), Performance management.

## 1 INTRODUCTION

In recent years we have seen a growing interest in the concept of added value of facility management (FM). RICS (2012) conducted research into strategic FM developments based on responses of 375 individual end-user facility professionals. The report concluded that facilities are increasingly being recognized as a strategic resource. However, achieving strategic alignment with other elements of the business has had mixed success: financial metrics and cost control dominate FM, and heads of facilities are buried in day-to-day operational concerns. Research by Workplace Law (2013) supported these findings: 90% of clients still feel that FM is seen in a supporting rather than a strategic role, and believe that FM will only achieve a higher ranking within an organisation's hierarchy when it finds new ways to deliver value. Added value however, remains a concept that is interpreted in many ways and subsequently there are many ways to measure it. According to Van der Voordt & Jensen (2014, p.16) this has resulted in a number of downsides of added value as a concept: not only do people differ in their perception of added value, the concept is also hard to operationalize and measure, even in economic terms.

One's perspective determines one's perceptions of the added value of FM. A business-economical perspective emphasizes the contribution to productivity, profit and branding, whereas the social-economical perspective is merely focused on satisfaction of stakeholders. From a relational perspective the process of account management adds value, whilst the sustainability perspective stresses reducing an organizations' footprint (Van der Voordt, 2012). A workshop held at Saxion University of Applied Sciences with Dutch facility managers of financial institutions in 2013 confirmed the results of a workshop held at the European Facility Management Conference in the same year (Van der Voordt & Jensen, 2014): participants found it difficult to envision specific measures that add value. However, without measurement and analysis the contribution and impact of FM on core business cannot be demonstrated. Moreover, a well-established link between FM-interventions and business results is important in breaking down the negative cost-cycle FM departments and suppliers are currently facing (RICS, 2014). The paradigm shift toward added value collides with the trend of Best Value Procurement (BVP). BVP is about a different way of finding and keeping collaboration between client and vendor, based on the expertise of vendors<sup>2</sup>.

The decision to outsource is often driven by cost-related arguments (Kakabadse & Kakabadse, 2002; Barrett & Baldry, 2007; Maas et al. 2010; Jensen, Van der Voordt & Coenen, 2012; Redlein & Zobl, 2014; Duchamps & Schaeps, 2015). This is also the case for Dutch companies that switch to IFM outsourcing: main reasons are reduction of costs and staff, and increased flexibility (Lennartz & Veeke, 2009). During the economic crisis organisations focussed even more on cost-reduction, this may explain a recent decrease in profit for IFM suppliers to about 2% of their total turnover. In the Netherlands, in 2014 the market value of facility management was approximately 37 billion euros. About 61% of facility services was outsourced, and IFM contracts covered 3.4% (€770 million) of the total outsourced facility services market (Van Diepen-Knegjens & Van der Spil, 2014). Duchamps and Schaeps (2015) have shown that compared to Belgium, the Dutch FM relative market size (% of GDP) is 5 times higher: 5.73% versus 1.02%; they suggest that the difference in FM market maturity could be a spin-off of the many multi-national headquarters located in the Netherlands. In the Netherlands, the IFM concept is the fastest growing FM concept, with

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<sup>2</sup> (www.bestvalueeurope.com).

an annual growth of approximately 20% since 2000. Trends are not the same throughout Europe, e.g. research by Redlein & Zobl (2014) shows that in Austria there is no trend towards only one external service provider with integrative service offer; a possible explanation is the reluctance to depend on one single external service provider.

First step for IFM-suppliers to break the negative cost-cycle is to identify, monitor and communicate their value added to clients. The question arises how? Therefore, the aims of this study are:

1. Identify the most important added values of IFM as perceived by the main IFM suppliers in the Netherlands.
2. Identify how IFM-suppliers monitor and report results to the client on these key values.

For this study we focus on the ten value adding FM strategies identified by Gerritse et al. (2014), based on previous research by Jensen (2010), Lindholm (2008), and Van der Zwart (2011). Table 1 compares the ten value adding FM strategies by Gerritse et al. (2014) with other studies, showing similarity with Lindholm (2008) and Van der Zwart (2011), as well as the wider scope of Jensen (2010).

Table 1 Comparison of the FM value adding strategies (Gerritse et al., 2014) and the FM/CREM added values (Jensen, 2010), Lindholm (2008), and Van der Zwart (2011)

Gerritse et al. (2014)	Jensen (2010)	Lindholm (2008)	Van der Zwart (2011)
Cost control/decrease	Cost	Reduce cost	Reducing of cost
Improving satisfaction	Customer and staff satisfaction	Increase employee satisfaction	Increasing (user) satisfaction
Increasing productivity	Productivity	Increase productivity	Improving productivity
Improving sustainability performance	Environmental (surroundings)	Increase innovations	Controlling risks
Risk control	Reliability	Increase flexibility	Increasing innovation
Stimulating innovation	Adaptation	Increase value of assets	Improving flexibility
Increasing flexibility	Culture	Promote marketing & sales	Improving culture
Support of culture	Social (surroundings)		Improving the financial position
Improving asset value	Economical (surroundings)		Supporting image
Support of corporate branding	Spatial (surroundings)		

## 2 METHODOLOGY

This qualitative study, part of a larger research programme on measuring added value, combines literature research, desk research, and semi-structured interviews. A literature review was used to operationalize key concepts related to added value, performance measurement, and IFM. Ten IMF suppliers are active on the Dutch market; 6 are globally operating suppliers, two are active on the European market, and two only on the Dutch

market. These organisations were mapped using desk research: document analysis on websites, corporate brochures, and annual reports, to identify what added values were highlighted by suppliers in profiling their company.

Subsequently, semi-structured interviews were held with strategic managers/directors of six IFM-suppliers (two have a global orientation, three a European orientation, and one is solely active on the Dutch market). Topics addressed were: definition of added value, company profile, ranking of added values from a client perspective, influencing factors, contracting values, and measuring values. Finally, the results of this study were presented to all participants during a seminar. Results were discussed in a game setting, and insights were shared and deepened.

### 3 RESULTS

#### 3.1 Core values and value for the client

Based on document analysis of corporate brochures, websites and (if available) annual reports of all IFM suppliers active in the Dutch market both core company values and added value to clients were determined. Core company values may be divided in 5 main categories: integrity (integrity, honesty, transparency, responsibility, trust), satisfied customers (customer satisfaction, service excellence, customer-oriented, quality), sustainability & CSR, innovation & entrepreneurship (innovation, creativity, flexible, entrepreneurship, co-creation, continuous improvement), and motivated staff (motivated teams, staff engagement, engagement). These values show that IFM suppliers focus on delivering excellent service, that quality is continuously monitored in order to satisfy their customers, and on being a trustworthy business partner.

An analysis of the added value mentioned in the documents showed that IFM suppliers focus on four of the ten added values identified by Gerritse et al. (2014), namely increase innovation, satisfaction, flexibility and sustainability. Control of costs and risk are possibly too obvious to mention explicitly; however, increase of asset value, increase of productivity, and support of culture and brand were also not mentioned. Besides the values addressed in this study, IFM suppliers suggested cultural fit, being a responsible employer, long-lasting relationships, cooperation or co-creation, international character and specific industry expertise for profiling.

In order to validate these findings six strategic managers/directors of the largest IFM suppliers in the Netherlands were interviewed. Suppliers need a well-established link between their FM solutions and business results of the client, in order to prove their value for the client and survive as a business. All respondents agreed that added value is always a trade-off of costs versus quality of service, with the aim of maximisation of financial and/or non-financial benefits. All respondents acknowledged the ten added values listed in the introduction; however, not all values had the same importance.

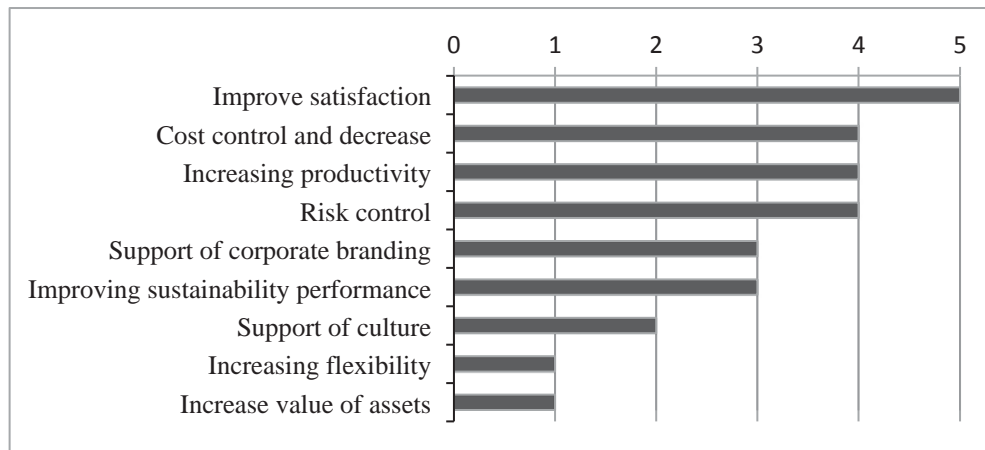
Both document analysis and interviews delivered information on ranking of added values. In corporate communications the most frequently mentioned added values of IFM for the client are: satisfaction, innovation, and sustainability. In the interviews respondents were asked to select and rank the top-5 most important added values of Gerritse et al. (2014). Figure 1 illustrates that 5 respondents selected satisfaction in their top-5, corresponding with the results of the document analysis. The supplier, that did not recognise satisfaction as top-5



value parameter, motivated this by stating that satisfaction is not a value-adding domain, but the result of the performance on the other nine value domains.

Four respondents selected the following values: cost control, improving productivity, and risk control. Especially suppliers with a multinational client-base experience the dominance of cost control. This could be a result of the Anglo-Saxon focus on maximising shareholders' value. Surprisingly, controlling costs was not mentioned in company documents studied in the desk research. It seems that controlling costs is an essential part of business, but not something IFM-suppliers use for profiling. One of the suppliers that did not select cost control as a top-5 value, motivated this by stating that costs cannot be evaluated without balancing this against quality delivered and contribution towards the other nine value parameters. All but one supplier agreed that increasing value of assets is not a top-5 added value of FM. This is not unexpected, as IFM-suppliers rarely manage the real estate portfolio. The supplier that did select this value is mainly contracted by multinationals, which could again be an effect of the Anglo-Saxon model many multinationals adopt.

Figure 1 FM values ranked in top-5 compared for selection frequency (N=6)



Risk control and stimulating sustainability are recognised to be important to some extent by all respondents. However, the selection of these values in the top-5 seems to be closely related to the suppliers' company core values. Likewise, values like supporting culture, innovation and flexibility seem to be selected for a top-5 position only if they explicitly fit the companies' profile. With regard to profiling one of the respondents stated: *"the distinctive character of suppliers is under pressure, especially on operational level. Some values have become commodities, like sustainability and CSR. Therefore, it is important for us to invest in partnership with our clients."*

Table 2 compares the findings of the document analysis and interviews. As stated before, a possible explanation for the absence of emphasis on control of costs and risk in corporate communications is that a contribution to these value domains is too obvious to mention explicitly. However, this does not explain for the absence of productivity and support of image as value adding domains in corporate communications. All respondents agree that the amount of value they can add depends on needs of the primary process. Furthermore, the outsourcing strategy influences contract management and performance monitoring. One

respondent added that besides the needs of the primary process, the professionalism of the client determines the level to which the added value requested is realistic.

Table 2 Comparison of prominent IFM added values in desk research and interviews

Desk research: Added values explicitly mentioned in corporate communications:	Interviews: Added values most frequently ranked in top 5
Satisfaction Innovation Flexibility Sustainability	Satisfaction Cost control or decrease Productivity Risk control Support of image Sustainability

Respondents feel the 10 added values by Gerritse et al. (2014) do not fully address specific added value of IFM. Additional values mentioned are:

1. Specialist knowledge,
2. Improving level of professionalism of the clients' FM organisation,
3. Relation with the client,
4. Offering new career perspective to outsourced facility staff formerly hired by the client,
5. Guidance in transition processes,
6. Reduction of absence due to illness,
7. Support of commercial performance,
8. Centralized management of FM,
9. Bring specific FM expertise into the organization,
10. Being able to fully understand and align with customers' needs.

Gerritse et al. (2014) found that determinants of added value of FM in the financial services industry are related to social context, history, and sector. Social context is considered to be the influence of trends, developments or events in the social context of the organization that influence management decisions. History refers to the buildings and installations acquired in the past, that still have an impact on the experienced service level. Sector determines the primary process and the required added value. New additions to findings by Gerritse et al. (2014) are: level of professionalism of the clients' FM department, and rules and regulations.

Rules and regulations influence to which extent the performance on value domains is included in contracts, especially related to risk control. As one respondent states: *"Client organisations are well aware of the risks, rules and regulations involved with the primary processes, but they lack knowledge on rules and regulations to apply to business support."* Professionalism of the internal FM department is also a factor. Respondents indicate that it is easier to add value to the client organisation if their FM-department is in an early stage of the maturity model. However, the more professional the internal FM department is, the higher the chance of a successful partnership, and the higher the chances that other value domains than costs and satisfaction can be addressed.

### 3.2 Values of IFM with respect to Added value map and dashboard

First of all, all added values mentioned in documents, workshop and interviews were mapped in the dashboard developed by Gerritse et al. (2014), see Figure 2. Figure 2 stresses the top 5

added values. A number of additional values mentioned by the respondents are not outcomes, but either basic FM provisions (e.g. specialist knowledge) or corporate results (e.g. offering new perspective to outsourced staff).

Whereas Gerritse et al. (2014) is solely focussed on outcome values (for the client), the FM Value Map (Jensen, 2010) includes surroundings and stakeholders. This map is based on the principle that the purpose of FM is to create value for internal customers by supporting the core business; the purpose of the core business is to create value for external customers/stakeholders.

Most of our findings can be allocated to the FM box in the Value map, see Figure 3. On input level IFM suppliers mention bringing in specialist knowledge. On processes level e.g. professionalization of the clients' FM organisation and management of transition processes. On output level IFM suppliers contribute by innovation (development), creative and/or tailor-made concepts (services and space), and the quality of the client/customer – supplier relationship. On outcome level reduction of absence through illness is seen as a contribution to increased productivity. Offering new perspective to outsourced staff is a Corporate Social Responsibility related theme, a social added value. Flexibility is related to adaption. Support of commercial performance is related to corporate branding. In the FM-value map culture includes image (Jensen et al., 2013), therefore support of cultural performance is linked to this value parameter.

The conclusion based on Figures 2 and 3 is that respondents feel IFM's added value is primarily linked to process and output level, whereas the added values by Gerritse et al. (2014) and Jensen et al. (2010) are positioned on outcome level.

### **3.3 Monitoring and reporting added value**

Interview results showed that of the 10 value parameters, performance indicators for customer satisfaction and costs are included in every IFM contract. Furthermore, the majority of Service Level Agreements (SLA's) contain clear metrics and certificates for sustainability performance and risk control, although the type of risk addressed very much depends on the industry and primary process of the client organisation.

On the contrary, clear performance indicators for improving productivity and supporting image, though regarded important FM value-adding domains, are lacking in contracts. Subsequently, the contribution of FM cannot be demonstrated. Especially regarding productivity IFM-suppliers feel the urge to quantify their contribution as this value domain is at the heart of the core business' needs. Establishing a set of indicators for the FM-contribution towards corporate productivity holds the promise of a ticket to the C-suite for internal FM departments, and an escape from the negative cost-cycle for FM suppliers.

Figure 2 IFM values identified in the added value dashboard (Gerritse et al., 2014).

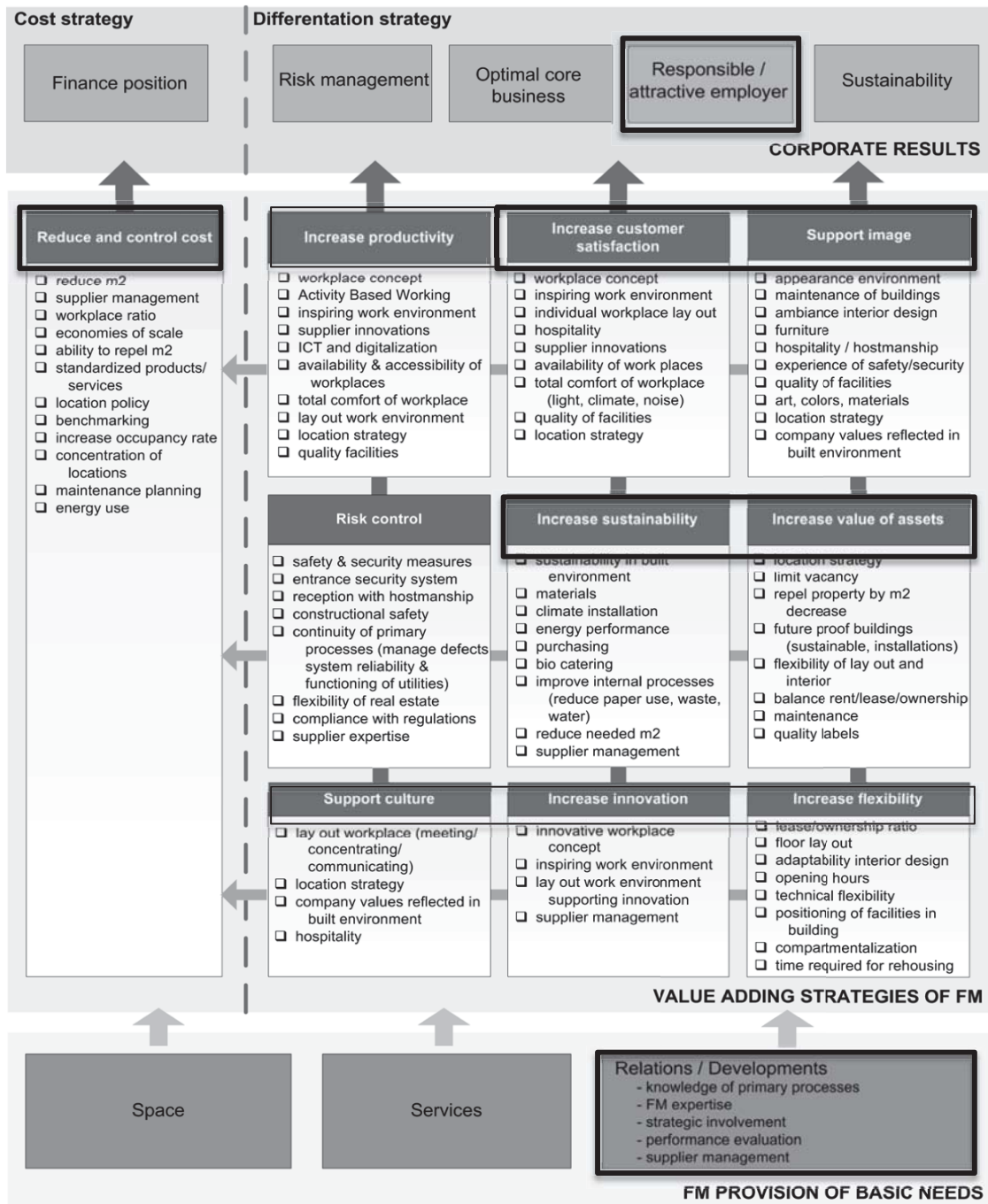
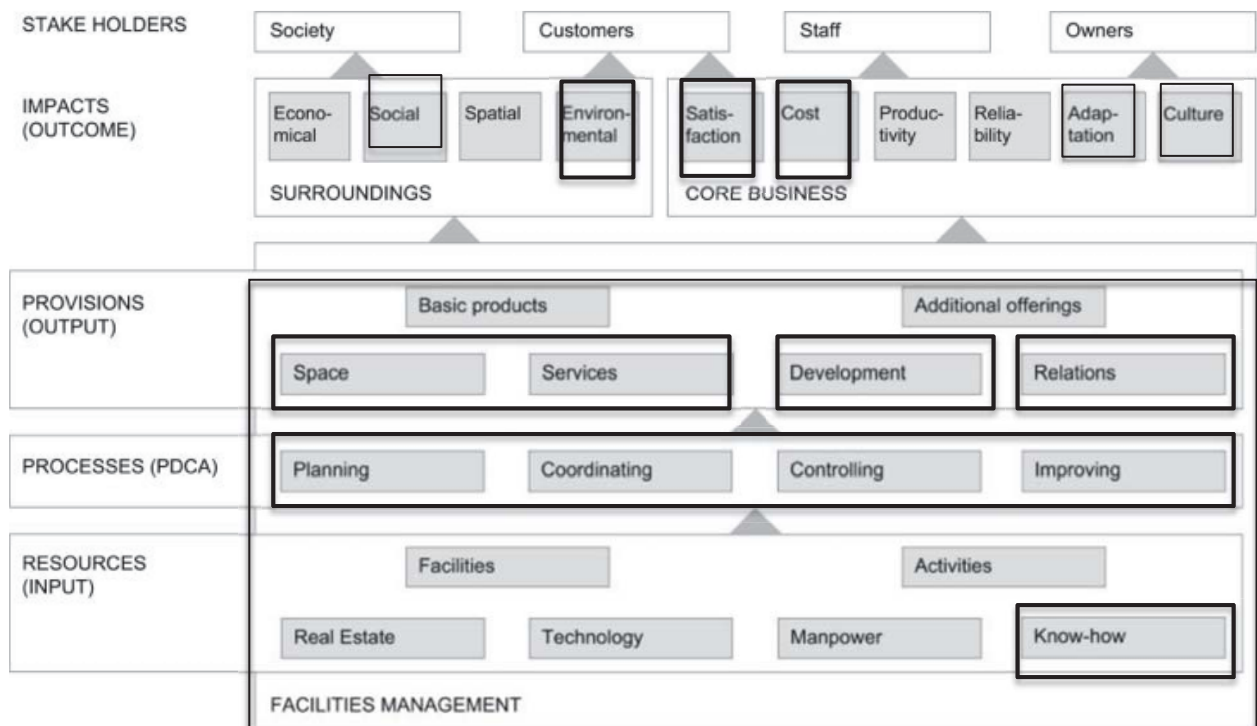


Figure 3 IFM values identified in the FM added value map (Jensen, 2010).



And even though flexibility is more and more a main reason for organisations to outsource activities, in general this value is not included in contracts. Attempts to measure flexibility are limited to questions in customer satisfaction surveys like: “how satisfied are you with our flexibility?”, limiting flexibility to a very narrow, operational definition. Suppliers that do report on flexibility performance on tactical level do this on hindsight and reflect on realised increasing or decreasing m<sup>2</sup> of workspace, and staff expenditure. To a lesser extent IFM-suppliers report on adapting to changing customer needs. In some international projects (e.g. moving projects) FM bonus/penalty schemes include parameters like flexibility, or staff retention rates. In the Netherlands this has not occurred yet.

Stimulating innovation was hardly mentioned in the interviews (Figure 1), possibly because contribution of FM towards corporate innovation is difficult to measure. Performance indicators in SLA's for innovation may be limited to measuring the number of suggestions for improvements, or innovations in operational FM processes. Likewise, in SLA's the interpretation of supporting culture is limited to *hostmanship*. Finally, suppliers indicate that their contribution towards the increase of value can be measured, however the indicators mentioned are related to risk control.

Values that have clear performance indicators are generally monitored using dashboards. Dashboards are contract-dependent; the supplier adapts to the clients' system (contrary to reporting tools developed by the suppliers). The Added Value Dashboard (Gerritse et al., 2014) is not designed to monitor the IFM supplier performance; a different set of performance indicators is needed for suppliers to report on, as well as other value categories that relate to the support process itself (Figures 2 and 3).

IFM-suppliers prefer dashboards with a simple layout and a maximum of 10 parameters. The use of sub-categories should be avoided. In some client organisations dashboards have been fully digitalised, whereas in other cases they are created using Excel. IFM-suppliers wonder whether their strategic client is really interested in graphs. A simple “traffic light system” would probably serve the same purpose. Most respondents stated that performance on other values than price, satisfaction and quality are not included in bonus/penalty schemes. The general feeling may be summarised by one respondents’ quote: *“There is a need for more research in the field of tooling to better demonstrate the impact of FM on core-business. A well-grounded method to really map the effect, instead of the estimation of effect, on productivity and absence rates.”*

#### 4 CONCLUSIONS

In this study IFM suppliers reflected on 10 added values of the Dashboard of Gerritse et al. (2014). Values domains most often mentioned are: cost control, improving productivity, and risk control. Some values have become commodities, like sustainability. The distinctive character of suppliers is under pressure, especially on operational level. Profiling based on corporate values may help to create a more distinctive company profile. Furthermore, expressing core values may be beneficial in tenders that aim for partnership, as the cultural fit is a critical success factor. Especially values like innovation and flexibility seem to be linked to the suppliers’ profile.

We conclude that the most important (strategic) added value of IFM is customer satisfaction. However, one could argue that satisfaction is not a value-adding domain in itself, but the result of the performance on the other nine value domains. Likewise, one respondent stated that costs couldn’t be evaluated without balancing this against quality delivered and contribution towards the other nine value parameters.

The IFM management/operational split influences contract management and performance monitoring, though it offers opportunity to focus on output and thus added value on tactical/strategic level. However, in the initial contract KPI’s are limited to costs, satisfaction, and often also sustainability. As the client-suppliers relationship develops over time, other values delivered are discussed and specific goals may be set. KPI’s often have a narrow and very operational focus. Improving productivity and supporting image are seen as important FM value-adding domains, but lack clear performance indicators. Subsequently, the contribution of IFM cannot be demonstrated. As Best Value Procurement is a trend and past performance is part of the selection criteria, being able to demonstrate the impact of IFM is increasingly important. Especially for productivity IFM-suppliers feel the urge to be able to quantify their contribution as this value domain is at the heart of the core business needs.

## 5 RECOMMENDATIONS FOR FURTHER RESEARCH

Further research is needed to develop tools to map the effect of IFM on core business, as well as on the performance of support processes. There is a need for a set of clear, tactical/strategic indicators for the IFM-contribution on the value domains: productivity, innovation, flexibility, and support of culture. Establishment of these performance indicators requires objective identification of causes and effects. However, value in a broader sense is the (subjective) result of complex and interconnected processes; this type of value can only be captured with a qualitative approach.

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## 2.2 A step-by-step plan to manage and measure adding value by FM/CREM

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### ABSTRACT

**Purpose:** To present a new Value Adding Management model in order to support decision makers in identifying appropriate interventions to add value to the organisation, to manage its implementation, and to measure the output and outcomes.

**Theory:** The paper builds on value adding management theories and models including the triplet input-throughput-output, a distinction between output, outcome and added value, the Plan-Do-Act-Check cycle, change management and performance measurement.

**Design/methodology/approach:** Literature review and a cross-chapter analysis of a forthcoming book, where authors from different European countries present a state of the art of theory and research on 12 value parameters, how to manage and measure each value, and to discuss the costs and benefits of typical FM and CREM interventions to enhance satisfaction, image, culture, health and safety, productivity, adaptability, innovation, risk, cost, value of assets, sustainability and Corporate Social Responsibility.

**Findings:** The new Value Adding Management model follows the steps from the well-known Plan-Do-Check-Act cycle. The four steps are supported by various tools that were found in the literature or came to the fore in the state-of-the-art sections of the 12 value parameters. Furthermore an overview is presented of ways to measure the 12 value parameters and related Key Performance Indicators.

**Originality/value:** Much has been written about adding value by FM and CREM. This paper presents a new Value Adding Management model that opens the black box of input-throughput-output-outcome and which is supported by various management and measurement tools.

### Keywords

Added value, FM, CREM, Plan-Do-Check-Act, Interventions, KPIs.



## 1 INTRODUCTION

In 2009 a EuroFM research group on “The Added Value of FM” started to explore the added value of FM, both from an academic and a practical point of view.. The driver behind this collaborative research was the perception that FM gradually has shifted from primarily steering on cost reduction towards managing facilities as a strategic resource to add value to the organisation and to contribute to its overall performance. The results have been published in a first anthology on the added value of FM (Jensen, Van der Voordt and Coenen, 2012), which was launched at EFMC 2012 in Copenhagen. Since then various follow-up steps have been conducted to further increase our understanding of the added value of FM, see Table 1. The findings confirmed the need for a second anthology on adding value by FM and CREM. In this second book 23 academics from 5 countries and 13 practitioners from 6 countries share their insights and experiences with adding value by Facilities Management (FM) and Corporate Real Estate Management (CREM).

This paper summarises chapter 17 of the new book and presents the new Value Adding Management (VAM) model (Hoendervanger et al., 2016). This VAM model is based on a review of the literature and a cross-chapter analysis of part II of the new book and aims to support decision makers in identifying appropriate interventions to add value to the organisation, how to manage its implementation, and how to measure the output and outcomes.

## 2 VALUE ADDING MANAGEMENT MODEL

We started our exploration of adding value by FM and CREM with a very simple process model according to the widely used triplet of input-throughput-output and extended it by outcome - impact/added value:

Input → Throughput → Output → Outcome → Impact = Added Value

In order to integrate VAM of buildings and facilities in business management and to make the VAM model more instrumental and applicable as a decision-support and management tool, this simple model has been extended to a more elaborated VAM model, see Figure 1. Because the Plan-Do-Check-Act (PDCA) cycle – also known as the Deming cycle - is widely applied to support total quality management, we used this cycle as a leading principle to elaborate the original simple VAM model.

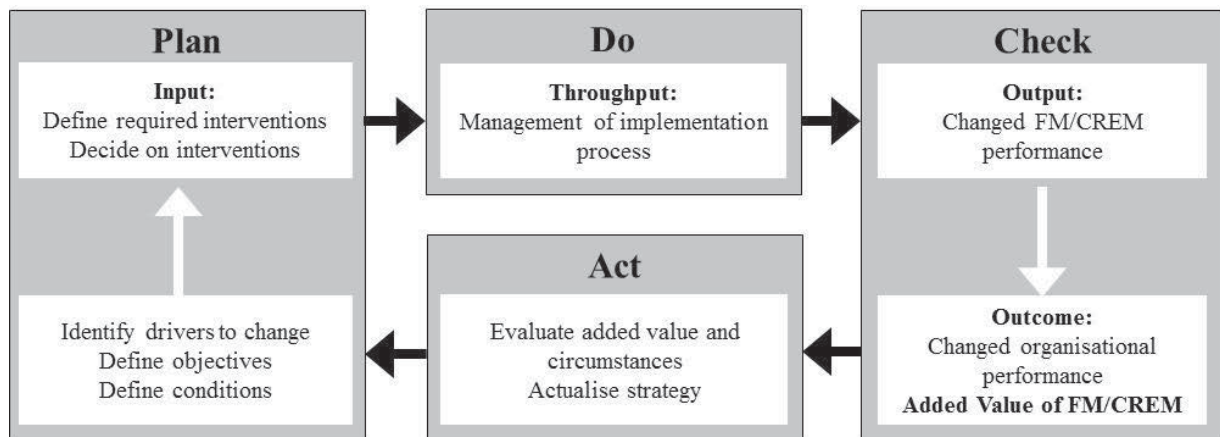
The cyclic character emphasises that value adding management is or should be a continuous process. Evaluation of realised output/outcome/added value may be a starting point for new interventions. We also used input from other models such as the Accommodation-Choice model (Van der Voordt et al., 2012). This Accommodation-Choice model has been developed in order to support decision-makers to realise a successful accommodation policy or an improved work environment that fits with the organisational objectives and internal and external constraints and balances between the needs of all stakeholders. It suggests that each facilities change process should start with identifying why an intervention might be needed and what conceptual choices regarding facilities change are expected to optimally facilitate the organisational strategy and current and future user profiles. It further suggest that all steps

from initiation to defining most appropriate interventions, its implementation and after care require continuous monitoring, evaluation and coordination. This model is supported by various tools such as the work environment diagnosis instrument WODI, software to calculate the required number of different types of work places, a Space Utilisation Monitor, and benchmark data on employee satisfaction.

Table 1 Research on adding value – from book one to book two

Period	Action	Findings and reference
2012 EFMC Copen- hagen	First Anthology on The added value of FM – Concepts, findings, perspectives.	Academic research on the meaning of added value and value adding management. List of 50 definitions of added value, classified into use/user/customer value, economic/financial/ exchange value, social value, relationship value, and environmental value (Jensen, Van der Voordt and Coenen, 2012)
2013 EFMC Prague	Workshop by Jensen, Van der Voordt and Coenen to further discuss “How to manage and measure different value dimensions?”	Attendants interpreted added value in a different way and found it difficult to operationalise added value in clear dimensions, interventions and ways to measure.
2014	Decision to write a second anthology and to integrate the added value of Corporate Real Estate Management (CREM).	Proposal by Jensen and Van der Voordt to elaborate input-throughput-output-outcome processes and (12) value parameters.
2014 EFMC Berlin	Interviews with practitioners if/how they apply the added value concept in practice, what values are prioritised, what interventions are implemented, and how the outcomes are measured	User satisfaction, productivity and cost reduction were highly prioritised. There is a need for a coherent definition of added value and appropriate tools to measure different value parameters. (Van der Voordt and Jensen, 2014)
2015 EFMC Glasgow  EuroFM report	Critical review of 21 papers from EFMC 2013, EFMC 2014 and CIB 2014 on the added value of FM and CREM	Good research to provide empirical evidence, with a focus on the benefits of interventions for particular stakeholders. Lack of integrated analysis including sacrifices (time, money, risks), and which stakeholders benefits most and least of particular interventions. Only few papers discussed the implementation of change. Lack of before-after evaluations. Insufficient building on former research. No consistency in definitions and operationalisations. (Jensen and Van der Voordt, 2015a and b)
2016	New book, entitled “Facilities Management and Corporate Real Estate Management as value drivers: how to manage and measure adding value”, edited by Per Anker Jensen and Theo van der Voordt	In part I the editors open the black box of input -> throughput -> output -> outcome -> impact/added value by discussing a taxonomy of six types of interventions, the process of aligning facilities to corporate strategies, and 12 value parameters. Part II presents the state-of-the-art of concepts and research findings for each value parameter and ways to manage and measure. Part III presents a new Value Adding management model and ends with reflections, conclusions and recommendations. (Jensen and Van der Voordt, 2016)

Figure 1 New Value Adding Management model



The next sections present how these insights and insights from other tools can be used to support the four steps of the PDCA-cycle. Box 1 presents an example of how the four steps can be applied in practice.

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#### Box 1 Application of the VAM-model: implementation of a new concept for FM in schools

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##### **Plan:**

The purpose of the intervention was to relieve the managers and teachers in the school for spending time on support activities and concentrate on educational activities. The intervention was to transfer the FM-related support staff at the schools to the FM department, who should be in charge of and improve the services and allow the school staff to focus on their core business.

##### **Do:**

The FM department initiated a pilot project at one school where they established a service reception as the centre of the contact between the school and the service organisation (actually a ‘front office’) and trained the staff to become service and customer oriented as part of the FM team, which could support and replace each other.

##### **Check:**

The evaluation of the case showed that the head master of the school had changed his time used on pedagogics versus FM related activities from 60/40% to 85/15%. Furthermore, the status of the teachers had increased, recruiting new teachers had become easier, student satisfaction had risen, and a better physical environment, reduced sickness, better service for the same money and an improved maintenance of the buildings had been achieved.

##### **Act:**

Based on the results of the pilot project the municipality decided that the FM department should implement the new FM concept in all schools in the municipality.

Source: Jensen et al. (2008)

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End of box 1

## 2.1 Plan

The main actions in the Plan-phase are to identify the drivers to change i.e. to define if there is a gap between the desired and actual performance of the organisation and the accommodation, facilities and services, and to define which interventions may result in improved performance. It is important to define the objectives of these interventions in a SMART way (Specific, Measurable, Achievable, Relevant and Time-bound) and also to define the conditions or prerequisites that should be taken into account. The Plan phase ends with clear decisions about which interventions will be implemented and a plan how to implement.

Within the Plan-phase it is recommended to make a clear distinction between the organisational strategy and the FM/CREM strategy. Both require a strategic analysis and both may reveal drivers for change. If for example an organisation wants to enhance innovation, it seems obvious to invest in a new interior design that may stimulate creativity and support exchange of knowledge. However, reducing real estate costs in order to increase the R&D budget might be more effective. This example illustrates that there may be different ways to use FM/CREM as a means to contribute to one or more organisational goals.

### *Tools to identify the need for change, objectives and prerequisites*

Analysing the context of value adding management may start with exploring the different roles, interests and power of stakeholders involved, using stakeholder analysis. It is relevant to make a distinction between external and internal stakeholders and end users (Ambrosini et al., 1998). Furthermore a SWOT analysis can be applied to analyse the need and direction for change. It is recommended to conduct a SWOT analysis of both the organisation and the FM/CREM processes and products to identify drivers for change *within* the domain of FM/CREM.

The value proposition model of Tracey and Wiersema (1995) may provide a useful starting point to relate a corporate strategy to particular FM/CREM value parameters. According to this model each organisation should make a fundamental strategic choice to focus on one out of three different value propositions: product leadership, customer intimacy, or operational excellence. This choice influences the selection of FM/CREM value drivers: product leadership stresses the FM/CREM contribution to innovation, whereas customer intimacy demands a focus on customer satisfaction; and operational excellence requires a productivity-oriented approach.

Another framework to support the Plan-phase is the one by Nourse and Roulac (1993). They link nine possible 'driving forces' behind a corporate strategy (e.g. market needs, technology, return on investment) to 7 components of competitive advantage (e.g. attracting and retaining customers, efficient business processes), 8 strategic accommodation choices (e.g. cost reduction, support of human resources, value creation of real estate) and 14 operational decisions (e.g. regarding the location, number of m<sup>2</sup>, ICT, ownership and risk management).

### *Tools to define required interventions and to select the most appropriate ones*

In the second part of the Plan-phase, the main question is how to translate the strategic focus and smart goals into appropriate and valuable FM/CREM interventions. To identify the most appropriate interventions it is recommended to create a FM/CREM strategy map. This tool, developed by Kaplan and Norton (2004), may help to identify critical success factors within chains of means/ends, which are crucial for adding value as defined in the strategic focus.

The Balanced Scorecard (Kaplan & Norton, 1992) is a widely used tool to link strategic analysis to critical success factors and KPIs.

Strategic criteria are a prerequisite to select the most effective FM/CREM interventions, i.e. the option(s) with highest benefits and lowest costs. Decision support tools such as business cases can be used to select the most appropriate interventions and to support decision making processes.

## **2.2 Do**

The Do-phase encompasses the implementation of the proposed interventions and management of the change process. Decisions to be made include, who should be involved in the process and how, time schedules, how to cope with resistance to change, and how to cope with the different needs of different stakeholders. According to the strategic management model of Johnson et al. (2009), the purpose of the Do-phase is to put 'strategy in action'. A major challenge is to keep focus on the initial goals regarding adding specific values. Implementation processes tend to develop their own dynamics, which can easily shift the focus from long-term strategic organisational goals to short-term tactical and operational goals of the participants.

### *Tools to support the implementation of change*

Change management has evolved as a specialist discipline and has produced many different tools. A tailor-made approach should be designed that fits with the characteristics of the intervention (complexity, budget, risks, time frame), the goals, and the social/organisational context. It is also in the Do-phase recommended to conduct a stakeholder analysis to define who should be involved in the process, in what way, and what their interests are. These stakeholders may or may not be the same as in the Plan-phase. The stakeholder analysis should take into account how different stakeholders perceive change, for instance by using the five-colours framework of De Caluwé and Vermaak (2003). This framework links five different change paradigms to five different management process approaches. Since a change approach has to fit with the expectations and needs of different participants and characteristics and goals of the intervention, it is often wise to combine two or more approaches. A blue-print approach to ensure that a refurbishment project will be finished in time and within budget might for instance be combined with a red-print approach for involving users effectively in the design process.

Avoiding or removing resistance to change is usually a major component of any change management approach. According to Kreitner and Kinicki (2007) there is no universal strategy for dealing with resistance, however communication is always essential and should at least include four elements: 1) inform employees about the change ('what'), 2) inform employees about the rationale underlying the change ('why'), 3) organise meetings for answering questions that employees may have, 4) let employees discuss how the change may affect them. The same principles can be applied to other stakeholders.

## **2.3 Check**

The Check-phase requires measuring the costs and benefits of the intervention(s) and the performance of the organisation and its facilities before and after the implementation of the intervention(s), and a check if the changed performance fits with the organisational strategy, mission, vision and objectives and as such adds value to the organisation. The Check-phase starts during or after the implementation of the selected interventions and measures, if and to what level the objectives have been attained, if the performance of the organisation and

FM/CREM actually has been improved, and if the improved output and outcome adds value to the organisations.

*Tools to check interventions on its aimed outcomes and impact*

Table 2 presents a selection of possible interventions and tools to measure the output and outcomes that came to the fore in part II of the new book. Usually various measuring tools are combined in a so-called Post-Occupancy Evaluation (POE), also called evaluation of buildings-in-use (Preiser and Vischer, 2004; Van der Voordt et al., 2012).

Regarding KPIs, a distinction should be made between output indicators to measure FM/CREM performance and outcome indicators to measure organisational performance. Figure ii shows examples of input -> output -> outcome -> added value chains to illustrate the complexity of cause-effect relationships between interventions, FM/CREM performance, organisational performance and added value.

For example, an outdated building or a building that cannot accommodate the growth of a company may be a driver to move to another building (input in first example of Figure 2). The move itself has to be managed and implemented (not shown in Figure 2). If the appearance of the new building or an existing building that is adapted to the requirements of this organisation fits better with the aimed image, this building can contribute to an improved corporate identity (output). This may subsequently lead to an improved organisational performance regarding, an improved brand recognition, and a higher market share. Finally, if these positive outcomes support the organisational objectives and the benefits outweigh the costs of moving and possible sacrifices such as longer travel distances for various staff members, the intervention actually adds value to the organisation. Assessing the added value of FM/CREM interventions should not only include 'objective' performance measurement and benchmarking, but also a 'subjective' evaluation whether the improved performance really adds value to the organisation, the clients, customers and end users, and society.

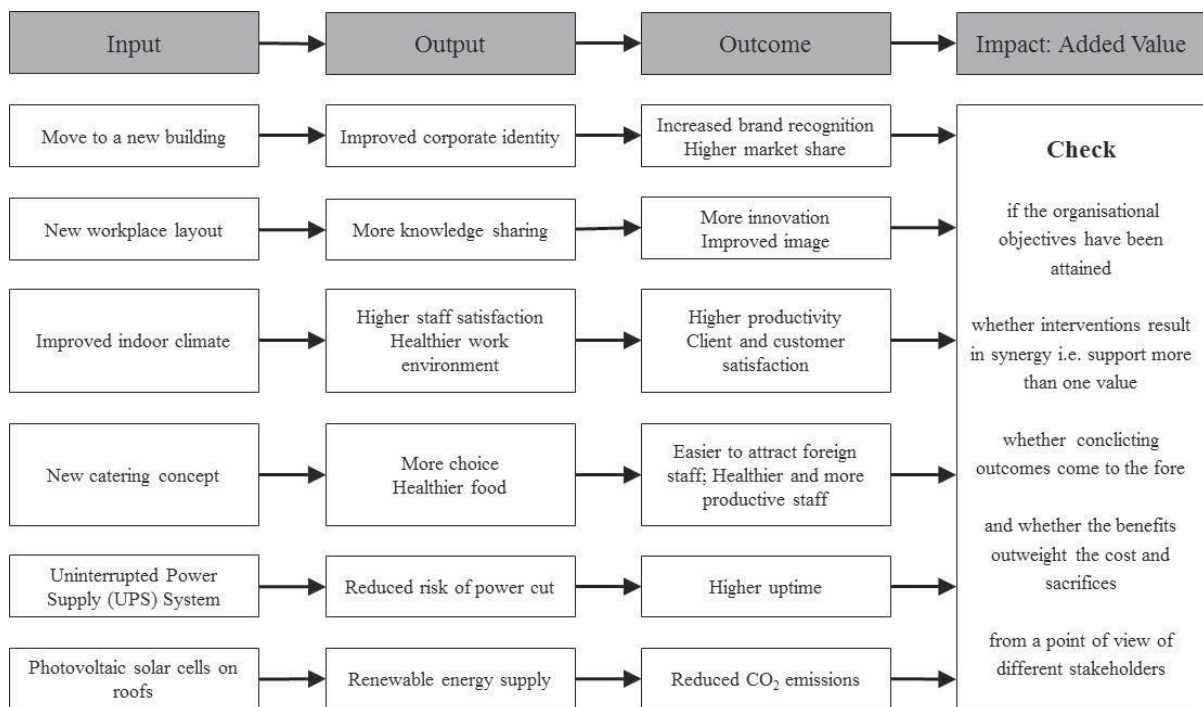
A common way to evaluate KPIs is to conduct performance benchmarking internally or with external partners. The benchmarking process can be carried out according to EN15221-7 (CEN, 2012). Benchmarking is an important tool to control cost and to find areas of improvement in FM/CREM.

Whether the increased performance also adds value to the organisation depends of the mission, vision and objectives of the organisation and the trade-off between benefits and sacrifices. For example, if the objective of the organisation is to be as green as possible and to perform in a social responsible way, a reduction in energy consumption adds value, whereas if the organisation just aims to fit with legislation and the performance assessment in the Plan-phase shows, that it already fits with the legal requirements, being "more green" does not add value to the organisation (though it is very welcome from a societal point of view!).

Table 2 Examples of interventions, assessment methods and KPIs

Value	Interventions	Tools to measure impact	KPIs (Top 3)
Satisfaction	More suitable spatial layout. More collaborative spaces. Better indoor climate.	Employee surveys. Interviews. Walk-throughs.	Employee satisfaction with: - Workplaces - Collaborative space - Indoor environment
Image	Move to a new location. High quality surroundings. Reorganisation of spatial layout.	Stakeholder surveys. Group discussions. Analysis of social media	Perceptions of Corporate identity, Corporate value, Corporate brand
Culture	More open settings to support collaboration. Shared desks/places. New behavioural rules.	Employee surveys. Observations. Interviews. Workshops.	Perceptions of - Corporate culture - Match between culture and work environment
H&S	Higher level of personal control. Ergonomic designed furniture. Better indoor air quality	Capture and react on complaints. Workplace H&S assessment.	Sick leave. Number of accidents. % of satisfied employees.
Productivity	Higher level of transparency to support collaboration. Facilities for concentrated work. Ergonomic furniture.	Observations. Measuring time spent or saved. Employee surveys.	Output per employee. Perceived support of: - Individual productivity - Team productivity
Adaptability	Surplus of spaces, load-bearing capacity, installation capacity, and facilities. Removable and relocatable units and building components.	Building performance assessment, i.e. using Flex 2.0 or Flex 2.0 Light. Observation of adaptations of the building-in-use.	Weighted assessment values, i.e. scores on scales of Flex 2.0 or Flex 2.0 Light.
Innovation and Creativity	Better visibility and overhearing. Different types of meeting spaces and informal areas. Virtual knowledge sharing ICT.	Spatial network analysis. Social network analysis. Logbooks on knowledge sharing activities.	Level of enclosure/openness. Average walking distance. Diversity of workspaces and meeting places.
Risk	Emergency and recovery plans. Back-up supply systems. Insurances.	Measuring time of business interruptions. Measuring risk expenses	Uptime of critical activities. Total risk expenses. Total insurance expenses.
Cost	Cost saving by - Establishing FM department - Process optimization - Outsourcing	Accounting with an appropriate cost structure. Measuring space, number of workstations and f.t.e.	Cost/m <sup>2</sup> , workstation or fte of Total FM, Space, Workplace
Value of Assets	Disposal of CRE. Sale and lease back. Improve owned CRE by adaptive reuse.	Estimate annual potential gross income and annual operational expenses. Market valuation. Estimate cost of new development.	Capitalization. Market value. Cost of new development.
Sustainability	Sustainability framework. Reduction of energy consumption. Reduction of travel and transport activities.	Critical success factors from corporate strategy Survey with multi-criteria scoring methodology Continuous review process.	Consumption of primary energy and water. CO <sub>2</sub> emissions. Access to transport.
Corporate Social Responsibility	Employing challenged workers. Promoting public transport. Circular purchasing model.	Depends on corporate CSR policy and target.	People: diversity of staff Planet: Utilization of space Profit: Total FM/CREM cost

Figure 2 Examples of input -&gt; output -&gt; outcome -&gt; added value chains



## 2.4 Act

The Act-phase is quite similar to the Plan-phase but starts from a different situation. Whereas the Plan-phase may start with an analysis of changing internal or external circumstances or a strategic analysis of the strengths and weaknesses of the organisation and FM/CREM products and processes, these factors are already known in the Act-phase. When all objectives have been attained and maximum value has been added, the Act-phase may include consolidation of the new situation, until new drivers to change come to the fore. If the objectives are not sufficiently attained or not optimally, or if too many negative side effects come to the fore, new interventions or broadening or strengthening of earlier interventions should be considered. Another option is to reconsider the objectives. It may happen that the aimed performance was not realistic and feasible within the current conditions. Moreover the context or conditions of the original objectives may be changed, which might force the organization to change its organizational and/or FM/CREM strategy. If new or revised interventions have to be implemented, the Plan- and Do-phases start again.

## 3 FUTURE PERSPECTIVES

In this paper we tried to connect existing models and tools to the original simple Value Adding Management model in order to make the VAM cycle more instrumental and practically applicable. Whereas many different tools are available, so far these tools are usually not integrated in a step-by-step approach. Besides, most tools focus on FM/CREM performance (output) and much less on assessing the contribution of FM/CREM to organisational performance (outcome). In much research a valuation of the trade-off between benefits and sacrifices in connection to organisational objectives (added value) and interrelationships is often lacking as well (Jensen and Van der Voordt, 2015a, 2015b).



An interesting next step could be to explore the similarities and dissimilarities between various FM/CREM models and generic management models and to integrate “the best of” in the new VAM model. This requires intensive collaboration with other support functions and knowledge fields such as HR, ICT, Finance, Marketing and PR.

Another next step could be to connect all tools to measure FM/CREM and organisational performance and related KPIs that are presented in Table 1 with other lists of KPIs such as the ones mentioned by Lindholm and Nenonen (2006) and Lavy et al. (2010, 2014). A third topic for future research is to further elaborate input -> output -> outcome -> added value relationships and to integrate current qualitative and quantitative data-collection methods to get clear and evidence-based pictures.

## ACKNOWLEDGMENTS

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## 2.3 How Real Estate and Facilities Management can contribute to value creation in different organizations

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### ABSTRACT

**Purpose:** This paper presents findings from the research project “Oscar – Value for Users and Owners of Buildings”, and investigates two research questions: i) What in early phase planning of real estate projects and facilities management creates value for owners and users of buildings? ii) Do respondents in private enterprises, public administrations and hybrid organizations have different opinions concerning what and how creates value for owners and users of buildings?

**Design/methodology/approach:** This study is based on a national survey (N = 837) among Norwegian owners and users of buildings. The data have been analysed through descriptive statistics, ranking of the means and one-way ANOVA.

**Findings:** Many owners and users of buildings have a short term financial focus and seem to overlook recent research concerning value creation. There are some interesting organization specific differences.

**Practical implications:** Our research provides guidelines concerning how real estate and facilities management can create value for owners and users of buildings in private enterprises, public administrations and hybrid organizations.

**Originality/value:** This is an empirical study with a significant number of respondents. Further empirical research is needed to establish whether it is possible to generalize the Norwegian results.

### Keywords

Facilities Management, Real Estate, Value creation, Ranks.

## 1 INTRODUCTION

How do Real Estate (RE) and Facilities Management (FM) contribute to value creation and enhance people and business in different categories of organizations? This study has investigated this question in different categories of Norwegian organizations, namely private enterprises, public administrations and hybrid organizations. Private enterprises can usually rely on the market and shop for the best premises and services. Inappropriate RE can be sold, and tenancy agreements can be renegotiated or abandoned. Public administrations often have

less room for manoeuvre. A public administration's location and annual budgets are usually results of political processes. The Norwegian public administration's FM is usually taken care of by in-house service providers. Hybrid organizations are current or former public administrations fully or partly owned by other public administrations (government, counties, municipalities, etc.) that often operate almost as private enterprises. Most Norwegian hybrid organizations, except the hospitals, buy many of their facility services from third party service providers. However, hybrid organizations usually have to find a balance between the public sector and the market's logics. Hybrid organizations often have to cope with a large number of stakeholders which often have divergent interests.

This paper presents some preliminary findings from the research project Oscar 'Value for owners and users of buildings', which is funded by the Norwegian Research Council and organized and managed by Multiconsult. Oscar was established in 2014, and will continue until December 2017. The research is conducted by 22 project partners from academia, and private and public sector organizations in Norway, Slovenia, and Germany. The name Oscar is given by Oscar Wilde's statement from *The picture of Dorian Gray*: 'A fool is a man who knows the price of everything, but the value of nothing'. The aim of Oscar is to develop knowledge, methods and tools that enable the optimization of the building design given the owners and users' needs. The basis for Oscar is an assumption about clear connections between the design and operation of the buildings and values for owners and users. The life cycle aspect is essential both as an input in early phase planning, and during the following phases, including the user phase.

Oscar's value contribution map is designed on the basis of the European FM standard EN15221, and contains two headings, namely 'space and infrastructure' and 'people and organization'. The value creation is understood as a result of the interaction between 'space and infrastructure' and 'people and organization' as well as value contributions from among others planners, architects, consultants, contractors, deliveries, Facility Managers and service providers.

This paper investigates two research questions:

- What in early phase planning of RE projects and FM creates value for owners and users of buildings?
- Do respondents in private enterprises, public administrations and hybrid organizations have different opinions concerning what creates value for owners and users of buildings?

## 2 VALUE AND VALUE CREATION

The value of the property itself as well as value of its uses should be important for all stakeholders in the RE and FM fields. The basic value system is defined by Rokeach (1960) as a relatively robust organization and structure of beliefs that pertain to the more desirable individual and social forms of behaviour and finite states of existence in the continuum of relative significance. Temeljotov (2005) states 'every environment surrounding 'humanity' has certain features, characteristics that need special attention, simply because they are very important for humans, their life, survival, living, leisure and work'.

Value creation is not yet a clearly defined concept. In the RE and FM field it goes in line with added value ability of real estate decisions, processes and inputs to create shareholder's

wealth (Jensen et al., 2012, Lindholm, 2008). Value creation is of great importance in business to business (B2B) marketing (Menon et al., 2005). Coenen et al. (2012) propose FM as a 'Value network' - network of relationships, which creates perceived value amongst key stakeholders (clients, customers and end users). Hjelmbrække and Klakegg (2013) state that human activity cause value creation, and that human activity is the only source of new value. Hjelmbrække and Klakegg (2013) consider value as a multidimensional concept, both as nouns (use value and exchange value), as a process (value creation), value propositions and captured value. Coenen et al (2012) prepared a list of multiple dimensions of FM value: exchange value, use value, environmental value, relationship value and financial value, and emphasized that key stakeholders are seen as an integrated economic system to co-create value in FM.

Through the literature review we found various value elements that assure the increasing value contribution of RE and FM both to the built environment, and to organizations and end users. From the user perspective, the value elements are connected with better living condition, like: sustainability, adaptability, reliability, flexibility, and perceived benefits (Sarasoja and Aaltonen, 2012; Valen et al., 2014; Haynes, 2008; Menon et al, 2005; Thomson, 1990; Zeithaml, 1988). For business the focus concerning value elements is harmonization of resources and provision (Coenen et al, 2012; Jensen et al, 2012; Boge, 2012; Huovila, 2012). These authors present a number of different definitions and focus points on added value of FM, depending on academic field and area of application. Different research perspectives in combination provide a holistic view by integration of an external market based view (aimed output) and the internal resource based view (input from FM and RE).

In the field of FM there has typically been more discussions about value creation seen through the lenses of conceptual models rather than substantial and empirical studies or evidence based research. Most empirical studies have been small N cases with special focuses. But Jensen and van der Voordt's (2015) review of research papers submitted to EFMC2013, 2014 and 2015 indicate a growing number of empirical studies, hereunder some studies based on large N surveys and quantitative methods. Kaczmarczyk and Murtough (2002) propose innovative officing as a new approach for delivering productive environments with holistic integration of people, space and technology to consider well-being and morale of employees, work settings, cost effectiveness and sustainability. Good discussions about value creation (and the opposite) were raised by Gorgievski et al. (2010) on post-occupancy evaluation of new ways of working, by Maarleveld et al (2009) on a working environment diagnostic tool, and by Zalejska-Jonsson (2014) on interior environment as a value for users of buildings. Göcer et al. (2015) show the requirements for buildings, what creates value. Junnila (2004) stressed the importance of facility activities in the environmental strategy of companies. The concept of value adding management was tested by Jensen and Katchamart (2012) in the Lego case and by den Heijer and de Jonge (2012) on university campus. Arditi et al. (2015) discuss capturing of value through construction of so-called smart buildings.

