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Preface of the publisher

16. Journal for Facility Management: Science meets Practice

The Facility Services (FS) industry is often underestimated. According to the EU statistics the outsourced FS according to EN15221-4 are the fourth largest industry considering value added and the third largest according to the number of employees. In Europe and the USA almost 10% of all employees work in this industry. It is a diver of the economic growth as it grows faster than most of the other industries. In addition, it cannot be offshored, as buildings have to be serviced where they are. Digitalisation will change the way FS will be provided in the future intensively. As FS are very repetitive most of the tasks can easily be automated. Especially IoT, Big Data, Artificial Intelligence and Machine Learning will change the operation in this area to a large degree. The people working in this industry will still be very important, as they are the face to the customer. Nevertheless, in the background emerging technologies will enable disruptive changes. A current study of the TU Vienna provides deeper insides about technical and economic feasibility. IoT providing accurate data about the condition of the buildings and their equipment are already widely spread. As the devices become self-sufficient (producing the power they need by themselves and connecting to the WIFI easily) and the price of the sensors dropped dramatically, this technology is economic feasible in a lot of use cases. Mobile apps as access-point to the data and enabling process optimisation are also already feasible. Big Data, AI and ML developed rapidly over the last year. The increased provision of SaaS tools supported their immediate use. As the technology is available now, office and residential developers but also service providers are to analyse their optimal use, that they will stay in the driver's seat and not technology companies will take over.

This issue provides you several insights into these topics:

- The Outsourced Facility Service Industry in Austria and its Neighbouring Countries and the Impact of Digitalisation on it
- Internet of Things for Facility Management
- National legislation, standards and recommendations with respect to water risk management and Legionella prevention

The first paper gives an insight in the size of the FS industry. It shows that in most European countries this industry was a driver of the whole economy during the crisis of 2009. It also provides a first insight how digitalisation will change the industry. This part of the paper refers to several studies that estimate the changes on a macroeconomic level, but also at the task level. It points out that mainly the jobs of the first line supervisors will change dramatically, as the equipment will report its status automatically to the technicians and "call" them directly in case it needs service or repair.

The second paper dives deeper into the subject of IoT. The Article shows how this technology will change Facility Management and how IoT can provide value added. Based on an intensive literature research and presenting case studies the paper shows how IoT can increase the efficiency of FM and can help to reduce costs.

The third paper deals with the national legislation, standards and recommendations with respect to water risk management. The paper discusses FM relevant duties. In the first part, the paper lists relevant statutes, standards and documents guiding the design, operation and maintenance to reduce risks. In the second part, they are compared to practice. The papers depicts that there are many differences in the available standards and regulations of the countries. It also stresses the importance of this subject as it can result even in lawsuits. These articles present high-class research results, providing new approaches and scientifically grounded answers to urgent questions within the area of real estate and facility management. The suggested solutions can be used directly by practitioners to solve day-to-day problems. They even suggest new service offerings or ideas for start-ups.

At this point, I want to thank all international researchers, who sent us numerous abstracts and papers for the double blind review. The decline rate kept high with more than 50%. The high quality research handed in enabled us to increase the quality of the IFM journal over the last years. Thanks for your help and we are looking forward for your support. I also want to thank the members of the editorial and the scientific board for their terrific work. They supported me in reviewing first the abstracts and then the full papers and gave a lot of input to the authors.

The high decline rate, the high reputed members of the editorial and the scientific board and the supporting universities ensure that the articles are not only having a high scientifically quality, but also that practitioners can put them into practice easily.

I also want to thank my team, especially Lisa Grasl MA und DI Christine Hax. Without their personal engagement, the journal would not be available in this high quality.

I wish you all the best from Vienna, an enjoyable reading, a lot of input for your research and/or for your daily work. I look forward to a lot of new abstracts and papers for the next call for papers for the 11th IFM congress 2018.

Yours

Alexander Redlein

Head of Editorial Board

To my family Barbara, Caroline Sidonie und Alexander David

Scientific Committee

Herausgeber / Editorial Board

Organisation

Vielen Dank an alle KollegInnen des IFM für die Mithilfe bei der Organisation!

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Science meets Practice I:

Impact of Digitalisation

The Outsourced Facility Service Industry in Austria and its Neighbouring Countries and the Impact of Digitalisation on it

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Abstract

With more than 14 million employees the FS industry is the 3rd largest industry in the EU. Research shows that the outsourced Facility Services industry is growing faster than business economy as a whole (Redlein & Stopajnik 2017) in the EU and in Germany. This article analyses the situation for Austria and its neighbouring countries.

It is also unclear how many employees in FS will be affected by digitalization in Austria. The number of employees is the basis to estimate the impact of digitalisation on the FS industry in Austria. Knowing how many people will be affected by automation helps governments and industry to take actions to prevent mass-unemployment and to make sure companies can find well-trained employees.

The analysis on the development of the FS industry in Austria and its neighbouring countries is based on data from Eurostat. To estimate the impact of digitalisation literature research is conduced, existing studies are analysed and transferred to the FS industry. Results show that in Germany, Austria and in Slovenia the number of employees in FS increased in relation to non-financial business economy. Only in Hungary a constant decrease compared to non-financial business economy since 2009 is visible. An analysis of the impact of digitalization on different tasks, occupations and industries shows, that the FS industry will be more affected than other industries.

Keywords: Digitalisation, Automation, Facility Services, Employment

1. Introduction

Enormous changes due to the ongoing automation and digitalization are foreseen for the labor market. The changes will vary among the different industries. It is not yet clear which industry will be affected to which extend (Bowles 2014). Studies predict different scenarios, but all studies agree that the world of employment is not going to stay the same. So also shifts ins skills are necessary (World Economic Forum 2016). This also accounts for the Facility Service (FS) industry. In order to prepare for future, to make sure that the skills of employees match the demand of the companies it is necessary to analyse how many people will be affected by those changes and how those changes look like.

It is already known that the outsourced Facility Service industry is huge in the EU: The outsourced FS industry counts more than 14 million people in the EU (Redlein & Stopajnik 2017) and the industry is increasing in relation to business-economy in the EU and in Germany. It is not yet clear if the FS industry is also growing in Austria and its neighbouring countries. Therefore, the research questions are:

- How did the outsourced Facility Service Industry develop in Austria and its neighbouring countries in terms of employees?
- How many employees in FS will be affected by digitalisation in Austria?

There are different reasons why the development of the FS industry has not been analysed in many countries and why the impact of digitalisation on this industry is not clear. The main reason is that the FS industry is not presented separately in official reports:

Structural statistics by the European Commission and national statistical institutions in the EU use NACE Rev.2, the statistical classification of economic activities in the European Community for their reports (Statistik Austria 2016). The FS industry is not presented as a separate industry in NACE. In this classification there is only the position "Combined facilities support activities" - in the German NACE-version this position is called "Hausmeisterdienste" meaning janitorial services. This position doesn't even include typical FS such as general interior cleaning services for buildings. The provision of single services e.g. heating can be found in different classes. (European Commission/Eurostat 2008). So the position "Combined facility support services" does not present the total FS industry. As most studies analysing the labor market and digitalisation are based on the classification of NACE, the total FS industry is also not included in those reports.

FS cover many different services. The opinions which services really belong to FS differ. (Thomzik et al. 2010) FS are defined as "support provision to the primary activities of an organization, delivered by an internal or external provider" (British Standards 2007). Starting in 2002 a European Norm for Facility Management (EN 15221) was created to enhance an EU-wide understanding of FS. This norm defines Facility Management and Services (Jensen 2010, Österreichisches Normungsinstitut 2012). The EN 15221-4:2011 by the technical Committee CEN/TC 348 "Facility Management" includes a list of services and activities to be considered FS.

The underlying definition and understanding of Facility Services in this paper is strictly based on this norm. The services that are considered FS according to the EN-15221-4:2011 are matched with the detailed industries of the structural business statistics by the European Commission to estimate the numbers of employees in FS for each year. So a valid measure is provided, that allows to compare the FS industry across countries and to other industries. Based on this approach the development of the FS industry in terms of employees in Austria and its neighbouring countries is analysed. The results consist of the outsourced services for all types of buildings and infrastructure (e.g. business buildings, private housing). The development from 2008 until 2014 is analysed, as long as the data base is sufficient.

2. Method

The method is structured into two parts: First the development of the FS industry in Austria and neighbouring countries is estimated. Then the impact of digitalisation is determined.

Development of the FS industry:

The size of the FS industry for the EU and the four largest national economies in Europe (Germany, United Kingdom, France, Italy) has already been assessed and its development has been presented (Redlein & Stopajnik 2017). The same method is applied for Austria and its neighbouring countries, because this makes results comparable within the whole EU and the method has been elaborated exactly for that purpose.

First the services that are considered FS according to the EN-15221-4:2011 are matched with the detailed industries of NACE Rev.2. Then the relevant industries for FS, namely the relevant industries for the usage and operation of buildings are selected from structural statistics by the European Commission on the most detailed level. (European Commission/Eurostat last modified 2017). The numbers of employees for FS are summed up and presented as a percentage of total non-financial business-economy to make trans-national comparisons possible. The results for the EU and Austria and its neighbouring countries are presented as long as the data base is sufficient.

Structural business statistics use the European-wide statistical classification of economic activities in the European Community (NACE Rev.2) (European Commission/Eurostat 2008). They are published online by the European Commission (European Commission/Eurostat last modified 2017) and comprise the NACE sectors B-N and S95. The European Commission uses the term business economy for those sectors. Agriculture and personal services are not part of it. Structural business statistics present structure, behaviour and performance of economic activities on the most detailed level of the statistical classification. Those statistics provide huge amounts of data and ratios such as turnover, value added at factor cost, employees, investment rate. The data was collected directly from enterprises by National Statistical Institutions. (European Commision/Eurostat last modified 2015). The data has already been checked before for its suitability, plausibility and validity. This was mainly done by calculating ratios such as value added per employee and analysing outliers.

The financial sector (K) is recorded from 2013 onwards. Even from 2013 onwards data is very often missing in different countries. This provokes breaks in time series and destroys reliable comparisons. Therefore, the financial sector is excluded in this analysis. Also the European Commission presents the total of business economy without the financial sector. (European Commission/Eurostat last modified 2018)

Impact of digitalisation:

In a second step an intensive literature research on the probabilities of automation is conducted. Then the most important studies are selected and, if possible, applied on the FS industry: The different industries for which probabilities of automation have been determined are matched with the services that are relevant for Facility Services. This way the probability of digitalisation for FS is estimated.

3. The Development of the FS industry - Results

The following graphics show the numbers of employees in FS and in total non-financial business economy from 2008 to 2014. The selected countries are Austria and its neighbouring countries as long as the data base is sufficient. In Switzerland and Czech Republic more than 8 values for services that are relevant for FS were missing in all years, therefore those two countries are excluded. France was added because it is one of the three biggest economies in the EU and that makes a comparison interesting. It must be noted that the number of employees includes part-time and full-time workers.

The first table shows a comparison of the number of employees in different industries in 2014. Slovenia is excluded because the data base for 2014 was not sufficient yet. The table shows that in the EU, in Germany, Italy, Austria and Hungary the FS industry even takes place 3. The largest industries are Manufacturing and Wholesale and Retail Trade.

	EU28	DE	FR	IT	AT	HU	SK
Manufacturing	29.900.000	7.269.135	3.014.251	3.654.887	620.993	678.247	467.686
Wholesale and retail trade; repair of motor vehicles anc	32.680.601	6.139.638	3.455.212	3.302.311	651.401	551.960	330.951
FS in total	**14.438.876**	**3.353.395**	**1.773.693**	**1.496.379**	**250.065**	**260.416**	**109.964**
Administrative and support service activities	14.195.840	3.175.663	1.975.927	1.122.393	219.660	207.932	81.566
Professional, scientific and technical activities	12.121.100	2.452.208	1.354.292	1.186.817	236.342	221.782	125.398
Construction	12.555.252	2.202.152	1.813.280	1.356.571	288.074	194.532	146.448
Transportation and storage	10.491.057	2.103.986	1.289.522	1.073.322	194.132	226.351	99.329
Accommodation and food service activities	10.807.897	2.085.047	1.027.310	1.295.869	291.003	127.646	56.465
Information and communication	6.315.880	1.180.249	840.487	531.567	108.628	118.359	54.091
Real estate activities	2.841.981	614.919	316.177	287.508	50.207	65.290	27.363
Electricity, gas, steam and air conditioning supply	1.230.152	228.179	190.297	88.476	29.297	24.782	18.104
Water supply; sewerage, waste management and remed	1.480.000	227.396	166.854	183.011	20.314	40.747	21.418
Mining and quarrying	566.936	60.841	21.523	31.222	6.265	4.298	7.137
Repair of computers and personal and household goods	414.682	41.710	83.729	44.641	4.168	10.773	3.775
Total number of employees	**135.601.378**	**27.781.123**	**15.548.861**	**14.158.595**	**2.720.484**	**2.472.699**	**1.439.731**

Table 1: Number of employees in different industries in 2014, own calculation on the base of annual detailed enterprise statistics (European Commission/Eurostat last modified 2017)

The first graphic shows the development of the FS industry in the selected countries from 2008 till 2014. Employees in FS are presented as a percentage of all employees in the non-financial business economy. This relation shows if the FS industry developed as the rest of business economy. Due to missing values the time series of the EU, France and Slovenia are not complete. The dip in the time series in France in 2012 and 2013 is also due to missing values. In France in those two years there are approximately 240.000 employees in FS missing. Therefore, this dip cannot be interpreted. In Slovenia data is not always complete but there we are talking about approximately 20 to 320 employees each year, this doesn't change the result too much. In Slovakia there is data missing in 2008 and in 2009 but also only about 180 employees, this number is also neglectable.