In Norway in recent years, there has been an increasing interest and focus on LCC, especially after revision of the public procurement law (Listerud et al, 2012), in which the net present value (NPV) calculations of the consequences of the investments over a defined period of time are required. From the perspective to make better decisions, clients can calculate different alternatives of investments.

An ongoing Nordic project ‘Sustainable refurbishment’ (2013-2015) shows that building adaptability in terms of possible reconstruction/refurbishment for changed use is one of the most important measures for achieving an effective long term environment for the business. From the hospital sector it was often seen that neglecting the adaptability perspective can lead to higher long term costs for core business (Department of National Health and Welfare, 1979, by Valen et al., 2014). Building adaptability can also affect the possibility for differentiated modifications and therefore also the organization's efficiency.

Through several years of work with strategic analyses, development planning and feasibility studies for RE portfolios and existing buildings, both in public and private sectors Bjørberg et al. (2012) found remarkably many indications of unfortunate technical solutions, detailed design and materials, even within new buildings. This leads to unnecessarily high operating and maintenance cost, increased replacement rate and negative impact on core business, and in the worst cases HSE (Health, Safety, Environment) related issues. A large proportion of the buildings, 31%, are assessed as ill-suited and/or inefficient seen from operational level, and with poor usability (Larsen and Bjørberg, 2013). In many instances these shortcomings are too costly for adjustments, and substantially reduce the functional life of the buildings.

According to a Norwegian definition (NOU: 22:2004) ‘good property management is to give the users satisfactory and efficient buildings at the lowest possible costs/use of resources’. In addition to this a government white paper Meld. St. 28 (2011-2012) points out the sustainability element in properties and states that ‘sustainable properties create the best usability for the core business over time and meet the demands of the owners, property managers and society’.

### 3 METHODOLOGY

The data presented in this paper have been collected through a national online survey from May until mid-October 2015. The survey was distributed to employees in the organizations participating in Oscar’s consortium, and to several others. The main channels for distributing the invitation to participate in the survey were business sector organizations in the RE, construction and service industries.

The respondents (N = 837) who answered the web survey were not recruited through random sampling. It is thus not possible to generalize the results. But the respondents included several managers and employees from the major actors in the Norwegian RE business, and a number of internal and third party service providers. The sample thus gives a fairly representative picture of Norwegian owners’ and even users on tactical level (customer) perspectives on RE and FM.

The questionnaire begins with questions about the respondent’s background. In Q8 the respondent is asked about her or his perspective (owner or user) when answering the remaining questions concerning Q9 the economic dimension (11 items + open question), Q10 the social dimension (11 items + open question), Q11 the environmental dimension (9 questions + open alternative) and Q12 the physical dimension (11 items + open question). This paper emphasizes the four value dimensions Q9, Q10, Q11 and Q12. All the 42 items (variables) in Q9 to Q12 have a four item Likert scale ranging from 1 = ‘No emphasis’ to 4 = ‘Very high emphasis, and ‘Don’t know/Not relevant’. The ‘Don’t know/Not relevant’ answers are coded as missing.

The survey data have been analysed with IBM SPSS version 22, through use of descriptive statistics (frequency, mean, cross tables, etc.), ranking of the means and analysis of variance (One-way ANOVA). ANOVA is a common method for testing whether two or more groups have significantly different means (Iversen and Norpoth, 1987). Those groups that have been subject to one-way ANOVA analysis have first been through Levene's test to verify that the groups have equal variance. A Levene's test with significance less than 0.05 indicates different variance, which means the data are not suitable for ANOVA (Field 2013, p. 193, 466-467). Scheffe's test has similarly been used to test the differences between three or more categories, to figure out which differences that are statistically significant different from the mean.

## 4 RESULTS

This section first provides an overview of the respondents (N=837). The next subsections present the results concerning the questionnaire's four value dimensions, namely the economic, social, environmental and physical dimensions.

### 4.1 The respondents

Table 1 provides an overview of the respondents' employer and gender.

Table 1 The respondents' employer and gender

<b>Employer</b>	<b>Female (%)</b>	<b>Male (%)</b>	<b>Total (%)</b>
Private enterprise	82 (17.9)	377 (82.1)	460 (55.0)
Public administrations	67 (25.2)	199 (74.8)	266 (31.8)
Hybrid organizations	24 (21.6)	87 (78.4)	111 (13.3)
Total	173 (20.7)	663 (79.3)	837 (100.0)

Almost 87 percent of the respondents are employed by private enterprises and public administrations. Almost 80 percent of the respondents are men. Most of the female respondents are employed by private enterprises and public administrations.

The respondents' age (N = 832) ranges from 22 to 83 years. The mean age is 49.71 years. The median age is 50. Most respondents are in their forties and fifties. RE and FM is often considered as the grown up persons' industries. This is clearly the case here.

Table 2 The respondents' education

Respondents' education	Female (%)	Male (%)	Total (%)
Engineering	96 (16.0)	504 (84.0)	600 (71.9)
Business administration	26 (30.6)	59 (69.4)	85 (10.2)
Architecture	21 (38.9)	33 (61.1)	54 (6.5)
Other educations	12 (25.5)	35 (74.5)	47 (5.6)
Finance, investment, law	12 (40.0)	18 (60.0)	30 (3.6)
Social science and humanities	5 (26.3)	14 (73.7)	19 (2.3)
Total	172 (20.6)	663 (79.4)	835 (100.0)

Table 2 shows the respondents' education, sorted in diminishing order. The great majority of respondents are engineers. Other common educations are business administration, architecture, other educations (craftsmen, etc.), and finance, investment and law.

The respondents' two most common roles are property and land owner (N= 198, 23.7 percent) and consultant engineer (N= 170, 20.4 percent). The third most common role is property manager (N =149, 16.1 percent). Only 27 of the respondents (3.2 percent) represent tenants or users. 19 (2.3 percent) represent FM service providers.

425 (51.0 percent) of the respondents have been involved in early phase development of RE. 472 (56.6 percent) have been involved in the construction phase. 284 of the respondents (34.1 percent) have been involved in the operation and FM-phase.

What kind of RE projects have the respondents been involved in? 437 (52.5 percent) have been involved in commercial premises and offices. 305 (36.7 percent) have been involved in housing projects. 249 (29.9 percent) have been involved in schools. 217 (26.1 percent) have been involved in facilities for assisted living. 167 (20.1 percent) have been involved in facilities for higher education. 149 (17.9 percent) have been involved in cultural facilities. 129 (15.5 percent) have been involved in hospitals. 115 (13.8 percent) have been involved in sports facilities. 103 (12.4 percent) have been involved in other projects, such as for instance military installations. Finally, 25 (3.0 percent) have been involved in prisons. The respondents have thus been involved in most kinds of RE projects.

Which perspective have the respondents chosen for the items in the four value dimensions? 569 (69.9 percent) have chosen the owner perspective, while 245 (30.1 percent) have chosen the user perspective. It is important to be aware that very few of those who answered the value dimension items with user perspective represented the end users of the buildings. Most of the respondents have positions at strategic (client) or tactical (customer) level in their organizations.

#### 4.2 The economic dimension

Table 3 provides an overview of the respondents' mean answers concerning the 11 items in the economic dimension in descending order, and standard deviation (SD) and rank within the economic dimension and the item's total rank in the four value dimensions. The answer alternatives in four value dimensions range from 'No emphasis' (1) to 'Very high emphasis, (4).

The two most important items, according to their means and total ranks, are Investment costs (1<sup>st</sup> of 42 items) and Effect on core business (2<sup>nd</sup> of 42) and Energy cost (6<sup>th</sup> of 42). Life cycle cost (21<sup>st</sup> of 42), cost efficient cleaning (30<sup>th</sup> of 42) and cost efficient services (36<sup>th</sup> of 42) are



less important. Market value in case of sale is least important (39<sup>th</sup> of 42). The items in the economic dimension have larger SD than the items in the other value dimensions. Large SDs indicates more variation in the respondents' view concerning the economic dimension's items than in the other three value dimensions.

Do owners and users have statistically significant different means on some of the items in the economic dimension? Yes, one-way ANOVA revealed that owners (2.84) have significantly higher mean than users (2.58) on Life cycle costs (DF = 1, F = 9.689, sign = 0.002), and users (2.72) have significantly higher means than owners (2.31) on Total cost per workspace in the building's operational phase (DF = 1, F = 19.880, sign = 0.000).

Table 3 The economic dimension

Item	N	Mean	SD	Ranks in dimension	Ranks total
Investment costs †	653	3.39	.698	1	1
Effect on core business	652	3.28	.725	2	2
Energy costs	658	3.07	.774	3	6
The building's economic life span (NPV of cash flow)	632	2.90	.828	4	12
Life cycle costs *	637	2.77	.886	5	21
Economic risk	591	2.61	1.012	6	29
Cost efficient cleaning †	623	2.55	.826	7	30
Total cost per workspace in the operational phase *	584	2.42	.978	8	34
Yield †	548	2.42	1.083	8	34
Cost efficient services (front desk, catering, security, etc.) †	593	2.39	.823	10	36
Market value in case of sale	590	2.30	1.111	11	39

\* Statistically significant different mean (min. sign 0.050) between owners and users.

† Statistically significant different mean (min. sign 0.050) between respondents in private enterprises, public administrations and hybrid organizations.

A one-way ANOVA similarly revealed that respondents in private enterprises (3.45) and hybrid organizations (3.43) have statistically significant (DF = 2, F = 4.179, sign = 0.016) higher means concerning investment costs than respondents in public administrations (3.28) Respondents in private enterprises (2.41) similarly have significantly (DF = 2, F = 9.47, sign. = 0.000) lower mean on cost efficient cleaning than respondents in public sector (2.69) and hybrid organization (2.70). The respondents in private enterprises (2.85) have a significantly (DF = 2, F = 54.299, sign = 0.000) higher mean on Yield than respondents in hybrid organizations (2.12) and public administrations (1.91).

### 4.3 The social dimension

Table 4 provides an overview of the respondents' answers to the 11 items in the social dimension.

Table 4 The Social dimension

Item	N	Mean	SD	Ranks in dimension	Ranks total
User involvement	613	3.00	.791	1	8
Security and safety (protection against unwanted incidents)	619	2.98	.802	2	9
Workplaces facilitating flexible ways of working *	597	2.96	.800	3	10
Architectonic qualities	617	2.84	.735	4	16
Owner governance	591	2.84	.756	4	16
Interior qualities facilitating well-being and tidiness *	612	2.81	.747	6	18
Areas facilitating formal and informal meetings *	591	2.78	.780	7	20
Orientable (intuitive signs, etc.) †	604	2.74	.819	8	23
Promoting pride (organization's cultural values)	599	2.68	.841	9	25
Individual management of sunscreens, light, temperature, etc.	608	2.67	.814	10	26
Facilities for physical activities (gym, wardrobes, etc.)	564	2.25	.847	11	40

\* Statistically significant different mean (min. sign 0.050) between owners and users.

† Statistically significant different mean (min. sign 0.050) between respondents in private enterprises, public administrations and hybrid organizations.

Many of the items in the social dimension have higher means and smaller SD than the economic dimension's items. The three most important items in the social dimension given the means and total ranks are User involvement (8<sup>th</sup> of 42 items), Security and safety (9<sup>th</sup> of 42) and Workplaces facilitating flexible ways of working (10<sup>th</sup> of 42).

Do owners and users have statistically significant different means on some of the items in the social dimension? Users (3.08) have significantly (DF = 1, F = 5.076, sign = 0.025) higher mean on Workplaces facilitating flexible ways of working than owners (2.92). Users (3.01) also have significantly (DF = 1, F = 18.007, sign = 0.000) higher means on Areas facilitating formal and informal meetings than owners (2.70). Finally, users (2.96) have significantly (DF = 1, F = 8.502, sign = 0.004) higher means than owners (2.76) on Interior qualities facilitating well-being and tidiness.

Only one item in the social dimension has similar variance across the three categories of respondents, and pass Levene's test. That is Orientable buildings, where respondents from private enterprises (2.65) have significantly (DF = 2, F = 3.946, sign = 0.020) lower mean than respondents from hybrid organizations (2.84) and public administrations (2.83). Thus, respondents in private enterprises seem to be less concerned about orientable buildings than respondents in hybrid organizations and public administrations.

#### 4.4 The environmental dimension

Table 5 provides an overview of the respondents' answers to the 9 items in the environmental dimension.

The most important items in the environmental dimension according to the means and total ranks are Energy efficiency (3<sup>rd</sup> of 42 items) and Indoor climate and comfort (4<sup>th</sup> of 42). The least important are Environmental certification (41<sup>st</sup> of 42) and Use of recycled/recyclable materials (42<sup>nd</sup> of 42).

Table 5 The environmental dimension

Item	N	Mean	SD	Ranks in dimension	Ranks total
Energy efficiency	600	3.19	.739	1	3
Indoor climate and comfort	598	3.17	.720	2	4
Use of materials and components with long life	602	2.96	.795	3	10
Use of renewable energy sources, reduced influence on the external environment * †	597	2.90	.808	4	12
Use of environmental friendly /labelled products	595	2.70	.801	5	24
Facilities for efficient waste management	591	2.63	.785	6	27
Greenhouse gas emissions during the building's life-span (LCA) †	575	2.37	.895	7	37
Environmental certification (BREEAM, etc.)	572	2.17	.919	8	41
Use of recycled/recyclable materials	577	2.06	.796	9	42

\* Statistically significant different mean (min. sign 0.050) between owners and users.

† Statistically significant different mean (min. sign 0.050) between respondents in private enterprises, public administrations and hybrid organizations.

Do owners and users have statistically significant different means on some of the items in the environmental dimension? The owners (2.95) have a significantly (DF = 1, F = 7.355, sign = 0.007) higher mean on Use of renewable energy sources than users (2.74).

Do the respondents from the different organizations have significant different means on some of the items in the environmental dimension? Yes, respondents from public administrations (3.01) and hybrid organization (2.98) have significantly (DF = 2, F = 5.338, sign = 0.005) higher mean on Renewable energy sources than respondents from private enterprises (2.79). Respondents from public administrations (2.50) similarly have significantly (DF = 2, F = 3.898, sign = 0.002) higher mean on Greenhouse gas emissions than respondents from hybrid organizations (2.41) and private enterprises (2.37). Thus respondents employed in public administrations and partly also hybrid organizations seem to be somewhat more concerned with environmental issues than respondents employed in private enterprises.

#### 4.5 The physical dimension

Table 6 provides an overview of the respondents' answers to the 11 items in the physical dimension.

The two most important items in the physical dimension based on the means and total ranks are Accessibility and universal design (5<sup>th</sup> of 42 items) and Area use (7<sup>th</sup> of 42). Generality is least important (38<sup>th</sup> of 42). The low total ranks for Life cycle planning (32<sup>nd</sup> of 42) and Innovative solutions (33<sup>rd</sup> of 42) may indicate that recent research based recommendations concerning increased value through RE and FM have not trickled down to every owner and user of buildings.

Owners and users do not have significantly different means in any of the physical dimension's items. Do respondents from private enterprises, hybrid organizations or public administrations have different means on any of the items in the physical dimension? The respondents employed by private enterprises (2.93) have significantly (DF = 2, F = 6.021, sign. = .003) higher mean on the buildings' flexibility than employees in hybrid organizations (2.77) and public administrations (2.67). That is also the case for parking facilities for cars where employees in private enterprises (2.78) have significantly (DF = 2, F = 30.523, sign.

=0.000) higher mean than employees in public administrations (2.35) and hybrid organizations (2.22).

Table 6 The physical dimension

Item	N	Mean	SD	Ranks in dimension	Ranks total
Accessibility and universal design	587	3.13	.718	1	5
Area use (logistics, movements of persons and goods, etc.)	582	3.06	.738	2	7
The existing building's technical condition in case of transformation and upgrading	543	2.87	.777	3	14
Suitable materials for intended use and life-span	585	2.86	.794	4	15
Flexibility (the possibility to change the building's floor plan, etc.) *	581	2.81	.835	5	18
Parking facilities for bicycles	580	2.75	.807	6	22
Elasticity (possibility to change the building's volume, use, etc.)	571	2.63	.836	7	27
Parking facilities for cars †	579	2.54	.773	8	31
Life cycle planning (integrated architecture and technology, long-term solutions, etc.)	570	2.52	.847	9	32
Innovative solutions	578	2.44	.795	10	33
Generality (the possibility to change the building's function, other uses, etc.)	566	2.34	.937	11	38

\* Statistically significant different mean (min. sign 0.050) between owners and users.

† Statistically significant different mean (min. sign 0.050) between respondents in private enterprises, public administrations and hybrid organizations.

## 5 CONCLUSION

This paper has investigated two research questions. Firstly, what in early phase planning of RE projects and FM creates value for owners and users of buildings? Secondly, do respondents in private enterprises, public administrations and hybrid organizations have different opinions concerning what and how creates value for owners and users of buildings?

The answer to the first question, namely what in early phase planning of RE projects and FM creates value for owners and user of buildings is Investment costs (economic dimension) (rank 1), Effect on core business (economic dimension) (rank 2), Energy efficiency (environmental dimension) (rank 3), Indoor climate and comfort (environmental dimension) (rank 4), Accessibility and universal design (physical dimension) (rank 5) and Energy costs (economic dimension) (rank 6). The economic logic is clearly dominant, and RE issues seems to be more important for value creation for our respondents than FM issues. This is most likely because of more respondents with an owner than user perspectives, because RE is more capital intensive than FM, and probably also because FM's influence on the core business' performance is not always straightforward and easy to recognize.

One way ANOVA of the items' means revealed that owners have significantly higher means than users on Life cycle costs and Use of renewable energy sources, and that users have significantly higher mean than owners on Total cost per workspace in the operational phase, on Workspaces facilitating flexible ways of working, on Areas facilitating formal and informal meeting, and on Interior qualities facilitating well-being and tidiness.

Do respondents in private enterprises, public administrations and hybrid organizations have different opinions concerning what and how creates value for owners and users of buildings?

One-way ANOVA revealed that respondents in private enterprises and hybrid organizations have significantly higher means on Investment costs (rank 1) than respondents in public administrations. Respondents in public administrations and hybrid organization have significantly higher means on Use of renewable energy sources (rank 12) than respondents from private enterprises. Respondents in private enterprises have significantly higher mean on the buildings' Flexibility (rank 18) than employees in hybrid organizations and public administrations. Respondents in private enterprises also have significantly lower mean on Orientable buildings (rank 23) than respondents in hybrid organizations and public administrations. Respondents in private enterprises have significantly lower mean on Cost efficient cleaning (rank 30) than respondents in public sector and hybrid organization. Respondents in private enterprises have significantly higher mean on Yield (rank 34) than respondents in hybrid organizations and public administrations. Respondents in private enterprises have significantly higher mean on Parking facilities for cars (rank 31) than employees in public administrations and hybrid organizations. Finally, respondents in public administrations have a significantly higher mean on Greenhouse gas emissions (rank 37) than respondents in hybrid organizations and private enterprises.

Further research, preferably in other countries than Norway is necessary to investigate whether we have stumbled across some general patterns concerning value creation from RE and FM, or if the findings are site and context specific for Norway.

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## **3 SERVICE EXCELLENCE**

### **3.1 THE IMPORTANCE OF PERSONALITY FOR END-USER SATISFACTION IN MULTI-TENANT OFFICES**

LIZANNE HARTOG, RIANNE APPEL-MEULENBROEK AND MINOU WEIJS-PERRÉE

### **3.2 A RESEARCH-BASED PROFILE OF A DUTCH EXCELLENT FACILITY MANAGER**

ANKE ROOS-MINK, JOHAN OFFRINGA, ESTHER DE BOER, MARJOLEIN HEIJNE, MARK P. MOBACH AND MARCA V.C. WOLFENSBERGER

### **3.3 SERVICE DELIVERY IN FM: ENHANCEMENT OR ENCHANTMENT?**

PATRICIA MCCARROLL



### 3.1 The importance of personality for end-user satisfaction in multi-tenant offices

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#### ABSTRACT

**Purpose:** Many different multi-tenant office types have arisen over the last decades, because owners/managers address the need of users to share facilities with other (small) organisations. However, existing literature on multi-tenant buildings from the point of view of end-user satisfaction is scarce, limiting input for user-centred design. Therefore, the aim of this study is to analyse the influence of personality on end-user satisfaction with multi-tenant office characteristics.

**Design/methodology/approach:** Data was collected through a questionnaire on user-satisfaction with 10 categories (containing 42 characteristics) of multi-tenant office variables and the Big Five personality traits. This was distributed in 17 different multi-tenant offices and yielded 190 respondents.

**Findings:** To determine the effect of personality a multiple regression model was performed per office variable category. Results showed that users who are extravert, open to experience and agreeable were more satisfied with 'office décor', 'seclusion rooms', 'washroom facilities', 'flexible workplaces' and 'privacy'. Only end-user satisfaction with 'entrée and atrium', 'ICT/equipment' and 'indoor climate' was not affected by personality.

**Originality/value:** Owners, developers and managers can use these results for developing user-centred designs, to optimise the level of satisfaction and to increase the well-being in their offices. This should decrease vacancy problems. This study also started building theory on end-user satisfaction in multi-tenant buildings, which could be further developed by studies with larger samples in different countries.

#### Keywords

User satisfaction, Personality, Multi-tenant offices, Multiple regression analyses.



## 1 INTRODUCTION

In general, it is important that the work environment has a positive effect on individual behaviour, as people spend a substantial part of their lifetime in a work environment (Earle, 2003). Since the sixties, the relationship between individual behaviour and the work environment has been recognised and received increased attention (Craik, 1966; Moore, 1980). For instance, researchers have recognised that the work environment could influence satisfaction with the work environment (O'Neill, 1994), the productivity (Gensler, 2005), job performance (Vischer, 2008), job satisfaction (Koster, 2009), creativity (McCoy, 2005) and stress levels (McCoy & Evans, 2005). In addition, studies have shown that the work environment has a significant effect on employees' feelings (Reijula et al., 2011).

Existing literature showed that knowledge about user experience is important for the development of work environments (e.g. Lindahl et al., 2010). User experience can be measured by user satisfaction because it is outcome-oriented and focusses on the functionality of elements of the work environment (Schmitt, 1999; Vischer, 2006). So far, prior research has focussed on the satisfaction of users with single-tenant office buildings, studying the relationship between individual behaviour and the physical characteristics of single-tenant offices, including layout, atmosphere and facilities (e.g. Mawson, 2002; Vischer, 2008). Opposed to single-tenant building satisfaction, research into the user satisfaction with multi-tenant offices is very limited.

The multi-tenant office is defined in prior research as '*a building with a number of spaces and possible some common facilities and/or services, which are offered to multiple organisations*' (Calder & Courtney, 1992; Weijs-Perrée et al., 2015). It appeared from the existing literature that the physical characteristics of a multi-tenant office such as facilities, representative interior and comfortable indoor climate were valued aspects for tenants (Ketting, 2014). Other valued aspects, supported by the physical characteristics of multi-tenant offices, were the flexibility and the possibility to share knowledge (Ketting, 2014). However, little is known about the user satisfaction with these characteristics of multi-tenant offices. Such knowledge could be valuable for the user-centred designs of multi-tenant offices.

Moreover, it is interesting to investigate the influence of personal characteristics of the users (e.g. personality traits) on user satisfaction with multi-tenant offices (Hills & Levy, 2014). Prior studies have shown that personal aspects were important for explaining user satisfaction (e.g. Hills & Levy, 2014; Volker & Van der Voordt, 2005). For instance, a recent study showed that employees were more satisfied with the physical work environment, if they can express their emotions and personality (Hills & Levy, 2014). So far, research into the relationship between personality traits and the physical work environment was limited.

Therefore, the aim of this study is to analyse the relationship between personality of users and their satisfaction with the physical characteristics of multi-tenant offices. With multiple regression analyses the data collected through questionnaires from 190 respondents of 17 different Dutch multi-tenant offices were analysed.

The next section reviews the existing literature on multi-tenant offices, user satisfaction and personality. The third section describes the methodology and data collection, followed by the analyses and results in the fourth section. The final section contains the conclusion and discussion.

## 2 MULTI-TENANT OFFICES AND THEIR USERS

Multi-tenant offices have emerged during the sixties in the US. The multi-tenant office was an Anglo-Saxon invention to accommodate small companies and to strengthen the local economic structure (Van den Berg & Stijnenbosch, 2009). Moreover, companies have clustered together because of the benefits such as sharing facilities and services, sharing knowledge and creating cost-savings. Multi-tenant offices provide shared office space, shared services and facilities that support companies. They can offer competitive advantages compared to other general offices (Fuji et al., 2014; Ketting, 2014). Different trends have underlain the increased demand for office space in the multi-tenant offices, such as technology changes, internationalisation (McAllister, 2001), individualisation, emancipation (Somsen, 2002), economic changes and the changing awareness of flexibility (Ouye, 2011). Prior research showed that multi-tenant offices can be divided into different multi-tenant office concepts. For example, Weijs-Perrée et al. (2015) classified four different multi-tenant offices, namely regular business centres, incubators, serviced offices and co-working places.

Multi-tenant offices offer flexible space for different types of users, from large organisations to start-ups and freelancers (e.g. Weijs-Perrée et al., 2015). Personality of users was mentioned as an underexposed and interesting subject in relation to user satisfaction. There are a few empirical studies that report the relationship between personality traits and user satisfaction (Hills & Levy, 2014). For instance, Oseland (2009) observed that peoples' satisfaction with their work environment may be influenced by their personality in single-tenant buildings and this highlighted the challenge to create work environments that reflect users' personalities. Other studies recognised the relationships between personality and workplace (Matzler et al., 2007), job satisfaction (Judge et al., 2000), work involvement (Bozionelos, 2004) and personalisation of the workplace (Wells & Thelen, 2002). Several of these studies have used the personality traits of the Big Five (i.e. extraversion, agreeableness, conscientiousness, emotional stability and openness to experience) to take the personal aspects of people into account in their research. However, the relationship between personality and user satisfaction with the physical characteristics of multi-tenant offices has not yet been studied.

## 3 SATISFACTION WITH THE PHYSICAL WORK ENVIRONMENT

User satisfaction refers to the level that the office and work environment meets the wishes and needs of the user (e.g. the functionality of this space and the level of physical, functional and psychological comfort) (Van der Voordt, 2003; Schmitt, 1999). Many studies have investigated the relationships between user satisfaction, offices and the work environment (e.g. Frontczak et al., 2012; Rothe et al., 2011) and provided lists of relevant work environment characteristics.

In this study, the selection of physical characteristics was derived from previous studies on single-tenant offices (e.g. Batenburg & Van der Voordt, 2008; De Been & Beijer, 2014; Zimring et al., 2005), supplemented with specific aspects of multi-tenant offices from literature (e.g. Barrow, 2001; Fuji et al., 2014; Weijs-Perrée et al., 2015). The literature of single-tenant offices showed that different researchers used factor analyses to determine which characteristics can be summarised into categories. The categorisation used in this study

was partly based on the studies of Van Susante (2014) and Liebrechts (2013). The categorisation of both studies together was 'office décor', 'facilities and services', 'seclusion rooms', 'office leisure', 'ICT and equipment', 'privacy' and 'office climate'. The factor 'desk/chair' and 'storage', derived from the study of Van Susante (2014), were deleted in this study because it is more focused on the building level in general instead of the workplace level. The category 'location', 'office exterior and division' and 'flexibility' were added to the existing list because these categories were important for research on building level of multi-tenant offices (Price & Spicer, 2002).

In total, 42 dependent variables (physical characteristics of multi-tenant offices) were derived, which could be assigned to the following ten categories:

- Location;
- Office exterior and division;
- Office décor;
- Facilities and services;
- Seclusion rooms;
- Office leisure;
- Flexibility;
- ICT and equipment;
- Privacy;
- Office climate.

#### 4 METHOD

This study was a quantitative research with an exploratory character. Data of personality of users and the user satisfaction was collected using a designed questionnaire (online and paper- and pencil). A questionnaire is a reliable, objective method to collect information about people's knowledge, behaviour and opinion (Sapsford, 1999).

To measure personality, the Big Five taxonomy was used. This taxonomy is the most validated method to define personality traits of users. It is widely accepted and most commonly used by researchers (e.g. Bhatti et al., 2013; Judge et al., 2000). The Big Five consists of five domains, namely 'extraversion', 'agreeableness', 'consciousness', 'emotional stability' and 'openness to experience'. The TIPI (Ten Item Personality Inventory) was used to measure the Big Five personality traits. Respondents were asked about their agreement with ten statements on a seven-point Likert scale ranging from strongly disagree (1) to strongly agree (7) (Goslin et al., 2003). The ten statements were five pairs of two reverse scores of the five domains (Goslin et al., 2003).

Some of the 42 physical characteristics were combined into one question to simplify and shorten the questionnaire for users. In total, ten categories with 37 questions were included in the questionnaire. User satisfaction with these physical characteristics was measured by asking respondents about their satisfaction with these physical characteristics on a five-point Likert scale ranging from very dissatisfied (1) to very satisfied (5).

To reach users of multi-tenant offices, 30 building managers and building providers of different multi-tenant offices were asked (by email or phone) whether the questionnaire could

be distributed among tenants and users of their multi-tenant offices. The 17 participating multi-tenant offices differed in location (from A-locations to C-locations), size (from 20,000 m<sup>2</sup> to 500 m<sup>2</sup>), type of multi-tenant offices (8 regular business centres, 2 incubators, 1 serviced offices and 6 co-working spaces), appearance (from old renovated industrial factories to new designed office buildings) and number of tenants (from 130 to 10 tenants).

In total, a minimal number of 750 multi-tenant office users have received the questionnaire. Out of the distributed questionnaires, 224 questionnaires were returned. This gave an overall response rate of (at best) 30%. Unfortunately, 30 questionnaires were incomplete or unreliable. From the useful 194 questionnaires, 100 questionnaires were collected by the online questionnaire and 94 questionnaires were collected by distributing questionnaire personally a paper-and-pencil among users of multi-tenant offices. Multiple regression analyses (MRA) were used to explore the relationship between the dependent variables 'user satisfaction with physical characteristics' and the independent variables 'personality traits'.

## 5 DATA DESCRIPTION

The 190 building users that participated were aged between 17 and 68 years old. This wide range can be explained by the fact that multi-tenant offices have different users, such as students but also freelancers. The descriptive statistics of the personality traits are shown in table 1. The Cronbach's Alpha of 'extraversion' ( $\alpha=0.478$ ), 'agreeableness' ( $\alpha=-0.265$ ), 'conscientiousness' ( $\alpha=0.422$ ), 'emotional stability' ( $\alpha=0.362$ ) and 'openness to experience' ( $\alpha=0.484$ ) were lower than  $\alpha=0.7$  which indicated that the homogeneity was not high enough. However, a previous study used the same method and also had low Cronbach's Alpha's (Goslin et al., 2003). The personality traits were identified as interval variables. The personality of the respondents in the dataset can be described on average as follows: the respondents stated that they were extraverted and enthusiastic. Moreover, the most respondents stated that they are dependable, self-disciplined, sympathetic, calm, emotionally stable, open and curious to new experiences.

Data about the user satisfaction is also shown in Table 1. A reliability analysis of the ten categories showed that the physical characteristics that were included in the ten categories were not homogeneous enough to use only ten categories in the further analyses. So, 16 physical characteristics were composed and prepared for further analyses. Satisfaction in general was highest with accessibility and the availability of fixed workplaces. The personal control of indoor climate received the lowest satisfaction.

Also, it was interesting to evaluate the total user satisfaction because the mean of user satisfaction with different physical characteristics did not differ a lot. The total user satisfaction was created by the mean of all 37 'user satisfaction with physical characteristics' variables, with a Cronbach's Alpha of 0.932. Total satisfaction was fairly high, as it scored 3.54 on a scale of 5.

## 6 RESULTS

In total, 17 MRA's were performed (Table 2). The results of the analyses indicated that user satisfaction with several physical characteristics does depend on personality. Table 3 provides a complete overview of the tested significant effects, which are discussed below.

Table 1 Descriptive statistics

	N	Mean	Sd.
<b>Personality traits (scale 1-7)</b>			
Extraversion	190	4.285	1.159
Agreeableness	190	5.660	0.922
Conscientiousness	190	5.380	1.018
Emotional stability	190	5.495	0.887
Openness to experience	190	5.640	0.959
<b>User satisfaction with... (scale 1-5)</b>			
Accessibility by public transport	176	3.98	0.965
Fixed workplaces	160	3.87	0.584
Accessibility by car	178	3.81	0.971
Office exterior and division	190	3.73	0.718
Office décor	185	3.72	0.729
Flexible workplaces	160	3.63	0.733
Seclusion rooms	145	3.62	0.692
Canteen/restaurant/coffee/tea	176	3.61	1.041
Entrée and atrium areas	179	3.59	0.898
ICT and equipment	157	3.59	0.825
Adaptability furniture	146	3.58	0.845
Privacy	161	3.48	0.786
Facilities and services	99	3.39	0.521
Washroom facilities	188	3.23	0.984
Office climate	186	3.12	1.064
Personal control indoor climate	176	2.98	1.017
<b>Total user satisfaction with physical characteristics</b>	<b>190</b>	<b>3.54</b>	<b>0.461</b>

'Agreeableness' was found to positively influence user satisfaction with seven physical characteristics. Also, a significant effect was found between 'agreeableness' and the total user satisfaction.

The relationship between 'openness to experience' and user satisfaction with physical characteristics can be described as mainly positive. Users who were more open to experience were more satisfied with the 'office exterior and division', 'office décor', 'washroom facilities', 'fixed workplaces' and 'canteen/restaurant/coffee/tea'. A negative relationship was

found with user satisfaction with ‘adaptability of furniture’ but this can be caused by the non-adaptability of furniture in the specific multi-tenant offices. It was positively related to the total user satisfaction as well.

‘Extraversion’ had a negative effect on user satisfaction with ‘office décor’, ‘seclusion rooms’, ‘washroom facilities’ and ‘personal control of indoor climate’. Positive relationships were found with user satisfaction with ‘accessibility by car’ and ‘privacy’. It is interesting that ‘extraversion’ had a negative effect on the total user satisfaction with physical characteristics.

Table 2 Specification of MRA’s

User satisfaction with...	Model (5 personality traits as independent variables)		
	Adjusted R <sup>2</sup>	F	N
Accessibility by car	0.031*	2.090	173
Accessibility by public transport	0.012	1.406	169
Office exterior and division	0.024*	1.899	181
Office décor	0.013	1.531	179
Seclusion rooms	0.022	1.632	138
Entrée and atrium areas	-0.011	0.620	174
Washroom facilities	0.038**	2.429	183
Flexible workplaces	0.027	1.859	156
Fixed workplaces	0.084**	3.811	153
Adaptability furniture	0.048**	2.441	142
Personal control indoor climate	-0.001	0.953	171
ICT and equipment	-0.018	0.454	152
Office climate	-0.016	0.415	181
Total user satisfaction with physical characteristics	0.029*	2.089	182

\*\* and \* indicate respectively significance at the 95% and 90% confidence level

Only one significant positive relationship was found between ‘emotional stability’ and user satisfaction with ‘accessibility by public transport’, and only at the 90% confidence interval. No effect was found on the total satisfaction. So apparently, this trait has little effect on user satisfaction. The personality trait ‘conscientiousness’ did not significantly influence user satisfaction with any physical characteristic nor in total.

## 7 CONCLUSION AND DISCUSSION

The aim of this study was to analyse the workplace satisfaction among users of multi-tenant offices and to determine a possible effect of personality. This exploratory research revealed that personality significantly influences user satisfaction with physical characteristics of multi-tenant offices, specifically the personality traits 'extraversion', 'emotional stability' and

'openness to experience'. Besides these effects, the study also analysed the total user satisfaction with physical characteristics of multi-tenant offices, which in general was high.

The results of this study provided relatively new and interesting knowledge which could be useful for real estate owners and developers. Because of the oversupply of offices and industrial buildings in the real estate market, the vacancy rates are high and the market changed from a supply-driven into a demand-driven office market, with a focus on the demand of users. Real estate owners and developers have been forced to think about user-centred designs, hence real estate owners and developers try to develop offices that are distinctive due to high quality and valued aspects for users. Often, vacant single-tenant buildings are being transformed into multi-tenant offices, for which the results here can provide input.

Table 3 Relationships between personality and user satisfaction

		User satisfaction with ...																
		Accessibility by car	Accessibility by public transport	Office exterior and division	Office décor	Seclusion rooms	Entrée and atrium areas	Washroom facilities	Flexible workplaces	Fixed workplaces	Adaptability of furniture	Personal control indoor climate	ICT and equipment	Office climate	Facilities and services	Canteen/restaurant/coffee/tea	Privacy	Total user satisfaction
Personality traits	Extraversion	+																
	Agreeableness		+		+				+	+	+			+				+
	Conscientiousness																	
	Emotional stability		+															
	Openness to experience			++				+		+	-					+		+

	Significant at 95% confidence interval
	Significant at 90% confidence interval
+	Significant positive effect
-	Significant negative effect
	No significant effect

For future studies, including other variables could strengthen the analyses. The relatively low percentages of explained variance (maximal 8.4%) of all the performed models showed that there have to be more variables that affect user satisfaction with physical characteristics. Demographic characteristics, interaction variables or variables that focus on the quality or importance of characteristics of the work environment, could also explain variance. Moreover, increasing the sample size is important to increase the generalisability of the. Also, adding specific information about the actual physical characteristics of the multi-tenant offices would provide more information about the influence of the implementation of specific physical characteristics on user satisfaction.

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### 3.2 A Research-Based Profile of a Dutch Excellent Facility Manager

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#### ABSTRACT

**Purpose :** This paper aims to establish the profile of an excellent facility manager in The Netherlands.

**Design/methodology/approach:** As part of a large-scale study on profiles of excellent professionals, a study was carried out to find the key characteristics of an excellent facility manager. Three panel sessions were held in different regions of The Netherlands. Sixteen facility management (FM) professionals with various work experiences participated in the conversations, led by a non-FM moderator. All material was recorded, transcribed, and labelled independently by three assessors. The concept profile that was derived from these analyses was administered in a survey twice to FM experts following a Delphi method.

**Findings:** Outcomes suggest a combination of the following five characteristics defines an excellent facility manager: he or she (1) possesses communication skills; (2) acts results-oriented; (3) is entrepreneurial; (4) is sensitive to the needs of the organisation; (5) demonstrates personal leadership. All characteristics were consistent with the nine FM Bachelor competencies of the Dutch standard (LOOFD). However, regarding the fifth domain (personal leadership), the observed profile of an excellent FM professional seems more challenging than the Dutch Bachelor standard.

**Practical implications:** The observed profile can be used to further strengthen the Dutch (Honours) Bachelor Programmes in FM. Exploring international (dis)similarities, possibly leading to an international profile of an excellent facility manager, is a future ambition.

**Originality/value:** This study describes the systematic design of a research-based profile of an excellent FM professional from a practice point of view.

#### Keywords

Professional excellence, Facility Manager, FM, Profile, Honours programme.

## 1 INTRODUCTION

This paper aims to empirically establish the profile of an excellent facility manager in The Netherlands from a practitioner's point of view. As a consequence of the development of honours programmes at Hanze University of Applied Sciences (UAS) Groningen, a need for direction emerged. What is professional excellence? And, in our case, more specific: what makes a facility manager truly excellent? Honours programmes are rather new in The Netherlands, in particular at universities of applied sciences (Wolfensberger, Van Eijl, & Pilot, 2012), so this has not been defined explicitly yet. The present exploratory study seeks to start answering this question by building a research-based profile from a practice point of view and thereby give direction to developers, teachers, and students of Dutch honours programmes in facility management (FM). Slightly rephrasing Paans, Wijkamp, Wiltens, and Wolfensberger (2013, p. 349), who studied the characteristics that define an excellent allied health care professional, "our hope would be that" FM professionals "in practice, students enrolled in education or honours programmes for gifted students, and teachers, could all use this profile as a reference tool".

## 2 METHOD

As part of a large-scale study on profiles of excellent professionals by Hanze UAS Groningen, a study was carried out to find the key characteristics of an excellent facility manager. The focus group design that was used is identical to the one described in great detail by Paans, Wijkamp, Wiltens and Wolfensberger (2013).

To start with, three focus group discussions were held in different regions of The Netherlands: Groningen in the north, Wageningen in the east, and Amersfoort in the west of the country. The discussions took place in 2014, on September 23 and 25, and December 18, respectively; venues were the university campus, a secondary vocational school including a conference hotel, and a FM experience center of an installation company. To select possible participants, former FM prize winners or nominees and members of several FM-related groups of a professional online platform (LinkedIn) were invited. Sixteen FM professionals with various work experiences (7 female, 9 male) ultimately engaged in the conversations.

The discussions about characteristics that define an excellent facility manager lasted about 90 minutes and were led by a non-FM moderator. The central question in the discussions was: "What do you think is an excellent facility manager?" One of the other researchers, an FM lecturer, was present at the table to ask questions for clarification purposes only. Another researcher/FM lecturer and two FM honours students observed the discussions and made field notes. All discussions were audio-recorded.

The next phase was to transcribe the audio recordings entirely, and label the texts independently by two separate assessors (the FM lecturers) and another pair of assessors (the FM honours students). At the start of this analysis open coding was used to break down the data into units, and subsequently distinguish concepts, preferably naming them by using terminology from the focus group discussions. Thus, all in all three independent labellings were created.

As a next step, a consensus meeting was held in which two researchers from outside of the FM school, the two FM lecturers and the two FM honours students together derived items (or aspects) and domains from the three labellings. On the basis of the notes of this session a first version of the profile was formulated, and carefully adapted until agreement among the researchers was reached that a good representation of the focus groups had been established.

To investigate the content validity of the concept profile that was derived from above analyses, a survey was administered to a Delphi panel consisting of 51 FM experts in total, such as professors, lecturers, researchers, policy makers and practitioners. These experts were contacted mostly via the FM Research Network Netherlands (FM-ReNN). Others were members of the advisory board of the School of FM of Hanze UAS Groningen, or other partners in practice. Focus group participants were not allowed. The panelists were asked to judge whether each aspect or domain (a cluster of aspects that fit together, form a category) was essential to the profile. The answer options were “essential”, “important but not essential” or “not necessary”. Content validity ratios (CVR) were calculated according to the following formula:

$$\text{CVR} = (n_e - N/2) / (N/2),$$

in which  $n_e$  represents the number of panelists finding an aspect or domain essential, and  $N$  is the number of panelists (Paans et al., 2013). To guarantee a majority of the panel found the items and domains in the ultimate profile essential, negative ratios were not tolerated. Therefore, after the first Delphi round some adjustments had to be made to the profile, and a second Delphi round with the same panelists as in the first round followed. The number of respondents was 22 in round 1 and 21 in round 2, a response rate of 43% and 41% respectively.

Finally, in both rounds the panelists were asked to score the placement of the items/aspects in the domains, using a four-point Likert scale, ranging from 1 (located correctly) to 4 (needs relocation). An aspect could only stay in a domain if a majority of the panel indicated it was located correctly. In the second round the profile turned out to be stable.

### 3 RESULTS

Findings (Table 1) suggest a combination of the following five characteristics defines an excellent facility manager: he or she (1) possesses communication skills; (2) acts results-oriented; (3) is entrepreneurial; (4) is sensitive to the needs of the organisation; (5) demonstrates personal leadership.

The strongest of these domains, according to the CVR's, is “acts result-oriented” (0.90), followed by “possesses communication skills” and “is sensitive to the needs of the organisation” (CVR = 0.71 for both). The respondents were somewhat less unanimous about “is entrepreneurial” (0.52), in particular regarding the aspect “identifies opportunities and acts on them” (0.09). An explanation for this result could be that depending on the context (more corporate or more commercial) and tasks the level of entrepreneurship between excellent facility managers may differ. The relatively most controversial domain is “demonstrates personal leadership”, although the CVR (0.10) indicates that still a small majority of the panel (55%) thinks it is essential to the profile.

Table 1 Content validity ratios of domains and aspects

	Domain / Aspect	CVR	CVR (fit into domain)
<b>[01]</b>	<b>Possesses communication skills</b>	<b>0,71</b>	
[01]	Adapts to diverse partners	0,27	1,00
[01]	Empathises	0,71	0,90
[01]	Operationalises ideas into a concrete plan and is able to convincingly substantiate this	0,27	0,90
<b>[02]</b>	<b>Acts result-oriented</b>	<b>0,90</b>	
[02]	Motivates employees to company involvement	0,73	0,90
[02]	Shows the added value for the organisation	0,36	1,00
[02]	Directs to accomplish desired results	0,18	0,90
<b>[03]</b>	<b>Is entrepreneurial</b>	<b>0,52</b>	
[03]	Acts proactively	0,64	1,00
[03]	Identifies opportunities and acts on them	0,09	0,90
<b>[04]</b>	<b>Is sensitive to the needs of the organisation</b>	<b>0,71</b>	
[04]	Maintains an overall view	0,64	0,90
[04]	Is aware of stakeholders' needs	0,64	0,90
[04]	Provides added values based on organisational goals	0,27	1,00
[04]	Quickly switches between different organisational layers	0,09	1,00
<b>[05]</b>	<b>Demonstrates personal leadership</b>	<b>0,10</b>	
[05]	Acts self-conscious and -critical	0,36	1,00
[05]	Knows own strengths and involves experts when required	0,36	1,00
[05]	Connects people	0,36	1,00

All aspects are convincingly placed in the right domain, according to the panel, with all CVR (fit)'s being either 0.90 or 1.00.

All characteristics are consistent with the nine FM Bachelor competencies of the Dutch standard. However, regarding the fifth domain (personal leadership), the observed profile of an excellent FM professional seems more challenging than the Dutch Bachelor standard.

#### 4 CONCLUSION, DISCUSSION, IMPLICATIONS

Taking into account the EN 15221-1, it can be confirmed that with a focus on excellence, FM is primarily regarded a managerial profession in The Netherlands. No specific FM qualities were observed in this current study. This was also mentioned in the open comments by some of the panelists and one of the reviewers. However, during the focus group discussion FM specific knowledge was mentioned on several occasions, but this was not considered as typical of excellent facility managers only and therefore left out.

Perhaps the reported relationship between excellence and communication skills, sensitivity to the needs of the organization, and leadership can be linked to the European Norm. These may be the necessary qualities of our profession to overcome the hard-bitten problem of integrating processes within an organisation, without being part of the primary process. Moreover, with the current observations the profession seems to be rather unbalanced with respect to the two headings under which FM is generally grouped in an European context: space & infrastructure and people & organisation. With its current focus on people and organisation, FM in The Netherlands may be in need of true integration of these two headings, in education as well as in profession. This may prove to be a vital constituent in balancing and integrating spaces and services for the advancement of excellence in FM.

Some limitations of this study make that based on the results we can speak of *a* profile rather than *the* profile of an excellent facility manager. Firstly, the number of focus group participants was rather limited and convenience sampling was used to acquire them. This may have affected the level to which the sample was representative of FM practitioners. Secondly, the qualitative and interactional nature of the focus group discussions cannot rule out social desirable input or certain subjective opinions to dominate entirely, although we countered this with the anonymous quantitative ratings by the expert panel. Furthermore, after the third discussion we seemed to have arrived at a point of data saturation: the first two discussions were confirmed rather than that new characteristics came up. Thirdly, one could question the validity of the concept of (professional) excellence to begin with. To not steer the focus group participants into a certain direction, the same standard questions were repeated over and over again, instead of coming up with preset definitions of excellence. Especially examples in the context of FM were to be avoided, of course, but this may have left participants on their own to figure out what was meant by excellence exactly. The definition of this concept may differ from person to person, and it may have been a difficult task to put these concepts into words while refraining from a purely semantic discussion. Note also that for the purpose of this paper the profile was translated from Dutch to English by the authors. Also since some of the phrasings in Dutch were metaphorical, slight interpretational differences between the Dutch and English version may occur. This should be tested.

The observed profile can be used to further strengthen the Dutch (Honours) Bachelor Programmes in FM. Exploring international (dis)similarities, possibly leading to an international profile of an excellent facility manager, is a future ambition.

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### 3.3 Service Delivery in FM: Enhancement or Enchantment?

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#### ABSTRACT

**Purpose:** Relationship management in FM is arguably essential in terms of service delivery (Coenen & Nwanna 2014). With the growth of knowledge workers, increasing socio-economic demand on space and wider political demands, the purpose of this paper is to position FM firmly as a service (as opposed to building maintenance) based industry. It uses the concepts of Disneyization to explore the elements existing within this subjective area, and then plot the contractual relationship accordingly.

**Approach:** This stance is novel, borrowing the concept from marketing and tying it with storytelling research to understand the different mechanisms and evolving trends of service delivery within the UK FM industry. The paper therefore seeks to utilise the role of corporate storytelling (Gabriel 2004) within FM, investigating if it is an unspoken core and unique disciplinary competence (enhancement) (Solnet et al 2008), or just smoke and mirrors, illustrative of an increasingly commoditised service in the face of wider economic pressures (enchantment). Scenario based interviews were held to investigate personal tales of service delivery and applied across to FM practice. This allowed the basic delivery mechanisms to be identified and mapped. Concepts of disneyization were then identified, which occurred naturally within the rhetoric as opposed to being specifically asked for within the interview setting. All participants are current, UK-based FM practitioners.

**Findings:** The findings indicated that the use of disneyization is not only useful for understanding the current nature of FM, but also for plotting what expectations are within a practical service delivery environment.

#### Keywords

Service delivery, Disneyization, Organisational storytelling.

## 1 INTRODUCTION

The debate over what Facilities Management (FM) is; what it should be and what it is forecast to become are not new deliberations (Price 2001), and yet they are influential in understanding the fluid and evolving nature of the discipline. This paper focuses on the service delivery nature of FM, using the concept of disneyization to uncover not only how UK practitioners see their roles, but to practically align this to contractual positioning. The intangible nature of FM delivery that exists is balanced with the more traditional, easy-to-measure elements which are arguably associated with the discipline, emphasized by its close association with the world of outsourcing (Ikediashi et al, 2014).

Aspects of storytelling are utilised in order to explore this intangible side, pulling through individual personal stories and applying them into an FM organisational setting. This personal, narrative element is arguably an under-used element within FM, despite recent



research indicating the importance of 'the little things' (Price et al 2013). This 'enchantment' would assist in providing FM with a distinctive quality from other secondary service professions, but could also start to represent core competency in terms of overall FM service delivery.

The paper proceeds as follows. First, the concept of organisational storytelling is presented and placed in context with the empirical research. This provides the foundations for the specific theory of disneyization to be introduced, which is broken down into specific themes and aligned with existing FM theory. Empirical research in the form of scenario (story-led) based interviews with current, practicing FM's within the UK market is then analysed which suggests a strong correlation with global service mechanisms. Specific areas are then mapped out and the implications for FM are presented.

## 2 ORGANISATIONAL STORYTELLING

There has been much work done on the importance of recognising organisational storytelling and the feasibility of using storytelling as a research tool. Forster et al, recognise that storytelling is "an integral part of the human experience ... dealing with issues of self-identity, group membership, past and future and good and evil" (1999, pg. 11), with Gabriel and Connell positioning it as an effective tool in the contemporary world of 'information overload' (2010). It is increasingly evident that organisations are not passive in the creation of narratives, but can orchestrate them proactively in order to achieve a specific purpose (Leung and Fong 2011).

The particular use of stories also allows the multiplicity of values and interests (Abma, 2003) to be made explicit in terms of transferring the recognised, positive elements of service identified in the story into the delivery of FM. Elements can be embellished to illustrate what the storyteller believes is an important point, as opposed to strictly relaying the facts of an event. Therefore, enhancement is arguably always an element within this form of communication, leading to possible elements of enchantment.

The term enchantment itself presents two meanings. It can indicate a more malevolent side in terms of presenting something that is not real - a manipulating force that can fool and dupe. Although this element is recognised, it is the definition of enchantment to mean "an aura of authentic presence, resisting rationalisation and promoting creative social connections" (Endrissat et al 2015, pg. 1557) that aligns to this research. It presents an interesting insight when FM as a profession is increasingly recognised as one that is under "constant reformation in accordance with the development and the changing needs of the core business, and on the other side a market in considerable growth and consolidation" (Jensen, 2010, pg. 383). This would indicate the need for something more than the current modus operandi of enhancement, supported by evidence that indicates an 'image deficiency' (Von Felten et al 2014), aggravating a possible impending 'skills famine' (BIFM, FM World 10.02.2015). To facilitate this positioning, the framework of Disneyization will be utilised to situate the stories in terms of delivery.

### 3 THE DISNEYIZATION OF FM

Disneyization highlights how the world of management has become increasingly global. It is distinct from 'disneyfication', which implies elements of infantilization and distortion (Bryman 2004), forcing the eternal 'happy ending'. Rather, it is the "process by which the principles of the Disney parks are coming to dominate more and more sectors of society" (Bryman, 2004: 1). It identifies four elements: dedifferentiation of consumption, performative labour, theming and merchandising which will be detailed in terms of their perceived manifestation in FM.

The dedifferentiation, or hybrid consumption is the general trend whereby the forms of consumption associated with different institutional spheres become interlocked with each other and are increasing difficulty to distinguish" (Bryman, 2004, p. 57). In terms of FM, it is formed in both the delivery and the services aspects of FM. At an operational level it may apply to the de-skilling of frontline operatives, in order to allow a more universal offer in terms of tasks i.e. the security function would also complete cleaning as multipurpose site operatives rather than a focus on a single role.

In terms of service, this manifests in the increased use of 'bundled' contracts (AMA Research 2014), and the evolution of Total FM packages (TFM). Following the definition of enhancement, dedifferentiation takes the traditional FM services, and adds new elements to aid improvement, such as event management into cleaning etc. Essentially, the hybrid consumption theory shows how FM maximises the possibility of pull through business by presenting an option to the client that they may not have otherwise considered buying or being associated with FM. Extreme manifestations are the creation of a destination "somewhere that people go to as a significant venue that will keep them there for some time" (Bryman 2004, pg. 58), moving from an enchantment of existing services, to a unified enchanted area that provides all, and more.

This is arguably connected to an increase in performative labour, where "the rendering of work by management and employees alike is akin to a theatrical performance in which the workplace is construed as similar to a stage" (Bryman 2004, pg. 103). By applying this to FM service delivery, it is not only the initial impressions of a building (a clean and welcoming reception area), but also within the ongoing people interactions (a smiling, named and helpful receptionist). The staging element is also visible in FM rhetoric, with front of house and back of house areas, often with uniforms/costumes to match, supported by the semantics of having a 'role' instead of a job. Scripted elements are also visible, such as telephone responses, voicemail and out of hours email notifications.

There is a heavy implication of control of the individual's behaviour to represent the collective organisation, and that this performative element is emotionally draining if it is a shallow representation. However, genuine efforts on behalf of a service provider (in-house or outsource) to motivate their staff arguably leads to job commitment and therefore organisational loyalty. Ultimately, this emotional connection would result in a genuine, credible (enhanced) level of service to perhaps a more memorable experience (enchantment).

The third element is theming: the "application of a narrative to institutions or locations ... which provides a veneer of meaning and symbolism" (Bryman 2004: 15). The narrative in this case is the discipline of FM itself. The multidisciplinary nature of FM could arguably dilute theming, which in turn may aggravate the confusion over FM's identity within

contemporary organisations. Indeed, on the surface there appears to be distinct dichotomies within the industry rhetoric (i.e. In-house/Outsource, Hard FM/Soft FM, Core/Non-Core), and the dedifferentiation would indicate the presence of many different logos and departmental branding.

However, by using theming, aligned identities of the industry can be illustrated, by looking at some of the metaphors that the FM industry uses. Specifically, the idea that FM is the 'Cinderella Industry' is widespread<sup>3</sup>. It highlights the association with 'dirty work' (Cassell & Bishop 2014), with the metaphor of the ashes, but also the 'hidden' theme that aligns with FM.

However, this also pulls through a magical element, an invisible force that balances and restores. A guest speaker at a BIFM conference "talked about an army of 'Fairy Folk' magically maintaining the workplace while everyone was asleep" (FMJ, 2010). This magical, creative association is arguably not the emphasised element of this theme, but places FM in a position that resists a commoditised, off the shelf delivery through scripted staff, into a service of creativity, and inherent, core knowledge.

In terms of the built environment that FM manages, theming would align with the creation of a physical landscape that reflects the identity and lifestyles that the company represents (van Marrewijk and Yanow 2010). This also links to the growing presence of customer co-creation, collaboration and connections (Vargo and Lusch 2004) to borrow from the domain of marketing, which may prove to influence the next evolution of partnership-based contracts.

The last element of the disneyization theory is that of merchandising, "the promotion of goods in the form of or bearing copyright images and logos" (Bryman 2004, pg. 79). BIFM have created 'FM TV' (<http://www.bifm.org.uk/bifm/about/facilities>), and there are FM based games and simulation packages. However, the most visible merchandising is arguably the staff themselves, and the logos they wear, a point often highlighted in TUPE arrangements. There is also the common stereotype of a FM uniform - the fleece. Dominate brands, logos and merchandising is appearing more and more within public arenas. Linking with the concept of performative labour, it is the idea of FM companies presenting staff with 'a way of life' - a manner in which staff are developed to deliver a service that can become a unique selling point in the overall contract. In this, "staff are trained to pick up on clues from customers that can later be used to surprise the customer" (Solnet 2008, pg. 186), such as a housekeeper overhearing a child's birthday and arranging (corporate) balloons to be left in the room.

By the use of merchandising, FM can not only create an enchanted service for the clients, but also empower staff to want to work within more 'enchanted' spaces, not necessary being visible in physical presence, but in trusted service. The FM industry is increasingly focusing on client loyalty and value propositions (Coenen, & Nwana, 2014), pulling on the idea of FM offering a 'brokerage role' (Heng et al 2005), and the idea that value will be through the delivery not only of the service, but of something highly memorable. The idea of merchandising in this sense brings to light the focus on the staff that are to deliver these new types of services.

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<sup>3</sup> BIFM (FM World, 2011), IFM (<http://www.ifm.net/documents/file/whitepaper/FM%20realising%20the%20value.pdf>) and RICS (<http://www.rics.org/Documents/RICS%20Strategic%20FM%20Case%20Studies.pdf>).

In closing, the concept of disneyization reveals many different insights into the service of FM. It represents a system, concerned "with the diffusion of *modes of delivery* of goods and service... it is a means of providing an efficient and highly predictable product" (Bryman 2004 pg. 162, italics original). Viewed within an FM context, it allows different avenues of service delivery to be explored within the confines of contractual arrangements, and in the next section we explore how many of these concepts are already visible, or feasibly possible, within the UK FM industry, and how they affect service delivery mechanisms.

#### 4 METHODOLOGY

Interviews were conducted with three UK client-side facilities managers (although it is acknowledged that some of the companies represented operate globally). Anonymity was ensured, and the hour long interviews were later transcribed, and identified numerically (P1= Participant one).

Although semi-structured, the main approach was scenario-based, with the participants being asked to describe a personal experience of good customer service. This was then probed in terms of identifying the elements they deemed important to allow an insight into the individual's perception of the event they had selected. The mechanism of storytelling captured the more fluid, emotive service experience- both enhancement and enchantment elements. The format of personal stories also allowed the learning from current or past experiences to be preserved and transferred (Leung and Fong 2011), in this case to an FM service delivery example.

The elements of disneyization were not explicitly mentioned in the interviews, allowing the stories not only to flow, but to ensure that the concepts were not being specifically targeted, but were embedded within the experiences that the FM practitioners identified.

#### 5 FINDINGS

The four elements of disneyization were all visible within the research. In terms of dedifferentiation of service delivery, there was clear evidence that a number of FM services were being delivered together ("*single source supplier*") in a variety of packages. This in itself is unsurprising, but the dominate thoughts in terms of the blurring of services was generally a positive move in the discipline. At the operative level it translated into widening skills as opposed to deskilling: "*It's all about getting people to do the obvious things*" P1, and presenting opportunities throughout the delivery chain "*the skill set ... people have to have now is not just technical in the areas that they're responsible for, but to have a good understanding of the business*" P3".

Although the segregation of services were assigned to roles such as a clear division between service provider and service receiver, there was a call for this dedifferentiation to decrease at this level "*it would be brilliant if....a contractor [could walk up to a client] and say I want to learn more about your business, I want to be able to operate my business so that it absolutely fully, fully works alongside your business*", P3.

However, the recent poor economic climate resulted in some contracts offering a multitude of services in a style that could align itself to dedifferentiation *the thing is, at the moment, it has been like a "dog eat dog", but everybody wants to work, you know, everybody wants the contract, so of course they'll fight for it, rather than holding their hands up and saying, can't do it for that amount of money, sorry, we have to walk away at this point, we're not going to get the service that we... which we want to give you, P1.*

In terms of performative labour, the research revealed the importance of the visible staff and the recognition of how important these roles are. This was visible across all the interviews:

*"[people] who actually want to do a better job and who actually want to be involved, not just in the contract piece, but they actually want to make the area better, the workplace better, whether it be through cleaning, maintenance, landscaping, administration, whatever that facility's piece maybe is, but they want to be part of the bigger, wider client team, rather than to be known as the contractor, so, yeah.P3.*

To support this, schemes to encourage staff in terms of increased service delivery were evident: *"getting our people to understand effectively who their customer is and understand what their needs are"* P1, but this was also motivated in terms of staff morale, recognition and also to increase personal job satisfaction. The idea of performative labour would arguably have a natural alignment with those 'frontline' services as the name would imply, but there were indications that it became more malignant at a managerial level *"sometimes I get the feeling they just didn't bother thinking about it"* (P3).

There were elements of certain roles having scripted elements, with one participant commenting that their engineers were given cards on detailing frequently asked questions (P1), but these were viewed more as a helpful tool rather than an enforced script. The idea of being on 'stage' was visible in terms of different levels of service being allocated into different physical areas, with different corresponding behaviours and costumes being directly stated in one interview: *" well, she's just a bit up-market. She is front of house, isn't she? She's not the normal"* (P2). This would also dispute the visible implementation of dedifferentiation, which is also supported by themes of service roles *"because sometimes organisations believe that they can probably beat up a soft service contractor more than they can beat up a hard service contractor, just because of the nature of the work that they're doing. So I think it's as bad on both sides and both are as important"* (P3).

The personal stories revealed the significance of being made to feel important, and treated as an individual person rather than part of a collective customer body. When these were aligned to FM service delivery, many of these themes remerged under the terminology of interaction, transparency and partnership. Consistency in service delivery was also evident, alongside a narrative of cost - *"that's been the driver, cost. For all you say it isn't, it is"* (P2).

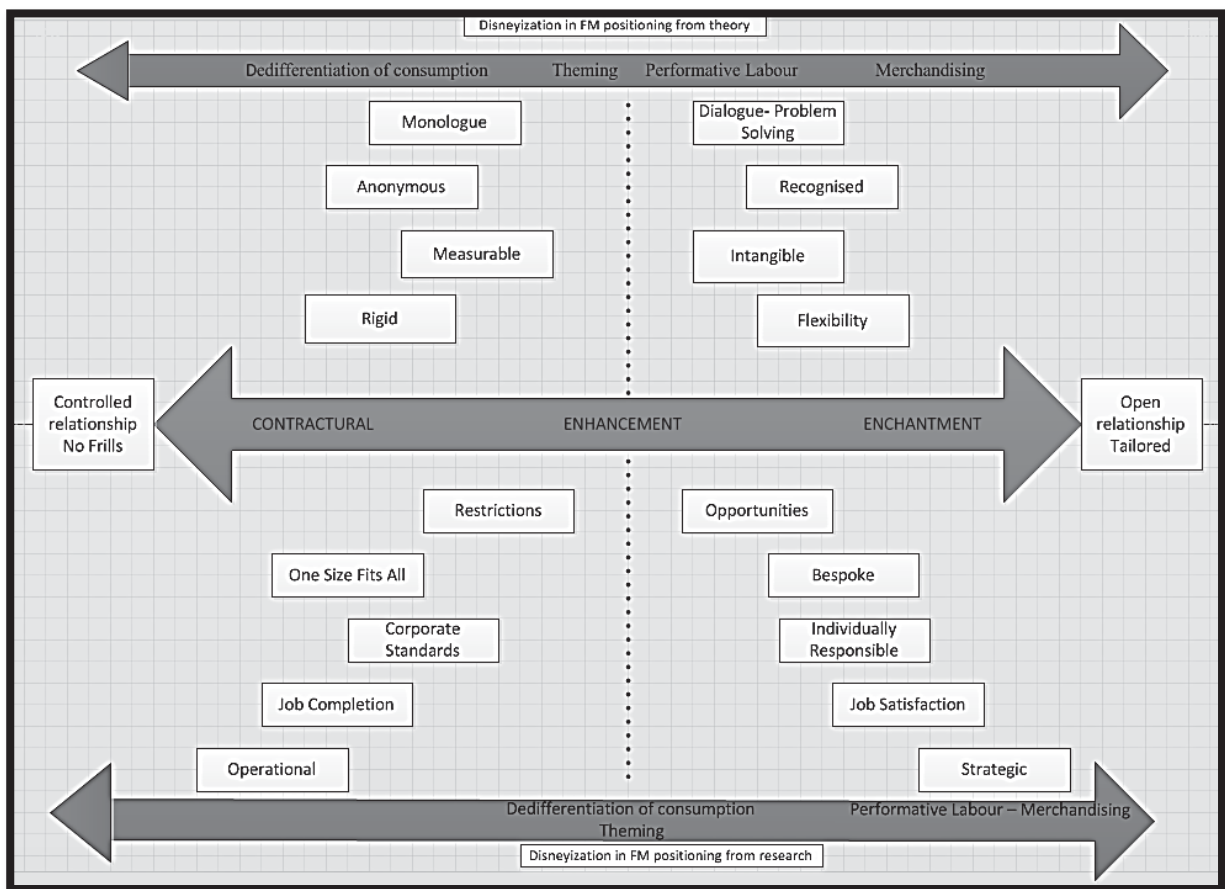
The idea of merchandising arguably would be better suited to a more observational technique than interviews, but by aligning performative labour with the concept, this widens merchandising to include the front line staff and their kit:

*"Usually the complaints tend to come from where you've got evening cleaners who come in after people have gone. But I think in the areas where the cleaner is visually there in the daytime, you don't tend to get the complaints as much....."*

*a couple of years ago, we went away from using polish ..., 'cause polish doesn't actually clean the dirt off a desk. It just puts a layer over the top and it looks shiny. But people have the perception their desks weren't being cleaned because when they came in, they couldn't smell polish... We use polish now, but it's mainly just so that people have that impression that their desk has been cleaned" (P2).*

To summarise, the different elements as identified were then mapped as illustrated in Figure 1.

Figure 1 Mapping of the different elements



A relationship defined by the contract is illustrated on the left hand side, with the boxes identifying the main characteristics of the service delivery. Disneyization theory (top bar) would indicate that dedifferentiation would be evident, but this is disproved by the research (bottom bar). Enhancement is placed in the middle, leading to an 'enchanted' contract aligning to a more open, yet tailored relationship and pulls on the specific areas of performative labour and merchandising. From a service provider point of view, figure one can be used to map the position of the client, and therefore the associated tools to aid service delivery, and vice versa.

To conclude, all the elements of disneyization were evident in the interviews. Dedifferentiation is arguably the least applicable, being considered as upskilling, but there was little evidence of pull through business operating in a proactive way. The narrative saw some themes common to the industry, although much of this was framed in future tense as opposed to current conditions. Cost was a common theme, indicating the industry may be faced with trying to maintain and enhance existing services, rather than investigating possible routes to enchantment, as illustrated in figure one (middle). The importance of performative labour was clearly recognised, and manifested itself as genuine and therefore positive phenomena, with perhaps an indication that it is not consistent across hierarchical levels.

It is unsurprising that FM in practice within the UK has, at its bedrock, a strong contractual element. By applying the concepts of disneyization, more intangible elements become visible, illustrating that there is a clear focus on enhancing already existing services, but also demonstrating a possible shift to more of an enchanting service - giving credibility to the profession, balancing the need for consistency whilst resisting rationalisation by developing creative social connections. If physical space starts to fade in terms of organisational priority, it is supposed in this paper that FM's understanding of its function through using mechanisms such as enchantment will be one of the vehicles to solidify the discipline and influence the next evolution of service contracts.

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## **4 SERVICE EXCELLENCE AND SUPPORTING THE ORGANISATION**

### **4.1 PARAMETERS FOR COMFORT: COMPARATIVE STUDY OF LAWS AND STANDARDS**

ALEXANDER REDLEIN AND CHRISTINE HAX-NOSKE

### **4.2 HIGHER EDUCATION LEARNING SPACE DESIGN: FORM FOLLOWS FUNCTION?**

RONALD BECKERS

### **4.3 EXPLORING THE UNQUANTIFIABLE? MODELLING FM SERVICE RELATIONSHIPS**

ILFRYN PRICE, STEPHEN DOBSON AND ALIREZA PAKGOHAR

### **4.4 MEASURING USER SATISFACTION**

CHRISTIAN HUBER, SABRINA EITZINGER AND DAVID KOCH



## 4.1 Parameters for Comfort: Comparative study of laws and standards

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### ABSTRACT

**Purpose and approach:** Many environmental factors are defined in laws and standards. But these regulations are mainly country specific and cannot easily be compared. In addition they have different intentions. EU-legislation and standards have led to the adaption of local regulations, but there are still differences and varying priorities in different countries. In order to give an overview of the situation, more than 100 laws, guidelines and standards from Austria, Germany, Switzerland, WHO, EU and USA were evaluated. In addition literature for the relevant areas was analysed.

**Findings:** The result is a database, showing key criteria, priorities and differences for health, wellbeing and comfort for different countries. To show how to use the database, this paper focuses on office environments. The room climate standards for Thermal Comfort, Indoor Air Quality, Acoustics and Lighting in office environments are compared for different countries, particularly the differences between office environments in the US and Europe and the legislative reasons behind it.

### Keywords

Room climate, Indoor Environments, Health, Comfort, Legislation and Standards.

## 1 INTRODUCTION

This paper has two goals: First one is to describe the development of a database on room climate parameters, which are defined in international and national laws and standards. Research from the last decades has shown, how much health and performance in office environments is influenced by room climate parameters. The Definition of room climate parameters in laws and standards shows us the state of the art.

The second goal is to show the use of the database, by comparing standards in different countries in respect to office environments. Despite to globalization, there are country-specific differences in legislation. This can be interesting for companies rolling out an office-concept on a worldwide basis.

## 2 METHOD

This review started with an extensive research of Austrian laws and standards to identify relevant room climate parameters. As mentioned above, room parameters refer to the climate conditions inside a room. The European standard EN 15251 gave orientation for key words and helped to structure the parameters. To cover entirely the Austrian building law, the Austrian federal legal information system and the Austrian Standards Database were our search platforms. The reference list in the found standards gave hints to further sources. In the next step platforms of overarching international institutions as EU, ISO (International Organization for Standardization) and WHO (World Health Organization) were screened. To compare the German speaking countries in the DACH-region (DACH stands for D-Germany, A-Austria, CH-Switzerland) we added Swiss and German laws and standards, here to mention the VDI-Guidelines (VDI: German Engineers Association). The USA does not have official national building codes, but each state or local government adopts codes, which are developed by recognized organizations (i.e. ASHRAE). Because of this, there is little uniformity among the regulations in different states (EPA). The study refers to the most common standards. The evaluation of laws and standards took place from March 2015 to August 2015; in total more than 100 laws and standards were evaluated, resulting in about 1700 requirements.

The result of the research of laws and standards was a database to make things comparable. Two areas had to be considered:

- Common parameter definitions
- Common room types

Room parameters can be defined differently, as well as the clustering of the related rooms. In the study room parameters were selected in the following way: Room parameters have to define the conditions inside a room, not the physical characteristics of the surrounding structures and not technical values for devices (i.e. air condition). The European standard EN 15251 helps to structure the parameters: This standard defines indoor environmental parameters for design and assessment of energy performance of buildings. According to this standard the parameters are structured according to Thermal Comfort, Indoor Air Quality, Lighting and Acoustics.

As mentioned above, there is also a big variety in the clustering and naming of room types. The definition of room types is often related to area measurement standards. Room types in the database are based on ÖNORM B1800:2013. The area measurement in this Austrian Standard is according to the European standard for Facility Management (EN 15221-6).

The second goal was the comparative study in respect to office environments. Relevant room climate parameters were compared between different EU-countries and the USA.

### 3 RESULTS

#### 3.1 Result 1: Database as a common model

The outcome of the extensive research of laws and standards is a rich database on room climate parameters per room type and reference to the source (law or standard), where the requirement was defined. The structure of the database allows filtering for various criteria. These are the chosen categories for indoor environment parameters:

Table 1 indoor environment parameters

<ul style="list-style-type: none"> <li>• <b>1 Thermal Conditions</b></li> </ul>
<ul style="list-style-type: none"> <li>• 1.1 temperature</li> <li>• 1.2 air humidity</li> <li>• 1.3 air velocity</li> </ul>
<ul style="list-style-type: none"> <li>• <b>2 IAQ Indoor Air Quality</b></li> </ul>
<ul style="list-style-type: none"> <li>• 2.1 carbon dioxide (as indicator and benchmark for other emissions)</li> <li>• 2.2 gaseous emissions (eg. formaldehyde)</li> <li>• 2.3 particles and fibres</li> <li>• 2.4 particle-ligated emissions (eg. dioxine/PCB)</li> <li>• 2.5 tobacco smoke</li> <li>• 2.6 odour</li> <li>• 2.7 radiation</li> </ul> <p>Mould fungus, viruses, bacteria and allergens were not part of this study.</p>
<ul style="list-style-type: none"> <li>• <b>3 lighting conditions</b></li> </ul>
<ul style="list-style-type: none"> <li>• <b>3.1 natural lighting:</b></li> <li>• 3.1.1 size of windows / daylight factor</li> <li>• 3.1.2 intervisibility</li> </ul>
<ul style="list-style-type: none"> <li>• <b>3.2 artificial lighting:</b></li> <li>• 3.2.1 illuminance</li> <li>• 3.2.2 luminous colour</li> <li>• 3.2.3 colour rendering index</li> <li>• 3.2.4 Unified Glare Rate</li> <li>• 3.2.5 lighting density</li> <li>• 3.2.6 shadows, contrasts</li> </ul>
<ul style="list-style-type: none"> <li>• <b>4 acoustic conditions</b></li> </ul>
<ul style="list-style-type: none"> <li>• 4.1. A- weighted sound pressure level ( L Aeq and L Amax)</li> <li>• 4.2. reverberation time</li> </ul>

The database allows filtering for different room climate parameters, for the scope of application or for the land of origin:

Table 2 structure database and example

parameter	unit	application scope	Value	labour law	source	origin/ applicability	legally binding?
i.e. temperature	°C	Workspaces Work with low level of physical strain (i.e. sedentary work)	between 19 and 25°	yes	Workplace Ordinance, §28	AUT	yes

To make room types comparable, the application scope of the evaluated laws and standards was assigned to room types from ÖNORM B1800:2013. See here an example:

Table 3 application scope and room assignment

ÖNORM B 1800:2013				Designation, as found in laws and standards
Nr.	usage	Nr.	Room assignment	application scope
2	Office Work	2.1 2.2	Office room Open plan office	Workspaces Work with low level of physical strain (i.e. sedentary work)

### 3.2 Result 2: Comparing countries

The database enables to compare laws and standards for different countries. In this paper, the focus is on office environments in Europe and the USA.

#### Thermal conditions in office environments

Fangers Model for thermal comfort (Fanger (1970)) is still the basis for standards on room climate worldwide. The Danish scientist Ole Fanger developed in the late 60ties the model of the predicted mean vote (PMV). The PMV describes the predicted mean thermal perception of building occupants, considering factors as sex, age, clothes, activity level or season. In warmer climates the comfort temperature for naturally ventilated buildings is much higher (van Hoof (2008)). This led to the development of an adaptive comfort model as an optional method in ASHRAE Standard 55 (2004).

European (ISO 7730) and national standards as well as ASHRAE-standards (ASHRAE Standard 55) are based on the PMV-Modell. This means, that the legal requirements for thermal comfort might be quite similar all over the world.

A glance at the laws and standards shows, that this is true in general. Differences can be found in the valuation of air humidity and air velocity as influence factors. Regulations are binding in some countries, in others they can be seen more as a recommendation. Table 4 gives a short overview: The comparison shows, that the relevance of air humidity for the satisfaction with the room temperature has a differing priority. In Austria air humidity is considered to be relevant only in rooms with air condition. Temperature is tolerable in a quite large spectrum between 19° and 25°, while there are no consequences when temperatures are higher than 25°. In German standards there exists a dependency between air humidity and

temperature, but only maximum air humidity is defined. In contrast to Austria there is a risk assessment for higher temperatures. With room temperatures higher than 35° work is not permitted by law.

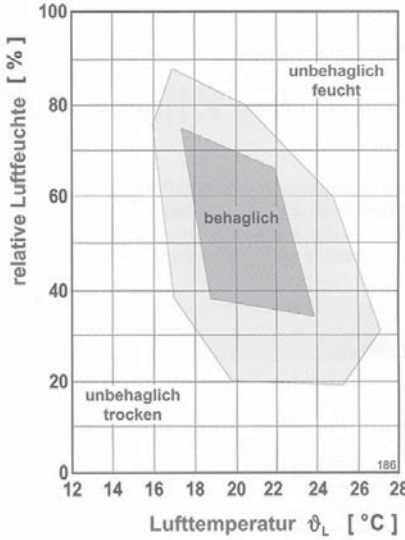
In Switzerland recommendations include air humidity and air velocity. Dependent on these two factors a temperature range for thermal comfort is defined. In Switzerland there is also an action plan for high temperatures.

In ISO 7730 focus is put on the dependency of thermal comfort on air velocity; the influence of air humidity is described as insignificant for temperatures under 26°. In contrast to this, the ASHRAE Standard 55 gives recommendations on temperatures, depending on air humidity. The European ISO-Standard recommends much lower temperatures than the American ASHRAE-Standard, especially in summer. The common assumption, that in America rooms are cooled down to much lower temperatures than in Europe is not reproduced in the comparison of the standards.

### **Indoor Air Quality in office environments**

*Indoor Air Assessment:* Guidelines to assess the indoor air quality can be found in different countries (in Austria: Guidelines for Indoor Air Assessment). In Europe emissions should be controlled with the EU-Construction Products Regulation and the CE-label for consumer products. The legally binding Austrian OIB-guideline requires that emissions from building materials must not be harmful to health. This requirement is deemed to be fulfilled, if approved building products are used in their designated purpose (OIB, 2011). Just one example that this control is not always working properly: In a project called 'Healthy Habitat School' the TUEV Rheinland and Sentinel Haus Institut built a classroom, added furniture, cleaned regular and made a refurbishment with new wall paint and new flooring after a period of time. They used approved randomly chosen building- and cleaning materials. The pollution of indoor air was much higher than recommended by the German Federal Environment Agency. On the other hand, they built a second classroom with a quality assessment on building materials and cleaning products. Materials were chosen, that were as sustainable and environmentally friendly as possible. This quality assessment resulted in a satisfactory indoor air quality. (Bachman, P. (2015)).

Table 4 comparison of thermal conditions for office workplace

land	air humidity and air velocity:	Temperature:	law or standard
Austria	Humidity between 40 and 70%. Only regulated for rooms with air condition. Air velocity Max. 0,10 m/s	Between 19 and 25°C 25° if possible not to exceed.	Workplace Ordinance VO§28
Germany	max. 80% humidity	20°C	ASR A3.5: Room Temperature
	max. 70% humidity	22 °C	
	max. 62% humidity	24°C	
	max. 55% humidity	26°C	
		26°C not to exceed If outside temperature >26°C and Indoor air temperature >26° additional measures and Risk assessment for special groups: pregnancy, older people.. If indoor air temperature >30°C action plan for all employees If indoor air temperature >35°C:Work not permitted	
	Air velocity: < 0,15 m/s	If indoor air temperature >20°C	ASR A3.6 Ventilation
Switzerland	recommendation of EN ISO 7730, additional: Recommendation of indoor air temperature, depending on Air Humidity and Air Velocity. Risk assessment and action plan for temperatures >26°C Diagram on the influence of temperature and relative air humidity on thermal comfort is part of the guideline:		Instructions to Ordinances 3 and 4 , Swiss Labour Law
	 <p style="text-align: right;">Terhaag (1986) Figure taken from: SECO (2015)</p>		
Europe, ISO	Summer: (Cat.A) 0,12 m/s Winter: (Cat. A) 0,16 m/s	23.5-25,5°C acceptable 21-23°C acceptable	ISO 7730:2005
USA Canada	Summer: (light clothing) if 30%, then: Summer: (light clothing) if 60%, then: Winter: (warm clothing) if 30%, then Winter: (warm clothing) if 60% then	24.5-28°C acceptable 23-25.5°C acceptable 20.5-28°C acceptable 20-24°C acceptable	ASHRAE Standard 55-2010 The same values are recommended by the Canadian Centre for Occupational Health and Safety. (ccohs.ca)

*CO<sub>2</sub>*: CO<sub>2</sub> (carbon dioxide) is an indicator for indoor air quality. The recommended values for good air quality do not vary much. The Austrian Guidelines for Indoor Air Assessment recommend a concentration of 600-1000 ppm as a standard mean value. EN 13779: 2007 defines the same value as a recommendation for moderate air quality. Besides to the MAK-Value (Maximale Arbeitsplatz Konzentration – maximum workplace concentration) of 5000ppm there are no binding regulations for CO<sub>2</sub>. The MAK-value limits the effects of chemicals workers may encounter in the course of their job; higher values are supposed to be harmful to health. The concentration of CO<sub>2</sub> influences performance and wellbeing with much lower values, as you can see from the general recommendations for air quality. CO<sub>2</sub>-Values in the concentration of 600-1000ppm indicate that the values for human emanations, odours and some other volatile organic substances are also in a good spectrum.

*Chemical agents*: With respect to legal regulations on occupational health, in all countries there is a kind of ordinance on the exposure to chemical agents (Austria: Grenzwertverordnung). It sets out exposure limit values and preventive measures to protect workers from the effects of chemicals they may encounter in the course of their job, so to say: Materials they use for their work, i.e. detergents for the cleaning stuff. The emissions from materials and devices in the office environment are not regulated in these ordinances, but in product regulations and guidelines for Indoor Air Assessment. The Austrian Guidelines for Indoor Air Assessment recommend the same value of 0.5 ppm for formaldehyde as the exposure limit value in the Austrian Grenzwertverordnung. In other cases values from these two sources can vary in a large spectrum. The Grenzwertverordnung- exposure limit value for i.e. styrol is 2000 times higher (85mg/ m<sup>3</sup>) than the recommended value from the guidelines for indoor air quality (40 µg/m<sup>3</sup>).

*Tobacco smoke*: Legally binding regulations, concerning indoor air quality, can be found in the laws concerning tobacco smoke. Protection of non-smokers is regulated in Austria in the Occupational Health and Safety Act (Arbeitsstättenverordnung). Non-smokers are widely protected, but if the company management has no own directives, in Austria smokers are still allowed to smoke at their workplace: If the employee has a single office or in the room are only other smokers and if the workplace is not open to customers, smoking is allowed. In the USA smoking is not regulated by the federal Occupational Safety and Health Administration. Each state has its own regulations. Surprisingly there are still some states, where smoking in workplaces is allowed. In North Carolina for example smoking is prohibited only in the enclosed areas of restaurants and bars (nolo.com).

### **Lighting in office environments**

*Natural lighting and views*: The lighting topic affects workplace design very much. In Austria the view outside from each stationary workplace is mandatory. For this reason, the typical American cubicle workplaces could not be realized in an Austrian office. European EN 12464-1 gives not so many restrictions, but underlines the importance of natural light.

*Glare effects*: To avoid glare effects on computer screens, the EU-Council Directive on the minimum safety and health requirements for work with display screen equipment regulates, that workplaces always have to be parallel to windows. If office furniture manufacturer show pictures of workbenches with windows in the back, this might be a project outside the EU.

*Acoustics*: Concerning acoustics, there are two main topics: Noise prevention and speech intelligibility. Most regulations on acoustics refer to characteristics of the surrounding building and outfitting elements. The recommendations on adequate maximum noise levels



do not differ very much: The Austrian VOLV (ordinance noise and vibrations) defines noise levels over 65dB(A) as disturbing for basic office work; for intellectual activity the critical value is 50dB(A). Worldwide, noise-induced hearing impairment is the most prevalent irreversible hazard (WHO, 1999). The critical value for noise induced hearing impairment depends from noise level and duration. The action value for long-term exposure – 8hours/day- is limited with 80dB(A), peak exposure is limited with 135dB(A) (VOLV). The critical values for noise induced hearing impairment are more relevant for other workplaces than offices. Office-related noise topics are:

- Noise as an environmental stressor with physiological and mental impact on health, concentration and performance
- Interference of noise with speech communication

Table 5 Natural lighting and views

land	Natural lighting	view	law or standard
Austria	1. size of translucent openings min. 10% of floor surface 2. windows have to lead directly into open air.	View outside mandatory from each stationary workplace. Window size at least 5% of floor surface of the room. Light domes or glass-roofs do not count for intervisibility.	Workplace Ordinance §28
Germany	Min. relation of translucent openings to floor surface of 1:10		ASR A3.4.: Lighting
Switzerland	Reference to EN12464-1		
Europe	Underlines the importance of natural light. Requirements for natural light are the same as for artificial lighting.		EN12464-1

### 3 CONCLUSION

By comparing office environments in the US and Europe despite to the globalization trend many differences can be found. Reshaping the own office environment, one might get inspired by trendsetting workplace concepts, seen for example at the new Facebook or Google headquarters. These concepts cannot be transferred one by one to European countries. Workplace design is regulated in labour law, which has its basic structure in EU regulations, but is in detail still country-specific. Therefore, when rolling out a workplace concept internationally the design and roll out team has to take into consideration the local regulations. This can even be the case when expats are working for a longer time in other countries.

The next step of the research is to set up statistical models, to link office environment parameters to the performance of the employees. With the help of the models it will then be possible to provide guidelines for “productive” workplace infrastructure.

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**Search platforms / weblinks: status January 21th 2016**

- Austrian Standards: <https://www.austrian-standards.at/home/>
- EPA United States Environmental Protection Agency  
<http://www3.epa.gov/region9/greenbuilding/codes/standards.html>
- Federal Occupational Safety and Health Administration, USA: <https://www.osha.gov/law-regs.html>
- North Carolina Laws on Smoking: <http://www.nolo.com/legal-encyclopedia/workplace-smoking-laws-north-carolina-46919.html>
- RIS Rechtsinformationssystem des Bundes, Österreich (Austrian federal legal information system):  
<https://www.ris.bka.gv.at/>

## 4.2 Higher education learning space design: form follows function?

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### ABSTRACT

**Purpose:** This paper aims to address the learning space preferences of higher education students for individual study activities that require concentration, and for collaborative study activities that require communication. Furthermore, the results illuminate the students' design preferences for the physical learning environment.

**Methodology/approach:** The paper first outlines the developments in higher education learning and teaching, and how these affect learning space design. It then presents the findings from a quantitative study based on a self-administered questionnaire that was filled in by 697 business students from a Dutch University of Applied Sciences.

**Findings:** The findings show that students perceive their learning space as important. In their perception specific learning settings contribute to the outcome of their individual or collaborative study activities. The results also show that, irrespectively their study activities, students prefer quiet learning spaces where they can retreat. Students prefer to do their individual study activities at home. For collaborative activities students favour quiet, closed learning space at the university, such as a project room. Regarding the preferred learning space, students value functional attributes of the physical learning environment as most important. Aesthetic factors are considered to be less relevant for supporting study activities.

**Originality/value:** Literature and practice show a shift in learning and teaching approaches in higher education institutions. From a facility management perspective, this raises the question how the developments in higher education will affect the demand for learning space. The findings of our study contribute to a better understanding of the interrelationship between study activities and preferences for the physical learning environment. These results can be used by facility managers to support decision-making concerning learning space design.

### Keywords

Learning environment, Learning spaces, Students, Higher education, Design preferences.

## 1 INTRODUCTION

Facility management literature shows a continuous attention for the physical learning environment of higher education institutions, and for the way higher education learning and teaching can be accommodated and serviced optimally (Beckers et al., 2015; Kok, 2015; Sandberg Hanssen & Solvoll, 2015; Rytönen, 2014). This is a logical result of developments in higher education that have led to the need for reconsidering the physical learning environment as well. The latter raises the question for facility managers and real estate managers of higher education institutions to what extent these developments in the core business might affect the demand for the physical learning environment, and what they have to do to keep that environment aligned with the expected changes in higher education

learning and teaching. To support evidence based decision-making, it is important to have insight in the requirements of higher education students for their learning environment. Therefore, this paper addresses which learning spaces higher education students prefer for their study activities and which aspects of the physical learning environment students value as important. The study that is presented in this paper has been conducted in a Dutch university of applied sciences (UAS) and involved a population of almost 1,000 business management students.

## 2 DEVELOPMENTS IN LEARNING AND TEACHING

Higher education still is an industrial oriented system where students are treated as if they are on an assembly line in a learning factory (Robinson, 2010; Leland & Kasten, 2002). At the start of the 21st century, higher education institutions have to change to prepare their students for the tomorrow's knowledge economy that requires new skills (Voogt & Pareja Roblin, 2012; Ananiadou & Claro, 2009). New learning approaches, such as blended learning and flipped classroom concepts (Abeysekera & Dawson, 2015) make use of the opportunities of the information and communication technology (ICT). This may result in students watching web lectures at home or in other places and come to the university to meet for social reasons and for working together. This means a rift with the past. Traditionally, education has been organised in groups with 30 students and a teacher, of which the latter tells what has to be done, where, and when.

Yet, there is a shift from this supply-driven approach of traditional learning to new, more customised, and demand oriented ways of learning (Van Aalst & Kok, 2004). In this new way of learning, students are expected to behave as self-directed learners who take responsibility for their own learning process, learn how to build and use networks, cooperate with others, and use ICT as a tool to find resources that can help them to achieve their learning goals. These modern students differ from other generations because of their use of technology in daily life (Prensky, 2001). They do not know any better than that they can always be online and that they can have access to the whole world for both social ends and educational needs. By bringing their devices into the classroom, this generation of students is a trigger for change in education (Veen & Vrakking, 2006). The increase of ICT in education makes it easier for students to have access to a huge source of data, which results in a teacher who no longer has the exclusive rights to knowledge supply (Van Aalst & Kok, 2004). He or she has become one of the sources in the students' network, which can be consulted for educational goals. That demands a new kind of school that looks more like a service organisation that facilitates learning instead of dictating it.

## 3 LEARNING AND TEACHING SPACES

In 2007, De Vries argued in her PhD dissertation that education buildings of Dutch UAS were not sufficiently prepared for the expected developments in higher education. Almost ten years later, many recent studies show that higher education buildings in the Netherlands and in other countries are changing (Beckers et al., 2015a; Harrison & Hutton, 2014; Fisher & Newton, 2014; Park & Choi, 2014, Matthews et al., 2011). These studies show that traditional classrooms are progressively being replaced by a variety of informal learning settings that support contemporary learning and teaching approaches. These developments in learning space design are reminiscent of the design of new office environments (Beckers & Van der

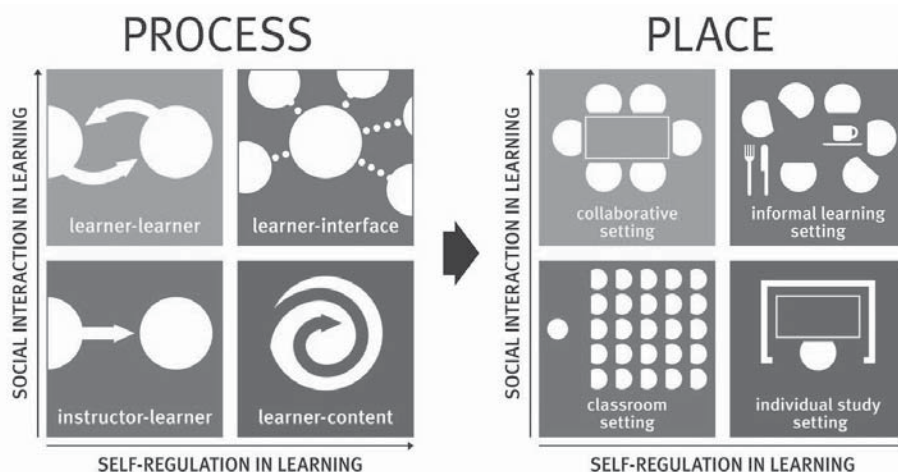
Voordt, 2013). Just like new offices (Duffy, 2000), new learning spaces have to support the need for self-regulation and social interaction. According to literature (Beckers et al., 2015), four main education processes can be distinguished, namely:

1. Programmed instructions;
2. Autonomous study;
3. Interactive learning in small groups (face-to-face);
4. Network learning through digital platforms.

Each of these processes and the underlying need for interaction or self-regulation has a specific physical learning setting to match (Figure 1):

1. A setting for large groups (e.g. classroom or lecture hall);
2. An individual learning setting for concentration;
3. A setting for small group work (e.g. project room);
4. Informal settings, often with catering services.

Figure 1 Learning and teaching space framework (derived from Beckers et al., 2015)



Mostly, the learning spaces of figure 1 are related to educational buildings. However, due to modern ICT devices, nowadays learning space is not limited to school buildings or universities. Analogous to the idea of third places (Oldenburg, 1999), every square meter of the built environment has the potential to support study activities, from home to the classroom and all kinds of public settings in between (Beckers et al., 2015b). So, informal learning settings can be found in coffee bars, restaurants, parks, and all kinds of public transport. It is expected that the increase of informal learning settings is related to higher expectations and demands of students for their physical learning environment (Beckers & Van der Voordt, 2013). There are many studies that investigated characteristics of the physical learning environment, such as Walden (2009), Woolner et al. (2007), Schneider (2002), Earthman (1998). Often, these studies focussed on the relation between the physical environment and the satisfaction of students or the learning outcomes of students, for example by studying aspects, such as lighting, colour, temperature, acoustics, layout, and furniture. Also, building size of the university building seems to be relevant for students' performance (Kok, 2015). According to Jamieson (2003), four key characteristics of the

physical learning environment should be taken into account related to supporting learning and teaching: comfort of the environment, aesthetic impact of the environment, layout of the environment, and fit-out (provided resources). The next section presents the results of an empirical study based on these four characteristics.

#### 4 RESEARCH METHOD AND PROCEDURE

The aim of the empirical part of this paper was twofold. First, it aimed to address which learning spaces students prefer for individual study activities that require concentration, and for collaborative study activities in small groups with peers that require communication. The collaborative study activities concerned working on group assignments and did not refer to social activities, such as hanging out, having lunch, or just drinking coffee. Second, it studied the students' design preferences for the physical learning environment.

For the study a self-administered questionnaire was used, based on a five-point Likert scale. Students were asked to indicate their preference for several learning settings, for both study activities, according to the third places of Oldenburg (1999): home, at the university, or elsewhere. The learning spaces at the university fit with the settings from figure 1, namely: individual settings, settings for small groups, and informal settings. Classrooms were excluded from the questionnaire, because classrooms are mostly scheduled and used for instructions, so students usually cannot choose these settings for individual or collaborative activities. The four characteristics of the physical learning environment were measured with seventeen items (Table 1) that were derived from literature (Yang et al., 2013; Harrop & Turpin, 2013; Walden, 2009; Woolner et al., 2007; Jamieson, 2003; Schneider, 2002; Fisher, 2001; Earthman, 1998).

Table 1 Characteristics of the physical environment

Comfort	Aesthetics	Fit-out	Layout
Natural lighting; Temperature; Furniture; Size of working surface.	Colour; Floor finishing; General finishing & decoration; Plants.	Desktop computers; Printing facilities; WiFi; Food and beverages.	Central location of learning settings; Transparency / openness; Retreat; Diversity of learning settings; Convenience to meet.

The study was conducted at the HAN UAS in the Netherlands. The sample was selected from 985 business management students in Nijmegen. The questionnaire was filled in by 697 students (71% response rate). The age, study year, gender, and living situation of the respondents are presented in Figure 2. An impression of the learning settings in the Nijmegen building is shown in Figure 3.

#### 5 RESEARCH FINDINGS

##### 5.1 Learning space preferences

The results, as presented in Figure 4, show that students prefer to do *individual study activities* that require concentration, at home. For these activities students do not favour open,

noisy settings, such as an atrium, corridors, the entrance area of the university building or an area with workstations for students, where talking is allowed. Catering areas, such as restaurants or grand cafés, are not popular either. When students work on individual study activities, they prefer to do these in closed, quiet learning spaces, such as individual cockpits or project rooms. An area with student workstations where it is quiet because talking is not allowed is sufficient as well. Other learning spaces than at home or at the university are not popular for individual study activities. Even when these spaces are explicitly meant for studying in silence, such as a library. Also, students do not prefer busy public spaces like a café in town for study activities.

Figure 2 Respondents characteristics (N=697)

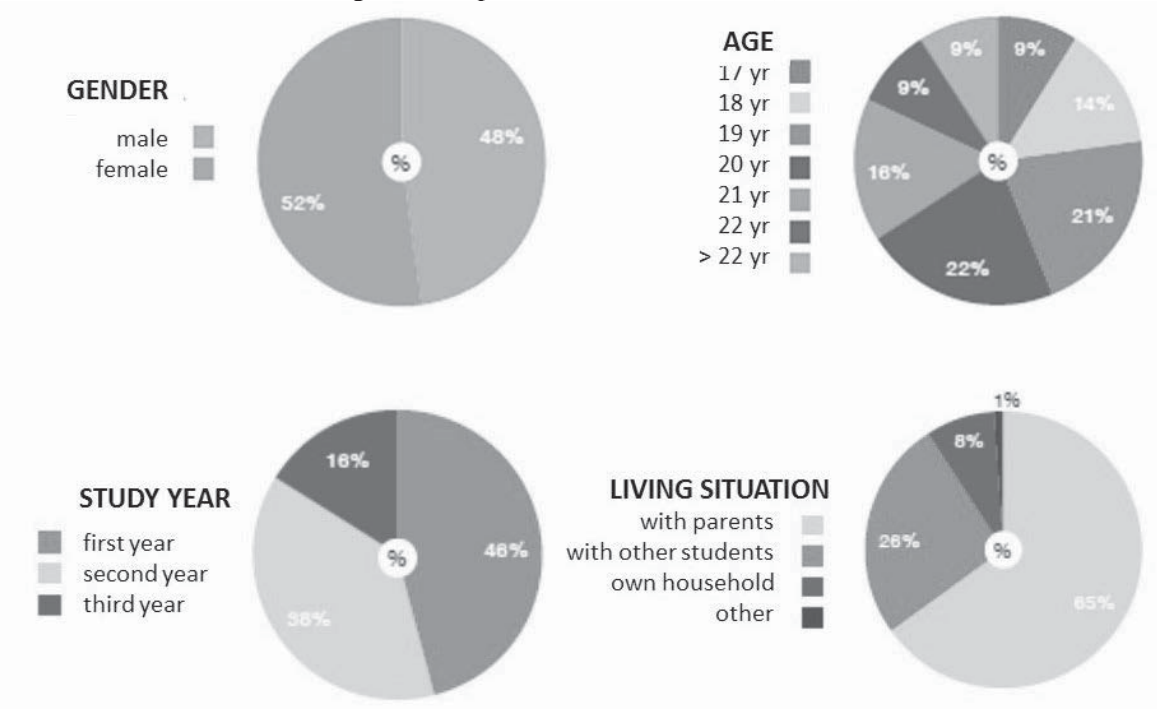
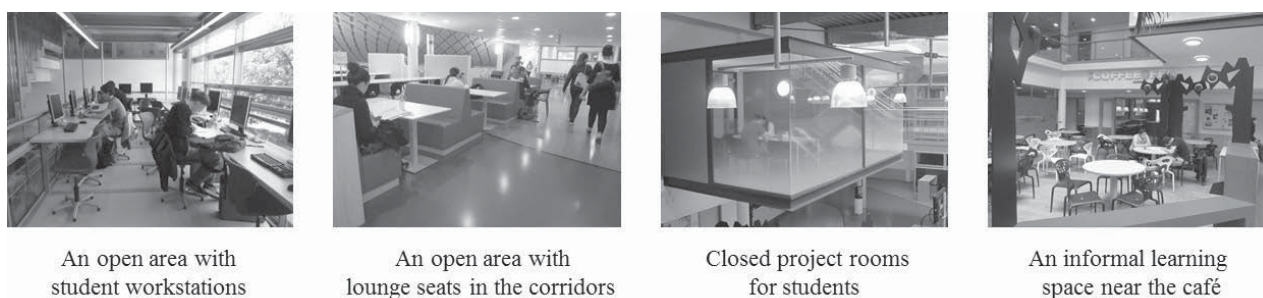
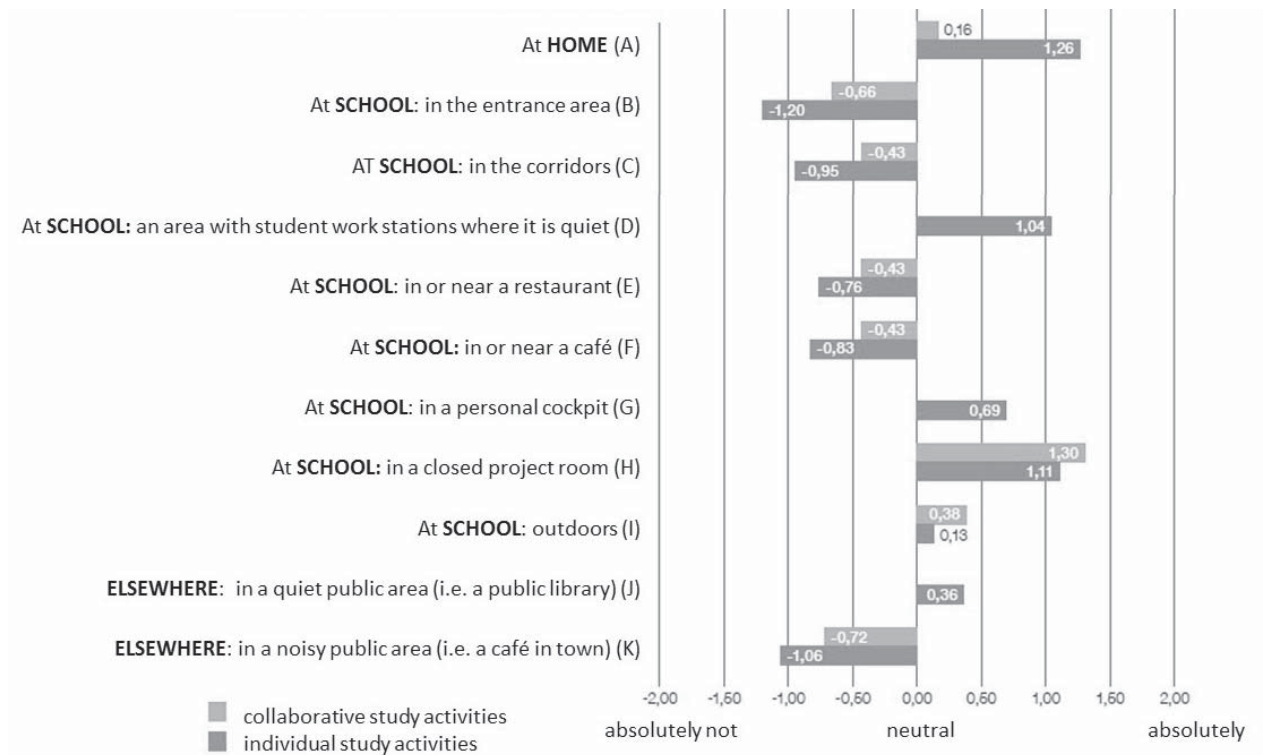


Figure 3 Impression of learning settings in the Nijmegen building



For *collaborative study activities* with peers in small groups, students actually have one favourite place, namely closed project rooms. All other learning spaces are valued as rather neutral or even as not popular for working together on study activities. In the questionnaire also a specific question was formulated regarding the preference of working together face-to-face or through online networks, such as FaceTime, Skype or WhatsApp. 63% of the respondents preferred face-to-face contact to virtual contact. 11% preferred virtual contact more. The other 26% were neutral in their opinion.

Figure 4 Mean values regarding the learning space preferences (N=697)



The overall picture of figure 4 shows a similarity between the preference of most learning spaces for individual activities and collaborative tasks. If a learning space is preferred or not preferred for individual activities, these spaces are preferred or not preferred for small group work as well. Nevertheless, an interesting question is whether there are significant differences between the two activities and to what extent specific learning space is more or less preferred for individual or collaborative activities. The *t*-values in Table 2 illustrate significant differences between the mean learning space preferences for individual and collaborative study activities.

Table 2 *t*-values to identify significant differences between learning space preferences per task

Learning space	mean difference	<i>t</i>	df	sig. (2-tailed)	<i>d</i>	95% CI	
						<i>LL</i>	<i>UL</i>
Learning space at home (A)	1.09	21.76	645	0.00	1.11	1.01	1.20
Learning space in the entrance area (B)	0.54	-15.92	688	0.00	0.63	-0.61	-0.48
Learning space in corridors (C)	0.52	-14.38	685	0.00	0.58	-0.59	-0.45
Learning space in quiet area with student work stations (D)	-	-	-	-	-	-	-
Learning space in catering area at school/university (E)	0.33	-8.67	690	0.00	0.35	-0.41	-0.26
Learning space in café at school/university (F)	0.40	-10.64	690	0.00	0.41	-0.47	-0.32
Learning space in personal cockpit at school/university (G)	-	-	-	-	-	-	-
Learning space in a project room at school/university (H)	0.19	-5.68	689	0.00	0.24	-0.25	-0.12
Learning space outdoors at school or campus (I)	0.25	-7.01	689	0.00	0.22	-0.33	-0.18
Learning space in a quiet public area i.e. in a public library (J)	-	-	-	-	-	-	-
Learning space in a noisy public area i.e. a café in town (K)	0.34	-8.82	685	0.00	0.35	-0.41	-0.26

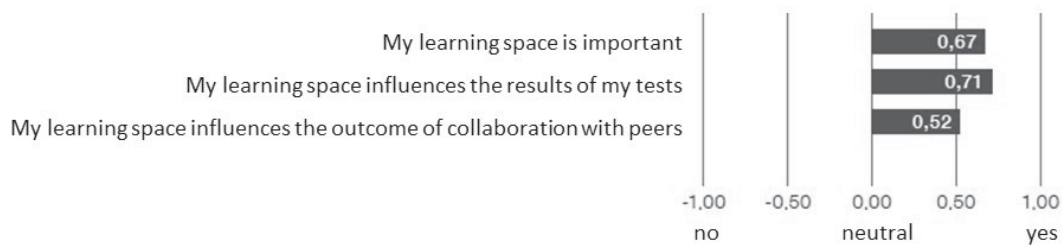


Cohen's  $d$  in table II shows a large significant difference between the preference to do individual or collaborative study activities at home, and also a medium difference for the preference to do study activities in busy areas at the university (e.g., entrance area, corridors, catering area, or a café). Small differences occur for the preference for quiet, closed learning space (project rooms) and outdoor spaces.

## 5.2 Relevance of the physical learning environment

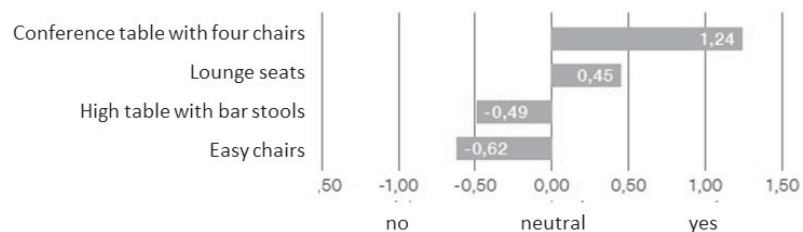
In general, students value their learning space as important and they think that it contributes to their performance (Figure 5).

Figure 5 Mean values regarding the relevance of learning space (N=697)



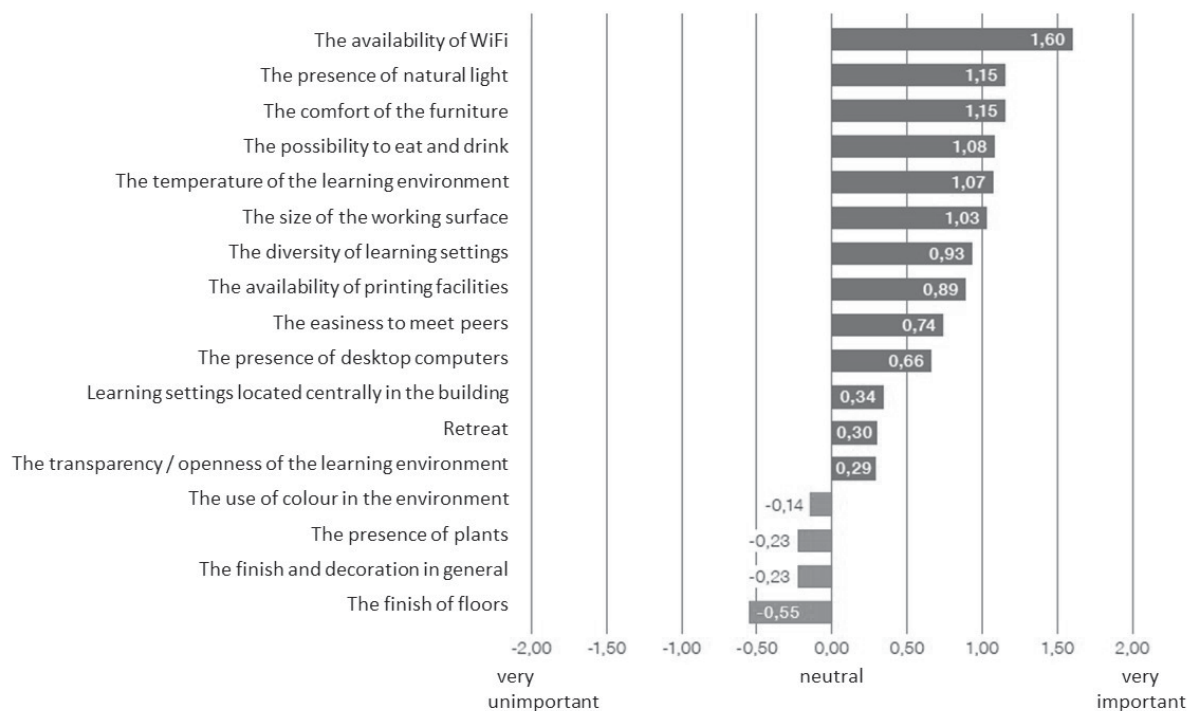
The results from the questionnaire show that students prefer functionality to aesthetics. For instance, traditional conference tables with regular chairs are by far the most preferred setting for working in groups. Easy chairs are not popular for these activities (Figure 6).

Figure 6 Mean values regarding the furniture preferences for working in small groups (N=697)



The relevance of functionality also shows up in the other results of the questionnaire. The students indicated the importance of the seventeen items related to comfort of the environment, aesthetical aspects of the environment, the layout, and the fit-out of the environment. Figure 7 presents the seventeen items that indicate the importance of the physical learning environment for students from most important to less important. Just like the preference for functionality in furniture, figure 7 shows that students value functionality as more relevant for their physical learning environment than for instance aesthetical aspects. The main item for students is the availability of WiFi in the environment. IT elements, like the presence of desktop computers and printing facilities in the learning environment are important as well, but other aspects, such as natural light, temperature, comfort of the furniture, and enough working space are more important in the eye of the students. The same goes for the possibility to eat and drink in the physical learning environment. Layout aspects, such as a variety in spaces for retreat and meeting space, or the location of learning spaces in the building, are less important to students. Aesthetical aspects of the physical environment, like colour or the finishing and decoration in the building, are perceived as not important in relation with study activities.

Figure 7 Mean values regarding the importance of characteristics of the physical environment (N=697)



## 6 DISCUSSION

The results of this study contribute two main insights to the current knowledge about the physical learning environment and learning spaces in higher education.

First, the study shows that students, regardless of individual or collaborative study activities, prefer a quiet study environment with sufficient possibilities for retreat. This is similar to the results of Price et al. (2003), who found quiet spaces as one of the most relevant study facilities of universities. Harrop and Turpin (2013) also argued retreat to be a key attribute of the physical learning environment. But how is this related to the increase of informal learning spaces in higher education buildings? These spaces are noisy and crowded and are therefore not popular with students for doing their study activities. Nevertheless, several studies show the relevance of these spaces (Sandberg Hanssen & Solvoll, 2015; Higgins et al., 2005). An explanation could be that informal spaces are deemed important but mostly for supporting other aspects of higher education learning such as serendipitous encounter and ambient sociality (Crook & Mitchell, 2012). So, a general conclusion that catering areas and informal learning spaces are not important is not convenient. These spaces are relevant to support social activities at the university, but are less preferred for study activities.