In Germany, Italy, Austria and Slovenia the percentage of employees in FS is increasing compared to the whole business economy year by year. In the EU and in France a slight increase is visible. In Hungary and Slovakia, there is an increase in 2009 but then the percentage is decreasing. In most countries it even looks like there is a little peak in 2009. In 2009 there was the economic crisis, this could be an indication that the FS industry reacted more slowly to the economic crisis than the rest of business economy. It is also possible that during the crisis companies outsourced Facility Services and employees changed from in-house FS departments to external FS providers.

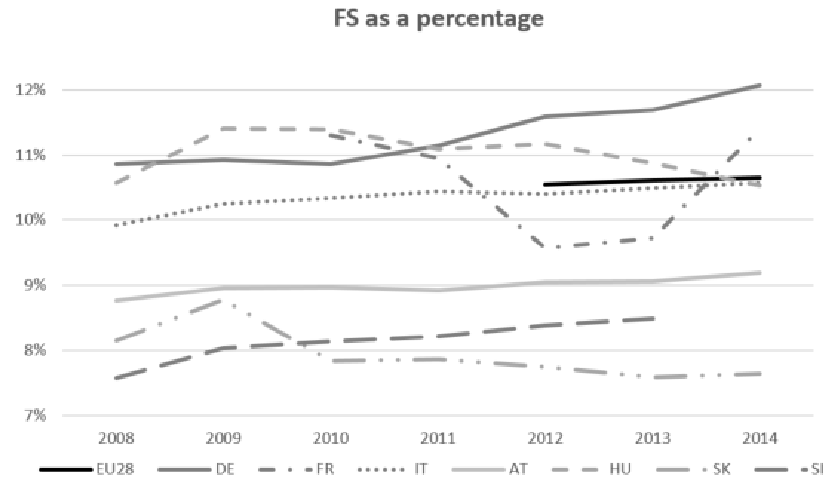

Figure 1: Employees in FS in total as a percentage of employees of NACE B-N, S95, excl. K, own calculation on the base of annual detailed enterprise statistics (European Commission/Eurostat last modified 2017)

To get a deeper insight into the development the total numbers of employees are observed: The next graphic shows the employees in FS in total. In Germany and Austria there are each year more and more people working in the outsourced FS industry. Again in France the dip in the time series is due to missing values and the years 2012 and 2013 cannot be interpreted. However, from 2011 to 2014 a small upwards trend is visible. The only countries that really show decreases are Hungary and Italy. Slovakia has a huge increase from 2009 to 2010 but in 2011 and 2012 the numbers go back a bit. In 2014 also Hungary and Slovakia recover again. Slovenia is quite stable.

This graphic shows that we are talking about huge numbers of employees although the increase in percentages seems minimal. E.g. From 2013 to 2014 in Germany there are 260,000 employees more in FS, in Austria there are 5,000 more, in Slovakia there are 3,000 more and in Italy there are 16,000 people less than in 2013. There is no differentiation between part-time and full-time employees.

Due to huge differences in the sizes of the countries the biggest economies Germany, France and Italy are described by the right Y-axis, and the other countries by the left.

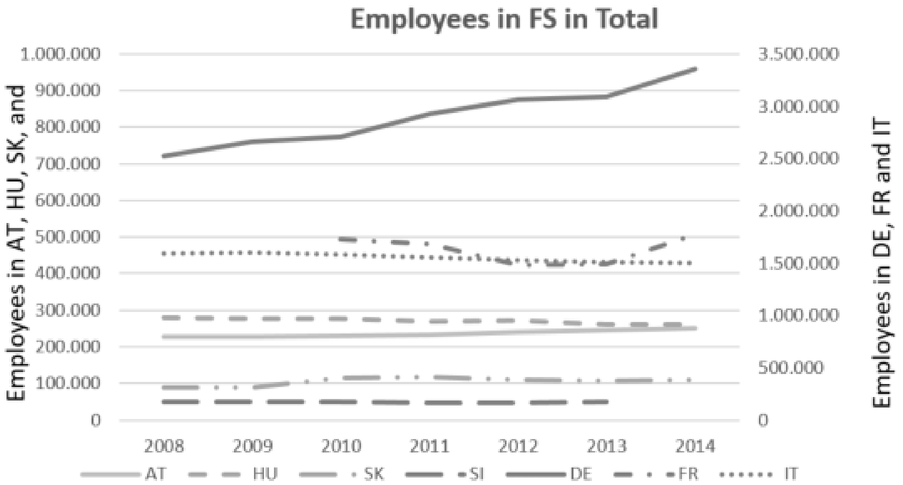

Figure 2: Number of employees, FS in total, own calculation on the base of annual detailed enterprise statistics (European Commission/Eurostat last modified 2017)

A comparison to the total non-financial business completes the picture. The crisis from 2009 shows a decline of the number of employees in all countries except for Germany. Besides that, total business economy shows the same trend as the FS industry: While in Italy and Hungary economy is going down, the other countries show (mostly) positive developments. Only Slovenia is also decreasing very slightly. The reason for the upwards trend in the first graphic in Italy is the fact that in relation to total business economy the FS industry decreased less. 2014 again is the year for recovery except for Italy. Slovakia shows the same huge increase after the economic crisis in 2009. According to the Institute of Labour Economics the drivers of recovery in Slovakia were exports and investment (Fidrmuc et al. 2013).

What is interesting to see is that the development of Italy-France and Austria-Hungary. Total non-financial business economy in Austria and Hungary was approx. in 2008 the same size but Austria keeps growing and Hungary shrinks until 2014. The number of employees in non-financial business economy in France and Italy were approx. the same in 2010 but since then they are drifting apart more and more.

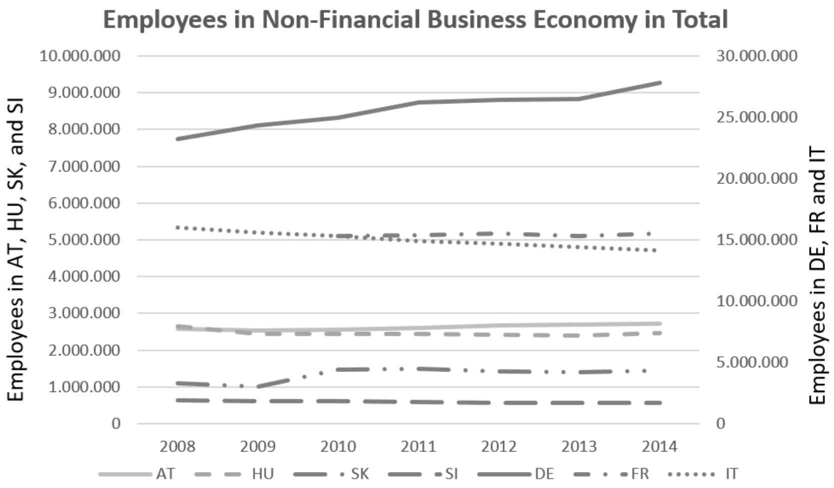

Figure 3: Number of employees, non-financial business economy (NACE B-N, S95, excl. K), own calculation on the base of annual detailed enterprise statistics (European Commission/Eurostat last modified 2017)

4. Impact of Digitalization on FS

Estimations on employment change due to digitalisation are everywhere. The world economic forum published their predictions in „The Future of Jobs" in January 2016. They estimate that until 2020 7,1 million jobs will be lost and 2 million jobs will be created in the countries covered by the report (15 major developed and emerging economies in the world, including France, Italy, Germany and the United Kingdom). They also predict that office and administrative workers will be affected most. The newly created jobs will be found in computer- and mathematical-, architecture- and engineering-related fields. The most important skills in 2020 are complex problem solving, followed by critical thinking and creativity. Emotional intelligence and cognitive flexibility also gain importance. Different tasks will get less important: Coordination with others, people management, quality control and active listening. The report also states that core skills will change. In Italy 48% will change, in France 38% of core skills will change, in Germany 39% and in the UK 28%. (World Economic Forum 2016)

Probably the most famous study is "The future of employment: How susceptible are jobs to computerisation" by Frey and Osborne (2013). It is the basis for most current studies. Frey and Osborne determined the probabilities of computerization for 702 occupations in the US. Those estimations were based on the technological progress in machine learning and mobile robotics. For the US they estimated that across all industries 47% of jobs might be substituted by computers. They also stated that low-wage and low-skills jobs were more threatened than others. An analysis of the probabilities of automation on different occupations suggests that FS activities are at very high risk: Installation, maintenance, repair work has a 50% probability to be automatized, the probability for janitors and cleaners is 66% and the estimation for first-line supervisors of housekeeping and janitorial workers is 94%. (Frey & Osborne 2013)

Bowles transferred this study to the EU (2014). As Frey and Osborne used the Standard Occupational Classification (SOC) for the US, a translation to a system used in the EU, International Standard Classification of Occupations (ISCO) was essential. Bowles estimated that 54% of jobs in the EU are at risk to be automatized. (Bowles 2014)

Brzeski and Burk applied this study also on Germany (2015). They had to make adaptions because of different classification systems and restricted availability of labor market data. They estimated that 59% of jobs are at risk in Germany. Most threatened are administrative activities like secretaries, followed by unskilled workers. (Brzeski & Burk 2015)

More recent studies show completely different numbers. They are still based on the research of Frey and Osborne but they assume that not complete occupations will be automized but only tasks. Those studies also agree that routine-tasks will be affected most. For OECD countries those studies estimate that only 9% of jobs are automatable. In the EU percentages range between 6% and 12% for the different countries in this study. For Austria and Germany 12% of jobs are at risk. Influencing factors that might change the situation have not been included in those studies. Those factors could be scenarios such as new technologies evolve into a mass product and get cheaper, production of this product could lead to more jobs or not (e.g. be off-shored). Another scenario is that employees find niches. (Arntz et al 2016, Bonin et al. 2015)

Nagl et al. based their study on digitalisation in Austria on Bonin et al.'s study which was based on Frey and Osborne. They came to the conclusion that 9% of jobs in Austria were at highest risk. As many studies before did, they also analysed the distribution of the estimated probabilities of automation in the different industries and published the probabilities for jobs at highest risk (more than 70%) and medium risk (30%-70%) per industry. The classification of industries is based on the ISIC System (International Standard Industrial Classification) which can be very well compared to NACE. (Nagl et al. 2017)

Nagl et al. did not use the industry structure on the most detailed level, but still implications for the FS industry can be derived. Our own calculation shows that approx. 40,000 employees in FS in Austria are in the highest risk category in 2014. The jobs of 200,000 employees in FS are at medium risk. This means that in FS 16% of employees have a high-risk-probability of automation compared to 9% in the whole economy. This shows that FS are particularly threatened.

By using smart technologies information on usage and condition of buildings can be analysed. The usage of sensors and robotics increases. Of course FS providers are aware of those changes and prepare. E.g. Granderath from ISS Germany explains that sensors got cheaper in the past years consequently international FS-companies get ready to use this technology. They have to stay up-to-date and provide modern services for customers. They also invest, e.g. in sensoring for buildings. Big-Data together with Sensors have a high potential and could transform FM completely. Companies already use intelligent systems and according to Granderath more employees, who are able to handle those systems, are needed in future. (Granderath & Bilski-Neumann 2016)

The WIFO and BMVIT 2017 developed different scenarios for digitalisation in Austria in future and defined success factors: The development of new products and services is necessary and the education of the population and employees is essential. This means that schools have to teach digital competences, companies need to train their employees and include them in the process of change and SMEs need to be supported to make employee-training possible. Furthermore, it has to be taken into consideration that the human ability of (re)-acting according to a situation and making small adaptions is not there anymore. (Dinges et al. 2017)

5. Conclusion

The outsourced FS industry counts more than 14 million people in the EU and takes place 3 compared to the other industries of non-financial business economy. An analysis of the development shows that overall in the EU, in Germany, in France, in Austria and in Slovenia the number of employees in the FS industry has increased in relation to non-financial business economy. Only in Hungary there has been a slight decrease since 2010. The total numbers of employees in FS have increased in Germany, France and Austria. In general, the FS industry developed even better than the rest of non-financial business-economy. Only the reaction to the economic crisis in 2009 was less strong and partly retarded.