Second, students value the physical learning environment mainly based on effectiveness rather than experience. Students attach importance to functional aspects of the environment, such as sufficient natural light, a nice temperature, functional furniture, and sufficient resources. Environmental aspects that support collaboration, such as the convenience to meet peers are perceived important as well. Aesthetical aspects of the physical environment are not relevant for students. These results confirm the findings of Jessop et al. (2012). They also

found that students are mostly concerned about the functional aspects of learning spaces and that they are not overly concerned about aesthetics. Nevertheless, literature shows the relevance of the increasing experience factor in society (Pine & Gilmore, 1999) that shows up in higher education as well (Beckers & Van der Voordt, 2013). Schools must be fun and attractive. Higher education is not only about learning and teaching, but above all about the whole context and atmosphere in which learning and teaching take place. This results in catchy and trendy interiors and furniture in higher education buildings that increasingly look like shopping malls with atria containing restaurants and grand cafés. An attractive university building is an important instrument to attract and retain students and staff (CABE, 2005; Price et al., 2003).

Once again, differences between the findings of the aforementioned studies can be attributed to the scope of said studies. Building conditions do matter (Price et al., 2009). Well-designed learning environments are relevant for the image of the institution and to support end-user satisfaction. Furthermore, learning spaces in many modern university buildings fulfil minimum standards. Once these are attained, the impact of place characteristics on preferred learning spaces may be less significant (Higgins et al, 2005). Education buildings and facilities may be considered commodities or hygiene factors. They can motivate students to a certain extent, but students are most aware of the environment when it is not satisfactory.

Finally, the current study aimed to address preferences for the physical learning environment. Despite of the sample of nearly 700 respondents, the study involved student of one Dutch UAS in a specific building in Nijmegen. Besides, these were all business students. Further research that involves students from other disciplines, in more different buildings and in other countries, would be a preferable next step, to look for differences or to endorse the findings of this Nijmegen study.

## 7 CONCLUSION

To conclude, learning space preferences of higher education students mainly result from their goal support and evolving study activities. This is a significant finding, because the expectation is that future activities in higher education learning and teaching will be different from current activities. Traditional instructional approaches for larger groups will shift into more collaborative activities in small groups, in which students are self-directed learners. This shift in activities will have significant consequences for the requirements for higher education physical learning environments. Therefore, the findings of this research can be used by facility managers of higher education institutions in order to support contemporary learning with suitable, future-proof learning spaces.

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### 4.3 Exploring the unquantifiable: Modelling FM service relationships

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#### ABSTRACT

**Purpose:** There is a strong case to be made that FM, and FM contracts, suffers from an obsession with numbers at the expense of relationships. Several contributions to EuroFM 2015 evidenced the point. The challenge is to express the impact in at least probabilistic numerical terms.

**Approach:** While precision may be impossible the paper argues that aspects can be modelled and specifically will present a generic model using Bayesian Belief Modelling (BBN). The model described treats contract outcomes as a compound of five variables:

- The dependence on material quality
- The dependence on staff
- The complexity of the contract scope
- The complexity of the contractual provisions
- The effective relationships between the parties

**Findings:** The model allows both a criticality matrix and risk profile to be defined for each variable and yields a probabilistic estimate of a successful contract outcome. The risk profile can be adjusted according to expressed opinions of parties to a particular contract.

**Originality/value:** The simulation, available to EuroFM members, illustrates how research can be converted to practical or educational outcomes.

#### Keywords

Facilities Management, Service excellence, Service relationships, Co-creation, Bayesian Belief Models.

## 1 INTRODUCTION

*See, the thing is, you've got a contract, you've got a set of KPIs, you've got a bunch of stuff that you need to deliver and you can be a hundred percent compliant in all of those areas and the client can still be really pissed off with you and I think, they're unquantifiable almost, although you guys will probably try and quantify it [laughs] but, you know, they're qualitative things, they're things which are very hard to pin down and these guys (Account Managers) are in exactly the right place to gather this stuff, not only in terms of adding new business and new services extending what we do with these clients, but to understand more particularly what is driving them and what is driving their needs.* Business Development Director. International FM supplier

That quotation from the SHU Service Excellence study (Price and McCarroll, 2013; 2015; Price et al. 2015) sums up a dilemma faced by FM. It has become overwhelmed with Service Level Agreements (SLAs) and KPIs. In practice contractual outcomes, for both parties, depend on relationships if the contract is not to spiral into a vicious circle of mutual recrimination and auditing, preserving jobs and advisory commissions but acting against any prospect of value co-creation. Research into relationships in FM is limited (Cui and Coenen,

2016). Yet, as Tucker and Roper (2015) demonstrated by their analysis of the FM competency frameworks of the three largest professional associations, the softer skills of relationship management are under appreciated, at least by those bodies. The excellence research illustrated how the ‘social constructs’ - perceptions parties to a contract have of each other - strongly influence outcomes and the achievement, if desired, of the holy grail of excellence. At EuroFM 2015 Price and McCarroll presented a Snakes and Ladders game board to allow people to explore those stories.

This contribution extends that exploration to a Bayesian Belief Model, BBM. We first introduce the theory behind such modelling. We then explain the construction of a model for FM service outcomes. We conclude by outlining how the model might be developed and used in practice. We believe the development not only offers something completely new to FM. We also see it as a rare example of translation of the technique into application.

## 2 BAYESIAN BELIEF MODELLING

Bayesian Statistics takes its name from the Rev Thomas Bayes (1701–1761) who first formulated a theorem about the probability of a given outcome based on the probability of given inputs. A Bayesian Belief Network (BBN) provides a means to model the resulting probabilities associated with an outcome based on a network (belief system) of assumed causes. The BBN can provide an important decision-support tool.

We have placed technical details in an Appendix 1 but consider this example (Figure 1). What might the relationship be between five variables: 1) Grade, 2) the difficulty of a course, 3) the intelligence of a student, 4) whether they have completed SATs tests and a 5) the Reference letter from their tutor. A simple diagram can be constructed for calculating probabilities (P). Here, the difficulty of the course (D) combined with the intelligence of the student (I) are unconditional factors<sup>1</sup> which influence their grade (G) which is therefore a conditional variable. SATs results are unrelated to a course grade but are conditional to the intelligence of the student. Finally, a tutor is likely to look at course grades in order to write a reference. Therefore the probability of a good reference is conditional to the grade.

Our challenge was different. Here is the Director of a very successful FM Business Unit - in a commercially successful FM business – discussing FM contracts<sup>2</sup>. We have added the emphasis.

*However, what you do find is six months into the contract there's always things in there that you didn't expect. Always. That then becomes down to the relationship that you have built or what they<sup>3</sup> are like as people or as a business of how flexible they want to be. The good ones will say I understand this is the market, let's talk of how we can get around it. The bad ones are the ones that turn around and say that's what you sold, that's what we paid for, that's it, get on with it. Then you just have another four years of pain of trying to work it out. So a lot of that is around the business culture and how they want to work with you or not.*

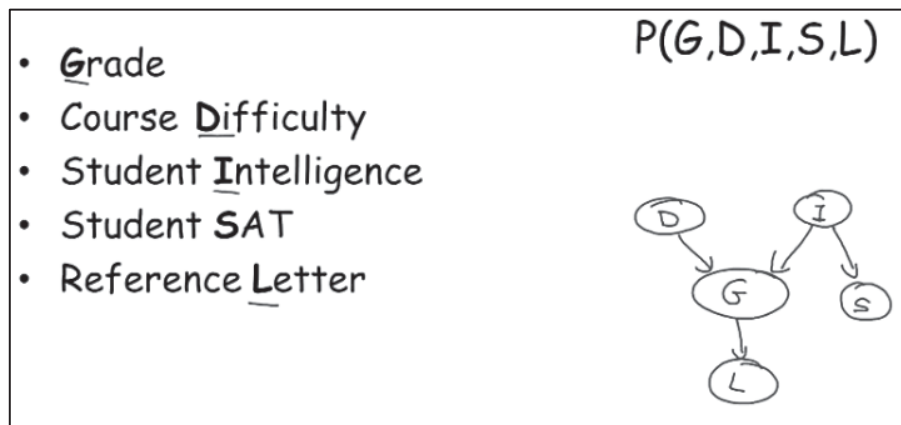
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<sup>1</sup> Bayesian modellers tend to refer to conditional and unconditional factors rather than dependent and independent variables,

<sup>2</sup> B2B

<sup>3</sup> The ‘intelligent client’ function managing the contract from the clients perspective

Figure 1 An Illustrative BBN

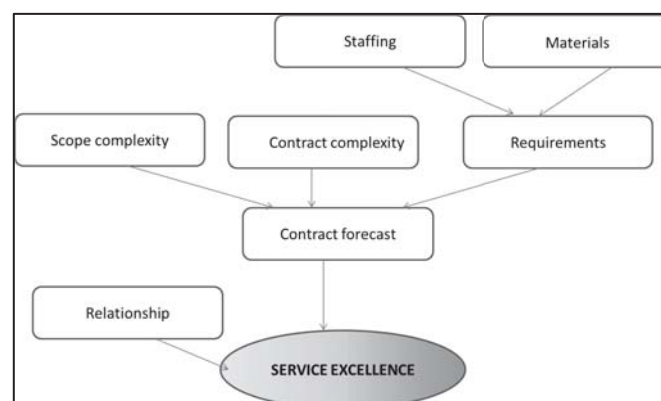


Service excellence in FM is found (Price et al., 2015) in the flexible contracts not the ‘four years of pain contracts. So what is the chance of one or the other outcome? We modelled this using the set of relationships summarized in Figure 2, deriving the variables from the interview data described by Price and MacCarroll (2013; 2015). We model a combination of contract issues and resource issues giving four inputs:

- Contract scope
- Contract complexity
- Human resource
- Material resource

A fifth variable, service relationship, can rescue a difficult contract or potentially scupper a good one.

Figure 2 Outline of the Service Excellence BBN



A risk profile can be set for each input. Figure 3 illustrates an example using the materials quality box. If you believe the quality of materials has only a moderate impact on the contract outcome (some might say a routine cleaning contract) you could set the figure in the bold box



to say **0.5** which corresponds to the probability of failure due to 'low' (L) quality materials (i.e. 50% chance success, 50% chance failure).

However, if you believe that materials failures would have a high probability of disrupting the contract (perhaps a maintenance contract for critical cooling plant), and therefore the quality of materials has a very high impact on success, then a figure of 0.9 in this box would indicate a 90% chance of failure if low quality materials are used (lower box in Figure 3).

Figure 3 Examples of the risk input matrix

		Materials Quality	
Failure		H	L
Y		0.5	0.5
N		0.5	0.5

		Materials Quality	
Failure		H	L
Y		0.1	0.9
N		0.9	0.1

What follows are a series of illustrations of how stories might influence the settings for each input variable. Cost assumptions are built into these illustrations, given the range of views on its influence.

As can be seen each input variable is provided with a sliding scale on which concerned parties can express their opinion of the likely quality. In practice this implies a judgement accessible from the various assertions made by parties to a particular contract. Figure 5 illustrates an example from the staffing variable and two contrasting narratives expressed in interviews. If the management attitude is that staff on a minimum wage should not be expected to care the quality delivered is likely to be less than in a situation of 'living wage'<sup>4</sup> and concern for individuals development. In the actual example the quality cursor has been set to the right of the scale.

The model is constructed in Excel (Figure 4).

### 3 DETAILS OF INPUT VARIABLES

The model is designed to be hands on. People can vary the risk matrix or the scale bar and see the visual impact on the outcome. What follows in this section are examples of the kinds of opinion that might drive a scale to one end or other.

#### 3.1 Quality of Materials

In general issues of materials were not among the main barriers to or enablers of FM Excellence raised in the interviews.

<sup>4</sup> See <http://www.livingwage.org.uk/what-living-wage>

Figure 4 Screen shot of complete model<sup>5</sup>

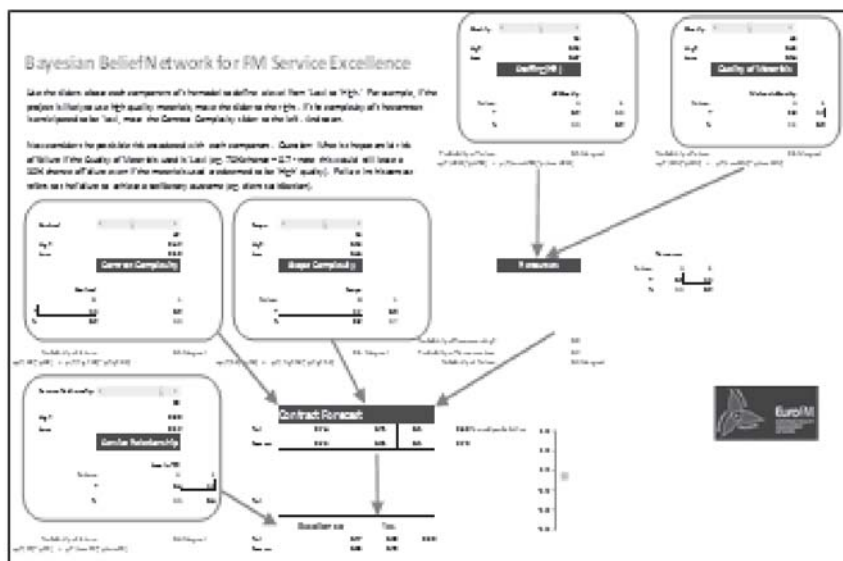
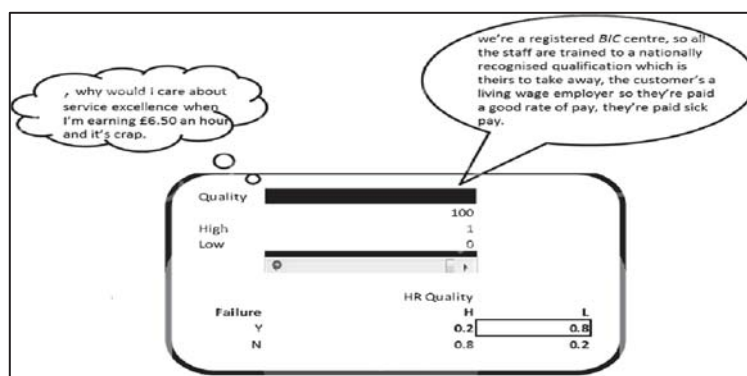


Figure 5 An example of quality input



On some contracts it is clear that what is expected is the highest quality. On others the expectation is quick and dirty. It turns out that on some contracts, and with some contractors a client’s suspicion that the contractor is “fishing for extras” mitigates against trusting that root causes of problems will be raised, or fixed. The only case of a request for a microphone to be turned off arose in the following exchange.

Account manager *Because yeah, at the minute there’s, you know, there is that repeat business aspect of we trust in them, i.e. they’ve been out for a lamp before and spotted this and, yeah, there is that trust element. You know, it’s the exact opposite as if you’re sending someone out to do maintenance on say boilers and they start picking up on loads of remedials and asking for 20 grand of remedials and then it turns out actually they weren’t really required, then that’s the opposite, isn’t it? That’s the exact opposite. That’s going and fishing for things that aren’t necessarily there.*

<sup>5</sup> Individual components are separately illustrated. A copy of the programme implemented in Microsoft Excel is available to members of the EuroFM RNG.

Interviewer. *Do you think contracts such as the one you currently have with ... would encourage fishing for extras? It's a very interesting point you've raised.*

The unrecorded reply was to the effect of the account manager discussing the risk involved with their boss.

### **3.2 Staffing**

*But I am very passionate about it and I really firmly do believe that you can deliver great things with great people, and those people that aren't necessarily perceived to be great could be great.* Client Procurement advisor for a global contract.

Quality of staff on the other hand is seen as an absolutely key issue, by suppliers and the more service oriented clients. In so many situations it is reaction of front line staff or their supervisors to unexpected situations that determines perceptions of excellence, especially for users of the service concerned.

There are the usual questions around management and the extent to which a service orientation is an attribute some individuals have more than others

*I mean we know some sites, the cleaners will go home or they'll go to inevitably another cleaning job.* Client FM manager

*So for instance, there are certain individuals there whose attitude and style stands out from the rest because of the way that they engage with you as an individual, the way that they smile, the way that they deal with issues. And I've seen that in our own operations, where you get certain individuals who have an ability to take a decision and take responsibility for putting something right when others would simply give us a stock answer or an unsatisfactory answer that actually only makes the situation worse.* Supplier Business Unit director

*I think, a lot of organisations don't give very clear messages about empowerment of people at the front line. So what am I allowed to do, what are the parameters within which I can operate and what am I expected to do? So confronted with a situation like this what would you, Mr Employer, want me to do about it? And I don't think we explain that very well sometimes.* Supplier Regional manager

*So it comes down to the people on site and the way that they deliver the service, the attitude that they have, how helpful they are; are they meeting the client's needs, requirements? Are they delivering what the contract is?* Client Operations Director

*I wonder how many FM staff actually know the objective of the organisation that they are providing services for though?* Supplier Business Development

*We do employ a lot of the immigrant community that come over here and I think it's easy to overlook them and say, well, it's a low paid job, you know, and we don't need to invest any time or effort in training and managing these people, but actually, you do.* Client FM Manager

### **3.3 Contract scope**

*So, you know, I think there is a... the existence of a contract gets in the way of a natural desire to do the right thing.* Client Operations Manager

Increasing complexity, and rigidity, of contractual scope is widely seen by suppliers and some clients as a barrier to excellence. Higher scope complexity reduces the probability of excellence.

Our client interviewees had varying approaches to contract scope. Some found service specific contracts with a few specialist providers generated the results they wanted and

excellence at particular points of customer contact. Others found the complexity of multiple contracting threatened the service experience of their customers.

*Our caterers supply our front of house as well in London. They don't supply front of house round the regions. They understand us.. I think engineering isn't quite as strong. It's not one of my areas but just looking from the outside I don't think it's as strong. Then you have the cleaning type operations who probably call themselves total FM these days because they provide a wide range of services. And again a mixed bag really as to whether they get it.* Client Accommodation Manager

*Now as it happens in that example, without getting too complicated, the engineers, who don't work for that provider, fixed that particular thing, hand driers, etcetera. They won't in the new contracts but they do in the current contracts, unfortunately, which, again, is about giving the whole facility over to one contractor.* Client FM Manager

*And then, in the public sector, there's a great deal of aversion to taking any risk. So if somebody comes to us and says, this is a piece we want doing, a lawyer steps past, I'm sorry, you can't ask them to do that because you didn't procure that service in the first place. And you think, well, we want to do it, our client wants it doing, and there's a whole sort of governance piece that says, no, I'm sorry, you can't do that work, so that is incredibly frustrating for both parties.* Supplier Business Unit Director

*What you do not see are FM providers really getting to understand their client, put themselves in their client shoes, delivering exactly what they really want and looking to exceed it. What they tend to do, unfortunately, is stick to what's in the contract, which is generally basic and occasionally they'll achieve that.* Client FM Manager

### 3.4 Contractual Complexity

Closely allied to scope complexity is what is widely seen as a growing complexity of contracts in terms of detailed KPIs and SLAs decoupled from need and driven by procurement advisors with no long term stake in the outcome. Again, increase in contract complexity is modelled as decreasing the likelihood of a favorable contract outcome

*I think clumsy widgets based procurements is probably one of the key reasons why organisations don't give themselves permission to try and put this out there in the marketplace because I think it can get stifled very, very easily.* Client Operations Director

*I think too many procurement or people involved in procurement are trying to buy a service in a box off the shelf. I go back to, KPIs do not work in terms of getting an organisation to perform... well, they don't work* Client Operations Director

*I don't think contracts and KPIs are the right way to measure some of these, to be honest.* Client Operations Manager

*I've had clients, particularly in the banking sector, there was one client that I know that had six hundred and ninety-four KPIs that you had to be reported on every single month. Now that meant we had to have a lot of people gathering all of that data, putting it in the spreadsheets and whatever.* Supplier, Regional Manager

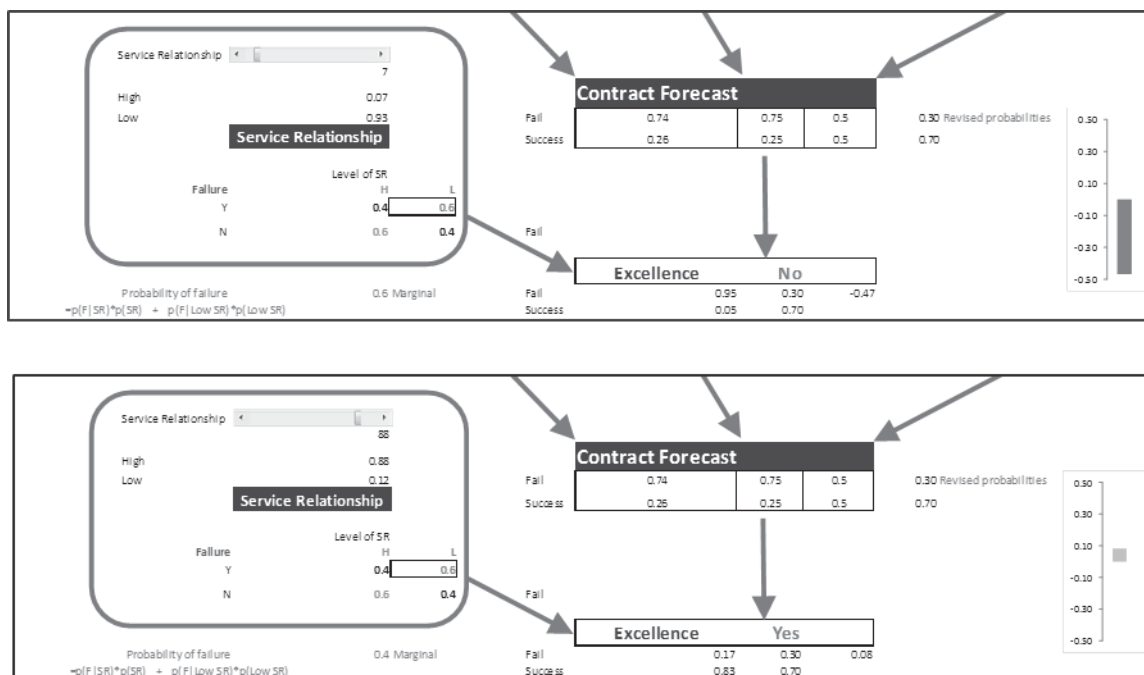
*It's no good just measuring operational parameters, they won't give you what you want.* Client Operations Manager

*So, from my point of view, service excellence for me is delivering a contract, okay, to the KPIs and SLAs that are in there and then being able to show what more we've done, where we've bought additional value to the client's business.* Supplier Account Manager

## 4 SERVICE RELATIONSHIP

Examples of final output modified by the service relationship variable are shown in Figure 6.

Figure 6 Examples of final output modified by the service relationship variable



The probable quality and risked importance of the first four input variables (treated independent) provide an estimate of the probability of the contract achieving FM Excellence (the dependent outcome). Ultimately though, excellence is a function of the service relationship. Figure 6 illustrates the outcome of two models where all the input predictions and risk profiles were held constant. The relationship estimate has been varied. In the first, where the relationship has deteriorated there is a high risk of the contract descending into acrimony and value co-destruction. In the second an effective relationship offers a chance of overcoming some of the barriers built into the contract by the other input factors. What drives the difference? Largely perceptions each ‘side’ has of each other. Compare the two views in Table 1.

Table 1 Contrasting stances in FM

Adversarial stance	Generative Stance
<ul style="list-style-type: none"> <li>• I perceive you to be acting in your own interest</li> <li>• Therefore I act in mine</li> <li>• Therefore you perceive me to be acting in my own interest</li> <li>• Therefore you act in yours</li> <li>• Therefore my perception is fulfilled</li> </ul>	<ul style="list-style-type: none"> <li>• I perceive you to be acting in a joint interest</li> <li>• Therefore I act in a joint interest</li> <li>• Therefore you perceive me to be acting in a joint interest</li> <li>• Therefore you act a joint interest</li> <li>• Therefore my perception is fulfilled</li> </ul>

### 4.1 Brokerage

FM is replete with brokers, between suppliers and the core business or between suppliers and the FM procurement organization. In brokerage theory there is a distinction drawn between *Tertius gaudens*, the third party who rejoices and *Tertius Iungens*, the third party who brings

people together (Obstfeldt, 2005). *T gaudens* rejoices in, and makes a living from conflict. All the active examples of generative partnerships that we encountered described *T Iungens* style behaviours. The same style has been identified as the only common characteristic among the Facilities Directors of NHS trusts which achieved consistent excellence over 4 rounds of PEAT<sup>6</sup> inspections (Macdonald, 2012).

On the client side *T iungens* individuals described active pursuit of good relationships and joint problem solving. They were also plugged in to the strategic direction of their organizations. We did not meet overtly *gaudens* style individuals in the client interviews, though we had them described to us by suppliers. We did though meet individuals who tended to view excellence as opulence and their role as gate-keeping between their organization and the suppliers. They were more prone to favour formal procurement processes and the industry that advises on same benefits from keeping parties apart.

On the supply side, brokerage takes the form of maintaining contacts at all levels. We encountered cases where local supervisors and staff had excellent relationships with key users beneath the 'radar' of the formal contract. We also encountered cases where middle levels of management, especially regional directors were too overloaded to recognize the clients who were genuinely seeking excellence.

Suppliers found it easy to recognize *gaudens* style influences in tender documentation and some mentioned the suspected presence of specific advisers as criteria for not bidding on particular requests. **They found it harder to distinguish would be *iungens* style clients<sup>7</sup>.** We are back to intangibles but consider signals each side sends the other.

## 4.2 Signals

What signals can each side send the other? One strong theme in the interviews with committed *iungens* style clients was a preference for solving problems over bearing grudges (e.g these three clients):

*So for example, KPIs, key performance indicators around service level agreements, arguably if somebody fails the KPI/service level agreement they are penalised and they lose it for good. Our strategy is actually we don't want to do that, we don't want you to go, we want you to succeed. So therefore if you fail it in one month we're going to give you two months to put it right. If you put it right in the two months and thereafter you deliver, then you get it back. So it's in a deposit account.*

*Where's the opportunity. It's not worked, you've not got it right, where's the opportunity to put it right, and how can we make sure there's something there to support you with that. And I think historically it's very much a slap and a punishment, go back in your corner, you've clearly not performed very well, we'll see you next month sort of thing. There's no incentive for them to be motivated. It's about motivating and it's about learning I think too. It's a journey. Life is a journey.*

*Now it would be very simple for me to take that £1300 off them and then there are two people that suffer. The Suppliers suffer because they've given me £1300 but they've got to try and find back stock for the silverware onto the ward. But ultimately the patient is still in that*

<sup>6</sup> Patient Environment Action Teams: A yearly audit introduced in 2000

<sup>7</sup> Emphasis deliberate

*position where they might not have it as quick as they would so we would sit down and say what is the instance. Is it that you're managing your cutlery badly or is it because we've got a bit of this? If it is, we'll manage it together so actually I don't want all of the money back. I want to see you put it back into that service on that level. We will register that you failed in case you keep doing it but actually you keep that money, make sure that you don't come back with no cutlery for that ward again. Taking that approach and being strong when we need to be, but also looking past the contract and what the actual effect is on the patient, I think has helped us foster that relationship. I think ultimately benefited the patient or the service user.*

And looking for opportunities to signal back (from a supplier):

*All these things, if you thought about it, none of them are in the contract and we could say no. But what it does is it makes us a partner and if you're a partner it's harder for them to say we want you to go, in a nutshell. So the value added for me is all the things that you are doing on top of your specification that the client goes that's fantastic.*

Signals matter (Forbes and Brady, 2015).

## 5 CONCLUSION

FM deals in relationships, a point made by all the service providers interviewed in the studies referenced above and by a majority of the client representatives. It functions in a service ecosystem (Vargo et al., 2015) in which the social constructs carried by individuals (Price et al. 2009) exert an influence on how they perceive, and are perceived, by others. We hope the model described here, and available to EuroFM members encourages researchers more familiar with numerical and analytical research traditions to explore the soft side. To practitioners who regard it as unquantifiable we would say, in an absolute sense – yes -, but that does not prevent relationships being rendered visible.

Our annotated bibliography may offer avenues for further research.

## ACKNOWLEDGMENTS

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## APPENDIX: BBN - AN ANNOTATED BIBLIOGRAPHY FOR ENTHUSIASTS

Numerically minded readers might like to explore the following:

- Lauría, E. J.M & Duchessi, P. J. (2006) A Bayesian Belief Network for IT implementation decision support. *Decision Support Systems* 42 1573–1588.  
This paper demonstrates how to create a BBN from real-world data on Information Technology implementations.
- Mo, J. & Zhao Z. (2007). Using Hybrid Bayesian Networks to Model Dependent Project Scheduling Networks. DOI 163 10.1109/ICNC.2008.734
- Cho, S. (2009) A linear Bayesian stochastic approximation to update project duration estimates. *European Journal of Operational Research* 196 585–593.  
By relaxing the unrealistic assumption of probabilistic independence on activity durations in a project, this paper develops a hierarchical linear Bayesian estimation model.
- Chin K-S et al. (2009) Assessing new product development project risk by Bayesian network with a systematic probability generation methodology. *Expert Systems with Applications* 36 9879–9890
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Less mathematical than many of the examples in this list.
- Wang, X., Wu, C. & Lin M. (2010) Software Project Schedule Variance Prediction Using Bayesian Network 10.1109/ICAMS.2010.5552847
- Hu Y. et al., (2013) Software project risk analysis using Bayesian networks with causality constraints. *Decision Support Systems* 56 439–449.
- Khodakarami, V. & Abdi. A. (2014) Project cost risk analysis: A Bayesian networks approach for modeling dependencies between cost items. *International Journal of Project Management* 32 1233–1245.  
The new approach explicitly quantifies uncertainty in project cost and also provides an appropriate method for modelling complex relationships in a project, such as common causal factors, formal use of experts' judgments, and learning from data to update previous beliefs and probabilities.



## 4.4 Measuring User Satisfaction

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### ABSTRACT

**Purpose and method:** To simplify the measurement of user satisfaction in buildings, a special survey was created. The current study shows how the application myBuildingMessage with its two questions was developed. It presents the method of data analysis, a facility management and real estate specific semantic analysis, used for the open question. In the development process, a case study was conducted to collect data on user satisfaction, once through an open questionnaire and once through a closed questionnaire, to analyze subsequently the differences between the two questionnaire forms.

**Findings:** The results show that, with little effort, myBuildingMessage can collect detailed information for facility management.

### Keywords

User satisfaction, Questionnaire, Open questions, Facility Management, Web-based surveys.

## 1 INTRODUCTION – INITIAL SITUATION AND PROBLEM

Optimizing user satisfaction and people's well-being in buildings plays a central role in facility management (FM) (GEFMA Richtlinie 100-1 2005). However, satisfaction being prone to subjective influences and specific conditions, this is a highly complex topic. To make matters worse, there is no uniform or predefined way of measuring satisfaction. Nonetheless, user satisfaction plays a crucial role in FM in general, and when it comes to the satisfaction of users of workplaces in particular, as there it influences how productive users can be. This circumstance is the reason why some of our research and studies deal with the measurement of satisfaction in office buildings (Appel-Meulenbroek, R. 2008: 43–55, Bluysen, P.M. et al. 2011: 2632–2640, Roelofsen, P. 2002: 247–264, Thomas, L.E. 2010: 610–624.)

The most common way of collecting data to measure user satisfaction is the use of questionnaires, followed by interviews and only sometimes physical measurements. In a systematic review of published scientific papers dealing with building users' satisfaction,

however, no standardized questionnaires for that kind of research could be found (Huber, C., Koch, D., Busko, S., 2014). The reason for that is presumably the complexity of the topic, which results in the existence of a large number of different questionnaires all around the world. The existing questionnaires are usually quite extensive and require a long time to fill in, which is why users often feel deterred from even starting to fill them in. The participants who do fill them in are faced with a number of questions covering various different subtopics, not all of which are important to them. This limited number of relevant questions in questionnaires in turn means that also the gathered data relevant for interpretation is limited. An unpublished survey that was carried out at the Kufstein University of Applied Sciences as part of the research project *Modular Questionnaire Assessing Building Users' Satisfaction*, shows this problem based on data gathered from 130 participants.

Nonetheless, looking at the data gathered in a 2014 telephone survey interviewing 14 FM consulting experts and facility services providers, there seems to be no doubt about the necessity of assessing building users' satisfaction in general and their satisfaction with the building's facility services. In this survey, 13 out of the 14 experts stated that user surveys are an important FM tool. So, to provide a new alternative to the limited number of (inappropriate) questionnaires, the Department of Facility & Real Estate Management developed, over the last two years, myBuildingMessage, an open questionnaire with only two questions.

The purpose of this paper is to analyze the applicability of such a short and open questionnaire when it comes to assessing building users' satisfaction. Below, the advantages and disadvantages and the requirements of an open questionnaire according to the literature are listed. Subsequently, based on the above mentioned findings, the Department of Facility & Real Estate Management's questionnaire, its design and method of analysis will be presented. In addition, the initial user satisfaction measurement results will be discussed.

## 2 OPEN VS. CLOSED QUESTIONNAIRES

According to Lazarsfeld, the controversy over open and closed forms of questionnaires started with the beginning of social research (Lazarsfeld, P.F. 1944: 38–60). Until this day, his works are still often quoted when looking at the two questionnaire forms. In practice, it is the closed questionnaire that pushed through and established itself (Geer, J.G., 1991: 360–370, Converse, J.M. 1984: 267–282). The reasons for this are the lower costs, the simpler process and the possibility of quantitatively analyzing the gathered data (Schuman, H. & Presser, S. 1979: 692–712). Despite these advantages of a closed questionnaire in terms of efficiency, the literature discusses two major disadvantages of this form compared with its open counterpart. First, the answers given in a closed questionnaire do not show how a participant would have answered spontaneously. Second, the predefined answers distort the results as they may lead to participants giving answers that they would not have thought of by themselves had the answer not been provided to them (Schuman, H. & Presser, S. 1979: 692–712, O'Cathain, A. & Thomas, K.J. 2004: 25). The disadvantage of an open questionnaire, on the other hand, is that, compared with a closed question, the answers are hard to compare with each other. This disadvantage results in a larger amount of work on the researcher's side when it comes to processing the gathered data, and in a higher proportion of answers being given that do not fit into groups of answers (Reja, U. et al. 2003: 159–177).

The following explanation shows the problems and limitations with open and closed questions based on a research experiment carried out by Schuman & Scott to measure public opinion. Half of the participants were given an open questionnaire and the other half received a closed questionnaire. The closed form included a total of five possible answers, the first four were relatively insignificant as a pre-study had determined, and the fifth option allowed for an open answer (Schuman, H. & Scott, J. 1987: 957–959).

The results of this experiment show that 60% of participants filling in the closed questionnaire went for one of the first four, insignificant, answers. Only 40% made use of the fifth option allowing them to give an open answer. In the open questionnaire, however, only 3% of participants gave answers comparable to the first four questions of the closed questionnaire. The other 97% focused on different problems. Based on these results, Schuman & Scott argue that a closed questionnaire leads to distorted answers even if there is the possibility of giving an open answer (Schuman, H. & Scott, J. 1987: 957–959), as participants tend to prefer giving low-effort answers instead (Zuell, C., Menold, N., & Korber, S. 2015: 115–122).

Schuman & Scott's study also shows the limitation of open questionnaires. The main problem there is the fact that open questions provoke different thoughts and different associations in the participants compared with what the researcher writing the question had in mind. In their experiment, Schuman & Scott asked the participants about their opinion regarding the most significant changes or events from the last 50 years. The most common answer given in the open questionnaire was the Second World War, the Vietnam War and events such as space travel. Less than 2% of participants choose to answer with the development of computers. Following these findings, the researchers conducted a second independent survey. This time, however, they opted for a closed questionnaire providing the four most common answers from the open pretest plus the development of computers as the fifth closed answer option. A sixth option allowed participants to answer freely. The results show that 94% of participants chose one of the five predefined answers with the majority, about 30%, choosing the development of computers as their answer. The researchers explained this result with the fact that while the open survey's question did not directly provoke the association with computers, the closed survey did (Schuman, H. & Scott, J. 1987: 957–959).

To summarize, the use of open questions is helpful to gain additional or more complex information about the participant's thoughts. The fact that open questions also have their advantages is why many surveys rely on a combination of both closed and open questions even if numerous studies show that open questions are more likely not to be answered because, as Zuell noted, they require a higher cognitive effort to be filled in (Zuell, C., Menold, N., & Korber, S. 2015: 115–122).

So, the most common approach to creating a closed survey is to start with an open pretest. This helps to identify important topics and relevant questions, and to gain information about how to best adapt the wording of predefined closed answers to the potential survey participants (Schuman, H. & Scott, J. 1987: 957–959).

The following table summarizes the advantages and disadvantages of open and closed questionnaires based on the literature in general and on Vinten in particular (Vinten, G. 1995: 27–31):

Table 1 Presentation of advantages and disadvantages of open and closed questions

Advantages	Disadvantages
Open Questions	
Free and spontaneous answers Chance to consider and assess possible answers independently Useful for testing hypotheses; identifying possible questions and answers (pretest for closed questions)	Potentially higher cognitive effort required by the participants Coding: higher cost and required time for processing and analyzing data Higher probability of not giving answers
Closed Questions	
Writing is not explicitly necessary Lower costs Easy process Easily comparable Useful for testing specific hypotheses	No spontaneous answers Distortion of answers (predefined answers) Pretest needed for identifying possible questions and answers

The time required to fill in a questionnaire can vary with both closed and open questions. If, comparing an open and a closed questionnaire, the same number of questions is asked, then the open form requires more time to answer. If, however, the number of questions can be reduced by choosing open questions, then open questions can be the more time-saving option. On the researchers' side, it is almost always the open survey that is more time consuming to process—an aspect that also has to be considered when deciding which form of questionnaire to create.

### 3 CONSEQUENCE: OPEN QUESTIONNAIRE FOR ASSESSING BUILDING USERS' SATISFACTION—APPLICATION REQUIREMENTS

The acquisition of data for measuring building users' satisfaction level is a very complex field that is influenced by various individual parameters specific to the real estate in question (Huber, C., Koch, D., Busko, S. 2014). As the comparison of survey forms has shown already, an open questionnaire is better suited to complex survey topics. In the application's development process, an analysis of negative aspects of an open questionnaire was carried out and the requirements of open surveys were identified. This approach and the information taken from the literature resulted in the development of the application's specific requirements. The aim is to use the advantages of closed and open questions like described in table 1 and combine these advantages in the survey. Especially open questions have content advantages, so that we focused to minimize the disadvantages via technical solutions.

#### 3.1 Response rate

Zuell's study examines, for example, whether the size of the response box and the including of motivational texts influence the number of nonresponses (Zuell, C., Menold, N., & Korber, S. 2015: 115–122). Unlike what Smyth and Emde & Fuchs found, Zuell argues that the larger the box, the lower the number of responses (Smyth, J.D. et al. 2009: 325–337, Emde, M. & Fuchs, M. 2012: 1–13). Smyth, Emde & Fuchs and Zuell, agree, though, that a motivational text, such as an explanation of or introduction to the study, significantly increases the number and the length of responses (Smyth, J.D. et al. 2009: 325–337).

An earlier meta-study carried out by Cook analyzed the response rate in web- and Internet-based surveys. He found that web-based surveys open new possibilities when it comes to collecting high-quality answers and increasing the response rate of open questions, and in

terms of design, visual support and interactive effects (Cook, C., Heath, F., & Thompson, R.L., 2000: 821–836). One other major advantage of such web surveys is that each individual version can, through filters, be adapted to the participant filling it in. This means that only questions relevant to or interesting for this one respondent are actually asked, resulting in a higher response rate (Holland, J.L. & Christian, L.M., 2009: 196–212).

To summarize, important for a survey's high response rate are a clear and detailed explanation about the survey and an appropriate structure.

### **3.2 Type of question**

As shown at the beginning in Schuman & Scott's example, the wording of open questions is key to provoking the desired association in the participants (Schuman, H. & Scott, J. 1987: 957–959). With questions on building users' satisfaction, it is especially important to guide the layman to consider not just the building itself but also the building's processes and its entire management. If a question is: "How satisfied are you with the building?", the participants will most likely only talk about the building itself (e.g., the bad building quality, the architecture, ...). The option of associating the question with service provision may be completely lost on the participants. On the other hand, when guiding the participants, the researcher writing the question must refrain from including specific examples as these would provide verbal anchors distorting the layperson's answers (Schaeffer, N.C. & Presser, S. 2003: 65–88), Sandelowski, M. 2014: 3–8). Such a question to be avoided would be, for example, "How satisfied are you with the building and the provided services within (such as the cleaning of the building)?" as it would distort the results in regard to the cleaning service.

### **3.3 Distortion regarding number of negative answers**

Poncheri's study shows that relatively unsatisfied members of staff are more willing to comment on questions in an open questionnaire than relatively satisfied staff. The more willing a participant is to fill in an open question, the longer the answer or explanation of a comment will be. Her theoretically sound results are in line with the literature and the PNA (positive–negative asymmetry) theory (Poncheri, R.M. et al. 2007: 614–630).

For measuring user satisfaction, that means that most responses will be of a critical nature, which allows researchers to focus on studying these negative aspects.

### **3.4 Evaluation and coding are time consuming**

The majority of publications draw attention to the time-consuming processing and coding of open questions. This opinion most likely stems from a technological age where the possibility of computer-supported processing was still limited.

A comparison of personal (interview), paper and web surveys clearly shows that web surveys are the more cost- and time-efficient form and come with additional advantages regarding standardized use and evaluation (Behr, D. et al. 2012: 487–498). The web surveys' advantages resulted in an increase in surveys conducted on matters of web design (e.g., the layout of possible answers) (Couper, M.P. et al. 2004: 111–127, Smyth, J.D. et al. 2009: 325–337).

Continuing with the topics discussed above, the next section presents the developed application. Its requirements correspond with those discussed in the literature and it makes use of the advantages of open surveys.

#### 4 APPLICATION: MYBUILDINGMESSAGE

myBuildingMessage is a web-based surveying tool assessing, with only two questions, building users' satisfaction level. Its first question is a closed question asking the user: "How satisfied are you with the building?", the answer can be given on a scale from 1 (= very satisfied) to 10 (= very unsatisfied), how satisfied they are with the building. The 1–10 scale allows for an initial quantification of the user's general satisfaction.

The second, open, question is: "What are you particularly satisfied/unsatisfied with?". Additionally description to the second question is optional: "Do not only think about the building, also involve the surrounding, the services, the facilities and your workplace." The question includes an additional text prompting the participants to provide their answer in as much detail as possible. However, no explicit examples are given, to avoid a distortion of the results (see Section 3.2). The application is programmed in a way that the layout of the question and the box for the answer adapts to the screen/display size of the used device. In addition, the answer box automatically adjusts to the length of the answer given to avoid confronting the participants with a box large enough for an extensive answer as this might deter some participants from answering at all (see Section 3.1). The advantage of the internetbased survey is that on the whole world can make this questionnaire and we can analyze the results in real time. Depending on the purpose of the survey, questions about the building's surrounding environment, the (facility) services or the work place can be included to help a layperson filling in the questionnaire to consider all important aspects (see Section 3.2). myBuildingMessage is constructed in a way that it can be adjusted for each individual survey. That way, the survey can focus on (single) specific buildings to achieve a maximum level of acceptance among the test subjects (see Section 3.1).

The myBuildingMessage survey is sent out to the desired group of users via web link. In addition, individuals can be granted access to the survey via tokens. The evaluation of the data can take place at the same time as the survey is being conducted (real-time analysis).

The closed question about satisfaction (1–10) is evaluated by summing up the answers of each level of satisfaction and calculating each level's proportionate representation. The answers given to the open question are analyzed semantically. For that, first the texts are neutralized and stop words are eliminated. Then, real estate specific key words are grouped to form word clusters. The used expressions of feelings (sentiments) in a sentence or part of a sentence (item) are used to decide whether a given item is considered to be positive, neutral or negative. Then, sentiments are assigned to the item's relevant word cluster.

The decision over whether words indicate a positive, neutral or negative sentiment is made through a sentiment analysis. If, for example, a user says: "The lights in my room are too dim," then the words *lights* and *room* can be assigned to real estate specific word clusters such as lighting and space. *Too dim* indicates that the statement is negative, meaning something that leads to users being unsatisfied. Unlike in a closed questionnaire asking, for example, about the satisfaction with the lighting, with the answer given in an open survey, FM can obtain information about the reason as to why a user may be dissatisfied. This results in FM being able to make more targeted adjustments. Currently, the online-based text analysis can process 80% of statements automatically. The rest are fed into an analysis tool to teach the application how to interpret them.

myBuildingMessage analysis uses word clusters such as the FM categories DIN EN 15221-1, DIN 276 and GEFMA 100-1. Additional clusters based on benchmarking reports and validated questionnaires relevant to the topic of user satisfaction can also be selected for the analysis.

Figure 1 Analysis cockpit of myBuildingMessage – Extract of the analysis interface



The analysis cockpit visualizes general survey data, such as the number of participants, the general level of user satisfaction and the satisfaction score. In addition, the clustered responses are visualized to give a quick overview of specific topic areas. This also allows for benchmarking of various real estate and internal process comparisons. On top of that, the sentiments, survey process and a word cloud for the rough grouping of the most important topic complexes are presented in the analysis cockpit.

As can be seen, it is possible to analyze an open survey efficiently. All the advantages of a short and open survey are utilized to collect and neatly present detailed information about the building users' satisfaction levels. In addition, the time efficiency of myBuildingMessage, both for the survey participants and survey creators, allows for regular user satisfaction surveys to be conducted.

## 5 CASE STUDY: OPEN VS. CLOSED QUESTIONNAIRES

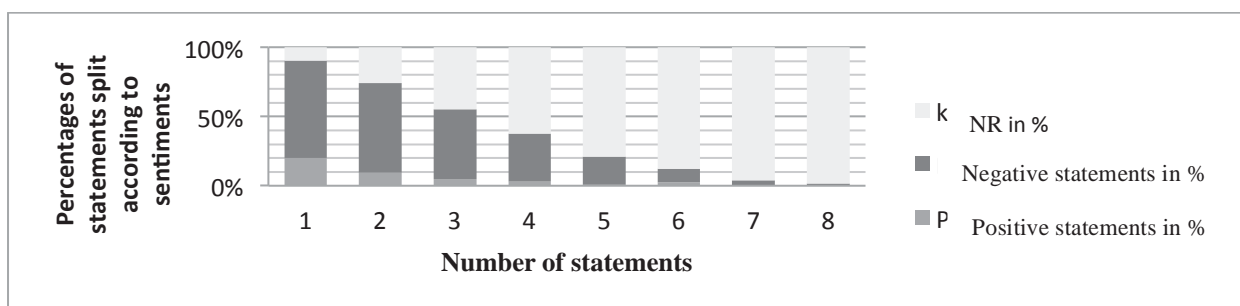
Below, a case study that was carried out as part of the myBuildingMessage application's development will be presented. The literature shows sufficient information about the

difference between open and closed surveys. However, as far as the authors of this paper are aware, there is no case or discussion of FM attempting to measure user satisfaction. This is why a comparison between an open and a closed questionnaire was carried out by the authors of this paper.

125 participants were asked about their user satisfaction by means of an open questionnaire. It included two questions and took on average five minutes to fill in. The same group received a comprehensive closed questionnaire with a total of 200 questions. Both the questions themselves and the number of questions were chosen based on what is considered typical for that kind of questionnaire according to the literature. The open questions were analyzed by means of a semantic analysis as described above; the closed questionnaire was analyzed by looking at how often individual possible answers to single questions were selected.

The results of the short, open questionnaire show that, on average, three statements with a total of 142 characters were written per participant. This length compares with, for example, a Twitter message, which allows for a maximum of 140 characters. Only 10% of participants did not respond. In total, 370 statements were made, 14% of which were positive and the other 86% were negative. The open questionnaire shows that it is the negative aspects in particular that are of importance to the users and are therefore mentioned. The following chart shows the distribution of positive and negative sentiment statements in regard to the number of statements.

Figure 2 Comparison of negative and positive responses



A comparison between the open and the closed questionnaires shows a high degree of agreement when it comes to the negative aspects. Both forms identify the key weaknesses, such as Wi-Fi connection, university cafeteria and parking. In contrast to that, a broader spectrum of topics is covered in the positive statements. The open questionnaire took less time to fill in and allowed for specific issues to be identified (e.g., the lack of electric sockets).

## 6 CONCLUSION AND OUTLOOK

This study shows that both closed and open questions have advantages. However, taking into consideration the complexity of the topic of building users' satisfaction, an open surveying method with software-supported analysis is preferable. myBuildingMessage, an application for surveying building users' satisfaction, exploits all the advantages of an open survey. As



has been shown in a number of field trials using the application, the optimized design and the automated analysis led to the development of a tool that allows easy capture of the satisfaction with and in buildings in a meaningful way that is useful for FM and the running of a building. In addition, it can analyze the results and present trends.

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## **5 SERVICE EXCELLENCE AND VALUE CO-CREATION**

### **5.1 FM LEADERS' MENTAL MODELS AND APPLIED LEADERSHIP STYLE IN FM SERVICES**

SIMONE SESBOÛÉ AND ALLA TOLSTOSHEEVA

### **5.2 IDENTIFYING AND MEASURING CUSTOMER VALUE - CASE MULTI-LOCATIONAL WORKER**

TYTTI VASELL, MAIJU VUOLLE, VITALIJA PETRULAITIENE, SUVI NENONEN AND TUULI JYLHÄ

## 5.1 FM Leaders' Mental Models and Applied Leadership Style in FM Services

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### ABSTRACT

**Purpose:** Mental models affect both individual's reasoning and behaviour and predict leadership effectiveness more than experience, knowledge, or training. The purpose of this study is to generate an in depth understanding of facility managers' mental models and to examine to what extent the mental models are constructed based on employees' different qualifications levels. Applied leadership behaviour was assessed to reveal the degree of consistency between mental models and behaviour.

**Design/methodology/approach:** Evidence is generated from ten facility managers in Swiss Facility Management (FM) service professions. Using Repertory Grid Technique, all facility managers' mental models are constructed based on employees' qualification levels when referencing to work factors such as motivation, need for control and working attitudes.

**Findings:** The identified mental models support the assumption that leaders perceive low skilled employees rather negatively in contrast to the high skilled group. Middle skilled employees are perceived positive when compared to low skilled employees and negative when compared to high skilled employees. The results revealed inconsistencies between leaders' self-assessed leadership behaviour and the mental models they hold about low skilled employees. Mental models and leadership behaviour were consistent for the middle skilled and high skilled employee group.

### Keywords

Facility Management, Mental models, Cognitions, Leadership, Job qualification level.

### 1 INTRODUCTION

FM employs a large number of people on low salaries and often with low skill levels. In an attempt to strive for service excellence, many FM organizations claim to be moving towards learning or people oriented organisations, however, management is still understood to be a function of control (Price & Akhlagi, 1999). Often facility managers hold professional trainings in more quantitative and/or technical subjects. Their educational background and potentially their early professional experiences and in particular their attitudes toward staff, especially lower paid, may predispose them to a rather control approach to management (Price & Akhlagi, 1999). However, this still widespread control conceptualisation of FM leaders is unlikely to meet the challenges facing the FM service profession in the future (Price & Akhlagi, 1999).

More than ever before, developing effective leaders necessary for mobilising and transforming FM service personnel plays a greater role in service organisations (Andersen & Ankerstjane, 2013). While classical leadership training that develops so called critical skills (Meehan and Reinelt, 2010), such as goal setting, motivating and inspiring people, or coping with conflicts is necessary, such skills are certainly not sufficient for leadership effectiveness (Magzan, 2012). Effective leaders do not necessarily have more knowledge or experience than ineffective leaders; rather, their way of handling the complex issues they face is more valid and effective (Johnston, 2008). That is, effective leaders challenge their cognitions or so called mental models (Magzan, 2012), those deeply ingrained assumptions or generalisations that influence how we understand the world and how we take action, rather than “merely” relying on learning new information (Johnston, 2008).

While the management and leadership literature is replete of studies with references to the importance of mental models, they and leadership issues in general have been less investigated in FM. The authors seek to advance leadership research in FM from a cognitive perspective by understanding the beliefs and implicit theories FM leaders hold of their employees. Creating awareness among FM leaders of the existence and the effects of their mental models is considered to be an important first step to improve service-oriented leadership in FM services.

Hence, the first objective of this study is to identify the content and structure of FM service leaders` mental models by using the *repertory grid technique*. The in-depth leader-centred approach is used to reveal the underlying, personally constructed, internal conceptions that affect how FM service leaders might act. The second objective of the study is to investigate the congruence of FM leaders` mental models and their applied leadership behaviours. Based on theoretical and empirical grounds, McGregor`s theory X/Y (1960) was identified to investigate how FM service leaders` mental models determine leadership style. McGregor (1967) proposed a theory of the human mind that a manager`s view of human nature affects his or her managerial style and choice of managerial strategies.

## 2 THEORETIC RATIONALE

### **Mental Models**

Understanding the belief system of individuals and to reconstruct the knowledge and reasoning for actions is assigned to the conceptualisation of mental models (Rook, 2013). Mental models are a reflection of individuals` comprehension within a specific area and for this reason can serve as a tool to understand and to increase required knowledge especially in an organisational and management context (Miller, 2003; Senge, 2006; Starkey et al., 2004). Mental models are researched in diverse disciplines such as system dynamics, psychology and cognitive psychology. Rook (2013) analysed definitions spread among various disciplines and came to the conclusion as to how mental models can be defined on a common basis:

*A concentrated, personally constructed, internal conception, of external phenomena (historical, existing or projected), or experience, that affects how a person acts. (p. 45)*

In other words, mental models are constructions of one individual`s mind and reflect the internal thinking which is affected by external processes. Mental models influence “the attitudes, views, actions, behaviours and decisions of individuals” and have the ability either

to assist or to limit capacities during actions and decision making in organisational contexts (Rook, 2013, p. 42). In line with this, Kelly (1955) developed the *personal construct theory (PCT)* to understand what the stimulus is for certain behaviour. PCT (Kelly, 1968) suggests that individuals develop personal “constructs” to categorise people and situations they encounter. Kelly (1955) chose the word “construct” to distinguish it from “concept”. The main difference is that a construct has a specific opposite which a concept does not have. Kelly argued that good only has a meaning if related to bad. Thus, all constructs are bi-polar adjectives; each construct consists of opposing sides such as intelligent-dull, stable-unstable, active-passive.

Individuals use these constructs to make sense of their observations and experiences to anticipate and predict events. In turn, these constructs determine then individual’s behaviour, thoughts and feelings. Each system of constructs is unique because they are based on an individual’s personal experiences. The understanding and the sense are reproduced into experiences and are stored in the cognitive system as a pattern – the mental model. While mental models may help filter out relevant information effectively from the environment, they may also reduce individuals’ ability to understand an information domain, implying stereotypic behaviour (Ireland et al., 1987).

### **Mental Models and Theory X/Y**

McGregor (1960) suggests two polarising assumptions supervisors may hold of their employees: Theory X and Theory Y. Theory X superiors have a pessimistic mind set and simplified assumptions that employees in general are lazy, lack ambition, avoid responsibility and do not contribute towards organisational goals. In contrast to Theory X is the Theory Y superior, who is assumed to perceive that their employees generally enjoy the work (McGregor, 1960). Employees can be easily motivated to work hard and are able to bear responsibility for autonomous performance. Also they are able to generate ideas which can be essential for solving organisational problems and are striving for personal growth through self-direction.

This research intends to create an understanding of mental models based on contrasting Theory X/Y using the *repertory grid technique (see below)*. The Theory X/Y distinguishes five dimensions: (1) Work - according to Theory X employees tend to show opportunistic behaviour, which means that they take selfish advantage of a situation and have minimalistic and self-interested behaviour patterns. Theory Y assumes instead that employees view work as a natural process. (2) Control - Theory X assumes that employees are lazy and passive. Theory Y assumes leaders perceive employees as loyal, able to adapt and highly self-disciplined. (3) Motivation – besides monetary interests employees are striving to satisfy physiological and safety needs as stated by Theory X. According to Theory Y employees’ motivation has an intrinsic nature. (4) Creativity including sub dimension skills – based on Theory X assumes employees prefer to be directed and are striving for a routinized task completion. Theory Y assumes employees as being highly engaged having specific skills, including intellect, which provides the ability to solve organisational problems. Self-control is perceived as indispensable in achieving organisational goals. (5) Responsibility - Theory X assumes that employees are not willing to bear responsibility, whereas Theory Y states the opposite – employees are perceived as actively searching for responsibility and as showing a responsible and engaged behaviour at work.

Within the different dimensions leaders’ basic assumptions, perceptions, expectations and attitudes towards the values and beliefs of employees are distinguished according to the two

poles of Theory X/Y. These mental models can be regarded as “implicit” personality theories as they serve to be the initiators of leadership behaviour (Sager, 2008, p. 135), as they provide an insight into “fundamental individual differences in attitudes leading to variations in leadership behaviour” in an organisational context (Kopelman et al., 2010, p. 121). Although more recent studies have questioned the rigidity of the model, McGregor's X/Y theory remains a valid basic principle from which to develop positive management styles and techniques.