It is not possible to say how large the impact of digitalization on this development has already been or if parts of this evolution have been provoked by digitalisation. However, many different studies on digitalisation predict that jobs will be (partly) lost. There are great variations in estimations. For the EU the predictions range between 6-12% (Arntz et al. 2016) to 54% (Bowles 2014). For Austria the probabilities of automation lie between 9% (Nagl et al. 2017) and 54%. A detailed look at the different industries shows that the FS industry will be affected strongly.

As the WIFO and BMVIT stated, it is absolutely necessary to train employees. First of all this can help prevent mass-unemployment and second well-trained people are needed to create new products and services and companies need skilled employees. To succeed companies and governments have to drive innovation forward and make trainings possible. Employees need openness and willingness for life-long-learning.

Concerning this study, it must be noted that services, which are made in house, are excluded and that most services around buildings and infrastructure cannot be off-shored. Which means that even more employees are working in this field and might be affected by digitalisation. This makes the topic of employee-training even more important.

There are options for further research in this field. Concerning the development of the FS industry the structure of employment in the FS industry could be analysed more detailed and the share of inhouse FS employees would be interesting. Regarding digitalization it would be interesting to analyse the state of automation in the different countries and to do more research on the actual application of different technologies in FS.

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Internet of Things for Facility Management

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Abstract

Forecasts talk of 50 billion devices with Internet connection for the year 2020. Some have influence and benefits for Facility Management. The Internet of Things (IoT) makes buildings smart and helps to manage them better, for example through "predictable maintenance" or the usage-dependent control of the building management system. It is necessary not only to collect data, but also to make them usable intelligently.

The benefits of using it in facility management and the importance of using standards are highlighted in the work. This results in savings potential for costs and resources. Which is shown in some practical examples.

This results in the importance of using IoT as well as potential criticisms that need to be considered.

Keywords: Facility Management, Risk Management, Legionella, Water System

Introduction

Das Internet of Things im Aufschwung

Die Sensoren werden billiger, smarter und finden immer weiteren Einsatz in Gebäuden sowie über Gebäudegrenzen hinaus. So sind die Preise für MEMS (micro-eletromechnical systems sensors) alleine in den Jahren 2010-2015 um bis zu 70% gefallen (Manyika J. et al., 2015). Sowohl ihre Interoperabilität als auch immer neue Methoden der Datenauswertung helfen, Büros, Gebäude bis hin zu ganzen Städten smart zu machen. Erstmals gelingt es dadurch, Technologien und Innovationen so zu vernetzen, dass die heutigen und folgenden technischen Anforderungen auf intelligente und ökologisch-nachhaltige Art und Weise erfüllt werden können (Manyika J. et al., 2015).

Gleichzeitig sinken die Kosten für Prozessoren und die Nutzung von Breitbandtechnologie. Mobile Endgeräte (Smartphones, Tablets, Wearables), die ortsunabhängig für Facility Management genutzt werden. Die Geschwindigkeit der Prozessoren verdoppelt sich dabei aber schon alle 18 Monate (Amiot E., 2015). Neue Protokolle, die eine fast grenzenlose Vernetzung von Geräten bei gleichzeitig höherer Sicherheit sowie eine wachsende Zahl von Methoden, die eine intelligente Auswertung der Daten erst möglich machen, sind bedeutende Technologie-veränderungen, die zum Aufstieg des IoT beitragen. So sind spezielle Methoden zur Konnektivität wie Wi-Fi, Bluetooth, ZigBee, LoRa, SIGFOX, RPL, CoAP oder Li-Fi im stetigen Wachstum. Zwischen 2014 und 2018 wächst die Verbindungs-Geschwindigkeit um den Faktor 4 (Amiot E., 2015).

Durch das IoT wird die reale Welt mit dem Internet vernetzt. Gartner spricht in ihrem Research Paper zu den Top 10 Technologietrends vom »Digital Mesh«, dem Netz, das die virtuelle und die reale Welt miteinander verknüpft (Cearley at al. 2016). Gegenstände werden befähigt, Informationen auszutauschen, miteinander zu kommunizieren.

Nicht immer macht das auch Sinn, bei der vernetzten Toilette, der funkenden Zahn- oder Haarbürste erschließen sich am ehesten Vorteile für die Hersteller oder sie sind wohl Tests, wie weit man mit Vernetzung gehen kann (Hiptmayr, C. 2017). Zum Teil gibt es auch Tendenzen, die gesetzliche Regelungen für Vernetzung vorsehen. Als Beispiel kann die ab 31.3.2018 geltende Verpflichtung zum Einbau von eCall, einem automatischen Notrufsystem genannt werden (Beschluss 585/2014 des Europäischen Parlaments und des Rates). Diese können bei

Ausdehnung der Nutzung zum Beispiel zu neuen Versicherungsmodellen wie fahrleistungs- oder fahrverhaltens-abhängigem »Pay as you drive« oder »Pay how you drive«.

Wenn es um die Steuerung von Gebäuden geht, so liegt der Nutzen jedoch rasch auf der Hand:

Auswirkungen auf das Facility Management

Die zunehmende Komplexität der Gebäude, steigende Kosten, dichtere Besiedlung und höherer Turnaround bringen Facility Manager immer mehr unter Druck, ihre Gebäude effizienter zu verwalten als bisher. Dazu kommen kürzere Bearbeitungszyklen für Wartungs- und Instandhaltungsaufgaben und die Anforderung, Informationen jederzeit und von überall für das Tagesgeschäft und für strategische Entscheidungen auf Knopfdruck verfügbar zu haben. Ein Netzwerk von Sensoren und hochkomplexen Softwarelösungen hilft dabei. Dabei ist besonders wichtig, einerseits Daten verfügbar zu haben und daraus auch die richtigen Schlüsse zu ziehen. Dies ist bei weitem noch nicht überall gegeben. So gaben in einer Befragung 2013 noch 57% der Unternehmen an, ihre Bestands- und Bewegungsdaten schriftlich zu dokumentieren, 17% gar keine digitalisierte Erfassung zu nutzen und weniger als 5% überhaupt mit RFID oder ähnlicher Technologie zu arbeiten (Schuh & Deindl, 2013).

Heute ist jedoch die Gebäudeautomation bereits ein unverzichtbarer Teil intelligenter Gebäude. Heizungs- und Lüftungssysteme werden automatisch geregelt, Aufzüge und Rolltreppen nutzungsabhängig gesteuert, Alarmsysteme und Energieverbraucher permanent überwacht. Die Technologien gehen dabei von einfachen Barcodes über RFIDs zu Beacons, die in zeitnahe Informationen liefern (z.B. Mukati & Mukati, 2016).