### **Mental Models and Leadership Style**

“The dominant conceptualization of leadership in organizational behavior is the charismatic/transformational style, a style often contrasted with a transactional style” (Anderson & Sun 2015, p. 1). While the true essence of transformational leadership is that these leaders display behaviours that cause employees to go beyond expectations (Judge & Piccolo, 2004), transactional leadership is about monitoring contractual obligations in the form of performance and output (Antonakis, Avolio & Sivasubramaniam, 2003, p. 265) as well as punishing the errors of subordinates (Tajeda et al., 2001).

Research states that both behaviour dimensions are related to leader effectiveness. Evidence suggests that transformational leadership may be particularly effective (i.e., having stronger motivational effects) in service professions where employees have contact with people who are affected by their work (e.g. clients and customers) (Liao & Chuang, 2007; Grant, 2012).

“In the service context, a transformational leader may convey to followers the value and importance of providing superior customer service, increase their enthusiasm in serving customers, instil confidence in them that they can provide high-quality service that they previously considered impossible, encourage them to come up with new and creative ways to serve customers better, help remove obstacles that prevent them from delivering high-quality service, and recognize their individual contribution in customer service” (Liao & Chuang, 2007, p. 1007). In turn, the contrasting transactional leadership style predicts effectiveness of the leader in a different manner (Howell & Avolio, 1993). Focusing on a transparent and pragmatic exchange relation, leaders make clear what followers can expect for fulfilling performance criteria and in so doing make followers perform up to standard (Bass, 1985; Bezuijen et al. 2009; Carmeli & Schaubroeck 2007). Based on the empirical evidence it becomes clear that a leader can apply both leadership styles (transformational and transactional) as both are associated with effectiveness as an outcome (Bass, 1985; Lowe et al., 1995).

Despite the evidence of the effects of transformational and transactional leadership on employees and organisations, there is still little known about the cognitive aspects that may facilitate the adoption of either leadership style (Pastor & Mayo, 2008). McGregor (1960) stated with Theory Y that it is human nature to satisfy higher order needs within organisational structures. It is known that McGregor`s Theory Y served as conceptual ground for the development of the transformational leadership theory (Bennis, 2003; Pastor & Mayo, 2008; Yukl, 1989), thus assuming that leaders` mind sets translate into leadership behaviour. However, there is no evidence that the development of transactional leadership theory is based on Theory X beliefs. Nevertheless, a logical causal link can be argued and is used during the empirical part of the study.

### 3 METHODOLOGY

#### Sample

Ten facility managers holding top management positions in different segments within the Swiss FM industry (e.g., FM service provider, FM in hospitals and elderly care) participated in the data collection procedure. The sample consists of three women and seven men who were on average (mean) 42.1 years old and have between 2.5 and 30 years of experience in a leadership role. All participants were informed by email and/or phone about the study and were asked if they were willing to participate. If they agreed, then a second email was sent including a questionnaire to self-assess their leadership behaviour (transformational/transactional). This was then followed by a personal interview with each FM leader to elicit their mental models.

#### Data Collection Procedure

##### *Transformational and Transactional Leadership Style*

To measure FM leaders' perceived leadership behaviour the authors used Bass and Avolio's (1999) Multifactor Leadership Questionnaire (MLQ); Form 5X—Short; 0 = not at all, 4 = frequently, if not always. The MLQ is a categorisation technique for identification of how leaders assess their own behaviour within the range of stated leadership styles divided by operationalised components. The goal was to collect data about how FM leaders evaluate their leadership behaviour with regard to whether they apply rather the transformational or the transactional leadership style. Due to the German speaking context of our study, we used the translated MLQ version of Felfe and Goihl (2014). FM leaders filled out the questionnaire online before participating in the personal interview.

##### *Mental Models*

To elicit FM leaders' mental models we applied the *repertory grid technique* (RGT). The first step was the identification of relevant concepts that form the basic elements of the mental map: FM leaders' perceptions and their constructions of employees' nature within different types of divisions. This specific application of RGT is based on semi-structured in-depth interviews (Flick, 2009). The interviews were conducted during 45 to 80 minutes in a face to face setting between FM leaders and researcher in German. Each interview was audio recorded.

In our study the repertory grid interview process consisted of the following four steps:

1. *Elicitation of employee groups*: Participants were asked to think about four elements, which can be divisions, functions or teams lead by them in their company. These four named elements were written on the element cards and two of them were shown to the interviewee in order to start the core of the interview process.
2. *Attribute elicitation of employee groups*: Showing two of the four randomly chosen employee groups to each participant, the researcher asked: "How do these two cards differ or are similar with regard to employees' 1. attitudes towards the job, 2. their behaviour at work, 3. their beliefs and values, 4. your behaviour towards the divisions/functions/teams?" The procedure was continued until all four cards were compared to each other. By contrasting different sets of elements in this way, a series of bi-polar constructs were generated. For example, a participant compared the teams with regards to *task completion* and mentioned that "*team A is more proactive*", then the participant was asked to assign "*proactive*" with the opposite pole, such as "*passive*". Thus, a bi-polar set is set up which can be expressed as: "*proactive ... passive*".

3. *Rating of how constructs influence behaviour:* The next step was to rate the initial and the opposite pole as a whole construct with regard to its influence on the participant's leadership behaviour. For example, if the initial pole was called "proactive" and the opposite pole "passive", that resulted in the construct "*task completion*". Or, the initial pole was "*team-orientation*" and the opposite pole "*egoistic behaviour*" then the construct was "*participation*". The objective of this step is to identify how the entire construct (e.g. participation, task completion) affects self-perceived leadership behaviour on the scale from 1 to 7 (1=very low influence; 7=very high influence).
4. *Assigning qualification levels to employee groups:* At the end of the interview, the repertory grid was complete when the element cards (divisions/functions/teams) were assigned with the qualification level of employees. As can be seen from Table 1, the division names were entered on the top of the grid and the construct poles were written on the left for the initial pole and on the right for the opposite pole. The left column represents how the combination of both poles as a construct influences FM leader's leadership behaviour in general.

Table 1 Sample Repertory Grid

Construct rating 1=influence low; 7=influence high	Initial pole (1)	1 Element : Cleaning	2 Element: Technical FM	3 Element: Reception	4 Element: Consultant	5 Element: Postal services	Opposite pole (0)
<b>7</b> task completion	proactive	1	0	1	1	0	passive
<b>6</b> motivation	intrinsic m.	0	0	1	1	0	extrinsic m.
<b>5</b> participation	Team- orientation	1	0	1	1	0	Egoistic behavior

### *Comparing Transformational/Transactional Leadership with Mental Models*

The last stage of data analysis combined a between-method comparison of participants' self-assessed leadership style and their mental models. A two-dimensional matrix was developed for each participant. An example of such a matrix can be seen in Appendix 1. In the left column of the matrix, the ratings of the MLQ self-assessed leadership style items are displayed, which indicate whether the participant has a transformational/transactional leadership style or no leadership at all. On the upper column are participants' mental models elicitations grouped along the dimensions of Theory X/Y and differentiated according to employees' qualification levels. It should be noted that the sample matrix in Appendix 1 does not entail the Theory X/Y dimension *responsibility* as this FM leader did not elicit constructs pertaining to the responsibility dimension. The essence of the matrices can be found in the middle quadrants. Participants' answers on leadership style and mental model elicitation are contrasted to each other: when consistent they are highlighted in green, when inconsistent they are highlighted in red, when not related they are left blank.

## 4 RESULTS

### *Transformational/Transactional Leadership Style*



Nine out of the ten FM leaders assess their leadership style as being predominantly transformational while they also perceive to apply one component of the transactional leadership style; the contingent reward component. One FM leader prefers to stay as an observer and to have a rather passive role. All ten FM leaders believe that their leadership behaviour creates positive outcomes. They perceive themselves as effective leaders who are able to generate satisfaction and extra effort in their employees.

#### *Eliciting Theory X/Y Constructs*

The analysis of the constructs and their poles with regard to the elements is done in a qualitative manner. Langfield (1971) and Feixas (2002) utilised the rarely used qualitative approach by applying a coding system on the basis of a content analysis. The content analysis helps to identify a valid set of constructs (Miles & Huberman, 1994) and by applying a coding procedure, provides a theoretical classification of constructs. The thematic coding is based on the theoretical assumptions of Theory X/Y (McGregor, 1960). An additional generated component is attributed to the *big five personality traits* (McCrae & Costa, 1996), as it could not be coded within the framework of the Theory X/Y.

Overall, the ten participants named 344 poles. As each pole is either initial or opposite, two of such poles are assigned to one construct. Thus, 172 constructs are elicited during the data collection procedure. The single constructs are aggregated into 33 thematic constructs which are assigned to five theory based themes: 1) motivation, 2) work, 3) control, 4) creativity, 5) responsibility. These five themes are considered as dimensions during the interpretation process of the data.

Out of 33 thematic constructs 12 are assigned to the dimension *motivation*. Four of them were stated 41 times (24%). Such intensity within the dimension indicates that FM leaders strongly evaluate employees` behaviour during task completion according to motivational factors. In order to increase the consistency of the dimension *motivation*, the constructs were grouped into the following four categories of *Maslow`s hierarchy of needs* (1954): safety & security, belonging, esteem, and self-actualisation. Further, for all statements directly entailing the term “motivation” a separate construct category “motivation” was created. The most frequent mentioned constructs are reported hereafter:

- Category *motivation*: The extent to which employees are either intrinsically or extrinsically motivated plays a significant role. The thematic construct motivation was mentioned 10 times (5.8%) and influences leadership behaviour strongly (5.2).
- Category *belonging*: The thematic construct *participation* was mentioned 15 times (8.7%) and does significantly influence leadership behaviour (5.3 on a 7-point scale). *Identification* represented as the need of employees to belong and to identify themselves with the company is also perceived by the FM leaders (7 times, 4%) and does influence their leadership behaviour significantly (5.5).
- Category *esteem*: The importance of esteem granted through rewarding is perceived by the leaders 9 times (5.2%) but has a lower influence (4.9) on leadership behaviour.

Another strongly represented dimension is *work*. It contains two thematic constructs – task completion and achievement orientation - which were mentioned 23 times (13.4%). Whether the tasks are completed actively or without any ambition, do influence FM leaders` leadership behaviour (5.1). 13 times (7.6%) leaders talked about this observation. Achievement orientation was described by FM leaders 10 times (5.8%). Whether the employees strive for

superior performance or act according to instructions does influence leadership behaviour (5.0).

The dimension *control* contains two thematic constructs: *adaptability* (8 times, 4.7 %) and *control* (7 times, 4%). A significant influence (5.9) on leadership behaviour plays on the perception of FM leaders, as to whether employees need to be controlled or not. Also the ability of employees to perform according to their profession or to isolate themselves has a strong influence (5.4) on FM leaders.

Within the dimension *creativity*, the thematic construct *self-initiative* was most often mentioned (8 times, 4.7%). However, the influence on leadership behaviour is weaker than in other dimensions (4.4).

The remaining three thematic constructs, which have a lower frequency, but do significantly influence leadership behaviour, are: *knowledge*, within dimension *skills* (frequency 4, 2.3% and influence on leadership behaviour 6.3), *responsibility* (frequency 5, 3% and influence on leadership behaviour 5.6) and *trust* (frequency 4, 2.3% and influence on leadership behaviour 6.3). Due to the low frequency rate a weighted interpretation is difficult.

#### *Assigning Qualification Levels*

FM leaders are aware of the differences among their employees' qualification levels and group them into homogeneous divisions. Not only could the differences in qualification levels be found, but also how the conceptions of employees' nature differ when categorising the divisions to low, middle or high skilled. In between group comparisons revealed that low skilled employees are perceived with typical Theory X characteristics: e.g.; low motivation, rather passive. High skilled employees are perceived as possessing Theory Y characteristics: e.g.; high motivation, engagement. Middle skilled employees share characteristics of both Theories X and Y depending on whether they are compared to low skilled or high skilled employees. Only one participant, who compared divisions consisting only of low skilled employees, constructed their nature according to both Theory X and Y. Beside that case, the rest of the groups were between group comparisons of different qualification levels. Systematically, the group that had higher qualification levels were described with Theory Y characteristics. The FM leaders stated that activities in the dimensions motivation, task-completion, need for control, creativity in problem solving, responsibility as well as skills, do indeed influence the way employees are perceived and how they are approached.

## 5 DISCUSSION

Contrasting constructs elicited during the data collection covered five dimensions of Theory X/Y (work, control, motivation, creativity including the combination skills and responsibility) as well as one personality based construct (introversion/ extraversion) which shed light on the cognition of FM leaders in Swiss FM service professions. Moreover, the study provides an insight into how cognitions are constructed based on employees' qualification levels (low, middle and high skilled). Micro level analysis shows that low skilled employees are predominantly constructed with regard to Theory X assumptions, high skilled employees according to Theory Y assumptions and middle skilled workers share both Theory X and Y attributes. Thus the findings support current empirical evidence as provided by other researchers (e.g. Karatepe & Kilie, 2007; Maxwell, 2006; Maxwell & Quali, 2002; Kosten, 2002) but also indicate conflicting views within leaders' cognition with regard to

leadership behaviour and constructions of employees' nature. The differences arose when the FM leaders compared qualification levels. The low skilled group is judged rather negatively on work factors when compared to the middle skilled employee group. In turn, the middle skilled employee group was perceived rather negatively on work factors when compared to the high skilled group.

The FM leaders in the study perceive themselves to apply transformational leadership style and one component of the transactional leadership style, which is contingent reward. These findings align with work by Berry's (1995; 1999) suggesting that leadership in the service segment is developing in a values-driven direction. In addition, Rothfelder's et al. (2013) support the findings of the study, as they state that transformational leadership behaviour and contingent rewards create high employee job satisfaction.

The analysis about how mental models direct leadership behaviour shows that there are discrepancies between leaders' self-assessed leadership behaviour (predominantly transformational) and the Theory X assumptions they hold of low skilled employees. A transformational leadership style that is based on trust and employee empowerment may not be a natural consequence of Theory X supervisor's beliefs that their employees have low motivation, low organisational commitment, and a high need for control and therefore must be forced to work. The underlying reasoning for these deviations may be due to the fact that low skilled employees are in some cases not directly led by the FM leaders under consideration. In addition, the literature presents reasons for leaders to perceive low skilled employees in contrast to high skilled on grounds other than the qualification level. These might be cultural differences based on values; beliefs and expectations employees and leaders do not share. Cultural differences may arise as on a nationality level as well as on organisational level (Schein, 1985; Hofstede, 1983). Variables such as age, social class, profession, time of working in the company and religion may affect the perceptions of leaders as well (Usunier & Lee, 2005). As the FM employee population is highly heterogonous in nature, FM leaders have the possibility to compare between different groups with different cultural backgrounds and different qualification levels, which could be another reason for the contrasting views.

## **6 CONCLUSION**

Effective leadership is connected with the ability to learn and change and this necessitates that leaders become more aware of their cognitions. Gaining self-awareness may help facility managers to better understand the myriad of relationships they need to manage. This is line with the propositions of Bull (2015) who suggested that "reflective practice" incorporated in FM education may help facility managers challenge their values and beliefs in the workplace to continually innovate. Given our findings, FM leaders will need to reflect on their internally constructed perceptions on FM service employees, in particular of those working in lower skilled jobs, to avoid the risk of stereotypic behaviour and thus hinder their ability to fully develop service excellence among those employee groups.

The sample size of this study is limited. However, our intent was to get a first in-depth insight on FM leaders' mental models which will provide the basis for further research activities. Future research is needed to investigate FM leaders' mental models in a larger scaled study. Also, the applied leadership style would be better assessed through employee ratings instead of using self-assessments. Our sample contained FM leaders with higher responsibilities in

their service organisations. To get a proper picture of mental models leading to leadership behaviour at the front of service organisations, direct supervisory roles should be included in the study.

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## APPENDIX 1: SAMPLE MATRIX ANALYSIS OF MENTAL MODEL AND LEADERSHIP BEHAVIOUR OF ONE FM LEADER

		RGT	5	4.3	4.3	3.6	4.5
M L Q		Outside View	Personality Low skilled: unremarkable Middle skilled: "Heroes" High skilled: unremarkable & "Heroes".	Work Low skilled: poor commitment, static, 0815 employees Middle skilled: 0815 employees, superior performance, can be mobilized High skilled: "Talents", can be mobilized, superior performance.	Control Low skilled: dependent on leader, resistance towards changes, need structure & rules Middle skilled: adjustment to changes, need of rules, dependent on leader High skilled: bear responsibility, autonomous performance with regard to rules.	Creativity Low & middle skilled: part of the standard business, followers, and look sometimes for challenges High skilled: future oriented, self-initiative, strive for challenges within routine.	Motivation Low & middle skilled: intrinsic motivation, team-orientation, strive for client's feedback and praise High skilled: extrinsic motivation, strive for leaders feedback, team-orientated but also individuals, look for praise.
		Inside View					
3	Ila	- Ability to build trust, to inspire pride and power					
3.5	Ilb	- Act with integrity - Focus on positive, high valued behavior - Provide desirable vision					
4	IM	- Ability to inspire others - Simple communication of shared goals - Positive expectations about its achievement					
3.5	IS	- Encourage innovative thinking, autonomous creative problem solving					
3.75	IC	- Unique treatment to maximize, to develop individual potential, satisfy needs					
3.75	CR	- Discuss responsibilities, state performance objectives, clarify rewards, punishments - Make employees perform up to standards					
3	MbEa	- Monitoring mistakes, errors, exceptions from the rule - Applying quick, thorough corrective measures					
2	MbEp	- Wait till a problem occurs before taking corrective actions					
0.25	LF	- Tendency to avoid involvement					
4	EFF	- Leader is efficient being a good representative of the followers.					
3	SAT	- Generate satisfaction					
4	EEF	- Ability to generate extra effort					

## 5.2 Identifying and measuring customer value - case multi-locational worker

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### ABSTRACT

**Purpose:** This paper presents measurements approaches by reviewing models and frameworks that can be utilised in identifying and measuring customer value in the context of multi-locational work.

**Theory:** Multi-locational, mobile workers utilise various spaces, tools and services during their workdays. Constantly changing needs and working environment challenge service providers to provide new physical, social and virtual working environments and service to attract and engage customer. Companies also need tools for measuring the created customer value.

**Design/Methodology/Approach:** Literature review about customer value in multi-locational work was conducted.

**Findings:** The four identified measurement approaches that define the roles of the customer are 1) customer as an employee and the end-user of physical work environment, 2) customer as the technology user in virtual work environment, 3) customer as a consumer and 4) customer as an organisation. Although the focus was on multi-locational working, it was noticed that the same methods and tools can be utilised in both single-location work context as in the multiple-location working environment. This might indicate that there is a need to develop tools more precisely for the multi-locational working.

**Originality/value:** This paper tried to understand how value is created for customers and present measurement approaches that can be utilised in identifying and measuring customer value in the context of multi-locational work.

### **Key words**

Facility Management (FM), Value co-creation, Customer experience, Customer value measuring.

## 1 INTRODUCTION

Multi-locational, mobile workers utilise various work spaces, tools and services during their workdays. In mobile way of working, the role of workplace management is shifting from space-focused thinking into taking responsibility for the total provisioning of what is needed to support work, together with physical, virtual and social dimensions. (Nenonen et al., 2005; Blakstad 2015). Technology development and a wider application of virtual tools have enabled employees to work anytime, anywhere, in a physical location or in a virtual world. The network of places for work opens up possibilities for the integration of places with different uses and ownership (Blakstad 2015). Mobile worker can be seen as a consumer of diverse places. Mobile workers are defined as employees who spend paid time working away from home or the main office; they are frequently moving and using physical and virtual tools (Vartiainen and Hyrkkänen, 2010), and this ‘virtual mobility’ allows to get in touch and work with other people from different places, in distributed teams. (Lipnack and Stamps, 2000).

Constantly changing working environment challenges service providers, because workers can choose the place where they work from the diverse service provider portfolio. Due to the changes in economy and technology advancement, the role of FM services providers has been changing in last few decades. Providing an attractive workplace with excellent services has become a primary requirement, pushing it towards adding value to the core business of organisation (Jensen et al. 2013). Measuring and monitoring customer value or workplace related value to multi-locational employees is hard, and it challenges corporate real estate and FM service providers to measure the impact of workplace on employee performance. To understand what customers value, we have studied different measurements frameworks and metrics for evaluating multi-locational employees’ satisfaction and experienced value. Different measurement approaches were reviewed and categorised based on the identified roles of customer.

## 2 MEASURING THE CUSTOMER VALUE - THE REVIEW OF FRAMEWORKS AND METRICS

From organisational point of view, the value of real estate has changed much during last few decades. From being a cost burden, real estate is seen more often as a support function for improving corporate performance. Strategic management and operational control has led to increased role of FM activities. Therefore, these FM activities need an evidence of added value to organisational performance by real estate. However in business relationships value shouldn’t be seen as one-way activity but rather as a co-creation, which is realised through customer experience. Customer experience has a link into a value creation process, where both customer and supplier companies receive value. We prefer the description, where customer experience is described as a journey, where value is gained and measured through



touch points, not only via the service/product delivered. In B2B context customer's objectives, needs and problems need to be understood more in-depth than generally in business-to-consumers (B2C) businesses. (Meyer and Schwager 2007).

To provide a thrilling, attractive customer experience and to measure it, it is important to understand who the customer is. In this paper, we identified various customer roles and perspectives related to multi-locational work. The role of the customer can be complex. From the literature we identified measurement approaches, which define customer roles in four different ways: 1) customer as an employee and the end-user of physical work environment, 2) customer as the technology user in virtual work environment, 3) customer as a consumer 4) customer as an organisation. Various measurement approaches and frameworks are needed due to many different organisational contexts and management needs. These measurement approaches are summarised in Table 1.

Table 1 The identified measurement approaches and frameworks of customer value with examples of measurement models and metrics

Measurement approach	Examples of measurement models or metrics	References
<p><b>CUSTOMER AS AN EMPLOYEE AND AN END-USER OF WORK ENVIRONMENT</b></p> <p>Objective and subjective measurement of work environment and work modes, workplace effectiveness and knowledge work performance</p>	<p>Employee turnover, employee complaints, well-being, individual and group productivity, cost and time savings</p> <p>Employees satisfaction and productivity related to work environments, e.g., Leesman Index, SmartWoW and WODI</p>	<p>Rice, 2002; Laihonen et al., 2012; Vicher, 2006</p> <p>Appel-Meulenbroek et al., 2015 Palvalin et al., 2015 Maarleveld et al, 2009; De Been &amp; Beijer, 2014</p>
<p><b>CUSTOMER AS A TECHNOLOGY USER</b></p> <p>User experience and technology evaluation models for measuring virtual and mobile work environment</p>	<p>User experience and context of use Technology Acceptance Model, Task-Technology Fit</p>	<p>Hassenzahl &amp; Tractinsky, 2006; Gebauer et al., 2010; Jumisko-Pyykkö &amp; Vainio, 2010 Davis, 1989; Venkatesh &amp; Davis, 2000; Goodhue &amp; Thompson, 1995; Kim, 2008; Yuan et al., 2010</p>
<p><b>CUSTOMER AS CONSUMER</b></p> <p>Customer experience, customer journey and value</p>	<p>Net Promoter Score, NPS Customer Effort Score, CES Customer Satisfaction, CSAT Service experience - EXQ Value in experience – VALEX Kano model</p>	<p>Reichheld, 2003 Dixon et al., 2010 Morgan &amp; Rego, 2006 Klaus &amp; Maklan, 2012 Helkkula et al., 2012 Kano 1991</p>
<p><b>CUSTOMER AS AN ORGANISATION</b></p> <p>Multi-dimensional performance measurement system and KPIs</p>	<p>FM Value Map Balanced Scorecard Value-creation functions</p>	<p>Jensen et al., 2012 Kaplan &amp; Norton, 1996 Sarasoja, 2012 Walter et al., 2001</p>

## 2.1 Customer as an employee and end-user of work environment

Measuring and monitoring customer value or workplace value to multi-locational employees is hard and has only few possibilities. It is challenging to measure the impact of workplace on employee performance. According to survey of Ouye et al. (2010), one third of examined companies did not track the distribution of how their employees use alternative workplaces.

When it comes to evaluating real estate and its relation to employees, Rice (2002) distinguishes direct (quantitative) and indirect (qualitative) measures. Number of workplace - related employee complaints and employee turnover can be considered as direct quantitative measures and employee satisfaction, productivity and the degree to which the environment facilitates the ability to work fall under qualitative indirect measures' category. One approach to measure the impact on specific work tasks and processes include, for example, cost calculations that are based on time savings.

Vicher (2006) suggests using productivity measures to identify the value of workplace. Due to the characteristics of knowledge work, so-called traditional productivity measures (quantitative outputs/quantitative inputs) do not usually fit in the requirements of the measurement context. However, there are certain alternative measurement approaches, which are a better match (see, e.g., Laihonen et al., 2012). Subjective measurements have been considered as a potential way to capture the multidimensional and intangible aspects of knowledge work productivity (Ramirez & Nembhard, 2004; Palvalin et al., 2015, Laihonen et al 2012) as well as measuring employee satisfaction and productivity related to different work environments. Such tools for measuring work environments, work modes and their impacts have been developed, for example WODI (Maarleved et al, 2009; De Been & Beijer, 2014), Leesman index (Appel-Meulenbroek et al. 2015) and SmartWoW tool (Palvalin et al., 2015).

From customer as employee perspective, productivity can be divided into individual productivity and productivity of workgroups (Vischer, 2006). Individual productivity is evaluated on the scale of individual workspace and the microenvironment influence on individual task performance by sing questionnaires and ergonomic analysis (Vicher, 2006). Group productivity is evaluated by teamwork quality and quantity. It might be measured in concrete terms (e.g. time to market of a new product) or in intangible terms (number of useful new ideas or successful recommendations). Group performance and value of social networks is the most difficult object to measure. (Vischer, 2006)

## **2.2 Customer as a technology user – emphasising context and user experience**

Technology development and a wider application of virtual tools have enabled employees to work anytime, anywhere, also via virtual channels. Tools like email, phone or video conferencing, enable employees to access knowledge online and be a part of the team without being in the same physical space. Electronic communication systems allow creating virtual teams, which save time, travel expenses and eliminate the lack of access to experts. Then, employees can work in multiple teams in multiple locations and are able to have a better work-life balance due to increased flexibility. (Cascio 2000)

However, multiple problems arise from virtual working. Team performance and individual productivity might lower down due to inabilities or unwillingness to use virtual tools (Lake 2013); management of virtual teams might become an issue for inexperienced managers (Cascio 2000), or employees might feel socially isolated due to the lack of face-to-face communication with colleagues and social aspect of workplace (Kurland and Bailey 1999).

User experience is an important aspect of mobile technologies (Gebauer et al., 2010) and refers to a person's perceptions and responses resulting from the use or anticipated use of a product, system or service (ISO 9241-210, 2010). User experience is affected by the user, the system and the context, in which the interaction between user and system takes place (Forlizzi & Ford, 2000; Hassenzahl & Tractinsky, 2006). Context of use is the main differentiator of mobile and non-mobile services and systems Context of use includes user

characteristics, tasks, as well as technical, physical, and social environment (ISO standard 13407, 1999). Context of use can also be separated from user, mobile system and the interactions between them. Various external context-related factors include physical, temporal, task, social, and technical and information contexts (Jumisko-Pyykkö & Vainio, 2010).

Various technology evaluation models have been used for measuring the adoption and usage intentions of mobile technologies. Performance impacts have been analysed and measured at some level. The models like e.g. the Technology Acceptance Model (TAM) (Davis, 1989, Venkatesh & Davis, 2000) and the Task-Technology Fit (TTF) model (Goodhue & Thompson, 1995) and their extensions include mobility and business use perspectives (e.g., Kim, 2008, Gebauer et al., 2010; Yuan et al., 2010). For example, Yuan et al. (2010) apply TTF to construct a mobile task model for identifying the suitability between *mobile task characteristics* (mobility, location dependency and time criticality) and *mobile work support functions* (location tracking, navigation, notification and online job dispatching).

### **2.3 Customer as a consumer - Customer experience related measurement tools**

Traditional measures concerning customer as consumer category include customer satisfaction and loyalty scores (Morgan & Rego, 2006), the Net Promoter Score (NPS) (Reichheld, 2003), and the Customer Effort Score (CES) (Dixon et al., 2010). More recently, a multiple-item scale for measuring service experience was developed and named Customers' service experience (EXQ) (Klaus and Maklan, 2012). Value in the experience (VALEX) was developed to interpret subjective value experiences (Helkkula et al., 2012).

Lemke et al. (2010) point out that supplier tend to focus on understanding and delivering value in use by considering also customer's objectives from using services or products that they seek for. The customer experience begins from the moment when customer compares the available options, browses company websites or asks opinions. Any communication or relationship with the potential supplier, previous experiences or expectations and supplier's brand creates an effect on overall customer experience. According to Meyer & Schwager (2007) a successful brand forms a customer experience by embedding the fundamental value proposition in every feature of the offering.

The five dimensional Kano model helps to identify customer value (Kano 1991). The quality dimensions are called one-dimensional, reverse, attractive, must-be, and indifferent (Löfgren and Witell 2008). The dimension is identified based on the state of customer satisfaction and the performance of the attribute, e.g., more there is one-dimensional attributes the more satisfied the customer is (Kano et al. 1991; Löfgren and Witell 2008). The logic in reverse attribute is the other way; the more there is such an attribute, the more dissatisfied the customer is. Attractive attributes, which can be considered as a positive surprise to the customer, provide increased customer satisfaction when fulfilled, but do not cause dissatisfaction because the customer does not expect them. Must-be attributes refer to the lowest level of customer value and thus increased customer value cannot be provided through them. Indifferent attributes do not cause satisfaction or dissatisfaction despite the performance level of the attribute.

### **2.4 Customer as an organisation– Measuring business performance**

From organisational point of view, strategic management and operational control has led to increased role of FM activities. The real estate is seen as a support function for improving corporate performance. The multidimensional performance measurement system can capture

and use both objective and subjective indicators. Literature presents several structural measurement frameworks that specify a typology for performance measures providing the basis for identifying and choosing the success factors to be measured (e.g., Kaplan & Norton, 1996; Nudurupati et al., 2011; Jensen et al. 2013; Riratanaphong & Van der Voordt, 2015). To understand the value of workplace and real estate for organisations, perceived value can be measured in different categories: people, process, economy and surroundings (Jensen et al. 2013). The most common frameworks to capture added value from FM perspective are: FM Value Map, framework developed by Anna-Liisa Sarasoja, or Balanced Scorecard.

FM Value Map was developed by Jensen and published in 2010. It's considered as a framework to understand and explain different ways of creating value for multiple stakeholders: owners, staff, customers and society. Various resources used by FM are considered as inputs, which produce outputs related to space, services and other impacting on employee satisfaction, cost, productivity, culture etc. (Jensen et al., 2012).

According to Sarasoja (2012) the maximisation of the wealth of shareholders by growing profitability and revenue can be reached by applying different strategies and connecting them into various aims within the organisation.

The four perspectives of Balanced Scorecard are 1) financial, 2) customer, 3) internal business process, and 4) learning and growth processes. (Kaplan & Norton, 1996). Levin (2005) argues that Balanced Scorecard it is not thorough enough. Instead of combination of space and business assessment methods, he includes not only people, work processes and technology, but also support systems, infrastructure and changes. According to Levin (2005), this combination of tools broadens an understanding how to analyse the workplace benefits.

One comprehensive, value creation-oriented way to analyse the potential of the counterpart is presented by Walter et al. (2001). According to this function-based model, value can be measured with value functions. The direct monetary functions are profit, volume and safeguard functions. Innovation, market, scout and access functions and the indirect functions are more difficult to measure and are often realised through the company's network. Value functions have proved to offer a useful tool to measure the created value, not only from the service provider point of view but also taking other stakeholders into consideration (Walter et al. 2001).

### 3 CONCLUSIONS

In this paper the focus has been on customer value measurements in a working environment with multiple locations. The aim was to present the measurement approaches by reviewing different models and frameworks in identifying and measuring customer value in multi-locational working environments. Four measurement approaches, that define the customer roles, were found:

- 1) Employee and the end-user of a physical work environment
- 2) Technology user in a virtual work environment
- 3) Customer as a consumer
- 4) Customer as an organisation

When using the measurements, the service provider should pay attention to physical, social and virtual aspects and provide services that attract, engage and create value for the customer. This paper mainly covers the subject from the perspective of a service provider.

There is not much difference with measurement tools utilised in both single-location and multi-locational work. However the literature review needs to be validated by empirical data. For example, the Table 1 is not complete and one need to map the measurement examples even more thorough way. In the future a pilot survey concerning the new methods and tools for multi-locational workers will be conducted and the picture will be more complete.

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## **6 SPECIALISATION ON SECTORS**

### **6.1 SHAPING CHINESE WORKSPACE BASED ON REGIONAL PREFERENCES: TWO STUDIES IN SHANGHAI AND GUANGZHOU**

DAIBIN XIE

### **6.2 QUALITY AND SATISFACTION OF THERMAL COMFORT IN DUTCH OFFICES**

HENK BRINK AND MARK MOBACH

### **6.3 ENERGY MANAGEMENT IN PUBLIC ORGANISATIONS**

MARKUS HUBBUCH



## 6.1 Shaping Chinese workspace based on regional preferences: Two studies in Shanghai and Guangzhou

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### ABSTRACT

**Purpose:** Culture, both regional and organisational, may significantly influence workspace preferences. Yet workspace preferences in China have scarcely been documented. Further, China itself consists of many varied cultural zones, which have to some extent been addressed by organisational scientists. This paper reports the findings of two studies that aim to illuminate regional cultural preferences within two regions: Shanghai and Guangzhou.

**Approach and findings:** The first study identifies cultural preferences through open questions and interviews. Employees' views on the most and least desirable workspace qualities, and their perceived core cultural values, were collected. The findings show significant differences in cultural values and desirable workspace qualities between the two cities. By using structured questionnaires, the second study further suggests significant cultural differences between Shanghai and Guangzhou, particularly in Uncertainty Avoidance and Long-term Orientation. Regression analysis indicates that the difference affects the way people perceive workspace quality.

**Limitations:** The limitations of the study are the focus on only two cities while other Chinese cities may perhaps reveal even greater cultural diversity, and the paucity of information on the organisational context.

**Originality/value:** The findings reported in this paper can provide insights into improved workspace briefing, design and management, in the cities studied. Rather than repeating standard workspaces in all locations, the evidence might also inspire other researchers and practitioners to investigate regional differences in workspace preferences in other parts of the globe, while workspace provision for international corporations may need to be adapted to meet local preferences.

### Keywords

Workspace preference, China, Culture, Regional difference, Satisfaction.

## 1 INTRODUCTION

Cross-cultural management is of rising importance for contemporary organisations (Adler, 2002), especially in large and growing economies like China. By 2015 there were over 46.8 thousand foreign direct investment companies in mainland China (State Administration for Industry & Commerce of the P.R.C, 2015). Besides, there are over 35 million white-collar workers in the country and the number is growing rapidly (Zhu and Chen, 2008). Despite this huge white-collar workforce, their workspace preferences have scarcely been examined. This suggests an incomplete understanding for global workplace strategy, despite a growing number of cross-cultural studies providing a glimpse of important international difference in



users' workspace preference (Meel, 2000; Riratanaphong and Van der Voordt, 2011; Rothe et al., 2011; O'Neill, 2012; Plijter et al., 2014).

Further, Chinese culture actually is not homogeneous and scholars believe that its regional differences are not always smaller than the differences between countries (Huo and Randall, 1991). Whether the regional cultures would affect workspace design in the context of globalisation remains doubtful.

Given the importance of the topic and knowledge gap, two empirical studies were conducted in Shanghai and Guangzhou during the summer of 2014 to help understand the issue. The first study aimed to map the contemporary differences in cultural orientation and workspace preference between cities. It helps to clarify the scope and significance of regional differences. The second study was designed to interpret how culture shapes workspace preference by affecting the way people perceive their workspace. The studies were designed to test the hypothesis that, despite internal migration and globalisation, there are significant differences in culture and workspace preference between the two cities.

The reasons for selecting Shanghai and Guangzhou is that these cities are similar in geographic, economic and educational features (Ralston et al., 1996) but with quite different historical regional cultures. Shanghai is located at the mouth of the Yangtze River in east China. It grew from a small market town to "China's first modern metropolis" under Western colonialism after the opium war in 1840. Today Shanghai is "mainly understood to reflect the impact of Western ideas and style" (Liang, 2010). Conversely, Guangzhou is a city with over 2000 years of history, serving as an open city for ancient empires. It is located at the mouth of the Pearl River in south China, the Cantonese regional. The Cantonese culture is thought to value its time-honoured history and commercial tradition.

## 2 CULTURE AND WORKSPACE PREFERENCE

Culture is a complex concept consisting of ideas, values, norms and artifacts (Hofstede et al., 2010). At its core is the value system that fundamentally constructs human's behavioural preference and selection (Schwartz, 1996; Ros et al., 1999). A body of researchers has tried to identify the relationship between cultural values and workspace preferences by adopting Hofstede's Value Survey Module (VSM). VSM is one of the most popular and elaborate surveys in work-related cultural values. It measures culture values in five dimensions: Power Distance (PD), Masculinity (MAS), Individualism (IND), Uncertainty Avoidance (UA) and Long-term Orientation (LTO) (Hofstede et al., 2010). Table 1 summarises the connections between certain workspace preferences and VSM dimensions as proposed in literature.

Rothe et al. (2012) defined preferences as desirable factors that 'cause happiness and satisfaction', deferring from hygiene factors that cause employee dissatisfaction. Since People's choice about whether a thing is desirable or undesirable is affected by their culture (Hofstede, 1984), it could be argued that the classification of motivation factors and hygiene factors might differ according to the cultural context. And further, as a kind of "mental programming" (Hofstede et al., 2010), the pattern employees perceive and evaluate the quality of workspace could be culturally different too.

Table 1 Physical Workspace Factors Related to VSM Dimensions

VSM	Preferences	Literature	Cultural context of case study	Connections to Hofstede's Dimensions
PD	Centralised- layout	Riratanaphong and Van der Voordt (2011)	Thailand	Smooth scheduling and low-cost production correspond with PD
	Single tenant building		Thailand	Order and stability are needed by organisations in hierarchy culture
UA	Plan spare working space for future		Plijter et al. (2014)	Netherlands
	Innovative office design	Gamey, UK & Netherlands		Low UA culture is more open to innovation
	Standardised workspace design	Riratanaphong (2014)	Netherlands	High UA culture values physical settings that meet health and safety standards.
MAS	Private office	Rothe et al. (2011)	Finland vs. Netherlands	The expression of status in physical space shows personal success
	Expression of status	Plijter et al. (2014)	Gamey, UK & Netherlands	
IND	Privacy	Rothe et al. (2011)	Finland vs. Netherlands	Individualism leads to the emphasises on personal time and space
	Good ventilation and lighting, etc.	VSM 94 questionnaire		

### 3 RESEARCH DESIGN

To avoid the added complexity that might arise from organisational culture, these studies were not conducted in specific organisations. Instead, the samples came from a relatively wide range of organisations and industries and were analysed as a whole by city. Later studies, not reported here, were devised to distinguish the effect of organisations.

In order to modelling user's "mental programming" of perceiving workspace, it is necessary to measure the priority and contribution of various workspace factors in determining workspace performance at the same time. Therefore workspace satisfaction was adopted as a key measurement in the research.

#### *Study 1: Mapping cultural difference*

Considering the fact VSM might be culturally bounded (The Chinese Culture Connection, 1987) and therefore insufficient for the study of a specific culture, it is inappropriate to deploy it directly. With a similar concern about using existing workspace evaluation tools, the study employed three open-ended questions to qualitatively capture the regional differences in both culture and workspace preference that were then analysed and related to Hofstede's dimensions. The questions are:

- 1) What do you think are the most important cultural values in your current city?
- 2) What do you like best about your current workspace?
- 3) What do you dislike most about your current workspace?

A structured interview and an online questionnaire were developed consisting of the above three questions plus questions about respondents' gender, cultural background and age. Respondents were allowed to highlight up to five items for each open-ended question. The initial respondents were selected purposely from the researcher's acquaintances working in Shanghai (n=7 from 7 organisations in 5 industries) and Guangzhou (n=24 from 20 organisations in 7 industries). They were interviewed through an online instant messenger APP. After the interview, interviewees were requested to distribute the link of online questionnaire to their colleague and whiter-collar friends.

The answers of open-ended questions were coded to create synonymous groups. Words or phrases with close meaning were put into the same group. This process was performed in Chinese to keep the original meaning of the answers. The percentage and frequency of responses in each group were calculated and compared.

### *Study 2: Workspace satisfaction*

In this study, a structured questionnaire was developed covering 25 workspace items within eight categories: working space, amenities, layout, building, services, location and overall satisfaction. These items cover the workspace issues reported in study one. Respondents were asked to evaluate their current working environment on five-point scales ranging from very dissatisfied to very satisfied. Considering the length of the questionnaire and the fact that it is unnecessary to measure the actual score of cultural values in this study, only five questions from VSM 2008 were selected and added to the questionnaire. They represent the five cultural dimensions in VSM respectively. The two open-ended questions about respondents' likes and dislikes were attached to the end of questionnaire.

The questionnaire was initially developed in English and then translated into simplified Chinese. It was distributed through email in a snowball pattern. The initial respondents were drawn from the researcher's acquaintances and selected randomly.

Linear-Regression Modelling was chosen to identify key workspace factors that predominate overall workspace satisfaction. Two models were set up for Shanghai and Guangzhou respectively. In order to further understand the influence of cultural values on predominant workspace factors that were identified, their correlations were analysed.

## 4 RESULTS

Study 1 received 163 valid responses. Because the answers about workspace likes and dislikes were quite divergent and the sample size was too small to create priority ranking, they were merged with the answers in study 2. Study 2 received 390 responses with 345 of them were valid. Table 2 and 3 shows the demographic characteristics of research samples.

### *Study 1: Mapping cultural differences*

Data analysis yielded 23 synonymous groups of cultural values. They were relabelled with equivalent English terms as has been proposed in the literature. Seven of them overlapped with the values in the Chinese Value Survey (CVS). CVS is a cultural survey specifically addressing on Chinese culture. Through the correlation between CVS dimensions and VSM dimensions (The Chinese Culture Connection, 1987), the seven values could be matched to VSM dimensions. The remaining values were compared to Hofstede's interpretation of his dimensions. Equivalent expressions were found for the most of them except cosmopolitan,

modernised and commercialised. Redfern and Crawford (2010) and Ralston et al. (1996) argued that “cosmopolitan” and “modernisation” associate with the adoption of Western behaviour and values in Chinese context, could be further broken down into more specific values such as individualism. To reduce data redundancy, they are removed from listed values finally. Table 4 present the culture values generated in this study and the cultural difference between Shanghai and Guangzhou in VSM dimensions. Both cultures show a preference for femininity and individualism, but Shanghai culture is relatively more masculine and individualistic. Guangzhou (Cantonese) culture is highly long-term oriented and has weaker uncertainty avoidance and shorter power distance while Shanghai culture turns out to be short-term oriented.

Table 2 Demographic Characteristics of Original Respondents and Merged Samples in Study 1

		Original Samples		Merged Samples		
		Guangzhou (n=81)	Shanghai (n=82)	Guangzhou (n=245)	Shanghai (n=156)	
Gender	Male	60.5%	34.1%	47.3%	37.4%	
	Female	39.5%	65.9%	52.7%	62.6%	
Cultural background	Local (born and grew up in the city)		43.2%	52.4%	22.0%	49.0%
	Immigrants	Living in the city > 10 years	17.3%	25.6%	16.7%	15.5%
		Living in the city 5-10years	18.5%	12.2%	32.7%	15.5%
		Living in the city <5 years	21.0%	9.8%	28.6%	20.0%

Table 3 Demographic Characteristics of Samples in Study 2

		Guangzhou (n=216)	Shanghai (n=129)	
Gender	Male	47.2%	38.0%	
	Female	52.8%	62.0%	
Cultural background	Local (born and grew up in the city)		21.3%	41.1%
	Immigrants	Living in the city > 10 years	18.5%	20.2%
		Living in the city 5-10years	42.6%	25.6%
		Living in the city <5 years	21.3%	9.3%

Through the merged data 37 groups of workspace factors were generated. Table 5 lists the top 15 of liked and disliked factors in the two cities. Respondents in both cities highlighted space amount, workspace atmosphere and colleagues as the most desirable features of workspace. But Shanghai respondents mentioned transportation, privacy, indoor decoration, working equipment & IT, cleanliness and flexibility more frequently while respondents in Guangzhou focused more on natural daylight, communication opportunities, indoor green plants and outdoor views. It is noticeable that the top few disliked factors in the two cities, as well as their ranking, are similar.

Table 4 Comparison of cultural Values Between Shanghai and Guangzhou

Value yielded in the survey	Related CVS* dimensions	Related VMS* dimensions	% frequency of mentions	
			Shanghai (N=82)	Guangzhou (N=81)
Quality of life		Femininity	45.1%	27.1%
Modest				
Kindness	Human-heartedness			
Courtesy	Human-heartedness			
Competitive		Masculinity	11%	2.5%
Material				
Working hard	Confucian dynamism	Long-term orientation	12.1%	43.2%
Thrifty	Confucian dynamism			
Pragmatism				
Normative		Short-term orientation	18.3%	24.7%
Shrewdness				
Respect for Tradition	Confucian dynamism			
Protect Face	Confucian dynamism			
Adventure spirit		Uncertainty Acceptance	3.7%	18.5%
Individualistic		Individualism	12.4%	21.5%
Freedom				
Trustworthiness	Integration	Collectivism	1%	9.9%
Tolerance	Integration	Short Power distance	14.4%	38.3%
Egalitarian		Short Power distance		
Social inequality		Long Power distance	6.1%	

CVS\* Chinese Values Survey,  
VMS\*\* Values survey Module

### *Study 2: Workspace satisfaction*

The cultural values in the survey were based on a singular question (Cronbach's Alpha = 0.724). T-test suggested that the cultural of the two cities were significantly different in the respect of Long-term Orientation and Uncertainty Avoidance (Table 6). Cantonese culture has weaker Uncertainty Avoidance but Stronger Long-term Orientation values.

In order to model the mental process of perceiving the physical workspace, a linear regression model has been developed to interpret the importance of various workspace factors in determining overall workspace satisfaction (Table 7). The results suggest that the overall workspace satisfaction of Shanghai employees is significantly influenced by privacy, workstation type consistent with personal status, catering, safety and space for meeting clients. Strong correlation between these variables and cultural values was found. All these four workplace factors significantly correlate with Long-term Orientation and Uncertainty Avoidance. The Power Distance value correlates to workstation type reflecting personal status. Masculinity correlates to privacy. Individualism correlates with workstation type reflecting personal status, safety and space for meeting clients (Table 8).

Table 5 Employees' Top 15 Liked and Disliked Workspace Qualities in Shanghai &amp; Guangzhou

Likes		Dislikes	
Shanghai (N=164)	Guangzhou (n=262)	Shanghai (n=164)	Guangzhou (n=262)
Transportation (9.7%)	Space amount (12.6%)	Air quality (13.4%)	Air quality (13.4%)
Atmosphere (9.7%)	Atmosphere (11.5%)	Privacy (11.6%)	Space amount (13.4%)
Privacy (9.1%)	Nature light (11.5%)	Space amount (10.4%)	Privacy (11.1%)
Colleagues (8.5%)	Communication opportunity (8.0%)	Cleanliness (6.7%)	Thermal comfort (7.6%)
Space amount (7.9%)	Green plants (7.3%)	Equipment & IT (6.1%)	Equipment & IT (6.5%)
Decoration (7.9%)	Catering (7.3%)	Thermal comfort (4.9%)	Breaking space (6.5%)
Equipment & IT (7.9%)	Outdoor views (5.7%)	Office layout (4.3%)	Cleanliness (5.3%)
Cleanliness (7.3%)	Colleagues (5.7%)	Catering (4.3%)	Colleagues (5.3%)
Nature light (7.3%)	Openness (5.7%)	Transportation (3.7%)	Office layout (5.0%)
Flexibility (6.1%)	Office layout (4.6%)	Colleagues (3.7%)	Nature light (11.5%)
Quietness (6.1%)	Privacy (4.6%)	Atmosphere (3.7%)	Quietness (3.8%)
Office Layout (4.9%)	Air quality (4.6%)	Breaking space (3.7%)	Decoration (3.4%)
Openness (4.9%)	Equipment & IT (4.2%)	Quietness (3.1%)	Green plants (3.1%)
Green plants (4.9%)	Decoration (4.2%)	Decoration (3.1%)	Catering (3.1%)
	Quietness (4.2%)	Location (3.1%)	Meeting space (3.1%)

Table 6 T-test: Differences in Cultural Values Between Shanghai And Guangzhou

	t	Sig. (2-tailed)
Power Distance	-.951	.342
Masculinity	1.091	.276
Individualism	-.811	.418
Long-term Orientation	4.234**	.000
Uncertainty Avoidance	2.193*	.029

\*p<0.05, \*\* p<0.001

In contrast, the overall workspace satisfaction of employees in Guangzhou is largely influenced with space amount, quality of local community, transportation and training space. It is interesting to discover that culture drew less influence on workspace preference in Guangzhou. None of the above workspace factors correlate with Masculinity significantly. The concern of transportation correlates with Power Distance and Uncertainty Avoidance; space amount correlates with Long-term Orientation; and training space correlates with Individualism. But all correlations are weak. Strong correlation could only be found between Long-term Orientation and local community quality (Table 9).

## 5 DISCUSSION

Study 1 mapped the cultural differences between Shanghai and Guangzhou as well as the difference in workspace preference. The results suggest that workspace factors that make

people happy (motivators) may vary between the different locations and cultures while factors leading to dissatisfaction appear common regardless of the locations and cultural difference. From the findings, it can be proposed that, for weak uncertainty avoidance and strong long-term orientation cultures, such as Guangzhou, environmental qualities defined by visual comfort and well-being are more affective in attracting employees. Meanwhile, the concern for communication opportunities might relate to its relatively collective culture. In contrast, Shanghai respondents show more desires for individualistic features such as privacy and flexibility that might be related to the culture's emphasis on individualism. These points were verified in study 2.

Table 7 Contributions of Various Workspace Factors to Overall Workspace Satisfaction in Shanghai and Guangzhou, Based on Multiple Regression Analysis

Shanghai			Guangzhou		
Workspace factors	B	Sig.	Workspace factors	B	Sig.
Privacy	0.172**	0.002	Space Amount	0.242**	0.000
Catering	0.149**	0.007	Quality of local community	0.183**	0.000
Workstation type reflecting personal status	0.205*	0.025	Transportation	-0.117*	0.017
Safety	0.12*	0.032	Training space	0.078*	0.048
Space for meeting clients	0.153*	0.038	Catering	0.08	0.077
Distance to supervisors	-0.166	0.052	Pace for meeting clients	-0.064	0.086
Connection to other departments	0.149	0.053	Creative interior design	0.073	0.111
Efficiency of lifts	0.117	0.063	General feeling of humanity	0.057	0.204
Indoor Green plants	-0.106	0.067	Safety	0.057	0.234
General feeling of humanity	0.133	0.084	Indoor environment quality	0.053	0.296

\* $p < 0.05$ , \*\*  $p < 0.01$

Table 8 Correlation between the Most Important Workspace Factors in Shaping Overall Workspace Satisfaction and Cultural Values in Shanghai

		Privacy	Catering	Workstation type reflecting personal status	Safety	Space for meeting clients
Power Distance	Pearson Correlation	.221*	.145	.242**	.214*	.131
	Sig.	.012	.101	.006	.015	.139
Masculinity	Pearson Correlation	.255**	.131	.201*	.175*	.118
	Sig.	.004	.138	.022	.047	.181
Individualism	Pearson Correlation	.189*	.105	.243**	.321**	.288**
	Sig.	.032	.235	.006	.000	.001
Long-term Orientation	Pearson Correlation	.334**	.279**	.292**	.301**	.223**
	Sig.	.000	.001	.001	0.001	.011
Uncertainty Avoidance	Pearson Correlation	.341**	.258**	.225**	.279**	.273**
	Sig.	.000	.003	.010	.001	.002

\* $p < 0.05$ , \*\*  $p < 0.01$

Table 9 Correlation between the Most Important Workspace Factors in Shaping Overall Workspace Satisfaction and Cultural Values in Guangzhou

		Workspace amount	Quality of local community	Transportation	Training space
Power Distance	Pearson Correlation	.070	.153	.142*	-0.30
	Sig.	.305	.025	.038	.656
Masculinity	Pearson Correlation	.039	-.037	.005	0.56
	Sig.	.565	.586	.941	.415
Individualism	Pearson Correlation	.140	.056	.000	.145*
	Sig.	.040	.411	1.000	.033
Long-term Orientation	Pearson Correlation	.170*	.176**	.000	.111
	Sig.	.012	.010	1.000	.104
Uncertainty Avoidance	Pearson Correlation	.048	-.157*	.158*	.025
	Sig.	.480	.021	.020	.712

\* $p < 0.05$ , \*\*  $p < 0.01$

Study 2 further strengthens the cultural difference between the two cities in terms of Uncertainty Avoidance (UA) and Long-term Orientation (LTO). Remarkably, the differences seem to have significantly influenced the way people perceive their workspace and workspace satisfaction. Factors concerning individuals such as privacy, careering, personal status, safety and space for meeting clients were identified as predominate factors of overall satisfaction in Shanghai. This result is consistent with study 1. All these five factors strongly correlated with UA and LTO. But Power Distance, Masculinity and Individualism also have strong correlation with some of them. In Guangzhou, the influence of culture seems less significant. The predominant factors of overall workspace satisfaction have relative weak correlations with cultural values. This might suggest that in a high Uncertainty Avoidance but low Long-term Orientation culture, cultural influences will become more serious as more cultural values will affect employees. In this type of culture, people tend to assess the office environment through qualities of personal space. But in high LTO and low UA culture, people evaluate the office environment more through collective attributes of space size and location.

The research adopted an abbreviated version of VSM questionnaire. This enabled the direct comparison of specific cultures effectively and efficiently. But for research adopting VSM scores as benchmarks, complete VSM survey should be applied.

## 6 CONCLUSION

Based on the responses from 345 respondents to map cultural differences and workspace satisfaction, people in the two cities of Shanghai and Guangzhou show significant cultural difference in terms of the values of Uncertainty Avoidance and Long-term Orientation. The differences suggest specific workspace design factors that might motivate employees. However less influence is shown for the factors that make employees dissatisfied. The value



differences identify different features affecting perceived workspace quality between employees in the two cities and indicate that more attention should be paid to individual space in workspace design in cultures like Shanghai with strong Uncertainty Avoidance and low Long-term Orientation. Later stages of this research will identify the effect of organisational culture on workspace preferences overlaid on the regional cultural differences.

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## 6.2 Quality and satisfaction of thermal comfort in Dutch offices

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### ABSTRACT

**Purpose:** This field study analyses the quality of the actual thermal comfort and indoor air quality in Dutch office buildings. A linear regression analysis was used to determine how much these variables and demographic variables influenced the perceived thermal comfort of office workers.

**Approach:** Data were collected on-spot at two Dutch office buildings (n=182) during the winter of 2015 and showed that the indoor air in these offices is of good quality and did not affect the perceived thermal comfort significantly. The indoor temperature was the most important variable that influenced the perceived thermal comfort. Indoor temperatures ranged in this study from 18 till 24°C and were therefore at the edge of acceptable European and Dutch standards NPR-CR 1752 (1999), NEN-EN 15251(2007) and NEN-EN-ISO 7730 (2007).

**Findings:** Office workers which experienced an indoor temperature of 20°C graded this temperature the highest (6.7 on a scale from 1-10). At 20°C the percentage of workers that was dissatisfied was the lowest (30%). This study also showed that female workers were more likely to have the sensation that it was too cold than male workers. European and Dutch standards prescribe that an indoor temperature between 21 and 23°C should be the most ideal temperature during wintertime. This study indicates that an indoor temperature higher than 22°C might be too warm for office workers in The Netherlands during wintertime and that application might influence office workers' satisfaction negatively.

### Keywords

Thermal comfort, Indoor temperature, Air quality, Standard.