Das IoT geht aber noch weiter: Liefert eine Anlage ihre Zustandsdaten online, so kann auch die Wartung danach geplant werden (Coster & Liu 2015). Sensoren erlauben es, dass Besprechungszimmer auf Basis ihrer Belegung beleuchtet, gelüftet und beheizt werden. Statt Sanitärräumen regelmäßig zu reinigen, können Wasserverbrauch und Raumnutzung den Reinigungsbedarf steuern (Spain, 2016). Auch externe Parameter wie Wind und Wetter können in die FM-Planung einbezogen werden (Jaspers, 2017. Schuster et al. 2017).

Voraussetzung dafür ist eine wohldurchdachte Planung des Einsatzes von Sensoren und Aktoren (z.B. Lauzi & Jörg, 2017). Die Daten, die im ersten Schritt überwacht werden, müssen intelligent ausgewertet und genutzt werden. Sowohl die Einsatzplanung des IoT für Facility

Management als auch die sinnvolle und effektive Nutzung der Daten sind Voraussetzung für den erfolgreichen Einsatz (Markowitz, D. 2016). Und das macht das IoT nicht von ganz alleine. Es liefert lediglich die Möglichkeiten dazu (Emonts-Holley, 2017).

Wozu das Ganze?

Der Einsatz des IoT ist natürlich mit anfänglichen Investitionen verbunden. Die Frage nach dem Nutzen drängt sich daher sofort auf. Kevin Ashton, der Gründer des Begriffs ging noch etwas utopisch davon aus, dass durch neue Technologie Computer dazulernen und mit ihrer realen Umwelt interagieren sollen. Zum Teil sind seine Visionen bereits Realität geworden.

Zumeist geht es dabei primär um finanzielle Aspekte. Wie kann man durch effizientere Nutzung der Dinge Kosten sparen? Ein zentrales Hauptaugenmerk im Facility Management.

So kann etwa Energie in verschiedensten Szenarien effizienter eingesetzt werden (Ang et al., 2017, Brundu, F.G. et al. 2017) (Fallbeispiel 2). Nur über konstante Energiedatenerfassung und die Möglichkeit einer zeitnahen Auswertung von Einsparungen durch den Einsatz intelligenter Steuerungen und energiesparender Verbraucher wird es möglich, Kosteneinsparungen über den gesamten Lebenszyklus von Gebäuden – beginnend bei der Planung, etwa mit BIM (Building Information Modeling) – zu lukrieren (Brad & Murar 2014, Nguyen 2016). Neben der direkten Einsparung ermöglichen Benutzeroberflächen, die die Messergebnisse der Sensoren in Echtzeit darstellen, bessere Kontrolle über den Energieverbrauch (Karlgen et al., 2008).

Ständige Überwachung der Daten und rasche Reaktion helfen, Energie oder bei der Wartung Kosten durch Optimierung des Ressourceneinsatzes einzusparen. Studien gehen von Einsparungen von 20-30% aus (Roth et al., 2005, King & Perry, 2017).

Dabei ist es unerlässlich im Auge zu behalten, dass die Kosten für die Implementierung von IoT-Anwendungen ebenfalls in die Berechnung der tatsächlichen Einsparungen aufgenommen werden. Vor der Implementierung einer IoT-basierten Lösung sollten in jedem Fall die Investitionskosten in die Amortisationsrechnung vollständig einbezogen werden. Erst dadurch ist es möglich, die Effizienzsteigerung gesamtmonetär zu beurteilen (King & Perry, 2017).

Im Falle der Wartung können die absoluten Kosten für die Wartungseinsätze gesenkt werden, zusätzliche Kosten durch sinkende Effizienz oder Ausfälle alternder Anlagen vermieden und die nicht zu vernachlässigenden Personalkosten reduziert werden (Yoshikawa et a. 2015).

Aber auch die immer drängendere Thematik der Nachhaltigkeit ist ein Treiber des IoT Einsatzes. Darauf sind wohl die öffentlichen Initiativen zurückzuführen, die durch den Druck zu effizienterem Ressourceneinsatz zur Sparsamkeit beitragen sollen. So wird etwa in Dubai die Umsetzung einer ganzen „Smart City“ geplant.

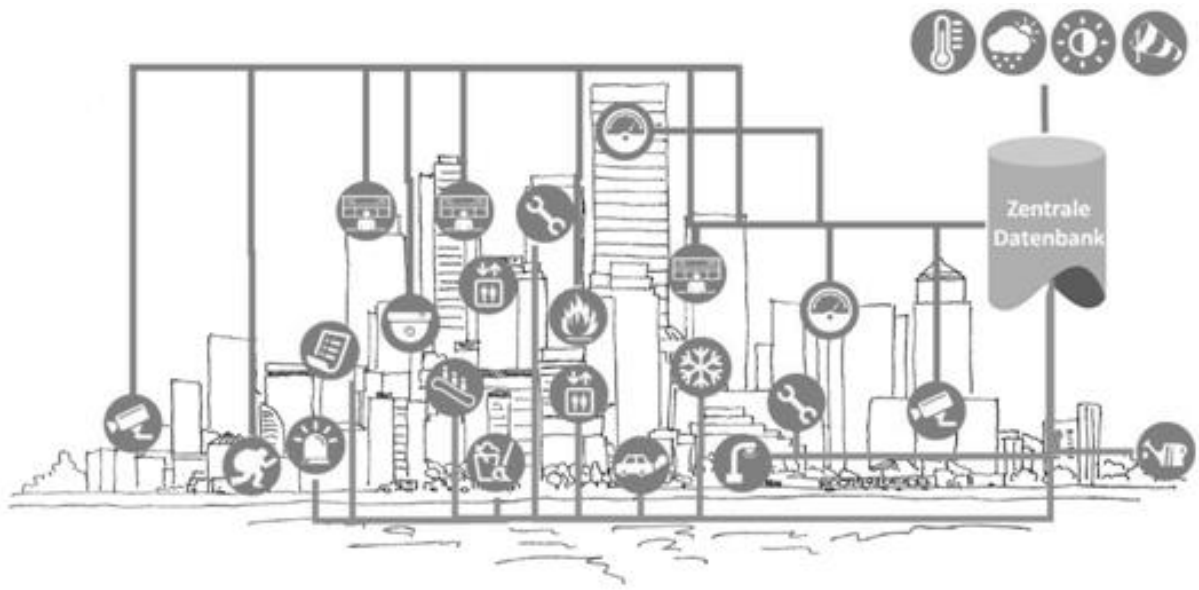


Abb. 1: Schema der Dubai Smart City (Eigene Darstellung: Martin Tscherkassky-Aleksić / fm-solutions)

Hier kommen auch Faktoren zum Tragen, die sich nicht nur auf die Einsparung von Kosten reduzieren läßt. Die Senkung der Nutzung nicht-erneuerbarer Ressourcen gewinnt immer mehr an Wichtigkeit. Dies hat einerseits mit der knapper werdenden Verfügbarkeit zu tun aber auch mit der steigenden Bedeutung eines Imagegewinns von Firmen, Organisationen, Kommunen oder gar Staaten durch die Umweltschonung. Dubai etwa hat sich als Ziel bis zur Weltexpo und seinem seinem 50jährigen Jubiläum 2020 als Ziel gesetzt, durch die Gestaltung einer durchgehenden Smart City sein Image als Ölstaat zum Vorreiter in neuen und ressourcen-schonenden Technologien zu wandeln.

Ein Beispiel für eine bereits realisierte Smart City ist Santander im Norden Spaniens (http://www.smartsantander.eu). 12.000 Sensoren überwachen unter anderem Straßen-beleuchtung, stehenden und fließenden Verkehr und Bewässerung öffentlicher Grünflächen.

Die Daten werden zentral gespeichert, für die Verwaltung genutzt, aber auch den BewohnerInnen zur Verfügung gestellt. Zum Suchen eines Parkplatzes oder der nächsten Busverbindung oder zum Einmelden von Schäden über die eigene „Puls oft he City“ Smartphone-App. In die Entwicklung in Santander sind Technologiepartner und die Verwaltung, aber auch in hohem Maße die Bevölkerung eingebunden. Dadurch wird gewährleistet, dass neben den technischen Aspekten auch die Aspekte der Akzeptanz und der Sicherheit berücksichtigt werden (Diaz-Diaz, R. et al. 2017).

Dubai und Singapur sind zwei Metropolen, in denen die Diskussionen für die Realisierung einer Smart City weit gediehen sind. Es ist bemerkenswert, dass in beiden Städten das Thema des Ressourcenmanagements im Vordergrund steht. In anderen Städten, wie zum Beispiel Wien oder Paris gibt es ebenfalls Diskussionen, durch den Einsatz von IoT-Lösungen die Kommunen für die Herausforderungen des 21. Jahrhunderts bereit zu machen. Jedoch ist hier noch ein weiter Weg bis zur tatsächlichen Umsetzung zu gehen. In Österreich wurde der Einsatz von IoT in der »Digital Roadmap« zu einem wesentlichen Element Leitprinzip erklärt (BKA & BMWFW, 2016).

Wesentlich weiter gediehen sind aber die realisierten Entwicklungen im Bereich der Smart Buildings – also einzelner Gebäude, die für das Facility Management von Bedeutung sind.

Standards

Einsatzszenarien für IoT Systeme im Bereich des Smart Buildings gibt es bereits länger auf dem Markt. Limitierender Faktor war in bisherigen Systemen jedoch oftmals, dass es sich meistens um proprietäre Insellösungen gehandelt hat. Kann die Klimaanlage eines Herstellers über Temperatur-, Luftfeuchtigkeits- oder gar CO_2-Sensoren reguliert werden, so ist dies alleine definitiv noch nicht als „smart“ zu bezeichnen.

Erst durch den Einsatz offener Standards wird es möglich, die Komponenten in Gebäuden so zu vernetzen, dass eine effiziente Nutzung in verschiedensten Bereichen entsteht. Die Nutzung von Protocol Gateways, die GLT-Netzwerkprotokolle wie BACnet^{TM} (Building Automation and Control Network) in IoT-Protokolle wie zum Beispiel AMQP (Advanced Message Queuing Protocol) oder MQTT (Message Queue Telemetry Transport) ist in der Praxis vorerst wichtig, um IoT Szenarien zu realisieren (Abdul-Qawy et al. 2015, Merz et al. 2016).

Immer mehr schaffen es ja inzwischen auch größere Anwendungsszenarien in den Bereich des Möglichen. Diese erfordern aber auf Grund ihrer Komplexität höhere Investitionen und eine reibungsarme Kooperation der Beteiligten. Die Nutzung etablierter Standards hilft hier weiter.

Es ist also nach wie vor wichtig, verschiedene Protokolle und andere Standards zu unterstützen, damit heterogene Architekturen aber vor allem auch Bestandsobjekte miteinander sinnvoll und effizient verbunden werden können.

Fallbeispiele

Im Rahmen zahlreicher CAFM Projekte konnten Erfahrungen zum Umgang mit der Anbindung von technischen Systemen an eine zentrale Datenbank oder auch an verteilte und vernetzte Datenbanken gewonnen werden. Dabei kommt das Thema IoT immer wieder ins Spiel.
Einige Fallbeispiele aus unterschiedlichen Branchen und Gebäudetypologien sollen die Bedeutung des IoT für das Facility Management in verschiedenen Bereichen demonstrieren. Sowohl in Einzelbereichen als auch umfassend. Sowohl in hochtechnologisierten Neubauten als auch in Bestandsobjekten.

Fallbeispiel Serviceunternehmen Erdölindustrie (Dubai)

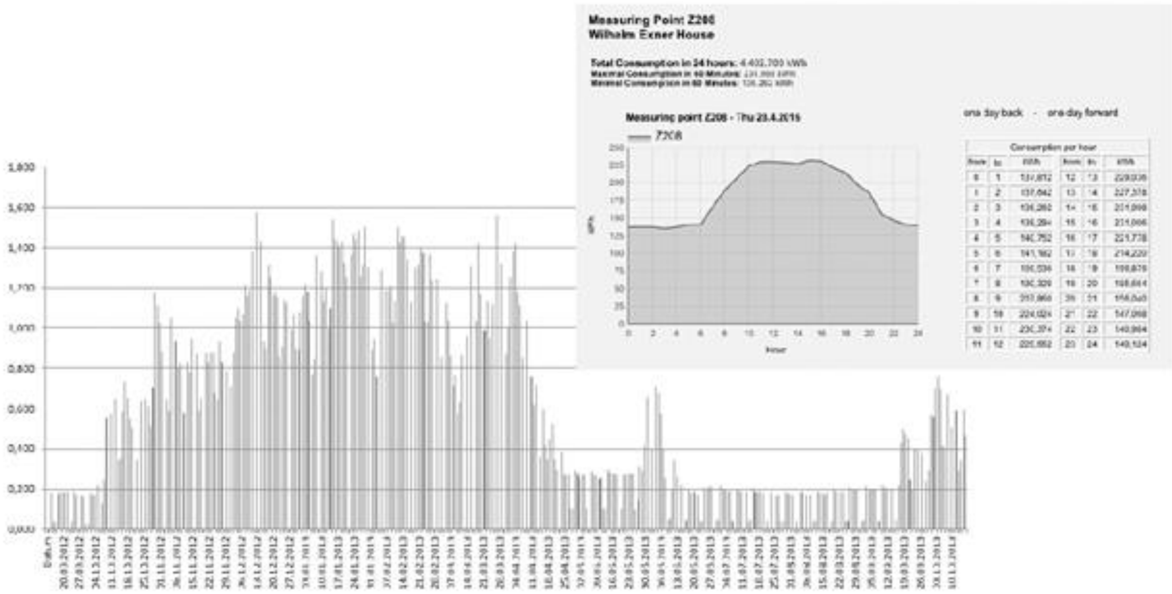
In der Firmenzentrale des Unternehmens in Sharjah (Vereinigte Arabische Emirate) wurde auf Basis einer CAFM Software, die eine Datenbank mit dem schon zuvor bestehenden Gebäudeleittechnik-System via BACnet^{TM}-Schnittstelle verbindet, ein intelligentes System zur Steuerung von Klimaanlagen, Beschattung und Wasserversorgung entwickelt.