## 1 INTRODUCTION

Office buildings must provide an environment that is comfortable for its workers. This environment should not harm their health and ideally should contribute to their performance and satisfaction. Differences between individuals complicate this. For example, gender influences the perception of thermal comfort (Karjalainen, 2007; Kingma and Van Marken Lichtenbelt, 2015). However, many studies tried to answer the question what the ideal indoor environment for office workers is. Although this ideal was never achieved, these studies were used to create an acceptable bandwidth for an optimal indoor environment. The results

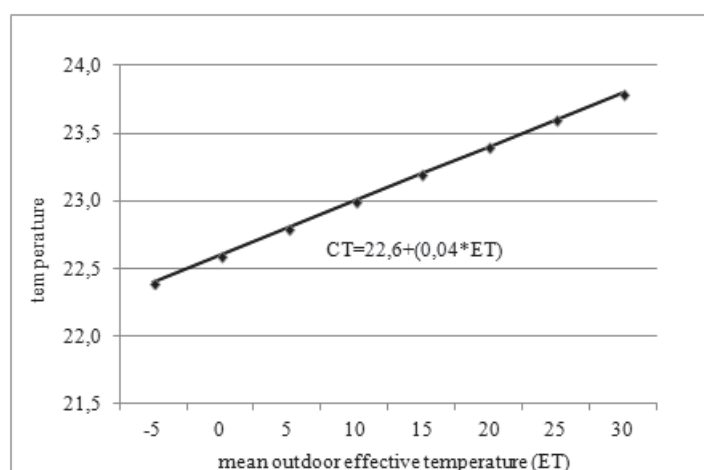
(Fanger, 1970; De Dear and Brager; 1998) were used in the preparation of various standards (NEN-EN 15251, 2007; NPR-CR 1752, 1999; NEN-EN-ISO 7730, 2007). This study focuses on the thermal comfort of office workers in the Netherlands during winter (heating) season and aims to provide information about actual indoor temperatures, humidity concentrations and carbon dioxide concentrations in Dutch offices. The purpose of this study to determine to what extent these environmental variables and demographic characteristics age and gender affect the perceived thermal comfort of office workers. The main research question is: “to what extent does demographic characteristics of office workers and the environmental variables of thermal comfort influence the perceived thermal comfort?”

## 2. THEORY

To understand how an optimal thermal comfort can be created, it is important to determine which variables influence the actual and perceived thermal comfort. The actual thermal comfort depends on personal and environmental variables (Fanger, 1970). Personal variables are the activity level (heat production in the body, measured in metabolic equivalent met) and the thermal resistance of the clothing of the office worker (measured in clo value) (Fanger, 1970; Bluysen, 2009). In this study the assumption was made that the activity level for office workers with sedentary activity is 1.2 met and the clo value for office workers is 1.0 clo during winter (heating season) (NPR-CR 1752, 1999).

The environmental variables that provide the actual thermal comfort are: air temperature, water vapour pressure in ambient air, mean radiant temperature, and relative air velocity (Fanger, 1970). Air temperature is also referred to as the indoor temperature of the ambient air. Existing standards NPR-CR 1752 (1999), NEN-EN-ISO 7730 (2005) and NEN-EN 15251 (2007) provide specific guidelines for indoor temperatures for single offices (cellular office) and landscape offices (open plan office) during winter (heating) season. De Dear and Brager (1998) have developed a model, collectively known as the adaptive comfort standard. This model indicates that the comfort temperature (CT) depends on the effective mean outdoor temperature (ET) and ranges for different climate zones (De Dear and Brager, 2002). The adaptive comfort standard can be applied in central heated, ventilated and air-conditioned (HVAC) office buildings. Figure 1 shows the comfort temperature (CT) according to the adaptive comfort standard.

Figure 1 Comfort temperature according to the adaptive comfort standard (Dear and Brager, 1998)



Water vapour pressure in ambient air is also referred to as humidity (RV) and is the absolute humidity expressed as water vapour pressure in the air, which influences the evaporative heat loss from a person (NEN-EN-ISO 7730, 2007). When moderate temperatures ( $<26^{\circ}\text{C}$ ) and moderate activity levels (metabolic equivalent met  $\leq 2.00$ ) are applicable, humidity only has a small effect on thermal sensation and perceived air quality in the rooms of sedentary occupancy (NEN-EN 15251, 2007; NPR-CR 1752, 1999; NEN-EN-ISO 7730, 2007).

Mean radiant temperature, in relation to a person in a given body posture and clothing placed at a given point in a room, is defined as: that uniform temperature of black surroundings which will give the same radiant heat loss from the person as the actual case under study (Fanger, 1970). The mean radiant temperature can be different for a standing person in comparison with a seated person. Also the distance between the occupant and a window (DNW) or radiator (DNR) can influence the mean radiant temperature. The vertical air temperature difference (VATD) is the air temperature difference between head and ankles and can cause discomfort (NEN-EN-ISO 7730, 2007).

Relative air velocity is also defined as mean air velocity speed (MAVS) and is the relative air velocity, in metres per second ( $\text{m s}^{-1}$ ). The air velocity in a space influences the convective heat exchange between a person and the environment. This influences the general thermal comfort of the body (heat loss) and the local thermal discomfort due to draught. There is no minimum air velocity necessary for thermal comfort (NEN-EN-ISO 7730, 2007). Table 1 shows acceptable environmental variable values in office buildings.

Table 1 Acceptable environmental variable values for thermal comfort

Source	OIT <sup>5</sup> (°C)	RV <sup>6</sup> (%)	VATD <sup>7</sup> (°C)	MAVS <sup>8</sup> ( $\text{m s}^{-1}$ )	CO <sub>2</sub> <sup>9</sup> (ppm)
NPR-CR 1752 (1999)	22.0 ± 1.0 <sup>1</sup>	30-70		0,15 <sup>1</sup>	460 <sup>1</sup>
	22.0 ± 2.0 <sup>2</sup>			0,18 <sup>2</sup>	600 <sup>2</sup>
	22.0 ± 3.0 <sup>3</sup>			0,21 <sup>3</sup>	1190
NEN-EN-ISO 7730 (2005)	22.0 ± 1.0 <sup>1</sup>	60	<2 <sup>1</sup> <3 <sup>2</sup> <4 <sup>3</sup>	0,15 <sup>1</sup>	
	22.0 ± 2.0 <sup>2</sup>			0,18 <sup>2</sup>	
	22.0 ± 3.0 <sup>3</sup>			0,21 <sup>3</sup>	
NEN-EN 15251 (2007)	21.0 <sup>1</sup>	30-50 <sup>1</sup>			750 <sup>1</sup>
	20.0 <sup>2</sup>	25-60 <sup>2</sup>			900 <sup>2</sup>
	19.0 <sup>3</sup>	20-70 <sup>3</sup>			1200 <sup>3</sup>
		>70<20 <sup>4</sup>			<1200 <sup>4</sup>
<sup>1</sup> Category A/1 <sup>2</sup> Category B/2 <sup>3</sup> Category C/3 <sup>4</sup> Category D/4 <sup>5</sup> For landscaped office; activity met 1.2; 1.0 clo during winter <sup>6</sup> Reference value winter period; NEN-EN 15251 (2007) gives indication when (de)humidification systems are installed <sup>7</sup> Difference 1.1 and 0.1m above floor <sup>8</sup> During wintertime <sup>9</sup> Sedentary occupants are the only source of pollution, outdoor concentration 400 ppm (Boerstra et al., 2013)					

The perceived thermal comfort depends on thermal neutrality and local factors of the office worker. Thermal neutrality is a necessary condition for thermal comfort and is defined as the condition in which the office worker prefers neither warmer nor cooler surroundings. Local factors can influence the perceived thermal comfort due to an asymmetric radiant field. For example, when office workers are located close to a central heating radiator or near a cold

window or wall. Fanger (1970) developed the PMV-PPD model, which predicts the mean vote (PMV) and the percentage of dissatisfied (PPD) of office workers regarding the perceived thermal comfort and is based on two dimensions: heat and cold. The PMV-PPD model indicates that when the PMV is optimal, still 5% of the office workers experience a cold or warm sensation, which is classified as the lowest percentage of dissatisfied (LPD).

Moreover, air quality was also studied to determine to what extent the quality of the air influences the perception of the thermal comfort. To assess the quality of the indoor air in buildings a common accepted indicator is the carbon dioxide concentration (CO<sub>2</sub>) in parts per million (ppm). Concentrations below typical recommended levels of 1000 ppm, implies a ventilation system efficient at diluting potential air pollutants (Newsham, Veitch, Charles, 2008). Table 1 shows acceptable carbon dioxide concentrations in office buildings.

To determine the actual thermal comfort in this study the outdoor temperature was measured because this is relevant in determining the optimal indoor temperature. Indoor temperature at desktop height and indoor humidity are important environmental variables to determine the thermal comfort. The indoor temperature at floor height was measured to determine the vertical air temperature difference that might indicate an asymmetric radiant field. Also the distance between the occupant and the nearest window and radiator was measured to determine if there was an asymmetric radiant field. The carbon dioxide concentration was used as an indicator for air quality.

To determine the perceived thermal comfort and air quality in this study office workers were questioned about the condition in which the office worker prefer neither warmer nor cooler surroundings and about the quality of the air.

### 3 DESIGN/METHODOLOGY/APPROACH

This study was carried out in two Dutch office buildings and data were collected at 185 workstations and their occupants between March-April 2015. Table 2 describes the environmental variables of thermal comfort, method of measurement and used equipment.

To define the actual and perceived thermal comfort, measurements were carried out at the workstation of each individual occupant. First, two student investigators collected the measurements at the workstation of the occupants under supervision of the researcher. Second, the occupant completed an 18-item satisfaction questionnaire. The occupant had to indicate to which extend the occupant agrees with the statement using a five-point Likert scales from 1, totally disagree to 5, totally agree. At last the occupant had to rate the temperature and the quality of the air in the room at that point in time using a 10-point scale (GRA\_TEMP, GRA\_AIR). Two scales were composed using specific statements that indicate the sensation that the occupant felt too warm ( $\alpha= 0.77$ ) or too cold ( $\alpha= 0.79$ ). One scale was composed using specific statements of the occupants' perception of the air quality ( $\alpha= 0.64$ ). Finally, one variable was computed using the grading of the temperature, grades 1-5 were labeled as dissatisfied (DIS) and grades 6-10 were labeled as satisfied (SAT).

After computing the scales, the data were checked. Two records were deleted because the data was not valid or incomplete. After this check, data of the physical variables were first compared with the standards to determine what the quality was of the actual thermal comfort. Secondly, a linear regression analysis was performed with the environmental variables and

demographic characteristics as independent variables and the perceived thermal comfort and air quality as dependent variables.

Table 2 The environmental variables of thermal comfort

Variable	Symbol	Description
Outdoor temperature ( $\Theta_o$ )	OTEMP	The outside temperature and the outside humidity was derived from a reliable open source (Verhoef, 2015) at the moment the occupant was questioned
Indoor temperature at desktop height ( $\Theta_o$ )	ITEMP	Temperature in degrees Celcius ( $^{\circ}\text{C}$ ) and is measured with an Atal ENV-MB350NV temperature sensor on the desktop height (average 0.7m)
Indoor humidity	IH	Humidity concentration (%) is measured with a Atal ENV-MB350NV humidity sensor on the desktop
Vertical air temperature difference	VATD	The difference between ITEMP and the indoor temperature at floor height +0.1m in degrees Celcius ( $^{\circ}\text{C}$ ) and is measured with a Atal ENV-MB350NV temperature sensor
Distance between the occupant and the nearest window	DNW	The distance between the occupant and the nearest window in centimetres (1 = 0 - 49cm, 2 = 50 - 99cm, 3 = 100 - 149cm; 4 = 150 - 200cm, 5 = > 200cm, 6 = There is no window)
Distance between the occupant and the nearest radiator	DNR	The distance between the occupant and the nearest radiator in centimeters (1 = 0 - 49cm, 2 = 50 - 99cm, 3 = 100 - 149cm; 4 = 150 - 200cm, 5 = > 200cm, 6 = There is no radiator)
Carbon dioxide concentration	CO <sub>2</sub>	Parts per million carbon dioxide concentration (ppm CO <sub>2</sub> ) is measured with a Atal ENV-MB350NV carbon dioxide sensor on the desktop

#### 4 RESULTS

In this study the actual and perceived thermal comfort were studied at the workplaces of 182 respondents in two office buildings. The first building (LG) was built in 2012 and is in use by an organisation in the public sector (local government). The second building (PS) was built in 2003 and is in use by an organisation in the private sector (banking). Both buildings met all standards for office buildings in the Netherlands, including the use of high insulating materials as HR++ glass and high insulated walls. Therefore, the assumption was made that the radiant temperature equals the indoor temperature. Both buildings were heated by a combination of radiators and heated air. The ventilation principle was based on a thermal wheel. Because not all respondents were located near a radiator (99 out of 182), the distance between the respondent and the radiator was excluded as an environmental physical variable. Air velocity was not measured in this study therefore the assumption was made that the mean air velocity is  $0.09 \text{ m s}^{-1}$  because windows in both HVAC buildings could not be opened (NPR-CR 1752, 1999). Both office buildings had an open plan office concept. The type of work in both offices was labelled as sedentary activity corresponding 1.2 met and an office clothing ensemble of 1.0 clo insulation (NPR-CR 1752, 1999; NEN-EN-ISO 7730, 2005). All respondents were interviewed, table 3 describes the demographic characteristics.

The recorded indoor temperature was between 18 and  $24^{\circ}\text{C}$ . In 97.8% the indoor temperature was categorized at least in category C of the NEN-EN-ISO 7730 (2005) and in category III of the NEN-EN 15251 (2007), see table 4. The Netherlands has a temperate maritime climate

influenced by the North Sea and Atlantic Ocean, with cool summers and moderate winters. Daytime temperatures vary from 2-6°C in the winter and 17 -20°C in the summer (Verhoef, 2015). The mean outdoor temperature (OTEMP) was 9.4°C.

Table 3 Demographic characteristics of respondents' buildings LG and PS (n=182)

Characteristic	Value for Building LG n=151	Value for Building PS n=31
Mean age (s.d.)	47.3 (10.8) years	38.7 (9.4) years
Sex	Male 41% Female 59%	Male 26% Female 74%

Table 4 Indoor temperatures (ITEMP) buildings LG and PS

ITEMP in °C	Frequency	%	Cumulative %
18	4	2.2	2.2
19	11	6.0	8.2
20	27	14.8	23.1
21	50	27.5	50.5
22	53	29.1	79.7
23	30	16.5	96.2
24	7	3.8	100.0

The recorded indoor humidity percentage was between 30% and 72%. In 97.3% the humidity percentage was categorized in category I (30-50%) of the NEN-EN 15251 (2007), see table 5.

Table 5 Indoor humidity (IH) percentages buildings LG and PS

IH in %	Frequency	%	Cumulative %
20-29	1	.5	.5
30-39	70	38.5	39.0
40-49	107	58.8	97.8
50-59	3	1.6	99.5
70-79	1	.5	100.0

The recorded vertical air temperature differences (VATD) were between 0 and 4°C. In 94% the vertical air temperature difference was between 0-2°C and can be categorized in category I of the NEN-EN-ISO 7730 (2005), see table 6.

The recorded indoor carbon dioxide concentration was between 448 and 1372 ppm. In 94.5% the carbon dioxide concentration was categorized at least in category II (< 850 ppm) of the NEN-EN 15251 (2007), see table 7.

Table 6 Vertical air temperature differences (VATD) for buildings LG and PS

VATD °C	Frequency	%	Cumulative %
0	89	48.9	48.9
1	62	34.1	83.0
2	20	11.0	94.0
3	8	4.4	98.4
4	3	1.6	100.0

Table 7 Recorded carbon dioxide concentrations (CO<sub>2</sub>) buildings LG and PS

CO <sub>2</sub> in ppm	Frequency	%	Cumulative %
< 650	88	48.4	48.4
650-849	84	46.2	94.5
850-1049	7	3.8	98.4
1050-1250	2	1.1	99.5
> 1250	1	.5	100.0

The linear regression model was used to determine which environmental variables and demographic characteristics influence the perceived thermal comfort and air quality. The sensation *too warm* increases when the indoor temperature rises and decreases when the distance between the workplace and nearest window becomes larger. The sensation *too cold* increases when the temperature drops and more women than men have the sensation that it is *too cold*. The grading of the temperature decreases when the indoor temperature rises. The quality of the air is less appreciated by women than men. Table 8 shows the outcome of the linear regression analyses.

Table 8 Regression model thermal comfort and air quality

	TOO_WARM	TOO_COLD	GRA_TEMP	AIR_QUAL	GRA_AIR
R Square	0.163	0.165	0.120	0.189	0.089
	Beta:	Beta:	Beta:	Beta:	Beta:
OTEMP	0.116	-0.077	-0.094	0.141	-0.148
ITEMP	0.305***	-0.232**	-0.302***	0.101	-0.159
IH	0.054	-0.008	-0.027	0.071	-0.103
VATD	-0.011	0.091	0.054	0.020	-0.052
DNW	-0.152**	0.049	0.098	-0.094	0.008
CO <sub>2</sub>	0.056	-0.054	0.030	0.061	0.034
AGE	0.000	-0.119	-0.037	-0.013	0.045
GENDER	-0.017	0.230**	-0.024	0.191**	-0.116
* p ≤ 0.05 ** p ≤ 0.0 *** p ≤ 0.001					

The indoor temperature is graded by the respondents by using a 10-point scale. Table 9 shows how the indoor temperature was graded by male and female respondents and the percentage of respondents that graded the temperature satisfactory and unsatisfactory (indoor



temperature of 18°C and 24°C was excluded because n is too small, respectively n=4 and n=7). The indoor temperature of 20°C got the highest average grades by male and female respondents but the lowest percentage of dissatisfied (LPD) for male and female respondents were different.

Table 9 Grading of the temperature and satisfaction by participants

ITEMP	Total	GRA_TEMP	% SAT	% DIS
19	11	6.09	55	45
20	27	6.70	70	30
21	50	5.38	50	50
22	53	5.47	60	40
23	30	4.93	50	50
ITEMP	Female	GRA_TEMP	% SAT	% DIS
19	6	5.33	50	50
20	19	6.47	63	37
21	34	5.50	56	44
22	33	5.61	64	36
23	16	4.81	44	56
ITEMP	Male	GRA_TEMP	% SAT	% DIS
19	5	7.00	60	40
20	8	7.25	88	13
21	16	5.13	38	63
22	20	5.25	55	45
23	14	5.07	57	43

## 5 CONCLUSION

A total of 182 office workers were studied at their workplace. The analyses showed that the indoor temperature in this study was the most important variable that significantly influences the perception of the thermal comfort and varied from 18-24°C. In comparison with actual indoor air temperatures of 19-23°C, male workers that experienced an indoor air temperature of 20°C, graded this temperature the highest and were more satisfied with this temperature than female workers. Female workers graded an indoor air temperature of 20°C also the highest but were most satisfied with an indoor temperature between 20 and 22°C. This study showed also that the indoor humidity and carbon dioxide concentrations in the two Dutch offices were within acceptable standards in more than 90% of all cases. Therefore, the quality of the indoor air is of good quality and did not affect significantly the perception of the thermal comfort. This study also showed differences in how male and female workers experienced the thermal comfort. When the indoor temperature drops more female than male workers experienced the sensation that the air temperature was too cold and the quality of the air is less appreciated by women than men. When the most actual standards are applied, the indoor temperature should be between 20-22°C (Category A, NEN-EN 15251, 2007 and NEN-EN-ISO 7730, 2005) or according to the adaptive comfort model (Dear and Brager,

1998) between 22.7 and 22.8°C (ET is resp. 2-6°C). This study indicates that an indoor temperature that is higher than 22°C might be too warm for office workers in The Netherlands during wintertime and that application might influence workers' satisfaction negatively.

## 6 LIMITATIONS AND FUTURE RESEARCH

The present study has limitations with respect to reliability. The accuracy of the measuring equipment could cause systematic errors. All measuring equipment was re-tested. All values were within the specified range. The margin amounts for the temperature reading is plus or minus 1 degree Celsius and for humidity plus or minus 6%. In future research the use of more precise equipment for the collection of, in particular, the relative humidity and the temperature, is recommended. This study did not measure the actual air velocity. The assumption is made that the air speed is  $\leq 0.15$  m s<sup>-1</sup> because both buildings were equipped with centralized HVAC systems. Actual air speeds might influence the perceived thermal comfort of office workers but could not be identified.

Because this study was carried out during wintertime in the Netherlands, the findings are only applicable in the winter (heating season). Due to geographical differences, these findings are only applicable in areas with a similar climate.

This study does not consider the individual situation of office workers regarding job satisfaction, group cohesion and team spirit. Also other comfort aspects such as acoustic comfort, illumination comfort and the electromagnetic environment can influence perceived thermal comfort. Therefore, we suggest further research should analyse the thermal comfort considering these factors.

Finally, conducting this study on a longitudinal comparative base makes it possible to measure the effects of lower indoor temperatures (<22°C).

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## 6.3 Energy Management in Public Organisations

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### ABSTRACT

**Purpose:** The purpose of this study is to examine the challenges involved in enhancing energy efficiency in organisations.

**Theory:** The theory is based on the approach in the ISO standard Energy Management System (EnMS) (ISO 50001, 2011). Implementing such a management system includes defining a strategy, setting efficiency goals and monitoring energy usage by collecting energy key performance indicators (KPI).

**Design/methodology/approach:** Participatory action research in two case studies applying Energy Management in public organisations has been undertaken. The aim was not to compare the two cases directly, but to learn about the main factors that influence the success of energy management. These results are compared with an Energy Management Balanced Score Card (Natural Resources Canada, 2015) and the Energy Management Model Equation (Jäschke Brülhard & Hubbuch, 2014).

**Findings:** The findings indicate that the calculation of energy KPIs does not yet cause energy savings. Further, the development of an energy strategy alone does not guarantee better energy efficiency. Most important are measures realised in a systematic way. Further a different approach was found: inefficient elements are sought out and then replaced by more efficient equipment. This very pragmatic approach can be accomplished fast and with less administrative hurdles. It can be shown that the Energy Management Model Equation (Jäschke Brülhard & Hubbuch, 2014) successfully describes the main factors that influence the success of energy management.

**Originality/value:** Up to now little research was done to rate barriers or stimuli in EnMS. These new findings are therefore valuable for improving the non-technical aspects in Energy Management.

### Keywords

Energy Management System, Implementation, Strategy, Efficiency, Metering.

## 1 INTRODUCTION

Energy efficiency is a key requirement for all organisations, whether private or public. The European Commission proposes a new 30% target for improving energy efficiency by 2030 (European Commission, 2014), compared to the existing target of 20% by 2020. Such an ambitious target can only be reached by improving the energy efficiency in any organisation and in existing buildings.

In a report published by the International Energy Charter, it is stated that in the public sector the energy saving potential in EU public administrations is estimated to be 20% and can also result in financial savings (Energy Charter Secretariat, 2008). According to the German Energy Agency (DNA) with organisational enhancements alone about 10% of the energy demand can be saved, with capital measures additional energy saving potential of up to 25% existing (DNA, 2013). Therefore, it can be assumed that the implementation of an Energy Management System can significantly reduce the energy usage and the energy bill of an organisation.

In Switzerland, the federal administration does not set quantitative goals as in the EU, but calls for more energy efficiency as a main measure to enable the “Energiewende” and the phasing out of nuclear power plants (UVEK, 2013). Energy Efficiency is also an important factor in reducing greenhouse gas emissions. Switzerland has set a 20% GHG-emissions reduction target by 2020, compared to 1990 (Swiss parliament, 2013).

Public organisations in Switzerland are expected to be exemplary in introducing energy efficiency measures. Further, the cantons can require big energy consumers to introduce an energy efficiency plan with a binding annual improvement target of typically 2% per year. Compliance is monitored on a yearly basis (AWEL, no date).

The Swiss canton and the University Hospital Zurich (USZ) that are examined in this study have both introduced an energy management scheme. They are using different approaches that are described and evaluated in this paper.

## 2 LITERATURE REVIEW

The scientific literature concerned with Energy Management and especially EnMS is still limited. What can be found are practice orientated books, e.g. (Hubbuch & Jäschke Brülhard, 2014), (Harris, 2012) (Duscha & Hertle, 1996), guidance and reports, e.g. (DNA, Handbuch für betriebliches Energiemanagement, 2014). A similar standard is GEFMA 124 (GEFMA 124-1, 2009).

In 2011, ISO published a new management standard on Energy Management Systems (ISO 50001, 2011). This standard will enable organisation to develop an energy management system (EnMS). An energy management system can be compared to the well-known quality management systems according to ISO 9001, or to an environmental management system according to ISO 14001. Such a management system shall be based on a policy in the organisation, here to use energy more efficiently. Targets and objectives to meet the policy shall be set. It also includes the measurement and monitoring of energy usage. In the end, a continual improving process shall be implemented (ISO, ISO 50001 - Energy management, no date). The result, of course, shall be an increase in energy efficiency and less consumption of energy.

The standard ISO 50001 is still quite new and the usage not very widely diffused. It was only in 2014 that ISO published the standard ISO 50004 (ISO 50004, 2014) that provides guidance in implementing and maintaining an EnMS. In Switzerland, the former EN 16001 (from 2009) or the GEFMA 124 recommendation for energy management (GEFMA 124-1, 2009) are not well-known. Up to the present time, ISO 50001 has only been introduced in a few organisations. In 2014 in Switzerland just 44 organisations were certified according to ISO 50001 (ISO, 2014).

According to ISO, the early adapters of ISO 50001 report major gains through energy management (ISO, 2011). Adapting an EnMS according to ISO 50001 means implementing a systematic approach to manage the usage of energy by the Plan-Do-Check-Act (PDCA) cycle, enabling a constant improvement of energy efficiency. The top management of the organisation shall establish an energy policy and appoint an energy management team or responsible person. A master's thesis indicates the enhancement of energy efficiency by 1 to 3% annually and nonmonetary side benefits by having an EnMS (Solati, 2014). However, typically there are still hurdles to overcome such as a lack of well-educated staff (BFE, 2014) (Aggeler, 2015) or too little funding for energy efficiency measures.

Tsung-Yung et al. (2012) about using the ISO 50001 approach state that Energy Performance Indicators (EnPI) have to be introduced. They also recommend establishing a so-called "Integration-energy-practice model" that enables learning from successful energy saving projects. It includes the usage of know-how from internal and external energy management experts. This model enables the successful implementation of corrective and preventive actions to minimise energy demand in buildings and/or processes of an organisation.

A report from Natural Resources Canada (2015) proposes a best practice method for energy management in commercial and institutional buildings. Several common problems that lower the energy performance are described, such as:

- Non-optimal investment decisions
- Incorrect or incomplete energy information
- A lack of awareness or capacity by the involved personnel
- Measures undertaken in a not well-defined and managed way.

By implementing best practice in energy management, these hurdles can be overcome. The main process shall be similar as in ISO 50001, a Plan-Do-Check-Update (PDCU) approach (Figure 1). Acting is here called update, to make clear that it updates a former state.

The report also proposes the use of an Energy Management Balanced Scorecard (EMBS) as a planning tool to:

- Assess the current state of your energy management practices
- Set objectives to improve the state of your energy management practices
- Define actions to achieve these objectives (Natural Resources Canada, 2015)

The proposed EMBS has eight categories: Commitment, Planning, Organisation, Projects, Financing, Tracking, Communication, and Training. The performance in each category is rated according to a scale of 1-5. Level 5 means the organisation works in an optimal way, while Level 1 means no actions or successful activities can be noted in this category. This EMBS can be used to set an energy policy or to check the state of an EnMS within an organisation.

The full table including descriptions for each category is included in Appendix 1.

Figure 1 PDCU model (Natural Resources Canada, 2015)



### 3 METHODOLOGY

This paper describes research where a qualitative, multiple-case study approach was chosen. From the literature review and standards the proposition can be formulated that the successful implementation of an EnMS leads to substantial energy savings. Therefore, the following research question has been formulated:

*What are the negative impacts or outcomes if the implementation of an EnMS in an organisation is not carried out as suggested in literature or standards?*

This question is studied in a holistic and qualitative way at two different public organisations, used to explore differences between these cases. In both cases, most of the findings are obtained through participatory action research. The author was actively involved in projects as an external expert.

The database used in this action research is based mainly on the following sources: document studies, interviews, reports from external specialists, observations in participatory action research and many talks, discussions and meetings with involved persons.

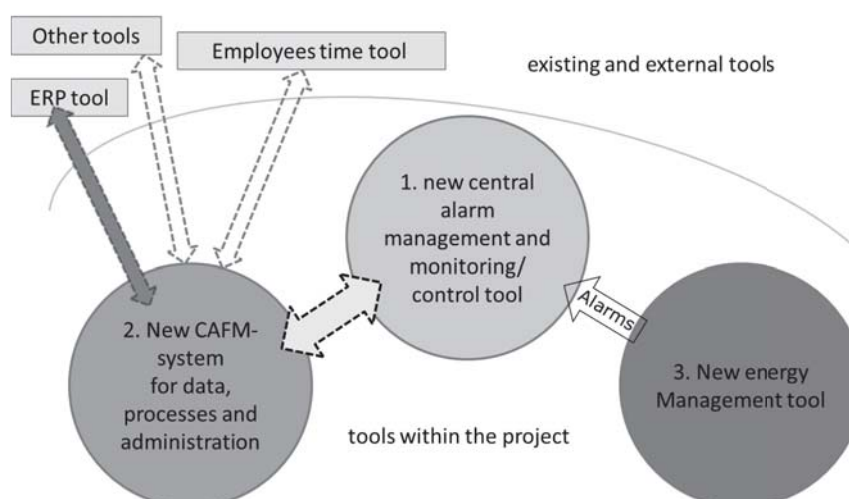
A critical realism view was used (Christie, Rowe, Perry, & Chamard, 2000), meaning that findings also have to be triangulated with learnings from literature, standards and best practice recommendations and with the view of different persons. Here two persons directly involved in the process helped to find the correct ratings for the EMBS. As there are only two cases, no general or generic theory can be derived from this research. But the

recommendations in the ISO 50001 and the EMBS can be checked for their validity in practice. Furthermore, the Energy management model equation (Jäschke Brülhard & Hubbuch, 2014) can be tested and lessons learned can be described.

The two cases can be described as follows:

Case One: In a Swiss canton, a portfolio of about 1700 public and private buildings has to be operated and maintained. The portfolio includes all sizes and ages of buildings. A building management department with a small central team is responsible for operation and maintenance. They are supported by local janitors in the larger buildings. A variety of IT tools are used to enable and support building management, of which three tools are used for energy management. As some main IT tools reach the end of their life, a new IT concept has to be developed. A new, integrated energy management tool is part of the new IT concept (Figure 2). The parliament of the canton requires the reduction of energy usage and the reporting of the undertaken measures and their success.

Figure 2 Case One: New IT concept including energy management (Hubbuch, 2015)



Case Two: A public hospital is required to save 2% of the energy demand per year under the canton's large consumer efficiency plan, set by the canton's office for water, energy and air AWEL (AWEL, no date). The hospital's building operation department was instructed by the hospital management to fulfil this obligation. The hospital provides about 880 beds for patients and employs 7400 staff. It consists of about 80 buildings on one site that are between 30 and 120 years old (Figure 3). Some additional buildings are located in the vicinity of the main site.

#### 4 FINDINGS

The two cases are examined and rated using the EMBS Method (Natural Resources Canada, 2015). In the conclusions, comparisons with the recommendations in ISO 50001 and the Energy management model equation (Jäschke Brülhard & Hubbuch, 2014) are made.



Figure 3 Aerial photo of the USZ for Case Two (Photo [www.spitalinformation.ch](http://www.spitalinformation.ch))

#### 4.1 Case One: a Swiss canton

In the case of the canton, the EMBS can be rated as follows:

**Commitment:** There is a commitment from the parliament and a target set for energy conservation by the government of the canton. However, there is no clear energy policy formulated with regard to a strategy or a systematic approach to introduce energy saving measures. Therefore, here the level is set to 3.

**Planning:** An energy management plan as a framework for reaching the targets is not formulated. This criterion is rated as level 2 only.

**Organisation:** There is one person working as energy delegate. This person is responsible for the buildings of the canton (and not for all other energy demands such as traffic) and mainly has the duty of running the energy measurement system and energy reporting. However, this person has very limited authority in the building department, and none in the canton as a whole. In the operational processes energy efficiency is not an integral part. Only new building projects must fulfil ambitious energy standards. This criterion is rated again as level 2 only.

**Projects:** In new construction and refurbishments projects that were ongoing anyway, new heat recovery or additional insulation was applied as the main measures. However, no improvements in the field of electricity demand were implemented. Neither operational nor behavioural energy efficiency projects have been implemented. Therefore, this criterion is rated as level 2 only.

**Financing:** There is a significant budget allocated to energy efficiency projects by the cantonal parliament. However, no clear criteria are set as how to spend this money or in what projects it shall be invested. This criterion is rated as level 4, as there is no lack of financial resources.

**Tracking:** The energy demand per building is measured and reported. Some key energy indicators are also calculated. There is, however, no measurement on a plant level or per project. Limited benchmarking and fault detection is undertaken. There is no full benchmarking process established. This criterion is rated as level 4.

**Communication:** There is a communication towards politicians, the public and for internal staff about energy. The value of energy efficiency measures could be better promoted. Also, the internal information and direct feedback to the canton's staff could be improved. This criterion is rated as level 4.

**Training:** There is no training program for the staff, but some people enjoyed training in energy efficiency. Training in energy management as a task for senior management is not implemented. This criterion is rated as level 2 only.

From these ratings, the following Table 1 gives an overview. The overall development of the canton's buildings energy demand can be seen in Figure 4. It can be noted that there is limited success in reducing the overall energy demand. The electricity demand in particular could not be reduced, but has still the tendency to rise. The total final energy demand for heat (adjusted for climatic conditions) is covered mainly by district heating from the town's central waste incineration plant and a central wood chips burning boiler, with natural gas boilers as peak demand suppliers. It could be reduced by the above-mentioned measures, but also with limited success, compared to the canton's aim to have a carbon neutral administration in the future. According to the publication on the canton's website, the reason for rising heat demand from 2012 to 2014 was due to operational and technical problems in four big buildings and a refurbished school building that again had to be heated (Energy Deputy, 2015). The large lump sum granted by the canton's parliament to be spent on energy saving projects could only be used partly and was spent mainly on measures to reduce the heat demand in buildings. This fact is also an explanation for why the total electricity demand is still rising. Figure 4 would look different if the rising number of floor area due to new buildings in the portfolio were not included in the rising total energy demand.

Table 1 Overview of the rating of case one, the canton

Level	Commitment	Planning	Organisation	Projects	Financing	Tracking	Communication	Training
5								
4								
3								
2								
1								

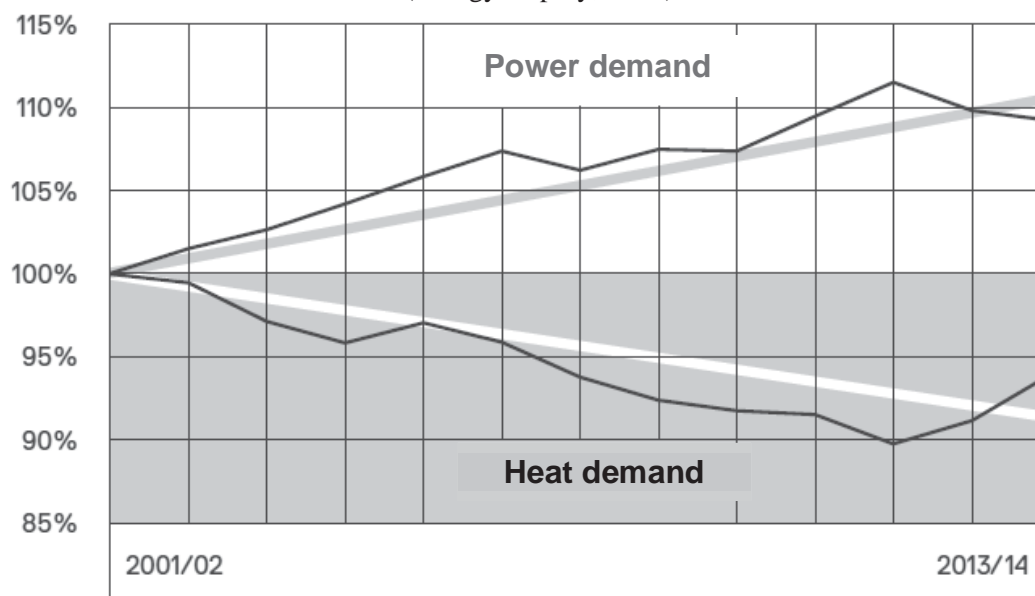
#### 4.2 Case Two: the University Hospital Zurich (USZ)

In the case of the USZ, the EMBS can be rated as follows:

**Commitment:** There is an obligation from AWEL to reach a reduction in energy demand of 2% each year from 2012 onwards. The hospital formulated an energy policy in an exemplary way (Geissler, 2014). There is strong support for energy management by the middle management, but less by the top management. Therefore here the level is set to 4 instead of 5.

**Planning:** There is one person named as the energy delegate in the technical maintenance department. An energy management plan as a framework for reaching the targets is not formulated. Therefore, there is only a systematic approach to introduce energy saving measures in some projects. This criterion is rated as level 3.

Figure 4 Total heat and power consumption of the public buildings in the canton (Energy Deputy, 2015)



**Organisation:** As stated above, there is a person who can be named energy manager. This person has limited authority, but does a very good job, as the person in charge has all necessary technical, methodological and social competencies. In the operational processes, energy efficiency is not an integral part. This criterion is rated again as level 3.

**Projects:** There are three main, systematic projects implemented to save electricity in lighting, ventilation and pumps. These projects are executed in a very systematic way and are subsidized by a Swiss national energy efficiency program (BFE, Wettbewerbliche Ausschreibungen - ProKilowatt, 2016). External experts add further know-how. Besides this, internal requirements for new projects or refurbishments are formulated with more focus on energy efficiency. However, an overall and systematic approach for all projects and activities is missing; this criterion is rated again as level 4 and not 5.

**Financing:** Getting financial recourses for energy efficiency measures is very difficult as the hospital is trying to reduce its costs due to a new pricing scheme for hospitals. Nevertheless, the above-mentioned projects could obtain the necessary internal funds because of subsidies from the federal government. Further, a better energy measuring system can be financed. This criterion is rated as level 4.

**Tracking:** The energy demand is measured and reported for the hospital as a whole. Additionally, the electricity consumption of each building is measured, and heat meters are continuously being installed. A systematic energy measurement system will be implemented in the next few years. The USZ is also starting a benchmarking process. This criterion is rated as level 4.

**Communication:** There is some communication on energy efficiency for internal staff, but direct feedback to the hospital's staff does not exist. The internal promotion of energy efficiency measures and external information could be improved. This criterion is rated as level 2.

**Training:** There is a limited training program for the staff. If a person seeks more training in energy efficiency, he or she may get support for this. Training of senior management for energy management is not implemented. This criterion is rated as level 3.

Table 2 gives an overview of these ratings. The overall energy demand could be reduced below the canton's target. Figure 5 shows the comparison between the target and the achieved savings between 2008 and 2014. In the first two years, energy efficiency was able to be significantly improved by realization of a number of "low hanging fruits". The boost in energy efficiency in 2013 and 2014 shows the effect of the three systematic efficiency projects in the scope of and subsidised by the ProKilowatt-program (BFE, 2016). Until 2014 the calculated relative energy efficiency could be improved by 14%, compared to the requested improvement of 6%. This calculated relative efficiency is the measured energy demand, compared to the demand of the previous year, and corrected if new equipment was installed.

Table 2 Overview of the rating of case two, the USZ

Level	Commitment	Planning	Organisation	Projects	Financing	Tracking	Communication	Training
5								
4								
3								
2								
1								

## 5 CONCLUSION

As requested by ISO 50001, an energy policy needs to be endorsed by the top management. In the case of the canton this is only partially true. In both cases there is no clearly formulated energy policy with binding targets and defined responsibilities and measures. Further, a PDCA or PDCU process in energy management is not yet implemented in both cases.

The case of the canton shows that only limited success can be achieved if energy management is not pursued in a structured way. At the hospital, on the other hand, the systematic approach and support by external experts have helped to make even bigger savings than the targets set by AWEL, with only some projects yet realised.

Figure 5 Obtained relative energy efficiency vs. target set by AWEL (Marti, 2015)



In the case of the canton commitment, financing, tracking and communication achieve good grades. However, the problem is the non-systematic approach which makes it difficult to achieve good results, although there is enough money and a high level of support from top management. With a PDCA-process fully implemented, the demanding targets set by the canton could be better reached.

It can be seen from the case at the USZ that partial funding by federal programs, even if not very substantial compared to the full cost of the projects, can have a very positive effect on decisions from the top management.

Finally the qualitative Energy Management Model Equation can be checked. It states that the success of energy management is the sum of all measures times the SEM (Success factor of Energy Management). The SEM can be estimated according to Formula 1:

Formula 1 Success factor of energy management (Jäschke Brülhard & Hubbuch, 2014)

$$SEM = \frac{(\sum \text{benefits}) * \text{engagement} * \text{systematic approach}}{1 + \sum \text{barriers}}$$

In the case of the hospital, there is a high engagement and a systematic approach towards energy conservation projects. This positive effect is decreased as there are still quite a few barriers to overcome, such as old and complicated buildings and strict requirements concerning utilization of the buildings, as well as limited financial resources. Nevertheless, the result is a quite high SEM. In reality, with a limited number of measures a good level of success can be achieved.

In the case of the canton there are fewer barriers, as most buildings are less demanding and the utilization is less challenging. Furthermore, the potential lack of money is less a barrier. However, there is no systematic approach to energy efficiency. Projects and measures are

carried out in an opportunistic way. Thus, the result is a small SEM. In reality, there is only limited success, regardless of the positive factors.

To summarize the most important lessons learnt, it can be stated that the implementation of an energy management system is a big challenge and needs support from top management and sufficient financial and personnel resources. To achieve the very best results in energy efficiency, the implementation of an Energy Management System such as ISO 50001 is the only effective solution. If this is not possible, a systematic approach in well-defined projects to enhance energy efficiency can also have positive effects.

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APPENDIX 1: ENERGY MANAGEMENT BALANCED SCORECARD FULL VERSION  
(Natural Resources Canada, 2015)

Energy management balanced scorecard

Level	Commitment	Planning	Organization	Projects	Financing	Tracking	Communication	Training
<b>5</b>	An energy policy exists that has clear targets, has the commitment of senior management and is communicated broadly.	A comprehensive energy management plan covers all major practice categories, defines how targets will be achieved and is implemented by all departments with full support from senior management.	Energy management is fully integrated into the management structure with clear delegation of responsibility for energy consumption.	Identification of capital, behavioural, operational and maintenance projects, development of business cases and implementation are ongoing.	Investment criteria, financing mechanisms and commitment to implement energy efficiency projects are clearly defined.	An energy accounting system sets targets, forecasts use, monitors use against a baseline and the forecast, and identifies faults. Savings are tracked at a project and system level by using submeters. Performance is benchmarked.	The value of energy efficiency and the performance of energy management are reported and marketed, both within the organization and outside, continuously.	Senior management, building operators and staff or tenants are trained to fully support energy performance.
<b>4</b>	<input type="checkbox"/> A formal energy policy exists but lacks active commitment from senior management.	<input type="checkbox"/> All departments are represented on the planning team with some senior management support.	<input type="checkbox"/> An energy committee is used as the main channel of communications along with direct contact with major energy users.	<input type="checkbox"/> There is formalized but infrequent identification of energy opportunities, basic business cases and implementation.	<input type="checkbox"/> Life-cycle costing and/or internal rate of return investment criteria are used.	<input type="checkbox"/> Facility-level performance is monitored against a baseline and benchmarked by using key performance indicators. Results from major projects are measured.	<input type="checkbox"/> An ongoing program of staff and tenant awareness exists, and progress is reported through regular publicity campaigns.	<input type="checkbox"/> Senior management or staff and tenants have received ad hoc training. Building operators are fully trained to support energy performance.
<b>3</b>	<input type="checkbox"/> The energy policy set by the energy manager, energy committee or equivalent has not been adopted.	<input type="checkbox"/> Only technical people or technical managers are involved in developing an energy management plan.	<input type="checkbox"/> An energy manager is in place but has no clear responsibility or authority.	<input type="checkbox"/> Development of energy savings opportunities is ad hoc and infrequent. There is only selected implementation.	<input type="checkbox"/> Investments are based on short-term or simple payback criteria only, with no consideration for life-cycle costing.	<input type="checkbox"/> Facility-level performance is monitored against a baseline by using utility data with ad hoc use of findings. No benchmarking is done.	<input type="checkbox"/> Staff and tenant awareness is occasional only and ad hoc.	<input type="checkbox"/> Building operators are trained to maintain major energy-intensive systems.
<b>2</b>	<input type="checkbox"/> An undocumented set of guidelines or procedures exists.	<input type="checkbox"/> One person has been delegated to develop an energy management plan.	<input type="checkbox"/> An energy manager is a part-time responsibility that has limited authority.	<input type="checkbox"/> Only informal assessments are made with ad hoc resources to identify energy-saving opportunities.	<input type="checkbox"/> Only low-cost measures are implemented.	<input type="checkbox"/> Cost reporting is based on utility invoice data. No benchmarking is done.	<input type="checkbox"/> Only informal contacts are used to promote energy efficiency.	<input type="checkbox"/> Building operators receive ad hoc training in energy-efficient technologies and practices.
<b>1</b>	<input type="checkbox"/> No guidelines or procedures exist.	<input type="checkbox"/> No energy management plan exists.	<input type="checkbox"/> There is no energy-related responsibility or contact between management, staff and the occupants.	<input type="checkbox"/> There is no mechanism or resources to identify or develop energy-saving opportunities.	<input type="checkbox"/> Energy efficiency investments are not pursued.	<input type="checkbox"/> No energy data are being tracked or benchmarked.	<input type="checkbox"/> Energy efficiency is not promoted.	<input type="checkbox"/> There is no energy management or operational training.
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>





## **7 FM IN HEALTHCARE**

### **7.1 COMPILATION AND CLASSIFICATION / REFERENCE MODEL OF KPIS FOR NON-MEDICAL SUPPORT SERVICES IN HOSPITALS**

NICOLE GERBER AND SUSANNE HOFER

### **7.1 COMPILATION AND CLASSIFICATION / REFERENCE MODEL OF KPIS FOR NON-MEDICAL SUPPORT SERVICES IN HOSPITALS**

FRANZISKA C. HONEGGER, ROMAINE SCHMIDT, GABRIELA ZANETTIN  
AND SUSANNE HOFER

### **7.3 SPACES AND SERVICES IN DUTCH HOSPICE CARE**

RIA MARTENS AND MARK MOBACH

## 7.1 Compilation and Classification / Reference Model of KPIs for non-medical Support Services in Hospitals

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### ABSTRACT

**Background:** Expectations for hospital services are high in Western (European) countries. However, hospitals are very complex institutions with many different stakeholders, interests and needs. This also influences the non-medical support services (FM), whose costs of providing the services amount to about a third of the total cost in a hospital. The complexity makes it very difficult to determine the interrelationships, possible synergies and sensible measuring points within the whole area of FM in Healthcare (HC).

**Purpose:** Until recently, different partial KPI models and compilations had been proposed, mostly focusing on technical issues. But a compilation and classification / reference model, including the whole range of FM services according to the Service Catalogue for non-medical Support Services in Hospitals (LekaS), had not yet been available. Research and development was therefore undertaken to find and define the significant, comprehensible, manageable and IT recordable key performance indicators (KPIs) for the FM in HC domain.

**Methodology:** The development of the compilation and classification / reference model was conducted within the principles of Consortium Research with subject matter experts, namely representatives of FM in hospital experts, consultants and software providers.

**Findings:** The presented compilation and classification / reference model of KPIs for FM in HC not only provides a holistic view of FM in HC KPIs and a basis for industry wide benchmarking, but also a new possibility of finding synergies in data management and resources.

### Keywords

Controlling, Facility Management, Healthcare, Key Performance Indicators, KPI-model.

## 1 STARTING POSITION AND STATE OF THE ART

Non-medical support services in hospitals are defined in detail by Gerber and Läubli (2015). Figure 1 illustrates the context. This definition was chosen as the conceptual basis for the further development of the presented compilation and classification of Key Performance Indicators for non-medical Support Services in Hospitals / FM in Healthcare (HC).

Non-medical support services account for up to 30 – 40% of the total costs in hospitals (Abel, 2009; Abel and Lennerts, 2006). Therefore, when discussing cost reduction measures in healthcare systems, not only the medical services have to be involved, but also the non-

medical support services (Thiex-Kreye, 2009). Key Performance Indicators (KPIs) are one way of efficiently controlling the business (Marr, 2012; Thiex-Kreye, 2009; GEFMA 260-1, 2012; Kronz, 2005). As Gerber and Hofer (2015) point out, so far there have been partial KPI models and compilations but no comprehensive models or compilations. Gerber and Hofer (2015) present a first development towards specific healthcare KPIs, depicting the interrelationships between the different service descriptions, however do not provide specific and explicit parameters for the different areas. It thus becomes clear that a comprehensive compilation and classification for FM in HC with explicit parameters has to be developed.

Figure 1 Service Allocation Model for non-medical Support Services in Hospitals (LemoS), visualizing the content of the Service Catalogue for non-medical Support Services (LekaS) (Gerber and Läuppi 2015, p. 7)



## 2 METHODOLOGY: CONSORTIUM RESEARCH

According to Otto and Österle (2010a), the Consortium Research (CR) method “aims at giving guidance to researchers in order to ensure knowledge transfer in multilateral collaboration with practitioners.” It “refers to research projects in which a number of partner companies together with academic researchers work on a certain research topic under the following conditions:

- Academic researchers and practitioners commonly define research objectives, assess progress of work, and evaluate project results.
- Research partner companies participate in research projects with their own experts and grant university researchers access to their knowledge resources.
- The results of the research are artifacts that offer substantial benefit for the companies participating.
- The companies participating test the artifacts developed in their business settings.
- The companies participating finance the research with resources in the form of money and time of experts.
- The research results are made accessible to the public.”

These definitions, together with the indication that Consortium Research projects last between two to eight years (Österle and Otto, 2009), correspond exactly to the context of the research and development project presented. As, according to Österle and Otto (2010a; 2010b), Consortium Research has been applied successfully in multi-disciplinary domains (as is Facility Management), the Consortium Research Method was chosen as methodology.

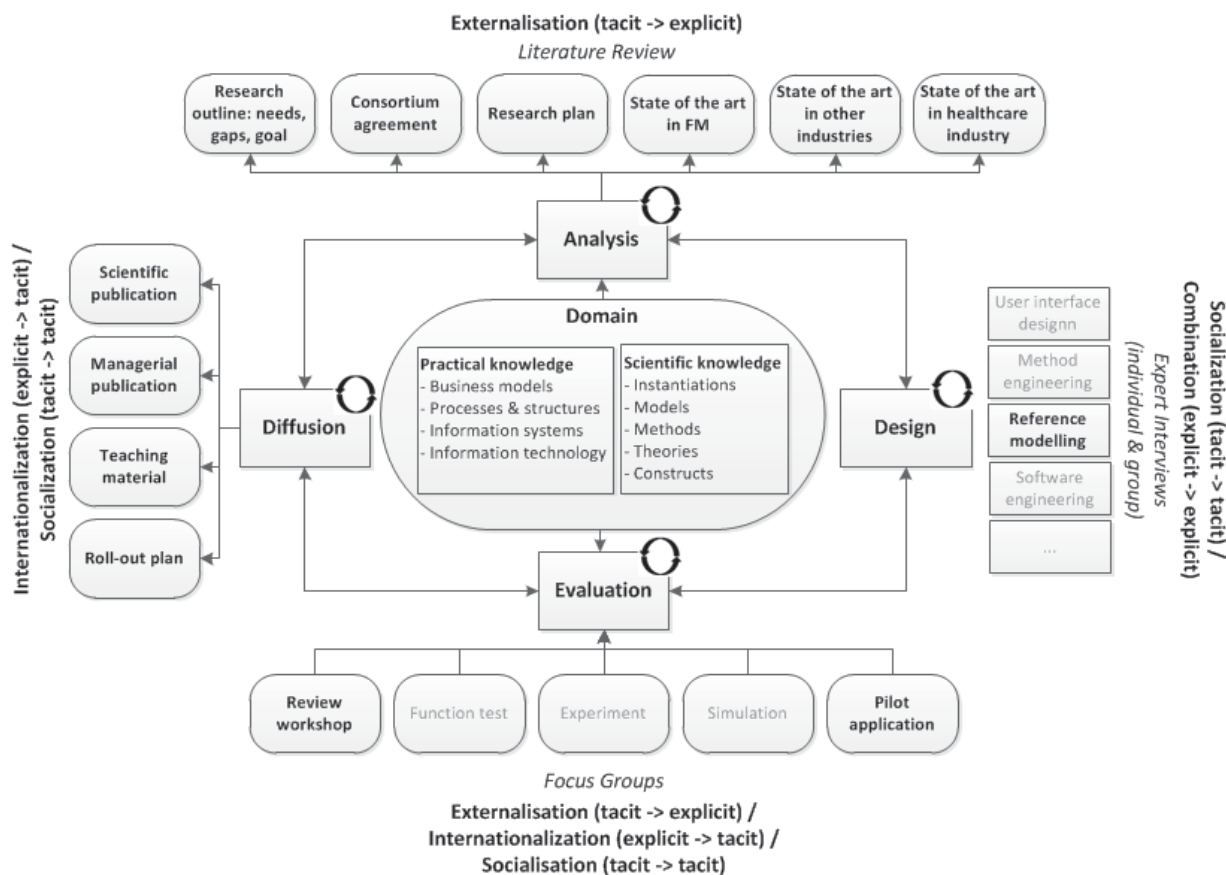
As Österle and Otto (2010a) specify in this context, the research techniques as depicted in Table 1, the aspects of Socialization, Externalization, Combination and Internalization had to be taken into account as well.

Table 1 Research techniques in consortium research (Österle and Otto 2010a)

“Socialization” (tacit → tacit)	“Externalization” (tacit → explicit)
Action research	Case studies
Creativity techniques, such as morphological analysis (Ritchey 2006)	Expert interviews
	Focus groups
	Grounded action research
	Surveys
“Combination” (explicit → explicit)	“Internalization” (explicit → tacit)
Case studies	In-house seminars
Content analysis	Joint project teams
Market surveys	

Specific focus was laid on the research technique aspect of Externalization during the Design phase, meaning the transfer of tacit knowledge from the subject matter experts to explicit knowledge for research and the whole industry. In order to do so, expert interviews were conducted within the Design phase of Reference Modelling as suggested by Österle and Otto (2010a). Figure 2 depicts the overall methodology applied. The sample comprised, next to the research partners, four FM in HC experts, two consultants for FM in HC and one FM in HC software provider. The sample was chosen to ensure that FM subject matter experts from different hospital and consulting categories and sizes were represented in order to cover the different needs of the whole industry.

Figure 2 Consortium Research aspects applied in the project  
(Own illustration based on Österle and Otto, 2009; 2010a)



In the following sub-chapters, the different steps and applied methods are described.

## 2.1 Analysis

Österle and Otto (2010) include the activities in Table 2 in the Analysis phase.

Table 2 Activities in the Analysis phase (Österle and Otto, 2010b)

Activity	Type of knowledge exchange addressed
Identify and assess existing artefacts in practice, i.e. solutions/instantiations, models, methods	Externalisation of what worked and what did not
Search for potential partner companies, discuss research ideas with subject matter experts	Externalisation through reflection of research gaps/goals against experience of practitioners
Check relevance of research gaps/goals and develop consortium agreement	Externalisation, enforcing practitioners' judgment regarding the relevance of the planned research

In the Analysis phase of the project, after finding the project partners and settling the agreements and the research plan, the state of the art was captured by finding KPI models and compilation/classification approaches in FM, in other industries and/or in the healthcare industry. As a result, roughly 1000 KPIs of the following (FM) areas were collected in tables: Procurement, Warehousing, Transport, Disposal and Recycling, Maintenance, Space

Management, Energy, Safety, Security, Cleaning, Sterilization, Catering, Textiles, Operation of accommodation and Operation of properties, Various Hotel Services.

## 2.2 Design: Reference Modelling / Compilation and Classification

In the Design phase, Österle and Otto (2010) suggest the activities as outlined in Table 3.

Table 3 Activities in the Design phase (Österle and Otto. 2010b)

Activity	Type of knowledge exchange addressed
Conduct focus groups on design decisions	Socialisation, through the exchange of knowledge, experiences
Reference modelling	Combination, through the incorporation of industry models etc.
Conduct action research within pilot projects	Socialisation, bilateral regarding both practical and scientific knowledge

In the Design phase, a comprehensive compilation and classification / reference model for non-medical support services in hospitals had to be set up, including the KPIs of the particular fields found in the state-of-the-art. As depicted in Figure 2, expert (individual and group) interviews were conducted. Due to its reference model character, the compilation and classification of FM in HC KPIs is considered a reference model. According to Fettke and Loos (2004), a reference model can be defined as a special model within a specific area (e.g. Healthcare or FM), while generally speaking, a model is a graphical display which reduces complexity, shows existing or desired parts of reality, is designed with particular intentions of and for specific stakeholders and embodies the subjective perspective of the modeller(s) (Prilla, 2010; Delfmann, 2006). One aspect to consider when modelling is the modelling language, which can be either textual or graphical (syntax) on the one hand, and informal, semi-formal and formal on the other (Bartsch, 2010). According to Gemino and Wand (2003), “the information represented is not necessarily information understood. Consequently, the usefulness of any technique should be evaluated based on its ability to represent, communicate and develop understanding of the domain.”

## 2.3 Evaluation

For the Evaluation, the activities in Table 4 are mentioned by Österle and Otto (2010).

Table 4 Activities in the Evaluation phase (Österle and Otto, 2010b)

Activity	Type of knowledge exchange addressed
Pilot and test artefact in “real-life” environments in the partner companies	Externalisation and Internationalisation
Conduct focus groups to evaluate artefacts	Socialisation and Externalisation, making judgments from practitioners explicit

In the Evaluation phase, the compilation and classification has to be validated. In doing so, a model can be judged by the generally accepted modelling principles established by Becker et al. (2012) assessing the quality of the reference model in different ways. The assessment includes the following aspects:

- Principle of correctness: making sure that the rules that a modelling language defines are observed (syntactical correctness) and that the aspects in the model are represented reasonably (semantic correctness)
- Principle of relevance: meaning that all aspects from the real world are represented in the model in a useful way and all aspects in the model have a counterpart in the real world
- Principle of economic efficiency: assuring that the model fits a specific business environment, uses an adequate modelling language and is only refined to the point that it still adds more value than the refinement uses up
- Principle of clarity: making sure that the model is comprehensive, readable and descriptive
- Principle of comparability: describing that procedures in the real world and the model are represented in a similar way and, if models are written in different languages, that they can be transferred
- Principle of systematic structure: defining that different model views correspond with each other

The model is currently being validated by practice through pilot applications. As 15 different FM areas are involved and as the setup for financial allocation for FM in HC is also being conducted in a parallel project, the validation of the KPI compilation and classification / reference model for FM in HC will take time, taking into account budgeting and controlling cycles of hospitals. The feedback from the focus group review workshops is currently constantly being collected. Further validation rounds will be held according to the need of the involved parties to reach the version of the model according to the generally accepted modelling principles described above.

## 2.4 Diffusion

For the fourth phase, the Diffusion, Österle and Otto (2010) include the activities in Table 5.

Table 5 Activities in the Diffusion phase (Österle and Otto 2010b)

Activity	Type of knowledge exchange addressed
Roll out results within the partner companies	Internalization
Publication/present results in industry events (both by researchers and practitioners)	Internalization and Socialisation

Consortium Research comprises the diffusion in the scientific, business and education context (see Figure 2). This publication contributes to an external diffusion. Workshops within the project partner businesses involved support the project-internal diffusion. For details about further publications and diffusion see chapter 6.

## 3 KEY PERFORMANCE INDICATORS (KPIs)

“‘What gets measured gets done’ and ‘if you can’t measure it, you can’t manage it’ are just two of the popular sayings used to highlight the critical importance of metrics.” (Marr, 2012). This indicates that it is necessary for managers to have a set of specific, useful and persistent numbers and measures to control and navigate their business (GEFMA 260-1; Marr, 2012; Johner, 2009; Mauboussin, 2012). In addition, DIN (2000) outlines that KPIs improve transparency and therefore improve communication between departments.

VDI 2893 (2006) points out that in order to choose the right KPIs and to set up a KPI system, the context of the enterprise and goals have to be specifically considered. In order to find the useful KPIs within their context, Johner (2009) suggests four steps:

- 1 Check the significance of the KPIs
- 2 Check sensitivity of the KPIs
- 3 Ensure comprehensibility and manageability of the KPIs
- 4 Recordability of KPIs with IT systems

Mauboussin (2012) suggests also four, but different steps:

- 1 Define the goal
- 2 Develop a theory for the cause and effect of value drivers
- 3 Find what the employees can do to reach the set goals
- 4 Control the numbers

And VDI 2893 (2006) proposes the following procedure:

- 1 Self analysis, setting up business processes
- 2 Define goals and map to perspectives
- 3 Set measurable influencing variables
- 4 Set baseline figures, collect and prepare data, check data situation
- 5 Determine and judge dependencies of baseline figures
- 6 Create KPIs

It becomes clear that different procedures can be chosen to set up KPIs but that the specific context has to be considered.

### **3.1 KPIs in FM and FM sub-domains**

As discussed in Gerber and Hofer (2015), the industries of the different FM sub-areas or the FM in branches other than FM in HC mostly have KPI models implemented or compilations available. Well-known examples are the Supply Chain industry with the areas Procurement, Storage, Transport and Recycling with its Supply Chain Operations Reference Model SCOR (2012) and the Maintenance KPIs defined in detail by VDI (2006).

### **3.2 KPIs in HC**

According to Gerber and Hofer (2015), in the healthcare context KPIs have so far mostly been assessed via governmental controlling reports, covering predominantly medical data such as number of treatment days, number of beds, case-mix index or doctors per discharges. The specific FM KPIs within HC have not yet been implemented.

### **3.3 KPIs in HC-FM**

Concerning KPIs for the FM in the HC sector, Gerber and Hofer (2015) point out, that several models have been presented but only in specific partial, mostly technical or real estate topics. A first approach to setting up a comprehensive model comprising all the non-medical support services in hospitals according to LekaS was presented by Gerber and Läuپی (2015), however the specific parameters and their classification is still missing. It therefore becomes clear that a comprehensive compilation and classification / KPI reference model for non-medical Support Services in Hospitals has to be developed.



#### 4 COMPREHENSIVE COMPILATION AND CLASSIFICATION / KPI REFERENCE MODEL FOR FM IN HC

Based on the approaches suggested by Johner (2009) and Mauboussin (2012) in chapter 3, in the Design phase of the project the following procedure for defining a suitable KPI system for the domain of FM in HC was set up in cooperation with the subject matter experts:

- 1st Ensure significance of all FM domains in the entire context of hospitals
- 2nd Find KPI reference standards in all FM domains
- 3rd Select significant, comprehensible, manageable and IT recordable KPIs in each FM domain

In the following sub-chapters, the three steps conducted and their results are described.

##### 4.1 Ensure significance of all FM domains in the entire context of hospitals

After an empirical project phase of three years, Gerber and Läubli (2015) set up a Catalogue for non-medical Support Services in hospitals, showing the significance of the whole context. Up until now, the catalogue has been bought and downloaded by practitioners as well as scientists and has been used as a basis for different further projects. The catalogue and its definition of the domain were therefore considered by the subject matter experts to have the necessary significance for being used as a conceptual basis.

##### 4.2 Find KPI reference standards in all FM domains

For all the different FM domains, literature research was conducted to compile existing KPIs. As references, the following sources could be identified:

- **Procurement:** Fowler et al. (2005); Gerber and Hofer (2015); Kumar et al. (2005); Supply Chain Council (2012); VDI 4400:2001
- **Warehousing:** Gerber and Hofer (2015); VDI 4400:2002; VDI 4400:2001; VDI 2525:1999
- **Transport:** Fowler et al. (no date); Fowler et al. (2005); IFMA (2007); VDI 2525:1999; Wissenschaftliche Gesellschaft für Krankenhaustechnik (2009)
- **Disposal and Recycling:** Fowler et al. (no date); IFMA (2007); Madritsch et al. (2008); Reineck et al. (2011); VDI 2525:1999
- **Safety:** Kumar et al. (2013); Fowler et al. (no date); IFMA (2007); Lavy et al. (2010); Stiftung sanaCERT (2011); VDI 2893:2006
- **Security:** Amt für Abfall, Wasser, Energie und Luft (no date); Loosemore and Hisin (2001).; Rotermund (2014); Stiftung sanaCERT (2011); Wissenschaftliche Gesellschaft für Krankenhaustechnik (2009)
- **Maintenance:** Donnell-Kay Foundation. (2005); Gerber and Hofer (2015); IFMA (2007); Lavy and Shohet (2007); Lavy et al. (2010); Loosemore and Hisin. (2001); Madritsch et al. (2008); IFMA (2007); Rotermund (2014); VDI 2893:2006; Wissenschaftliche Gesellschaft für Krankenhaustechnik (2009)
- **Space Management:** Gerber and Hofer (2015); Hinks and McNay (1999). IFMA (2007); Lavy et al. (2010); Loosemore and Hisin (2001); Rotermund (2014); SIA 213:2005; Wissenschaftliche Gesellschaft für Krankenhaustechnik (2009)
- **Energy:** Amt für Abfall, Wasser, Energie und Luft (no date); Gerber and Hofer (2015); IFMA (2007); Lavy et al. (2010); Loosemore and Hisin (2001); Madritsch et al. (2008);

- Pati et al. (2008); Rotermund (2014). Wissenschaftliche Gesellschaft für Krankenhaustechnik (2009)
- **Cleaning:** Caquas (2010); Gerber and Hofer (2015); Hotellerie Benchmark (no date). IFMA (2007); Loosemore and Hisin (2001); Madritsch et al. (2008); Rotermund (2014); Wissenschaftliche Gesellschaft für Krankenhaustechnik (2009)
  - **Sterilization:** Caquas (2010); Gerber and Hofer (2015); Spring (2008); Swissmedic (2005); Wissenschaftliche Gesellschaft für Krankenhaustechnik (2009)
  - **Catering:** Gerber and Hofer (2015); Hotellerie Benchmark (no date); Wissenschaftliche Gesellschaft für Krankenhaustechnik (2009).
  - **Textiles:** IFMA (2007); Madritsch et al. (2008); Pericin (no date); Wissenschaftliche Gesellschaft für Krankenhaustechnik (2009)
  - **Operation of accommodation and Operation of properties:** IFMA (2007)
  - **Various Hotel Services:** IFMA (2007); Rotermund (2014); Kanton Zug - Direktion des Inneren (2013)

#### 4.3 Select significant, comprehensible, manageable and IT recordable KPIs in each FM domain

After the compilation of all the FM (in HC) KPIs from literature mentioned above, the different KPIs were classified by the following aspects:

- Operational cost KPIs
- Quality KPIs
- Efficiency/utilisation KPIs
- Internal-external ratio KPIs
- Financial ratios

KPIs declared as non-hospital specific and “KPIs” that only defined single parameters were eliminated.

The complete list of all compiled and classified KPIs of all the FM in HC area according to LekaS can be consulted under [www.zhaw.ch/en/lsvm/institutes-centres/ifm-institute-of-facility-management/about-us/hospitality-management/](http://www.zhaw.ch/en/lsvm/institutes-centres/ifm-institute-of-facility-management/about-us/hospitality-management/) as of Q2/2016.

## 5 DISCUSSION AND CONCLUSION

The compilation and classification / reference model for FM in HC presented is set up in a textual informal modelling language according to Bartsch (2010). The principle of syntactical correctness has therefore no strict restrictions and can therefore be rated as given. The fact that the FM in HC areas from LekaS (Gerber and Läubli, 2015) are covered ensures the semantic correctness, the principle of relevance as well as one part of the principle of comparability. As the model is set up as a very specific reference model for FM in HC, one part of the economic efficiency principle is also given. Whether the modelling language chosen is adequate and how intensively the refinement of the model has to be conducted in order to comply with the principle of economic efficiency will have to be determined in the validation phase. The same applies for the proof that the model fulfils the principle of clarity. The aspects of comparability and systematic structure will come in once further views are modelled and linked to the reference model presented.

With the compilation and classification / reference model for FM in HC developed, several innovative features can be presented:

- an extensive compilation of KPIs not only for specific areas, but also for the holistic view of FM in HC according to LekaS (Gerber and Läubli, 2015)
- a systematic basis for defining significant, comprehensible, manageable and IT recordable KPIs
- a possibility to find synergies in data management and resources by the identification of the same parameters throughout the different FM in HC areas
- a basis for industry-wide benchmarking by the existence of precise definitions of KPI parameters

## 6 LIMITATIONS AND OUTLOOK

As mentioned in chapter 2.3, the validation has to be completed within the next years. This also includes the completion of the FM in HC KPI meta model by Gerber and Hofer (2015) with all the parameters currently lacking as well as an exact matching with the detailed process descriptions, being developed in a parallel project following the iterative principle depicted in Figure 2. The detailed information on the state of the art in KPIs, KPIs in FM and KPIs in healthcare as well as the classification of all the collected KPIs and the detailed explanation of all compiled and classified KPIs in the reference model for FM in HC will be published on [www.zhaw.ch/en/lspm/institutes-centres/ifm-institute-of-facility-management/about-us/hospitality-management/](http://www.zhaw.ch/en/lspm/institutes-centres/ifm-institute-of-facility-management/about-us/hospitality-management/) in Q2/2016 in addition to the information on the process model for non-medical Support Services in Hospitals and the new standards for allocating FM in HC cost in order to reach the proposed KPIs. Once those three topics can be matched, complete and thorough benchmarking in different FM areas in HC between different hospitals and hopefully countries will be possible. Moreover, the question about how to specifically handle the FM in HC data with corresponding software applications can be answered.

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## 7.2 Moving non-nursing Activities to FM - Example of a successful Collaboration of FM Research and Practice

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### ABSTRACT

**Purpose:** This research sets out to provide a nursing home with evidence-based data enabling a reorganisation process aiming to professionalise Facility Management (FM) services (non-nursing tasks) on wards. The aims include developing a vision and strategy for these services in alignment with the organisational strategy, to provide a catalogue of non-nursing activities, to outline when and by whom these activities are performed, and to provide indications for a future detailed cost benefit analysis for the introduction of ward hotel services as FM responsibility.

**Theory:** FM in health care institutions, traditionally FM services on wards, are carried out by nursing staff. Defining non-nursing activities that can be carried out by staff reporting to the FM department, instead of nursing staff, is one way of addressing nursing shortages.

**Design/methodology/approach:** The research is based on a single case study, including literature and document research, semi-structured non-participant and semi-participant observation, semi-structured expert interviews with nursing management from these wards, and a focus group with residents of the nursing home.

**Findings:** An evidence-based vision and FM strategy aligned with the overall business strategy for non-nursing activities on the wards was developed, as well as a process and service level framework. The cost benefit analysis shows an average of 17,824 hours per year spend on non-nursing activities. This leads to a potential of around 8.5 full time equivalents to be transferred from nursing to FM responsibility.

**Originality/value:** The findings of this applied research visualise how a close collaboration of FM Research and Practice works for the benefit of both disciplines.

### Keywords

Nursing home, Healthcare, Facility Management, Ward services.

## 1 INTRODUCTION

Switzerland's total health expenditure, expressed as a percentage of GDP, is, according to the OECD, one of the highest in the world (OECD, 2011). Process and cost transparency within the healthcare system and its different institutions is still very immature. This is connected with the Swiss political system consisting of 26 entities, each with different rules and regulations with corresponding implications on industry. With regard to healthcare, these country specifics have led to a high non-transparency (Meier, 2011). Besides hospitals focusing on acute-care, a vital part of the healthcare system are long-term care institutions. Only in 2014 the Swiss Federal Office of Public Health published for the first time a comprehensive overview of operational figures of long-term care institutions, such as nursing homes (FOPH, 2014). Based on 2013 figures, that report states a total of 1,556 nursing homes in Switzerland providing long-term care to their residents. Their total costs amount to CHF 9,262 million (€ 8,430 million) while providing 94,157 beds. On average CHF 283 (€ 258) per day and bed. The average length of long-term stays is 942.2 days. Only the 2012 figures serve as a reference but already there, an increase of 2.6% of the total cost is stated. These institutions also face a restrictive environment, mainly because demographic change of the population increases the need for medical treatments and therewith costs, especially through the increasing number of chronically and multi morbid illnesses (Deloitte, 2014; Economist Intelligence Unit, 2011), which places great strain on the resources of long-term care facilities. Another major challenge is the increasing shortage of skilled labour in healthcare institutions in most European countries (Hasselhorn, Tackenberg, & Müller, 2003; Simoens, Villeneuve, & Hurst, 2005) including Switzerland. Switzerland has a high demand for foreign-trained workers to make up the shortfall, for example in 2013, foreign-trained doctors made up 27% compared to a 17% OECD country average, and nurses constituted 18.7% in contrast to 5.9% OECD average (OECD, 2015). Hence it is important for every single long-term care institution to set up its organisation as effectively and efficiently as possible.

## 2 BACKGROUND THEORY

Nursing not only need to deal with reduced financial resources, but they also need to manage the rising expectations of residents and other stakeholders, such as staff. In order to stay competitive, the performance of qualitative services is necessary. In addition to processes that focus on the respective core functions of treatment and care, support processes are also affected by this move to provide effective and efficient services that are tailored to their end-users. These support processes can be put under the remit of facility management (FM), a practice that is defined as the "integration of processes within an organisation to maintain and develop the agreed services which support and improve the effectiveness of its primary activities" (CEN, 2006, p. 5).

A further aspect regarding the importance of FM processes is that the quality of medical treatment and care is not the only criteria for residents when choosing a nursing home. So-called "hotel services", sometimes also referred to as "housekeeping services" as part of FM, are increasingly important for attracting residents and also play an important role in resident satisfaction (Haseborg & Zastrau, 2005; Weilmhammer, 2005). Especially in the setting of nursing homes, as FM services need to create as far as possible a home-like atmosphere for its often long term residents.

Traditionally, FM services on wards in nursing homes as well as hospitals are carried out by nursing staff. In line with financial pressure and labour shortage of skilled nursing staff, skills-oriented allocation of work is essential. Defining the non-nursing activities that can be carried out by staff reporting to the FM department instead of by nursing staff is one way of addressing nursing shortages, while at the same time enhancing service quality. Paeger (2009) states that these non-nursing tasks take up between 20 – 30% of a nurse's time. There is an ongoing trend in Swiss hospitals towards removing responsibility for domestic / housekeeping services (such as food ordering, service and clearing away; flower care or errands) from the remit of nursing staff and putting them under the responsibility of staff assigned to the FM department (Honegger & Hofer, 2015; ZHAW/IFM, 2012).

In Switzerland, these tasks are often assigned to a sub division of the FM department referred to as "Room-Service" or another name indicating non-nursing activities. In this paper, the term ward hotel services is used because it focuses on a nursing home, where activities are not primarily focused on patient rooms but on the whole ward which is home for its residents. Studies conclude that the room-service concept is beneficial for hospitals because it both increases patient satisfaction and reduces costs (Aase, 2012; Buzalka, 2004; Elan, 2008; Mahoney, Zulli, & Walton, 2009; Stanga et al., 2003). These studies state a positive impact on patient satisfaction, because skilled room-service staff is more focused on the quality of food service delivery than the nursing staff. In contrast to nursing staff, staff assigned to the FM department considers these tasks to be their primary focus, resulting in improvements in the patients' service experience. Furthermore, non-nursing activities under the remit of the FM department means that FM has total process responsibility for the services. With direct managerial authority over its own staff, it is much easier to professionalise the service than when using nursing staff which the FM department usually has no direct authority over.

Because there is not yet scientific evidence available on the benefits of such ward hotel services in the setting of nursing homes in Switzerland, the research this paper presents is about a Swiss nursing home that realised the potential of a ward hotel services concept and took the decision to plan and subsequently implement such a concept. In order to start this organisational change, evidence-based data representing the current situation as well as a strategic alignment was needed, and it was this data and information this research set out to provide. Thereby the nursing home decided to collaborate with research to develop and apply an aligned methodology, based on scientific grounds.

### 3 METHODOLOGY

#### 3.1 Research Aim and Corresponding Tasks

Based on above background, the aim of the research was to provide the nursing home executives with an evidence based conceptual study containing the essential foundations to opt for and eventually implement hotel services on wards across the nursing home.

The guiding research tasks contained two main tasks:

- **Methodological level:** Development of an aligned research methodology to obtain the required evidence-based data. This methodology chapter represents already part of the achieved results.
- **Content level:**
  - To develop a vision and strategy for the hotel services in alignment with the organisational strategy
  - To provide a catalogue of non-nursing activities



- To outline when non-nursing activities are performed and who performs them
- To provide indications for a future detailed cost benefit analysis for the introduction of ward hotel services

Based on the aim and corresponding tasks, the results achieved were developed into a concept paper addressed to the nursing homes executive board as a basis for decision making.

### 3.2 Qualitative Case Study Design

To achieve the aim, a case study design with a predominantly qualitative approach was conducted. Various definitions of case study designs exist. For this research, the following definition was used: “Case study research in business uses empirical evidence from one or more organisations where an attempt is made to study the subject matter in context. Multiple sources of evidence are used, although most of the evidence comes from interviews and documents” (Myers, 2011, p. 76). The findings of this research are derived from a single case study, on the subject of non-nursing activities on nursing home wards in a single nursing home.

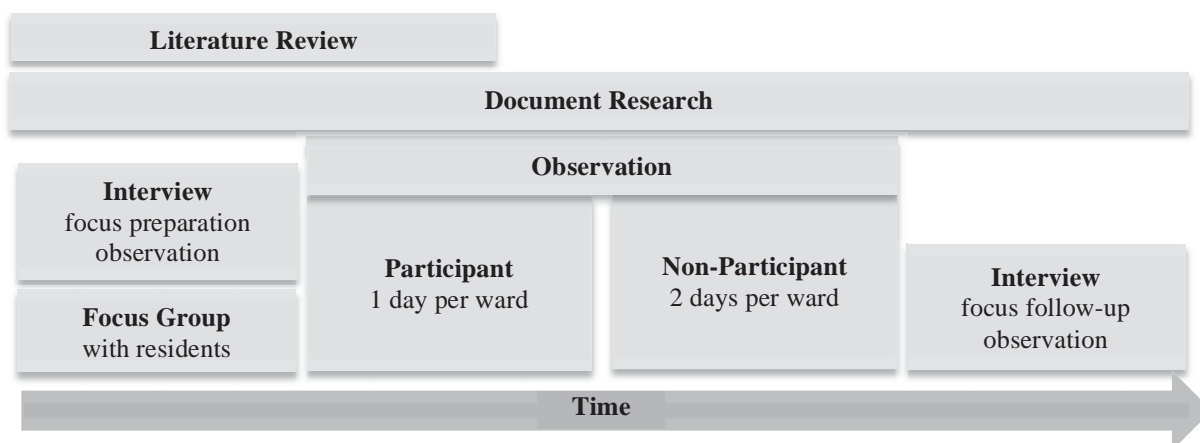
### 3.3 Case Selection

This research was undertaken at the request of the nursing home itself. Organisationally, the nursing home is a non-profit foundation providing different in- and outpatient services for elderly residents on behalf of a Swiss city. Residential care capacity is 155 beds with an occupancy rate of 99%, according to the annual report 2014.

### 3.4 Data Collection and Analysis

In line with a qualitative case study research design, data collection was performed using a multimethod approach for qualitative studies (Saunders, Lewis, & Thornhill, 2007), which included literature review and document research, semi-structured expert interviews with nursing management from these wards, semi-structured non-participant and semi-structured participant observation on three specifically selected wards and a focus group with residents of the nursing home. Timewise the data collection instruments used in these methods informed each other. Figure 1 displays the chronological connection of the methods used.

Figure 2 Chronological Overview of Research Methods



Detailed literature and document research, focusing on available process and service descriptions, enabled information to be gathered that informed and added depth to the observation and interview data. The research project was highly supported by a member of

the executive board who granted data access. Semi-structured expert interviews were conducted with nursing management on the three wards in order to inform and verify the observations. Hence the interview guidelines focused on gaining information about daily activities on the wards. The interviews further informed the nursing managers about the upcoming observation activities what enabled to obtain informed consent from the participating ward.

For the observations, a recording sheet was developed. This enabled the documentation of the times and nature of non-nursing activities with an indication of who performed each task in a structured way. Additional comments could be made, hence the semi-structured nature of the observation. Information from the literature was used to create a list of common non-nursing activities in order to predefine the record sheets. Data was collected on the wards, between 7 am and 7-9 pm, the times when non-nursing activities predominantly take place. The three sample wards were purposively chosen; two of them represent average wards and one caters for the special needs of residents with dementia. A total of 37 records sheets were obtained through the non-participant information provided by the staff that were on duty these two days and carried out non-nursing activities. The participant observation resulted in a total of 3 record sheets as the researcher was present 1 day in each of the three sample wards.

Data analysis applied a coding strategy for the qualitative data. Codes represent a thematic structure that serves to compare and describe settings (Flick, 2009). The codes used were informed by existing literature on non-nursing activities and iteratively derived from the data. Descriptive statistics were used for the time related quantitative observation data.

## 4 FINDINGS & DISCUSSION

### 4.1 Methodological Level

The development of afore explained methodology required a close collaboration of research and practice. The alignment of research terms and procedures to the needs of practice without losing their established profile was challenging but worthwhile for both sides. Thereby clear target-group-oriented information was crucial to gain the needed confidence to both develop and apply the data collection instruments. It can be stated that the methodology served its purpose.

### 4.2 Content Level

Also the development of the content for the conceptual study required a close collaboration of research and practice. Below stated results were regularly discussed in order to keep the parties involved updated.

#### **Developed Vision and Strategy**

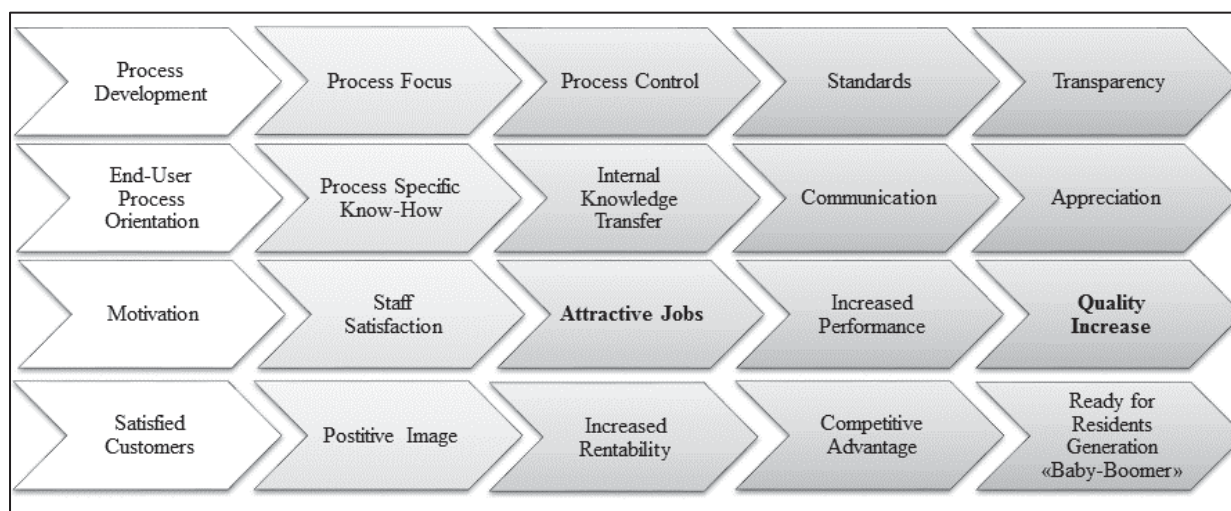
Derived from the background theory and in alignment with the organisational vision, a clear vision was formulated to serve as a guiding element for further concept development, see Box 1.

#### Box 1 Vision of Ward Hotel Services

Ward hotel services create attractive jobs for both nursing and hotel staff. They generate skilled service specialists and hence enable service excellence. Hence customer satisfaction increases, positively impacting the organisational image. This in the long term meets the increasing demands of future residents and creates a competitive advantage for the organisation. (translated version)

As indicated in the vision, the overall aim of ward hotel services are attractive work places for both skilled hotel and nursing staff as well as to attain high service quality, which can be achieved by implementing the ward hotel service concept. This is clearly aligned with the overall organisational strategy of the nursing home stating that the FM services shall be enhanced to a comprehensive service provider (page 21 of internal strategy paper). Figure 2 displays the key terms of the comprehensive ward hotel service strategy, based on the background theory. These key terms are used to promote the concept within the nursing home. The terms in bold are of special importance to the nursing home.

Figure 3 Key Terms Strategy Ward Hotel Services



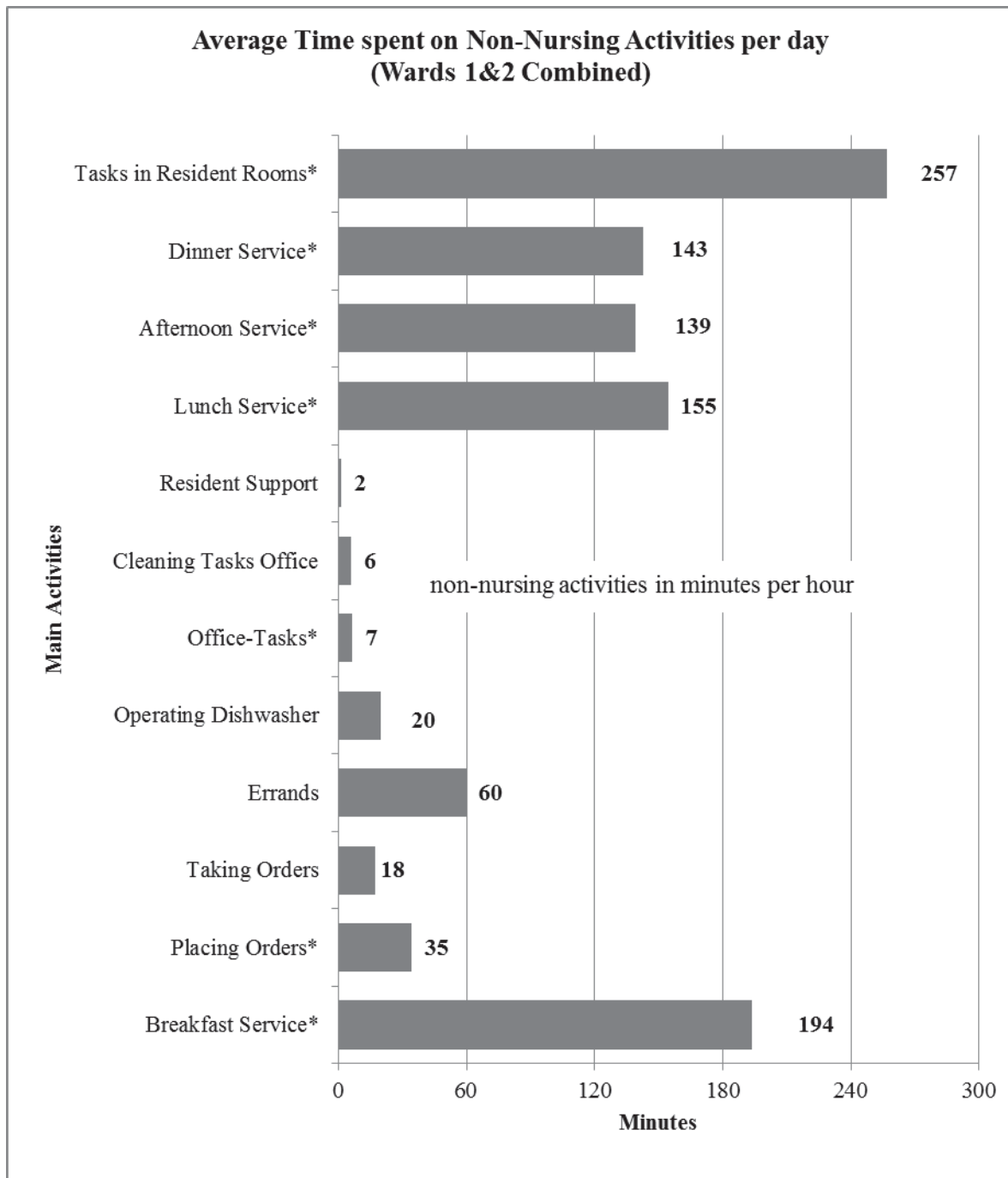
### Structure of Non-Nursing Activities

The catalogue of non-nursing activities was developed using existing literature and documents paired with experiences from other institutions. It was fed directly into the development of the data collection tools to outline when these activities take place. An excerpt exemplifying this extensive catalogue is provided in Table 2.

Based on explained samples, the results of both participant and non-participant observation were processed in the same way. Representative results of the non-participant observation are displayed in Figures 3 and 4. Figure 3 shows the average time spent on non-nursing activities. The time encompasses results of the 2 day observation time frame on wards 1 & 2 displayed in minutes per hour. That means that numbers mostly exceeding 60 minutes indicate, that several nursing staff are simultaneously occupied with allocated activities. Asterisks mark tasks that subsume a range of related tasks.

It is visible that meal services and tasks in resident rooms are time consuming tasks. For clearer insights, the subsumed activities of the breakfast service and activities in resident rooms are listed in table 2. The identified around 80 non-nursing activities are clustered in six main areas of activities: Catering, living, logistics, entrance and exit of residents, diverse activities. They are aligned to current activities in this specific nursing home and might vary in other settings.

Figure 4 Average Time spent on Non-Nursing Activities per Day.

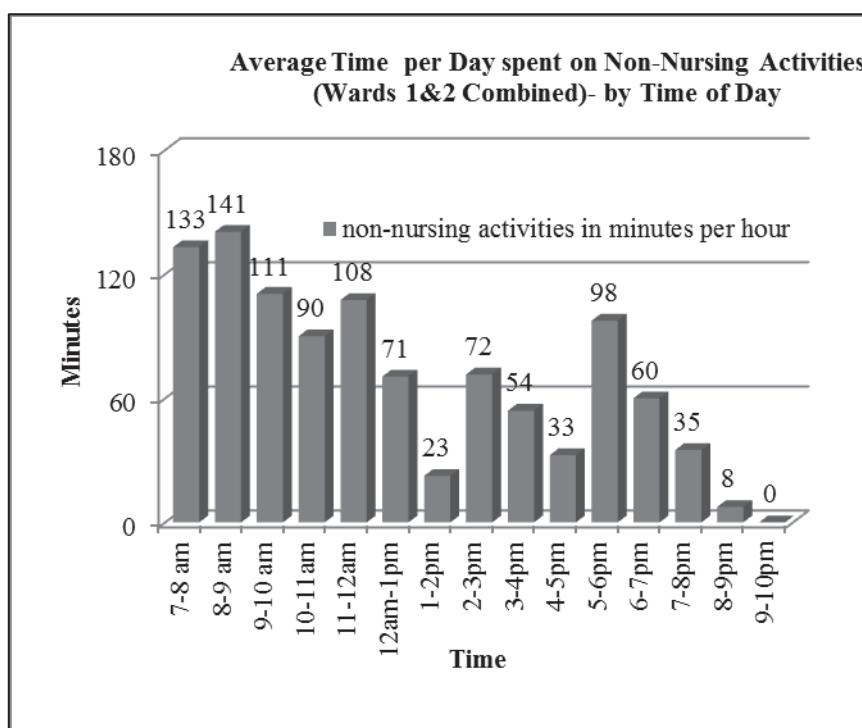


Another way to display the structure of non-nursing activities is shown in Figure 4 where the average time per day of non-nursing activities on the two sample wards is structured by time of day. Corresponding with the previous structure of time by activities, the peaks around the meal times are clearly visible. Activities in residents' rooms cannot be assigned to specific times as they occur throughout the whole day. However, the higher time distribution in a.m. hours indicates that these presumably take place predominantly in these hours too.

Table 2 Excerpt of Non-Nursing Activity Catalogue

Activities Breakfast Service	Activities in Resident Rooms
Set table	General tidying
Prepare and serve hot and cold drinks	Make beds
Place napkins with residents	Put fresh linen on beds
Serve meal trays	Putting away residents' clothes
Meal Assistance (spreading, chopping, ...)	Stock up materials
Second serves	Stock up linen
Errands to kitchen	Dispose dirty linen
Tray clear up	Waste disposal
Assistance cleaning residents	Cleaning residents glasses
Errands between different meal areas	Cleaning activities
Waste disposal	Disinfection activities
Disposal of used napkins	
Table cleaning	

Figure 5 Average Time per Day spent on Non-Nursing Activities by Time of Day



Results of all samples, based on participant observation, state the amount of non-nursing activities as a percentage of the overall work task as 49% on ward 3 and 38% on wards 1 & 2. The results of the non-participant observation are lower with 36% on ward 3 and 26% on wards 1 & 2. These differences can be accounted for by a combination of unpredictable events in daily routines and observer bias, despite well-structured recording sheets.

Extrapolated to one year, these results indicate a total of 11,543 hours of non-nursing activities on ward 3 and a total of 6,281 hours combined on wards 1 & 2. Transferred to working hours of a 100% job position, this results in 5.5 f.t.e. positions for ward 3 and 3 f.t.e. for each of ward 1 & 2. Certainly, as the calculations include observer bias and are based on samples, these figures cannot be taken too directly to feed into the reorganisation project.

They have to be looked at with care. However, they do show the dimension of work places possibly affected by the introduction of ward hotel services. They provide thereby a valuable indication for future detailed cost benefit analysis. The non-nursing activities were carried out mainly by nursing assistants who were supported during peak hours by skilled nurses.

## 5 CONCLUSION

This research set out to provide the nursing home executives with an evidence based conceptual study containing the essential foundations to opt for and eventually implement ward hotel services as FM responsibility across the nursing home. This aim has been achieved. An organisation specific catalogue stating around 80 non-nursing activities was developed and serves as a basis for carrying out the reorganisation project implementing hotel ward services. The vision and strategy developed for a future ward hotel service is neatly based on theory and therefore serve their purpose as guiding elements in the process of implementing it.

However, as results are based on data from sample wards and do not include the entire population (all wards), and due to the subjective nature of the observation data, their outcome cannot be viewed as sacrosanct. Nevertheless, they are of high value for the conceptual study and provide enough evidence for the executive board to opt for the reorganisation project. This also includes a more detailed calculation of how many f.t.e positions and corresponding heads are moved to FM.

As ward hotel services as FM responsibility are not yet commonly applied in long-term care institutions, this nursing home could position itself among the leading organisations taking advantage of this approach. It can also be concluded that this paper represents a compelling example of how research and practice collaborate for the benefit of both disciplines.

### **Relevance of Findings**

The findings are of particular interest for the nursing home involved in this research. Moreover, they are also useful for any other long-term care institutions aspiring to professionalise their services by introducing a ward hotel service concept under the remit of FM, especially in light of the previously mentioned challenges that Swiss healthcare institutions are facing. One might wonder why such research activities are necessary, as the benefits of such concepts are already proven and in place in hospitals. Even though there are similarities between acute and long-term care institutions, the collection of organisation specific data is still essential, because the change in work force allocation is significant; justification and acceptance rely on specific data.

### **Outlook**

By the time of this paper's publication, these initial measures to introduce ward hotel services will have progressed. One of the researchers involved is directly contributing to the implementation, as he is now working as a practitioner in this particular nursing home. It is interesting to observe whether or not the shift of non-nursing activities to FM responsibility gains also ground in long-time care institutions.

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## 7.3 Spaces and Services in Dutch Hospice Care

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### ABSTRACT

**Purpose:** Palliative care improves quality of life of patients and relatives facing life-threatening illnesses; it places their needs central (WHO, 2015). It is however unknown if facility design in Dutch hospice care facilities fulfils these needs. This paper aims to establish if services and spaces of hospice care providers match with needs of users.

**Design:** This explorative study includes a literature review on needs and supporting services and spaces, using evidence-based design and indoor-environment design literature. Semi-structured interviews were conducted with caregivers and support staff.

**Findings:** Patients in the final stages of life need a last refuge that requires a higher standard when compared to regular healthcare environments. The spaces and service delivery processes at hospices seem to be optimal while in other (hospice) care settings users miss adequate spaces and services. In addition, management in care systems needs to reconfigure accordingly in order to offer flexible customisation e.g. allocation of staff. Several space and service requirements have been identified, like domesticity, lay-out, style of décor, space for loved ones, quiet, and personal artefacts.

**Practical implications:** The research findings will be used for follow-up research that will result in aligning the designs of spaces and services with needs of hospice care users.

**Originality/value:** The role of facility management in palliative care has rarely been studied. Current findings may be regarded as a starting point for further investigation in this area, allowing hospice care to improve its spaces and services in order to meet patients' and relatives' needs.

### Keywords

Facilities, Hospice care, Service, Space.

## 1 INTRODUCTION

Palliative care is an approach to provide patients under chronic as well as life threatening/limiting conditions with relief. It is applicable early in the course of illness, in conjunction with other therapies that are intended to prolong life. In contrast, hospice care is end-of-life or terminal care (AWPC, 2014) and focuses on helping “people who are dying to have peace, comfort, and dignity” (Sparks & Villagran, 2010). Although both forms of care



are strongly related, the focus in this paper is on the latter which takes place in hospices and other healthcare organizations in The Netherlands.

According to the WHO (2015) hospice care providers deliver palliative care in order to improve quality of life of patients and relatives and it places their needs central. However, it is yet unknown if facility design, in this case the design of facilities at Dutch hospice care providers, actually fulfils such needs. This research explores to what extent these facilities match the needs of users. Or more specifically, it aims to establish to what extent the design of facilities (e.g., spaces and services) of Dutch end-of-life or terminal care providers are consistent with the needs of inpatients and their loved ones when it comes to hospice care, end-of-life or terminal care.

## 2 DUTCH HOSPICE CARE IN CONTEXT

In The Netherlands hospice or end-of-life care is provided in different environments: 1) at home, 2) in a hospice, 3) an almost-home home, 4) in special departments of nursing or care homes, and 5) in hospitals. In 2010 there were a total of 1,314 places available in these institutionalised facilities for hospice care (Agora, 2015). The Netherlands has 295 providers and service delivery units per 56,000 inhabitants; thus 1 unit per 190 inhabitants.

The number of the different Dutch palliative care settings are (Agora, 2015):

A hospice or almost-home home	157
Special departments of a nursing home	91
Special departments of a care home	41
Facility with hospital admission	29

In the Netherlands a hospice, or ‘almost-home home’, is focused solely on terminal palliative care. The primary focus of a nursing home is providing palliative care to elderly people and a care home is also for the elderly but does not deliver medical care. A facility where hospital admission is possible is able to deliver intensive medical care and can be exclusively for children (12 of the 29) (Agora, 2015).

Australia is one of the countries that stands out globally: hospice-palliative care services are at a stage of *advanced* integration into mainstream service provision. Only 8.6% of all countries worldwide are considered to be at this advanced stage of integration (AWPC, 2014). In contrast, The Netherlands is a country where hospice/palliative care services are at a stage of *preliminary* integration into mainstream service provision. Research by the Comprehensive Cancer Centre of the Netherlands (IKNL, 2015) shows that hospice care in hospitals is gaining momentum. Many hospitals already have or are developing palliative consultation teams. The IKNL states that many teams are in the early stages of development and not many hospitals have beds which are labelled as palliative care beds. Hospice care is developing but is most often limited to specific instruments and departments (IKNL, 2013). This paper focuses on institutionalised care in hospice care units in different institutions because facility management (FM) can exert control in these situations.

### 3 SPACE DESIGN

The need for an adequate environment that fits the needs of users is in line with the assumption that nature-based organisation of architecture is valuable for human emotional and cognitive functioning (Joye, 2007). Yannick draws from environmental psychology and aesthetics in stating that architectural mimicry of natural settings helps organisations to function better: nature can be tapped in a built context. Different types of settings can trigger different affective states in individuals (e.g., liking or disliking responses). Yannick contends that affective responses stem from a rapid, automatic, and unconscious process by which environments are immediately liked or disliked. Ulrich (Ulrich, 1983) has argued that these affective reactions are rooted in human evolutionary history. In this context, geographer Jay Appleton framed these rapid affective responses in the prospect-refuge theory. This theory supposes that human beings' preferences for certain environments correlate with two environmental qualities: prospect and refuge. The concept of prospect refers to settings that facilitate obtaining information about the environment. A typical example is the standing on a hill, which aids to visually access and inspect the surrounding area. The concept of refuge points to settings that can provide shelter and protection, like a cave which can protect users against predators and weather conditions (Appleton, 1975). This paper affirms the importance of the hospice care unit as a last refuge. This last refuge function of hospice care units results in the need for higher standards in service level and spaces when compared to regular healthcare environments. Is it possible to define the specific services and spaces of hospice care units?

### 4 SERVICE DESIGN

Hospice and health care are complex forms of service management. Current characterizations of service processes distinguish them from manufacturing processes on the basis of intangibility, simultaneity, perishability, heterogeneity, and customer contact (Metters & Marucheck, 2007). The need for research on services has been consistently repeated for more than 30 years. The urgency for rigorous study to improve the design, competitiveness, efficiency, and effectiveness of service delivery has never been greater. This research directs more attention towards hospice care services and thus is 'an onset to answer the clamour by practitioners for new theories in a new initiative known as services science' (Metters & Marucheck, 2007).

From a service package point of view hospice care consists of supporting facilities, facilitating goods, information, and explicit and implicit services (Fitzsimmons & Fitzsimmons, 2008). Consistency, quantity and selection define the facilitating goods. The information should be accurate, timely, and useful. Explicit services are classified by training, comprehensiveness, consistency and availability, which all vary in the different hospice care settings. The implicit services, the last feature of the service package, are distinguished by attitude of service, atmosphere, waiting, status, sense of well-being, privacy, security, and convenience. The primary process is supported by the total service package. Health care organisations have a high degree of interaction and customisation, which leads to the ability of the patient to personally affect the nature of the service being delivered (Fitzsimmons & Fitzsimmons, 2008). Does this process at the different hospice care units in the Netherlands run smoothly or is the service delivery suboptimal?

## 5 THEORETICAL FRAMEWORK

Two questions need further elaboration before exploring methods and results of the field research at hospice practices: 1) How are spaces and services related? 2) Do spaces and services have a positive impact on experiences in hospice settings?

### **Servicescape: relation spaces and services**

Within service management the concept of a ‘servicescape’ (Bitner, 1992) is frequently used to connect spaces and services, as it illustrates the relationships between users and the environment in a service organisation. The framework includes the environmental dimensions of an organisation as well as the responses to it. Bitner integrates spaces with the moment of truth in service settings: interactions between customer and employee (services). The environmental conditions consist of ambiance, space and function, and signs, symbols, and artefacts. The interactions between customer and employee in service settings are not only influenced by their internal responses and behaviours (approach, avoidance) but also by the environmental conditions. A clear implication of her framework is that spaces and services are related since the physical setting can aid or hinder users in a hospice service setting: they are an important part of the service package. Hence, in this current study, the framework of Bitner will be used to classify empirical observations into environmental conditions (ambiance, space function, signs, and artefacts), responses and behaviours with reported positive experiences.

### **Spaces, services and experiences**

An Australian systematic review by Virdun, Luckett, Davidson, and Philips (2015) reported the six most important elements of inpatient end-of-life care, as identified by patients with palliative care needs and their families:

1. Effective communication and shared decision making,
2. Expert care,
3. Respectful and compassionate care,
4. Trust and confidence in clinicians,
5. Financial affairs for families and
6. An adequate environment for care and minimising burden for patients.

An adequate environment for care is one of six important elements of inpatient end-of-life or hospice care. The authors conclude that health care services should reconfigure care systems accordingly and ensure universal access to optimal end-of-life care within hospitals (Virdun et al., 2015). This Australian study stresses the importance of an environment that minimises the burden for patients.

Beng et al. (2015) have found that the well-being of patients is central in hospice settings. Several themes contributed to the well-being, for instance, positive engagement and positive circumstances. Positive engagement occurred when patients were able to participate in routine and leisure activities. Reported activities were housekeeping, exercising, connecting, sharing, and relaxing. Positive circumstances refer to being functional: patients were happy when they were still able to walk around, eat, and cook (Beng et al., 2015). This suggests that hospice care units should resemble domestic settings. Schuurman (1992) defines domesticity as *the materialistic condition for and appearance of domesticity*. In his view domesticity has three meanings: ‘involvement in and care for the interests of the home and household’; ‘the attachment to life at home in the family’ and ‘cosiness’ (Schuurman, 1992).

The mentioned Australian and Malaysian studies seem to indicate that an adequate hospice care environment has a domestic ambiance and elements that facilitate functional and leisure activities. This current study explores the support that spaces and services may have for patients. Moreover, the above observations introduce a new question: Do the spaces and services of Dutch hospice care units offer a domestic environment with functional and leisure facilities that positively influence experiences?

## 6 METHODS

Semi-structured, explorative interviews were conducted with respondents (caregivers and supporting staff). The interviews were planned in four locations: a hospice or almost-home home, in special departments of a nursing and a care home and in a hospital (total of n=5). This breakdown into different palliative settings is based on the subdivision that exists in The Netherlands within the type of facilities for this specific form of care. It is used by Agora, the national platform networks palliative care (Agora, 2015). During this research much effort was put in finding different respondents at different settings to allow for systematic variation. The locations differ in style and ambiance. The hospice looks like a stylish home with warm colours, and spaces for housekeeping, cooking, dining, connecting, sharing, and relaxing. The hospice also provides (bed)rooms for loved ones. The special departments in a nursing home and the care home look like old fashioned institutions where some elements have been added: a couch, radio, picture and a small refrigerator. The facility with hospital admission resembles a clinical hospital with more or less the same added elements as the special departments.

The questions were based on the environmental dimensions of Bitner's servicescape and qualitative indicators found in medical surveys. The first respondent (hospice caregiver) was totally unfamiliar with any qualitative indicators and therefore the questionnaire was simplified (unfamiliar qualitative indicators were taken out) and modelled after the environmental dimensions of the servicescape model and the (first) findings of the literature review. Respondents could indicate the importance of a factor with a Likert scale.

The interview transcripts were imported into the qualitative data analysis software (QDAS) program ATLAS.ti<sup>TM</sup> for thematic analysis to evaluate, search, and query the data in order to discover patterns, visualize, and share the findings (ATLAS.ti, 2015). This program is based on the grounded theory approach of Glaser and Strauss (The discovery of grounded theory: strategies for qualitative research, 1967) and allows interview material to be openly, dimensionally, and selectively coded (Strauss & Corbin, 1998). With ATLAS.ti<sup>TM</sup>, characteristic statements from the interviews were highlighted and the specific wording and phrasing of significance for the analyses were assigned to a code. Some of the codes included in later analyses were thus generated on the basis of interview questions (i.e. of a selective-deductive nature) while other codes were generated on the basis of the data itself (i.e. of an open-inductive nature) (Miles & Huberman, 1984).

The coding process required reading and several times re-reading of both the complete transcripts and the categorised chunks to develop an in depth understanding. The repeated analysis of the codes made it clear that not all data could be covered by the groupings of Bitner. The decision was made to focus on the environmental dimensions (spaces) and services, in line with the theoretical framework.

The coding process was reviewed twice to ensure the accuracy of the code allocation and families, items that were similar or belong to the same concept. During this process it was necessary to relocate several items for the third time as the conceptual families were clarified.

## 7 RESULTS

The transcripts yielded 308 codes divided into 25 groups or families which were classified into 10 clusters (Table i). The bulk of the data refer to spaces: environmental dimensions or supporting facilities that influence the servicescape, mentioned 52% in total. Domesticity, lay-out, and style of decor were reported as the most important environmental elements of the facility, followed by space for loved ones, quiet, furnishings and personal artefacts.

The rest of the data was divided in moderator responses (personal traits and situational factors), internal responses (feelings, beliefs, cognitive and physiological reactions) and behaviour (Table 1). From a service management perspective internal factors that need to be taken into account were the need for control, privacy and flexibility, all customer moderators (16%). The only other result that stands out is that 11% of the behavioural items that were mentioned all refer to the willingness to fulfil wishes (employee approach).

Table 1 Results in Hospice Care Spaces and Services (in percentages of total 308)

Environmental dimensions % (n)	Moderator responses % (n)	Internal responses % (n)	Behavior % (n)	Total
Ambients conditions 6 (20)	Employee 6 (18)	Employee 8 (25)	Employee approach 11 (33)	31 (96)
Space & function 26 (79)	Customer 16 (49)	Customer 4 (13)	Social Interaction 2 (6)	48 (147)
Signs & artefacts 20 (61)			Customer approach 1 (4)	21 (65)
Total 52 (160)	22 (67)	12 (38)	14 (43)	100 (308)

Implicit services that were mentioned under the environmental dimensions were atmosphere, security, and convenience. A behavioural factor mentioned was attitude of service.

All environmental dimensions were deemed most important on the Likert scale. The nursing home and hospital-based respondents rated their care unit with insufficient grades (5 or lower on a 10 point scale) and the hospice scored the highest grades (all grades above 8 were only observed at hospices). The service delivery process at nursing homes and hospitals was not assessed as positive and adequate nor were the units described as domestic environments with sufficient functional and leisure facilities that positively influence experiences.

Finally, a large family of codes (113) did not fit into the Bitner framework nor the service package but all referred to the care systems that enable the care units. They represented organisational aspects influencing the care delivery process: policy, organisation size, work pressure, number and type of caregivers and related issues.

## 8 DISCUSSION AND LIMITATIONS

The goal in this research was to establish to what extent the spaces and services of Dutch hospice care providers match the needs of inpatients and their loved ones. Both the Bitner model and the service package theory do not cover all the data. They do not include organisational aspects that facilitate the service delivery process. The environmental elements

of the Bitner model are useful. They are also part of the Fitzsimmons service package as supporting facilities. Another compelling element of the service package is the implicit services. The impression that is wrongfully given is that if one simply adds the service package to the primary process it will have positive outcomes. However, in the primary process the spaces and services cannot be separated. It's design relies and depends on the total service package and therefore a holistic theoretic framework is needed. Further research may result in finding or creating an all-inclusive model.

One also needs to take into account that the scope of this preliminary research was indicative. The number of respondents, time restrictions and ethical problems of directly approaching patients and relatives have limited the scope of the study.

## 9 CONCLUSION

Patients in the final stages of life need a last refuge and as such require a higher standard when compared to regular healthcare environments. The service delivery process at hospices in this explorative study were optimal while in other hospice care settings miss adequate spaces and services. The organisation of these care systems should be flexible and customised.

### **Space design**

Is it possible to define the specific services and spaces of hospice care units? The supporting facilities and goods need to be consistent with the nature of a safe haven. The facilitating goods should be carefully selected. The architectural design can improve patient's well-being by including domestic facilities for routine and leisure activities. An adequate environment for care is one of six important elements of inpatient end-of-life or hospice care.

The study showed that domesticity, lay out, and style of decor were the most important environmental elements of facility, followed by space for loved ones, quiet, furnishings and personal artefacts. This is in line with the theory that a domestic environment with functional and leisure facilities influence the experiences.

The architectural design should provide non-clinical interior decorating and appropriate spaces. This was consistent with our observations. The hospice care unit seemed to have adequate supporting facilities and consistent and convenient facilitating goods. The spaces for hospice care units also included functional and leisure facilities (for housekeeping, connecting, sharing, and relaxing) in a domestic style and the facility lay out enabled walking, eating and cooking, and furnishings for family and loved ones. Staff reported that most patients appreciate a quiet ambiance and need room for personal artefacts, which was also observed in practice. The only aspect that was not observed were facilities for exercise.

### **Service design**

Does the complex service process at the different hospice care locations in the Netherlands run smoothly or is the service delivery suboptimal? Not much research has been done into this matter. The primary medical process is supported by the total facility service package, e.g. cleaning, catering, and security. Literature made clear that in a service setting the communication is important. Explicit services were found to vary in the different hospice care settings. The implicit services were labelled optimal only in the hospice care facility. In

the other settings it was confirmed that the service process does not run smoothly and the service delivery is suboptimal.

Health care organisations deliver capital intensive services and have a high degree of interaction and customisation. This was also observed in Dutch hospice practices. Reported behaviours with a positive impact included extensive communication. The hospice respondents stated that there was a high degree of interaction and alignment with patient needs which enabled a personal influence on the nature of the hospice care service being delivered. Caregivers tailored to the need for control, privacy, and flexibility and the need to fulfil patient's wishes. Once again, in the other non-hospice settings this was labelled as suboptimal.

### **Relation spaces and services**

The services and spaces are related and they actually do hinder users in a non-hospice service setting. These settings do not offer a domestic environment with functional and leisure facilities. The nursing home and hospital spaces and services received insufficient marks and the hospice scored high grades.

## 10 FUTURE RESEARCH

In the Netherlands the hospice care services are at a stage of *preliminary* integration into mainstream service provision which confirms that there is room for improvement (AWPC, 2014). According to the IKNL palliative care is taking place more and more in hospitals instead of in hospices. Many hospitals have or are developing palliative consultation teams. It is yet unsure how hospitals in general consider to cater for the different needs of patients that require hospice care with spaces and services.

Researchers and facility managers need to focus on improving the complex service delivery process in non-hospice care environments.

Follow up qualitative and quantitative research will be done with patients and/or next-of-kin directly in an effort to corroborate these findings and to eliminate anecdotal findings. The goal is to work towards a new holistic model to enrich service science and at the same time improve the spaces and service delivery process in all Dutch hospice care facilities.

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## **8 CONNECTIVITY AND DIGITALISATION**

### **8.1 THE ROLE OF FM IN PREPARING A BIM STRATEGY AND EMPLOYER'S INFORMATION REQUIREMENTS (EIR) TO ALIGN WITH A CLIENT ASSET MANAGEMENT STRATEGY**

SIMON ASHWORTH, MATTHEW TUCKER AND CARSTEN DRUHMANN

### **8.2 INEFFICIENCY IN FM, CAN BIM HELP??**

GIULIA CARBONARI AND SPYRIDON STRAVORAVDIS

## 8.1 The Role of FM in Preparing a BIM Strategy and Employer's Information Requirements (EIR) to Align with Client Asset Management Strategy

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### ABSTRACT

**Purpose:** To investigate the role of Facility Management (FM) in developing client strategy for Building Information Management (BIM) and Employer's Information Requirements (EIR) in order to define what information is needed, in which format and when in the BIM process.

**Design/methodology/approach:** BIM/FM related scientific literature and UK standards/guidelines were reviewed to establish key documents/terminology facility managers (FMs) should be familiar with when engaging in a BIM project. A workshop questionnaire assessed UK FMs level of understanding of BIM documents/terminology. An *FM-BIM Strategy Concept Model* was subsequently developed to summarise the role of FM in the BIM process.

**Originality:** The research address a significant research gap regarding the FM role in developing a BIM-strategy/EIR at the start of the BIM process aligned with the client's Asset Management (AM) strategy. The concept model outlines the process for co-creation with clients and other whole life stakeholders to prepare a BIM strategy/EIR based on a solid understanding of BIM standards, guidelines and tools. The *FM-BIM Strategy Concept Model* is based on UK standards. However the general principles could be applied to any country with a similar whole life cycle design, build and operate processes and standards.

**Findings:** Most FMs have heard about BIM but few have a deep understanding or practical experience. Guidance is needed focusing specifically on what FMs need to know when developing the client BIM strategy/EIR. These documents can then be used to brief stakeholders in the creation of assets to ensure the right information is handed across for operation.

### Keywords

Facility Management (FM), Building Information Modelling (BIM), Organizational Information Requirements (OIR), Asset Information Requirements (AIR), Employer's Information Requirements (EIR).

## 1 INTRODUCTION

Across the world BIM as a process is rapidly becoming the norm in the design and construction industry. Increasingly Governments are now mandating BIM for the acquisition, design, build and operation of their public assets, buildings and infrastructure projects. According to UK BIM standards the BIM process should start with the client (or FM Representative) carrying out a review of the client's Organizational Information Requirements (OIR) and Asset Information Requirements (AIR) using Plain Language Questions (PLQ) to define what information the client needs from the capital expenditure phase regarding their assets in order to meet the needs of their organization and asset management strategy in the operational expense phase.

Key issues are; FMs practical experience of BIM projects and the time they need to become familiar with the wide range of available standards in order to piece together how to engage in the BIM process. The authors believe the UK Government and industry has done an excellent job in providing industry with a wealth of information/guidance about BIM in terms of standards, guidance and tools. However getting a good overview of the whole BIM process takes time and requires familiarity with a range of different standards and documents which need to be read as a whole in order to make sense of the big picture. In practice many FMs do not have the time to read all the guidance in depth which makes it difficult to piece together how they can best engage. The lead author believes the *FM-BIM Strategy Concept Model* can help give an overview of the role of FM in the BIM process and which documents/terminologies they need to get to grips with.

## 2 LITERATURE REVIEW

In order to deliver best value from assets it is essential to consider value from a whole life perspective. According to Akcamete et al. (2010) the operational cost of assets equate to approximately 60% of the total cost. Early engagement by FM is thus critical in the whole life design RIBA process as “up to 80% of the operation, maintenance and replacement costs of a building can be influenced in the first 20% of the design process” (BSi, 2008, p. 20). Eastman et al. (2011) note that “clients stand to benefit on their construction projects by adopting BIM technologies and workflows to guide their delivery process to higher quality and performance for a whole building life approach”. Research by a CIB team broadly concludes BIM can be considered to add value across all the life stages of an asset (Schultz et al., 2103).

Research by Eadie et al. (2013, p. 150) indicates that “clients followed by facilities managers benefit most from BIM implementation”. However, they also note that BIM adoption in the operation and maintenance (O&M) phase is currently less than 10% and potentially significant unrealised benefits could be achieved if more focus was given to the impact of BIM in the O&M phase (Eadie et al., 2013). This aligns with other research on *literature in information technology in FM* (Ebbesen, 2015) which indicates only 25% of research focuses on technology implementation and use in organisations and BIM is the technology most in focus. However, the research indicates currently CAFM is the key technology actually being used in practice. According to Burcin et al. (2012, p.441) “FM organizations have already started implementing BIM or plan to implement BIM in their processes in the immediate future”. Further research by Adamu et al. (2105) considered co-creation through BIM, concluding a procedural framework for Social BIM could be created and demonstrated using

real-time shared situation awareness amongst remotely located users. Shepard (2015) suggests in order for the BIM process to deliver maximum value to clients there should be a BIM strategy in place which aligns with the client asset management strategy.

Akcamete et al. (2010, p. 8) also highlight a worrying trend; “the opportunities for leveraging Building Information Models (BIMs) for facility operations are compelling and yet utilization of BIMs during building operation and maintenance is falling behind the BIM implementations for design and construction”. Liu & Issa (2103, p. 417) suggest “research on BIM use for facility management is lagging behind the study of BIM in design and construction phases”. There is a strong need for FMs and clients to be involved early in the design phase as this is the most appropriate time to ensure decisions are “based upon accurate and relevant information and data, and their impact on operational needs has to be understood before they are committed to construction work and/or installation” (BSi, 2015, p. 7).

BS 8536 is a critical reference document for UK FMs starting to be involved in a construction project. It uses an evidence-based approach and incorporates the essential elements of the UK guidance/standards: Government Soft Landings (GSL), BS 1192, PAS 1192-2, PAS 1192-3, BS 1192-4 and PAS 1192-5 with the focus of preparing a brief for the design team from the client perspective for BIM level 2 projects. It clearly endorses early FM involvement:

*The appointment of the operator, operations team or facility manager, as appropriate, should be made before any decision is reached on whether or not to proceed with the project. Where this is impractical, the owner should ensure that expertise on asset/facilities management is available so that operational requirements and the expected performance of the asset/facility form an integral part of the decision making* (BSi, 2015, p. 13).

BS 8536 also promotes the need for the client to assess the organisation’s AIR and manage the production of the EIR (BSi, 2015, p. 21) and “extends the commitment on the part of the design and construction team to aftercare post-handover of the asset/facility and its correct, safe, secure and efficient operation in line with environmental, social, security and economic performance targets”. (BSi, 2015, p. 7).

PAS 1192-3 notes the BIM process should start by defining and specifying what information/data is required at handover to the FM operational team to support the client’s asset management system, i.e. in the Asset Information Model (AIM) (BSi, 2014, p. 3). This will ensure the FM team can manage the asset as effectively and efficiently as possible and optimise its performance during operation. Figure 4 in PAS 1192-3 (BSi, 2014, p. ix) depicts a process flow diagram showing the relationship between the various elements of information management. It starts with a review of the client’s OIR in order to generate the AIR, i.e. “the data and information requirements of the organization in relation to their assets” (BSi, 2014, p. 3). The AIR is then used to specify the information requirements for the client’s AIM. The AIR with the use of PLQ helps inform and generate the client’s EIR. The EIR is defined in PAS 1192-2 as a “pre-tender document setting out the information to be delivered, and the standards and processes to be adopted by the supplier” (BSi, 2013, p. 4). The EIR helps the construction contractor understand what information is needed by the client, in what format and when during each stage of the RIBA whole life stages (RIBA, 2013).

The contractor responds to the client EIR with a BIM execution plan (BEP) which explains “how the information modelling aspects of a project will be carried out” (BSi, 2013, p. 3). On contract award the BEP is developed in the contractor’s master information delivery plan

(MIDP) to determine “when project information is to be prepared, by whom and using what protocols and procedures” (BSi, 2013, p. 5). Information is then gradually built up in the contractor’s Project Information Model (PIM) which is the “information model developed during the design and construction phase of the project” (BSi, 2013, p. 5) by the contractor and its supply chain. This is used to deliver information to the client at agreed information exchange points, i.e. “pre-defined stages of a project with defined format and fidelity” (BSi, 2014, p. 4). This then allows and empowers the FM/client to make informed comments on design and decisions about the continuing project.

However, getting a good understanding of what the client’s OIR and AIR actually are is not as easy as it sounds. This is because each organization is unique and in some case there is no AM strategy written down. In practice, few real examples or templates exist that FMs can refer to for guidance. When starting the development of a BIM strategy, FMs need to first review both the client’s existing corporate and AM strategies. The corporate strategy will define the organisation’s vision, mission, aims and objectives. The AM strategy (if one exists) should be aligned with the corporate strategy and might be developed around a standard such as BS ISO 55000 which aims to enable the “organization to achieve its objectives through the effective management of its assets. The application of an asset management system provides assurance that those objectives can be achieved consistently and sustainably over time” (BSi, 2014c, p. v). A good AM system is important to an organisation to help improve informed decision making, financial performance and efficiency and effectiveness of assets, reduce risk, improve services and outputs, demonstrate legal, statutory and regulatory compliance as well as demonstrate social responsibility in terms of reducing emissions, reducing energy use, ensuring ethical business practice and providing better assets to society (BSi, 2014c, p. 2).

By spending more time at the start of the process to fully understand the organisation’s corporate and AM strategy the OIR and AIR will be easier to define. An ideal place for FMs to start is to ensure they read and have a good understanding of BS 8572 (BSi, 2011). It acts as a guide to the procurement of facility-related services. In addition BS 8536 (BSi, 2015) which explains how to prepare FM briefing documents for design and construction projects. Also important is GSL which provides guidance regarding “a way to improve performance of buildings and to meet the requirements of those that use them” (BSRIA, 2013, p. 1). Taking this approach will allow the creation of a BIM strategy that reflects the AM strategy of the client (Shepard, D, 2015).

As well as the aforementioned documents FMs should also familiarise themselves with other key documents when developing the BIM strategy. PAS 1192-5 (BSi, 2015b) addresses security issues which need to be taken into account in the BIM process. BS 1192-4 (BSi, 2014a) addresses the critical issue for most FMs of data population in their Computer Aided Facility Management (CAFM) tools using the COBie information exchange format to transfer the non-graphical data from the BIM models via Excel exports quickly and accurately into the client’s CAFM tool. FMs may also benefit from an understanding of PAS 91 (BSi, 2013a) which is essentially a client pre-qualification-questionnaire to help establish contractors’ BIM competence. The UK CIC suite of documents are also important for use in standard client contracts. They include; the BIM Protocol (CIC, 2013, S. iv) which “identifies the Building Information Models that are required to be produced by members of the Project Team and puts into place specific obligations, liabilities and associated limitations on the use of the models”, the BIM Protocol-Appendix 1 (CIC, 2013a) which makes suggestions for who should be responsible at each stage and what levels of detail is required for information,

whilst Appendix 2 (CIC, 2013b) is a rough framework for generic information requirements. The CIC Scope of Services for Information Management (CIC, 2013c) is a contractual template for outlining the role of the individual who is responsible for Information Management. The CIC Best Practice for Professional Indemnity Insurance when Using Building Information Models (CIC, 2013d) can be used to cover insurance issues in a contract.

Finally FMs should be familiar with the NBS BIM Toolkit and Digital Plan of Works tool (NBS, 2016), the NBS BIM Library (NBS, 2016a) and Uniclass 2015 system (NBS, 2015) which are important as the BIM Library and Uniclass are used to define BIM objects and their parameters which will end up providing the data for the FM CAFM tool, and the BIM Toolkit which is used to manage responsibilities for outputs in BIM projects (which should include the FM role).

### 3 METHODOLOGY

A mixed method approach was adopted using data/findings from the authors' previous research to inform the start of the research. A literature review of relevant academic papers and industry standards, guidelines and publications was carried out to establish current levels of BIM use in the operational phase and to identify the key UK BIM standards/guidelines available to help FMs manage and be proactively involved with BIM projects.

A questionnaire was then designed based on the initial research for use at a BSRIA "FM and BIM workshop" in London on 5.2.2016. The purpose of the workshop was to assess FM practitioners (from across various industry sectors) knowledge of the BIM process and understand perceptions of how BIM might be used by, and benefit the FM industry. Six research questions (in a UK context) were investigated: a) What is the current level of use of BIM by FM?, b) When will BIM impact on FM in the future?, c) What is the level of understanding by FMs of the suite of BIM Standards and guidelines?, d) What is the level of understanding by FMs of specific BIM terminology orientated towards FM?, e) What are the FM perceived benefits of BIM? , and f) What do FMs feel are possible concerns and barriers to BIM use and adoption in the FM industry? The literature research and questionnaire findings were then used to develop the *FM-BIM Strategy Concept Model* as part of one of the lead author's ongoing PhD work.

### 4 FINDINGS

33 members of the workshop completed the questionnaire. Respondents were asked, if their company was currently using BIM; 69% said their company was and 31% not. Regarding if their company had a BIM strategy; 67 % reported their company had one and 33% said no. They were also asked, if they were using BIM strategy did it currently align with the company's asset management strategy. 59% said it did align and 41% said it did not. When asked, if they expected BIM to impact on the FM industry and their job in the future, 100% of the respondents answered yes. With respect to the timescale for BIM to impact on FM; 53% felt that BIM will have a significant impact on FM in 5 years, 21% in 2 years, 15% in 1 year, 11% thought longer than 5 years and no one answered BIM would have no impact. 94% felt that BIM would be beneficial to FM in the future whilst 6% were unsure. When asked, if BIM would offer a competitive advantage to companies adopting it (over those that don't),

88% agreed and 12% were not sure. The level of familiarity and knowledge of key standards needed in the BIM process are shown in Table 1. Note: Shortened titles are used in the table with full titles found in the Reference list.

Table 3 FM familiarity with BIM standards and guidelines in the UK

<b>Key BIM standards and guidelines for FM</b> n = 33 for all answers	<b>No knowledge</b> %	<b>Heard of but not familiar</b> %	<b>Know fairly well</b> %	<b>Know well</b> %	<b>Know well and use in Practice</b> %
BAS 1192: Collaborative production of information	9.09	54.55	15.15	3.03	18.18
PAS 1192-2: Construction phase of BIM	12.12	42.42	21.21	6.06	18.18
PAS 1192-3: Operational phase of BIM	12.12	39.39	21.21	9.09	18.18
BS 1192-4: COBie use with BIM	12.12	33.33	27.27	9.09	18.18
PAS 1192-5: Security and BIM	15.15	60.61	12.12	3.03	9.09
CIC BIM Protocol	33.33	27.27	30.30	3.03	6.06
CIC Guide: PI Insurance when using BIM Models	48.48	39.39	6.06	6.06	0.00
CIC Scope of Services: Information Management	45.45	33.33	9.09	3.03	9.09
Government/BSRIA: soft landings	9.09	33.33	27.27	18.18	12.12
Digital Plan of Work (dPoW): NBS Tool	21.21	42.42	15.15	15.15	6.06
Uniclass 2015: Classification system	21.21	36.36	18.18	12.12	12.12
BS8536: FM Briefing for construction	18.18	57.58	9.09	3.03	12.12
PAS 55: Asset Management Guidance	21.21	36.36	24.24	6.06	12.12
ISO 55000: Asset Management	18.18	42.42	27.27	6.06	6.06
PAS91: Construction Pre-Qual Questionnaire	27.27	48.48	18.18	6.06	0.00

The level of familiarity with key BIM terms used in the BIM process is shown in Table 2.

Table 4 FM familiarity with key BIM Terminology in the UK

<b>BIM Process “Term / Terminology”</b> n = 33 for all answers	<b>No knowledge</b> %	<b>Heard of but not familiar</b> %	<b>Know fairly well</b> %	<b>Know well</b>	<b>Know well and use in Practice</b> %
Organizational Employers Requirements (OIR)	12.12	39.39	24.24	9.09	15.15
Asset Information Requirements (AIR)	9.09	33.33	27.27	15.15	15.15
Asset Information Requirements (AIR)	6.06	36.36	30.30	9.09	18.18
Plain Language Questions (PLQ)	12.12	39.39	27.27	12.12	9.09
Asset Information Model (AIM)	6.06	36.36	27.27	12.12	18.18
BIM Execution Plan (BEP)	12.12	36.36	30.30	9.09	12.12
Common Data Environment (CDE)	15.15	33.33	21.21	12.12	18.18

Respondents view as to possible benefits to FM in the future are shown in Table 3.

Table 5 Possible benefits of BIM to FM in the UK

<b>benefits of BIM to FM in the future</b>	<b>Agree</b>	<b>Disagree</b>	<b>Don't know</b>
	<b>%</b>	<b>%</b>	<b>%</b>
<b>Note:</b> more than one answer was possible			
Visualization of buildings for FM and Clients and Investors	100.00	0.00	0.00
Improved asset management and maintenance time	93.94	3.03	3.03
Improved space management	87.88	9.09	3.03
Quicker cost estimating and long term life cycle costing	84.85	3.03	12.12
Simulations e.g. energy, fire evacuations etc.	87.88	6.06	6.06
Improving the transition handover between build and operation	90.91	0.00	9.09
Lowering carbon emissions	51.52	15.15	33.33
Lowering insurance costs for buildings	45.45	9.09	51.52
Improving health and safety for FM tasks in operation	78.79	3.03	18.18
Direct data transfer into FM management systems (e.g. CAFM)	93.94	3.03	3.03
Adopting BIM can increase profitability	63.64	3.03	33.33

Personal concerns regarding the use and adoption of BIM are shown in Table 4.

Table 6 Concerns regarding the use and adoption of BIM in the UK

<b>Concerns regarding the use and adoption of BIM</b>	<b>Respondents</b>
	<b>%</b>
<b>Note:</b> more than one answer was possible	
Data Management	63.64
Unknown technology and integration with CAFM tools	48.48
How to include BIM into contracts and legal Issues	42.42
Knowledge regarding BIM standards, guidelines and specifications	39.39
The cost of implementation (resources or time)	33.33
Knowledge about how to set up a BIM strategy (OIR, AIR and EIR etc.)	30.30
Basic knowledge and training about BIM and its usefulness to our organization	24.24

Possible barriers to BIM adoption are shown in Table 5.

Table 7 Possible barriers to BIM adoption in the UK

<b>Possible barriers to BIM adoption</b>	<b>Respondents</b>
	<b>%</b>
<b>Note:</b> more than one answer was possible	
Lack of in-house expertise	51.52
Cost of set up and implementation	45.45
Lack of client demand	36.36
The projects we work on are seen as too small	12.12
BIM is not always relevant to the projects we work on	9.09



## 5 DISCUSSION

With respect to the six research questions investigated (in a UK context):

a) *What is the current level of use of BIM by FM?:* Eadie et al. (2013) report current BIM use in operation low at approximately 10%. However, the survey indicates a 100% expectation that BIM will impact on the industry. The findings indicate a gap between expectation and reality and broadly correspond with previous research by Ashworth (2016). The figures indicating 94% of FMs believe BIM will be beneficial to their industry and 88% believing companies who adopt BIM will have a competitive advantage over those that do not also align with research by Eastman et al. (2008) and Eadie et al. (2015).

b) *When will BIM impact on FM in the future?:* The survey indicates most FMs expect BIM to significantly impact on their industry and their jobs within 5 years.

c) *What is the level of understanding by FMs of the suite of BIM Standards and guidelines?:* It is difficult to draw clear conclusions regarding the level of understanding but in terms of generalisation the research shows the majority of FMs have heard of, but are not familiar with key BIM standards and guidelines, e.g. BS 8536 (57.58%) and PAS 1192-3 (39.39%). This is of concern as these are key documents for FMs involved in any BIM project. FMs that did have a high level of familiarity tend to work in consultancy or managing/technical director roles.

d) *What is the level of understanding by FMs of specific BIM terminology orientated towards FM?:* The majority of respondents had heard of but were not familiar with the key BIM terms asked about. The answers indicated 6-15% had no knowledge of the terms.

e) *What are the FM perceived benefits of BIM?:* The majority of respondents felt BIM would provide benefits to FM; visualising a building being top of the list followed by improved asset management and maintenance time and direct data transfer into FM management systems (e.g. CAFM). However, a significant percentage (51.52%) were not sure if BIM would make any difference to “Lowering insurance costs for buildings” and 33.33% were unsure if BIM can increase profitability and lowering carbon emissions.

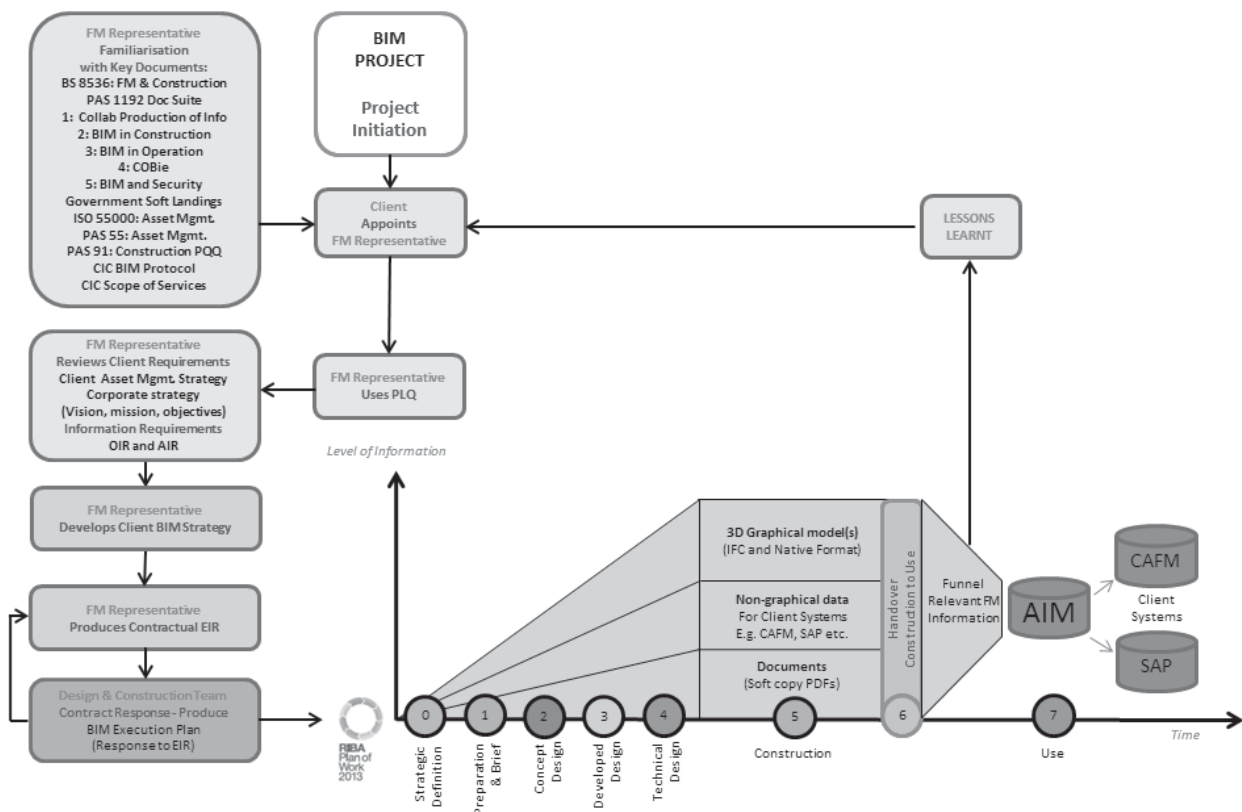
f) *What do FMs feel are possible concerns and barriers to BIM use and adoption in the FM industry?:* The top three concerns were; 1) data management, 2) unknown technology and integration with CAFM tools and 3) how to include BIM into contracts and legal issues.

The survey was limited in the sense that a wider number of participants than 34 might provide more informed results. It is also UK focused but this was intentional as the guidelines/standards used in the development of the conceptual model are from the UK. However the results do not differ significantly from other research by the authors in the Swiss FM industry. The Author also believes that although a model might need to be tailored to a specific country the basic principles could be easily applied to any country with a similar design, build and operate whole life process.

## 6 FM-BIM STRATEGY MODEL

The research findings indicate the need for further guidance for FM. The lead author is investigating this further as part of a PhD. Research on the BIM process/UK standards impact on FM was used as the basis for the development of the *FM-BIM Strategy Conceptual Model* (Figure 1) which attempts to summarize key elements of the role of FM in the BIM process.

Figure 6 FM-BIM Strategy Concept Model (Ashworth, 2016)



The conceptual model is a graphical representation of FMs role in the BIM process. According to UK standards and key documents, e.g. BS 8536, on inception of a BIM project the client should elect a representative to act on their behalf. The authors view is that this should be a facility manager, as it is especially important if a meaningful early FM input is to be achieved. FM is also ideally placed to understand the organizations needs in terms of its culture, corporate strategy, vision, mission, objectives. They are well placed to understand the asset management strategy (made up of organizational and asset information requirements; the OIR and AIR) and discuss these needs with clients through the use of plain language questions.

The results form the basis of putting together a BIM strategy which includes the client employer's information requirements (EIR). This document defines what information is required, in which format and when over the whole life process. The EIR becomes a contractual document, which is then used by the design and construction team to produce their BIM execution plan stating, how they will meet the information needs laid out in the EIR. The whole life (design, build and operate) process then starts (shown in the model based on the stages of the UK RIBA process, but it could apply to any country). As the project develops through the various stages 3 types of information are built up; 1) 3D graphical BIM

models, 2) non-graphical data (for use in client CAFM tools), and 3) reference documents. However FM does not need all the information generated in the project. As such the BIM handover planning process should incorporate a reduction process (represented by the “relevant FM information” funnel). This will ensure that only data relevant to FM is transferred into the Asset Information Model (AIM) using COBie or another selected process. This data can then be used in many ways, e.g. in CAFM or CRM tools such as SAP.

## 7 CONCLUSION

In order for FMs to fully engage and participate in the BIM process they need to be engaged early to help ensure the client’s information requirements are clearly defined. To properly fulfil this role they need to understand in as much depth as possible the relevant standards and guidelines so they can ensure a BIM strategy and EIR is developed which aligns with the client AM strategy. This will ensure the design and construction supply chain can deliver the right information.

At present the level of understanding of the BIM standards, guidelines and terminology needs to be improved through ongoing education and familiarisation. The author aims to follow a recommendation from the research as part of an on-going PhD to develop a *FM-BIM Mobilization Framework* using the concepts outlined in the *FM-BIM Strategy Concept Model* to provide specific advice for FMs regarding how they can best use the existing suite of BIM standards and guidelines to help develop a client focused BIM strategy and EIR at the start of the BIM process and remain engaged as the project moves from design and construction to build and handover for operation.

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## 8.2 Inefficiency in FM, can BIM help?

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### ABSTRACT

**Purpose:** The Digital Built Britain (BIM Level 3) aims to extend BIM into operation, by promoting a life cycle approach for buildings through an integrated digital environment. Nevertheless the main focus of both BIM level 2 and level 3 is mainly on design, construction and hand over, therefore the current understanding and use of BIM for facilities management is still limited. Current literature and research focusing on BIM and FM show only a marginal use of the technology, especially in terms of how BIM can be used beside maintenance. The purpose of this research is to determine which tasks, among the ones performed by facilities managers are perceived to be more inefficient. By identifying the data needed to improve the performance of tasks, the study aims to establish if building models can retain this information and increase the efficiency of FM practices.

**Findings:** This paper presents the results of an online questionnaire survey aimed to ascertain the level of perceived inefficiencies in facilities management. Through the analysis of Industry Foundation Classes (IFC) data models, the research identifies the data set needed to improve inefficiencies and indicates the benefits of implementing BIM within the FM industry.

### Keywords

Facilities Management, Building Information Modelling, Industry Foundation Classes, Inefficiency.

## 1 INTRODUCTION

The last decade has been characterised by an ever increasing adoption of IT in the construction industry (Laakso and Kiviniemi, 2012) that has replaced traditional manual processes and improved the industry's practices (Mitropoulos and Tatum, 2000). However, this adoption can be considered uneven, with rates that vary significantly between companies and stages of the building life cycle. Since the 1980s, when facilities managers had their first encounter with IT, the impact of technology on the industry has been profound and caused many changes in the way the industry developed. Although FM is often considered a cost centre (RICS, 2014), the role of facilities management is to allow employees to work in an efficient and productive environment (May and Williams, 2012) by reducing at the same time the business bottom line. From building control systems to videoconferencing facilities, from Computer Aided Facility Management (CAFM) to Computerized Maintenance Management Systems (CMMS), IT has allowed facilities managers "to do more and accomplish many tasks faster" (May and Williams, 2012). Due to the nature of their work, facilities managers deal with tremendous amount of data in heterogeneous formats, like text, spreadsheet and database. Most of the documents are still paper based (Kassem et al., 2015) and part of the

FM role is to recreate incomplete and inaccurate information (Lucas, 2013). A variety of software tools have enabled facilities managers to collect, store and manage information, increasing the accuracy and allowing cost and trend analysis (May and Williams, 2012) but they are not perceived as an enabler for strategic value (Antoniou and van Harmelen, 2008).

Compared to other fields in the construction industry, FM always had a more pragmatic behaviour regarding the implementing of new technologies to support the business needs. In the technology adoption lifecycle, the FM industry cannot be considered as part of the early adopters, but rather a laggard industry, always monitoring new developments before implementing them. Nowadays the same is happening regarding the implementation of Building Information Modelling; by integrating all the data and information needed for a project, BIM is supporting project teams in working together and improving project outcomes (Hadzaman et al., 2015). While the adopters report great benefits from its implementation, both at company and project level (Muñoz and Arayici, 2015), FMs are showing limited interest in the process and technology, creating a vicious circle that inhibits BIM adoption in FM applications (Kassem et al., 2015).

## 2 EFFICIENCY AND TECHNOLOGY

For long time the construction industry has been challenged to improve its efficiency (Oman and Dulaimi, 2015). In 1998 Sir John Egan together with the Construction Task Force wrote the “Rethinking Construction Report” with the scope of improving the quality and efficiency of UK construction. One of the substantial changes they suggested to enable improvements and achieve a modern construction industry was the use of technology. More recently, as part of the Construction 2025 strategy published in 2013, the UK Government views the construction industry in 2025 as efficient and technologically advanced. Many of the recognised problems within the construction industry can be overcome by adopting new technologies, such as BIM (Oman and Dulaimi, 2015). The same applies for facilities management, and technology is now considered a part of the facility infrastructure (Best et al., 2003). To improve efficiency in FM, technology should have a twofold role, as highlighted by Best et al. (2003):

1. Enable strategic decision, supported by statistically significant information derived from real data;
2. Supports the day-to-day operation by providing relevant and real time data.

BIM is currently used both for strategic decision and as a support tool for day-to-day tasks in numerous construction projects during design and construction. Nevertheless, the literature confirms that BIM in FM is still at an early stage of implementation and acquiring the data necessary to manage a building is one of the major obstacles (Ebbesen, 2015).

## 3 BUILDING INFORMATION MODELLING

“A ‘building information model’ is a digital representation of the building, from which views and data appropriate to various users’ needs can be extracted and analysed to generate information that can be used to make decisions and improve both the process of delivering the building and the entire life-cycle use of the building.” (Barnes, 2013). Although BIM has been utilised since early 2000 (Eadie et al., 2013), only recently in the UK, due to the

Government demand of BIM Level 2 from April 2016 for publicly funded projects, BIM has become more widely utilised. The literature offers now numerous case studies presenting the results of using information modelling for design and construction, compared to the “traditional” CAD. The model availability and the use of BIM seems most appropriate for new buildings, although the major opportunities for improvement comes from utilising information models for the existing building stock. However, the process of implementation of existing buildings’ information models can be complicated. The most commonly used process to create as-built 3D models is Scan-to-BIM, a technology that uses 3D laser scanning (Hajian and Becerik-Gerber, 2010) to collect detailed data of existing building (Bosché et al., 2014). Although the methodology is faster than traditional surveys (Lijing and Zhengpeng, 2008), researchers agree that there are still several limitations such as time (Saidi et al., 2011), cost, scanning range (Fard et al., 2011) and accuracy that reduce to few the percentage of buildings and users that are actually interested in modelling existing buildings. Although the creation and implementation of information models for existing buildings is still a big issue (Volk et al., 2014), the potential benefits of using BIM for FM seem to be significant. The role of the model would be to act as unique source of data that can be used for multiple purposes while managing the building.

Becerik-Gerber et al. (2012) identify the following possible application areas of BIM for FM:

- Locating building components
- Facilitating Real-Time data access
- Visualization and marketing
- Checking Maintainability
- Creating and updating digital assets
- Space management
- Planning and feasibility studies for noncapital construction
- Emergency management
- Controlling and monitoring energy
- Personnel training and development

As part of a three years project, the researcher is developing a new methodology, called RetroBIM framework, envisioned to enable the creation of information models for every typology of existing buildings and addressing the different requirements of breadth and depth of information. The framework is based on an iterative process with increasing level of information details that will allow facilities managers to create a model tailored on the building, its use, the management strategies and the users. This paper presents part of the RetroBIM framework aimed at identifying, through the analysis of Industry Foundation Classes (IFC), the data set needed in order to use BIM as a tool for improving the inefficiencies in FM.

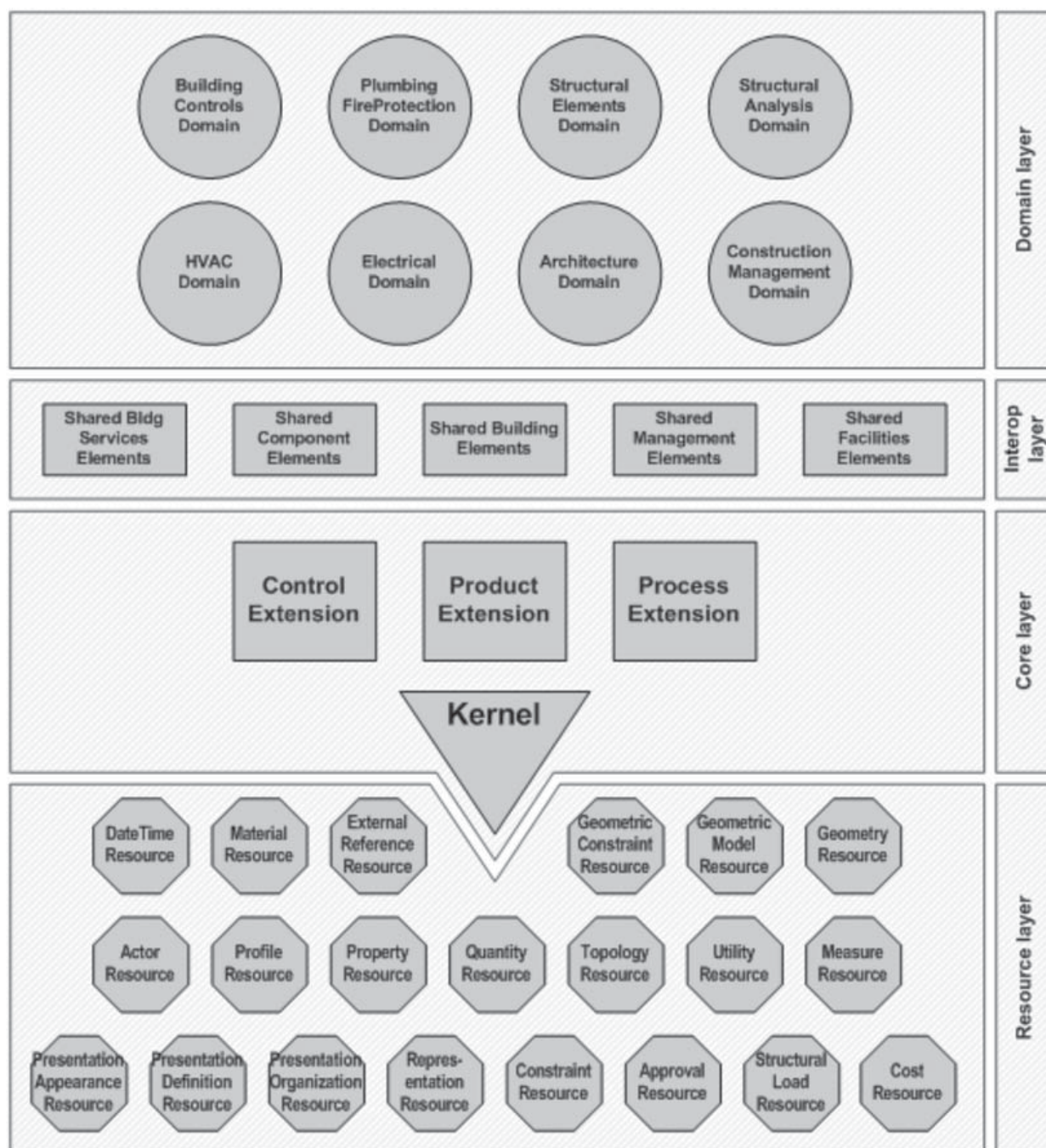
### 3 INDUSTRY FOUNDATION CLASSES (IFC)

The “Industry Foundation Classes” (IFC), developed by buildingSMART, is a conceptual data schema that defines all components of a building (Vanlande et al., 2008) and aims to integrate information required by different stakeholders (Kang and Hong, 2015). The specification includes terms, concepts and data originated within the construction and facility management industry (buildingSMART, n.d.). The IFC4add1, latest version released in July

2015 and used for this paper, can hold interdisciplinary information about the geometry and the attribute data of the different elements in a building information model, and can be used to exchange file format for BIM data (Sun et al., 2015) between different software applications used in AEC (Kang and Hong, 2015). The purpose of IFC is to standardise the sharing and data access in information models while enabling interoperability between heterogeneous software (Mitchell and Schevers, n.d.).

The IFC model represents a series of four conceptual layers, providing an increasingly specialised functionality.

Figure 7 Data schema architecture with conceptual layers (BuildingSmart, n.d.)





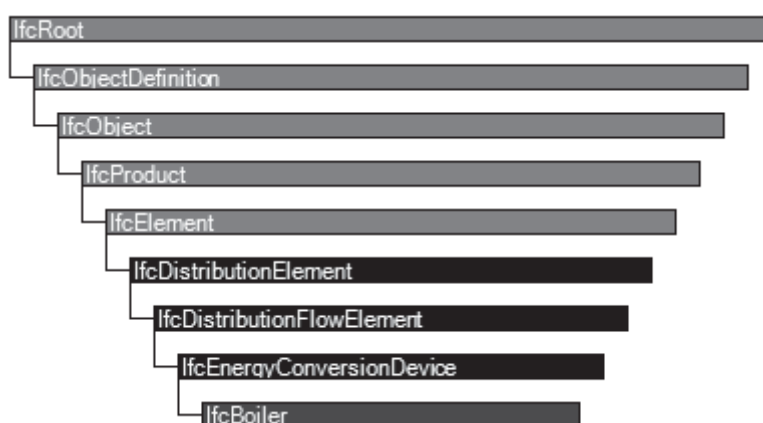
The layers, as described by buildingSmart (n.d.), are:

- Resources layer – the lowest layer includes all individual schemas containing resource definitions
- Core layer – the next layer includes the kernel schema and the core extension schemas, containing the most general entity definitions, all entities defined at the core layer, or above, carry a globally unique id and optionally owner and history information
- Interoperability layer – the next layer includes schemas containing entity definitions that are specific to a general product, process or resource specialization used across several disciplines, those definitions are typically utilized for inter-domain exchange and sharing of construction information
- Domain layer – the highest layer includes schemas containing entity definitions that are specializations of products, processes or resources specific to a certain discipline, those definitions are typically utilized for intra-domain exchange and sharing of information.

The Facilities Management Domain is defined by the `IfcSharedFacilitiesElements` Schema, together with `IfcProcessExtension`, `IfcSharedMgmtElements` and `IfcFacilitiesMgmtDomain`, providing a set of elements that can be used to share information concerning facilities management.

Each building element (or entity, as defined in the IFC) is identified in a unique way through a hierarchical structure that starts from the `IfcRoot`. The first level of specialization from the `IfcRoot` comprises three fundamental entity types: the object definition (`IfcObjectDefinition`), the relationship definition (`IfcRelationship`) and the property definition (`IfcPropertyDefinition`). The object definition includes all physically tangible items, such as wall, beam or covering. The `IfcRelationship` handles the relationships among objects while the property definition generalised all the characteristics of the different objects. This first level of specialization develops further in several subtype tree, as illustrates in Fig. 2 that presents the example of the hierarchical tree definition of a boiler.

Figure 8 `IfcBoiler` (BuildingSmart, n.d.)



The different entities have also sets of specification, not required to be implemented, that can be used to provide specific information related to the item.

For example, every boiler insert in the model can be described by five different groups of information: object typing, property sets for objects, quantity sets, material constituents and post nesting. The object typing defined details such as the boiler type (e.g. water, steam, etc.), quantity sets describes values for the length, area, volume, etc. of the boiler, the material constituents provides details on the material from which the casing is constructed while the port nesting indicates possible connection to other objects such as pipes. The property sets that can be add to the boiler are summarised below (Fig. 3). For details on the single values please refer to the IFC website.

Figure 9 Boiler property sets

Condition	Boiler Type Common	Electrical Device Common	Environmental Impact Indicators
Assessment Date	Reference	Power Factor	Reference
Assessment Condition	Pressure Rating	Number of Poles	Functional Unit Reference
Assessment Description	Heat Transfer Surface Area	Has Protective Earth	Unit
	Water Storage Capacity	IP Code	Expected Service Life
	Is Water Storage Heater	Rated Current	Total Primary Energy Consumption Per Unit
	Nominal Energy Consumption	Rated Voltage	Water Consumption Per Unit
	Nominal Part Load Ratio	Nominal Frequency Range	Hazardous Waste Per Unit
	Water Inlet Temperature Range	Conductor Function	Non Hazardous Water Per Unit
	Outlet Temperature Range	Insulation Standard Class	Climate Change Per Unit
	Status		Atmospheric Acidification Per Unit
	Operating Mode		Renewable Energy Consumption Per Unit
	Energy Source		Non Renewable Energy Consumption Per Unit
			Resource Depletion Per Unit
			Inert Waste per Unit
			Radioactive Waste Per Unit
			Stratospheric Ozone Layer Destruction Per Unit
			Photochemical Ozone Formation Per Unit
			Eutrophication Per Unit
			Life Cycle Phase

Environmental Impact Values	Manufacturer Occurrence	Manufacturer Type Information	Service Life	Warranty
Total Primary Energy Consumption	Acquisition Date	Global Trade Item Number	Mean Time Between Failure	Warranty Identifier
Water Consumption	Bar Code	Article Number	Service Life Duration	Warranty Start Date
Hazardous Waste	Serial Number	Model Reference		Warranty End Date
Non Hazardous Waste	Batch Reference	Model Label		Is Extended Warranty
Climate Change	Assembly Place	Manufacturer	Sound Generation	Warranty Period
Atmospheric Acidification		Production Year		Warranty Content
Renewable Energy Consumption		Assembly Place		Exclusions
Non Renewable Energy Consumption				
Resource Depletion				
Inert Waste				
Radioactive Waste				
Stratospheric Ozone Layer Destruction				
Photochemical Ozone Formation				
Eutrophication				
Lead In Time				
Duration				
Lead Out Time				

Due to its strong link with FM industry and interoperability among AEC/FM software, the research is based on the IFC specification. The researcher used IFC entities, based on the concept that if the information can be exchanged between different software, the information exists in the model.

## 5 METHODOLOGY

In order to identify the efficiencies of the tasks performed by Facilities Managers, a questionnaire survey was created. Based on a literature investigation and the analysis of over 300 job descriptions, the researcher identified 68 different tasks, divided in eleven groups:

property management, service provision, procurement, budget management, client-stakeholders management, security, safety health & environment, contract management, business continuity management, maintenance and project management. The questionnaire included three different sections – respondent' profile, task efficiency and information modelling – but for the purpose of the paper only the results of the first two sections are presented. The questionnaire was available online between October and November 2015 and the participant were invited directly through email in order to assure consistency in the population sample and not bias the results. The participants were asked to rate only the tasks they are usually involved with using a 5 point Likert scale ranging from very inefficient to very efficient. For the purpose of the research, efficiency is defined as the ratio of all the inputs in producing an output and an efficient process aims at minimising the resources required to complete the process. The questionnaire objective is to understand, through the participants' evaluation of the different tasks, the respondents' perception of efficient and inefficiency of the tasks they perform. The tasks identified as most inefficient were then mapped against the IFC to verify if BIM can store useful information to improve the efficiency and the volume of information required.

## 6 RESULTS

A total of one thousand responses were received of which 752 were considered for the final analysis, all based in the UK. Of these, approximately 26% were executive managers (responsible for strategy), 46% senior managers (responsible for a building or a group of buildings), 21% managers (responsible for specific service/s e.g. maintenance) and 7% were operational and other roles. The participants worked for different types of companies: the majority were from national based organisations (41%) and multination organisations (39%). All the 68 tasks provided were rated very inefficient or inefficient by some of the participants, with a percentage that varied between 27% and 3%. The tasks defined as most efficient are the ones regulated by norms or laws, such as safe working practices, risk management, emergency procedures, building certifications and compliance with statutory requirements.

On the contrary, the tasks identified as the most inefficient, as shown in Figure 4, are the ones not regulated by norms.

## 7 ANALYSIS

Some of the tasks identified as having the highest percentage of inefficient, such as asset record and whole life costs, can be improved by using BIM, as discussed previously but some of the other tasks, such as satisfaction survey and market intelligence, might not have a direct link with BIM. If the BIM model is not available, as is the case for the majority of existing buildings, it is helpful to understand the amount of information required to assist facilities managers and which information should be implemented first in the model to improve the inefficiencies of certain tasks.

The mapping process of the tasks against the IFC was limited to the entities that can be implemented alone in a model, without the need of supporting information. The single entities contained in the IFC were considered both for direct use during the performance of

the task and as supporting information for analysis. Figure 5 summarised the results of the mapping and indicates the number of data related to each task.

Figure 10 Inefficiency in FM

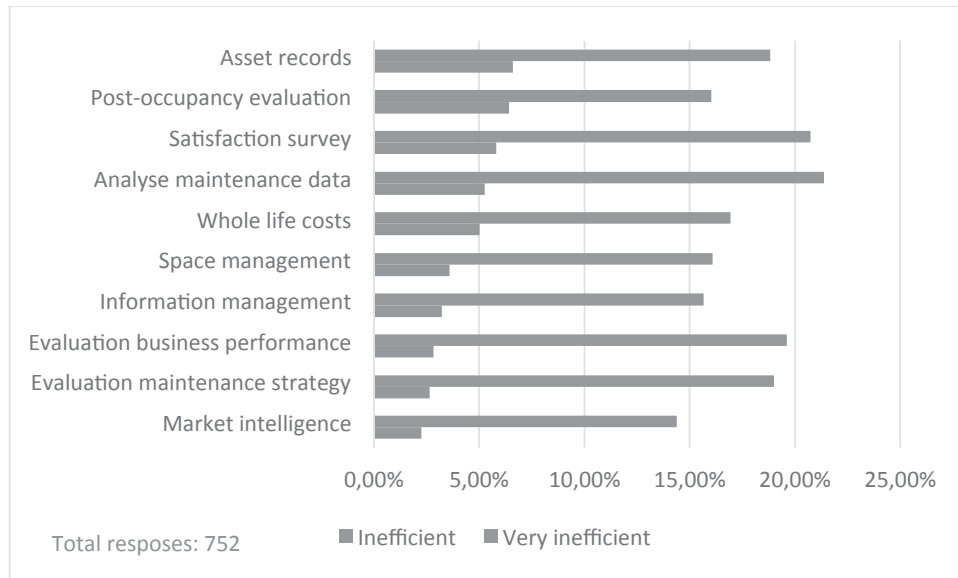
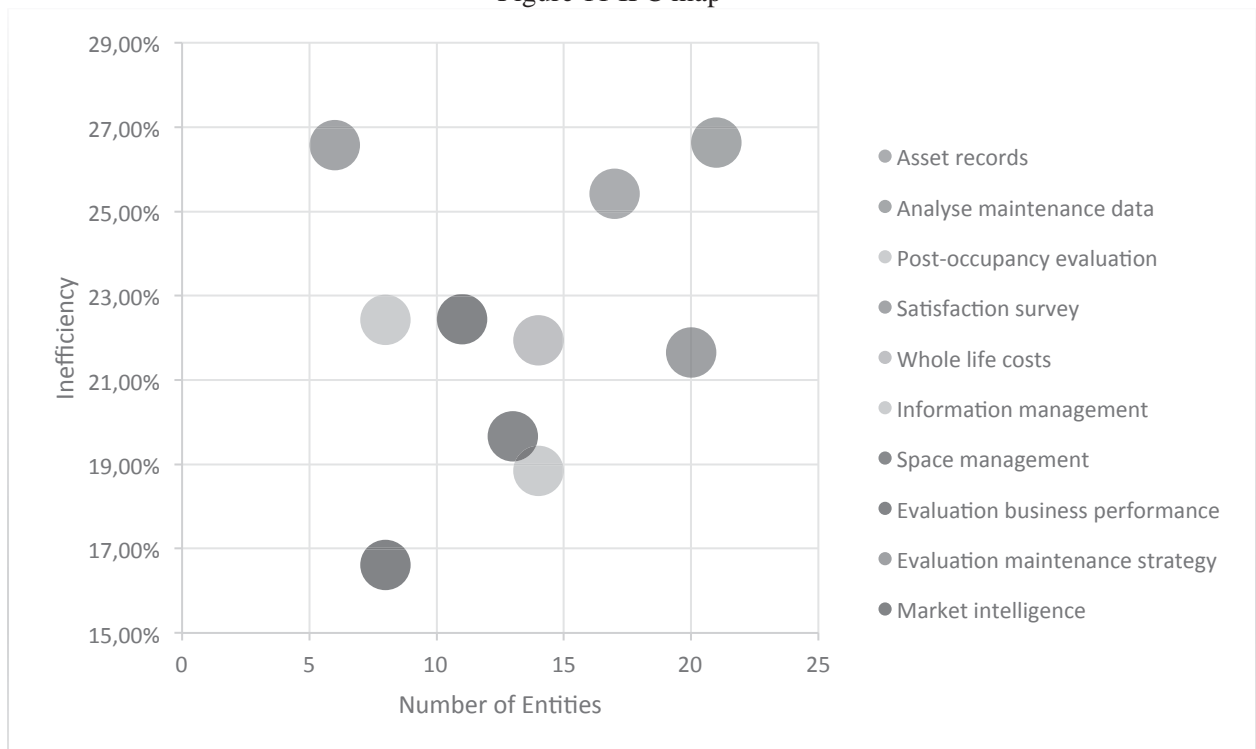
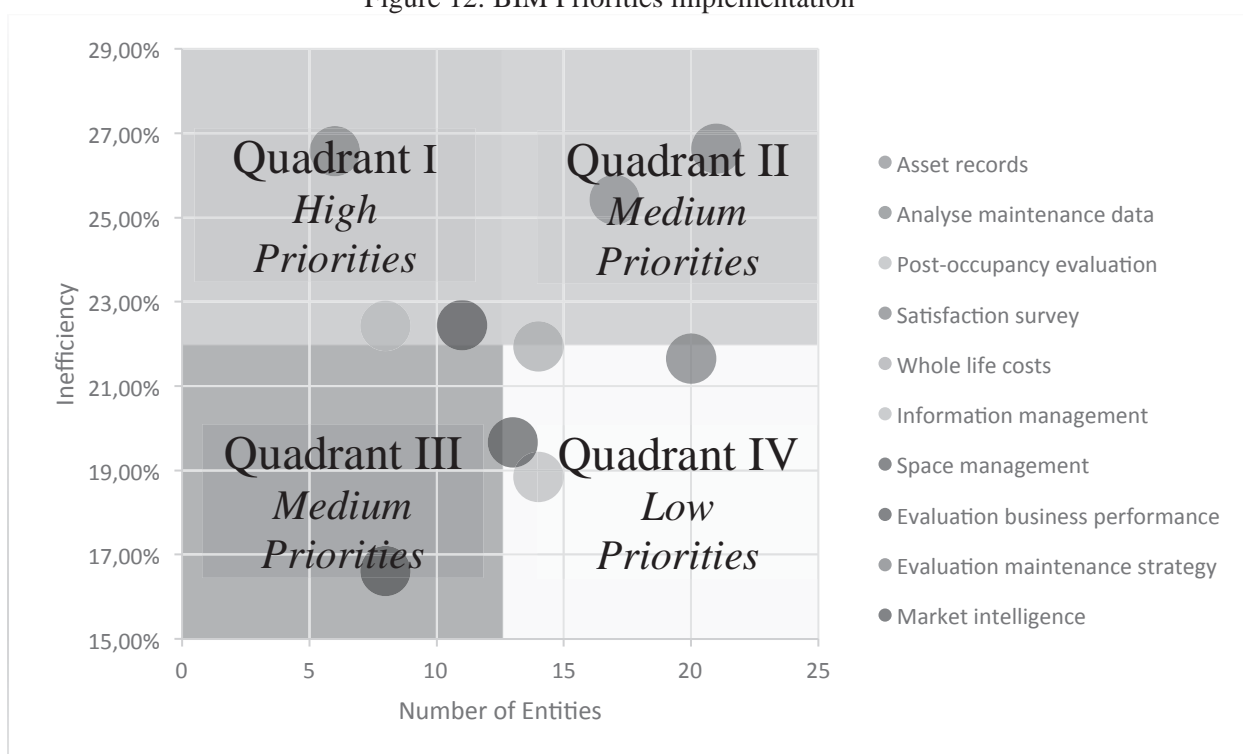


Figure 11 IFC map



By dividing the tasks in four groups (Figure 6) it is possible to identify the BIM Implementation Priorities, in order to improve the efficiency. The tasks located in Quadrant I are defined as high priorities because they scored high value of inefficiency but they required a limited amount of information to be implemented. Quadrant II and III are both medium priorities: although the tasks located in quadrant II are more inefficient than the one in quadrant III, they require a higher volume of information. The decision to implement items from quadrant II and III can be based on the opportunity to maximize the amount of tasks that can be improved by implementing the fewer number of information. In fact some of the task can be automatically covered by implementing information in the model for other tasks. Finally, the tasks in quadrant IV are low priorities because less inefficient than the other tasks and with a high number of information required.

Figure 12: BIM Priorities implementation



The tasks represented in Figure 6 are the most inefficient tasks identified through the questionnaire but the same process can be applied to all the FM tasks. The same methodology can be used by facilities managers to improve tasks' efficiency by implementing information models tailored on their needs. By evaluating the list of tasks used for the questionnaire, the FM can identify the high, medium and low priorities in terms on information that should be implemented within the BIM model.

## 8 CONCLUSION

Facilities Mangers should consider BIM as a tool for knowledge creation and support the improving of working tasks by developing strategic solutions. BIM should not be considered merely as a tool that could make facilities management tasks more efficient, but also an enabler for the interpretation and analysis of the information.

The evaluation criteria chosen for the study are based on the review of common FM tasks and then formulating them as a questionnaire, to capture the views of professionals. Although there are limitations linked with the subjective opinion provided by the respondents, the analysis presents important information for possible improvements of the tasks by implementing and using BIM. The research will continue with an in-depth analysis of each task and how the efficiency can be improved by using BIM.

The results from the questionnaire combined with the IFC map presented in the paper highlights some of the uses of BIM for FM. Even though some of the tasks are not directly linked with BIM and are not identified as possible application areas, the information that can be included in the model can still be used for informed decisions. Tasks such as market intelligence and satisfaction survey require the support of external information that are not included within the model but the analysis can still benefit from the use of the model. The methodology proposed for the identification of the priorities support FM in the implementation of information models based on their needs and current inefficiencies, without using costly and time consuming technologies.

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The 15th EuroFM Research Symposium was organized as part of the European Facilities Management conference EFMC 2016 in Milan Italy, 8-9 June 2016.

The objective of the research symposium is to present original research that contributes to the understanding of the role of FM in organisations and to encourage discussions and the development of new knowledge amongst researchers and FM professionals and educationalists on this important topic.

This year the research symposium was fully integrated with the business conference to support a strong cross-fertilisation between research and practice. Most sessions included a combination of research and business presentations. The main difference between the presentations was that the research presentations are based on research papers, which have been through a rigorous review process as used for earlier EuroFM research symposia, and the papers are published in this scientific publication.

All together 40 abstracts was received and after the review process 22 papers was accepted and are included in this publication.

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