Es wird einerseits zum Lastenausgleich und zur Wetter- und insbesonders Temperatur-abhängigen Steuerung, andererseits zur prädiktiven Instandhaltung der entsprechenden Gebäudetechnik eingesetzt.

Durch die Installation von Sensoren/Aktoren und die intelligente Steuerungstechnik konnten Ausfälle der Anlagen vermieden, die Kosten der Instandhaltung und damit verbunden für den Ersatz von Anlagen vermindert werden und gleichzeitig bei den MitarbeiterInnen das Bewusstsein für Einsparungspotenzial erhöht werden.

Fallbeispiel Universität (Wien)

In einem großen Bereich einer Wiener Universität wurde ein System für Energiemonitoring eingerichtet, das es ermöglicht, in Echtzeit Strom- und Wärmeenergieverbrauchsdaten einzusehen und im Bedarfsfall gegen zu steuern. Smarte Zähler liefern laufend Daten an die FM-Datenbank, in der die Verbrauchswerte als Verlaufsgrafiken zur Verfügung stehen. Im Lauf eines Jahres werden aktuell etwa 2 Millionen Messwerte übernommen. Diese Angaben werden für Projekte zur Energieoptimierung (Umrüstung auf LEDs, Nutzungs-abhängige Verbrauchsabsenkungen, Kommunikationskampagnen zur Verbesserung des Nutzer-verhaltens) eingesetzt.



Slika 2: Langzeitverlauf und Tageskurve des Stromverbrauches in einem Universitätsgebäude (Eigene Darstellung)

Der nächste Schritt in diesem Projekt ist die Anbindung des Gebäudeleittechnik-Systems an die CAFM-Software in einigen Laborgebäuden. Durch den Einsatz von Sensoren in den Labors können die Lüftungsanlagen an die Belegung optimiert werden. Wichtig ist dabei inbesonders die Einhaltung der erhöhten Sicherheitsanforderungen im Rahmen von Versuchsanordnungen.

Fallbeispiel Flughafen (Deutschland)

Für einen deutschen Flughafen wurde das Facility Management mit IoT Komponenten im Bereich Wartung und Reinigung angebunden. Bedarfsorientierte Einsatzplanung führte zu einer Einsparung von 20% gegenüber den Kosten vor der Implementierung. 18.500 Aufträge pro Jahr werden aktuell abgewickelt.

Besonderheiten bei diesem Fall sind einerseits die hohen Anforderungen an Sicherheit und Serviceverfügbarkeit und die über eine Anbindung des Facility Management Systems an das AOS (Airport Operation System).

Bei der Wartung konnte der Anlagenausfall durch vorausschauende Wartung beinahe komplett eliminiert werden (-90%). Dadurch ist es gelungen, die Kosten für Neuanschaffungen drastisch zu reduzieren, die durch die Sicherheitsanforderungen komplexen Einsätze zu minimieren und eine für den Betrieb unumgängliche hohe Verfügbarkeit der Systeme zu gewährleisten.

Die Kosten für die Reinigung konnten durch den Einsatz von Sensoren in den Böden sowie zur Frequenzmessungen in den Waschräumen stark gesenkt werden (-30%) bei gleichzeitiger Steigerung der Kundenzufriedenheit. Dies gelang durch eine Umstellung der Intervall basierten Reinigungseinsätze auf bedarfsorientierte Reinigung.

Fallbeispiel Bürogebäude (Taiwan)

Im aktuell zweithöchsten Bürogebäude der Welt, das noch vor dem Einsetzen der Bedeutung des IoT erbaut wurde (Eröffnung 2004) konnten durch nachträglichen Einsatz eines optimiertes HKLS System mit Timer-kontrollierter Entlüftung und eines EMCS (Energy Management and Control System) zur Optimierung von Kühlbedarf und Wasserverbrauch durch Einsatz von Sensoren für Temperatur, Luftfeuchtigkeit und CO_2 signifikante Einsparungen im Betrieb erzielt werden (-25%). Dadurch gelang es sogar, dass Taipei 101 seit 2011 LEED Platin zertifiziert ist in der Kategorie „Betrieb bestehender Gebäude“.

Lernen lernen

Das Internet of Things wird weiter an Bedeutung gewinnen. Speicher werden billiger, die Zahl der Sensoren steigt. Wesentlich ist jedoch, dass nicht nur Daten gesammelt werden, sondern diese auch sinnvoll genutzt werden. Millionen Ablesewerte machen kein Energiemanagementsystem aus. Sie decken zunächst nur den ersten Schritt, das Energieverbrauchs-Monitoring. Erst die Interpretation der Werte und das Ergreifen der notwendigen Schritte führen zu sinnvollen Anwendungen.

Ähnliches gilt auch für den Einsatz im Bereich der Wartung. Ziel ist es, die Wartung und Instandhaltung zeitlich so zu planen, dass es keine Ausfälle gibt, Instandsetzungen minimiert werden, Kosten für Ersatzteile oder den Austausch defekter Anlagen zu reduzieren und damit insgesamt die Performance der Geräte zu steigern.

Derzeit noch als Inseln bestehende Anwendungsbereiche des IoT (Wohnbereich, Fahrzeuge, Infrastruktur und kommerzielle Gebäude) sind gerade dabei zu verschmelzen, was der Transformation des Internet der Dinge immer mehr an Bedeutung geben wird.

Aus dem Hype, den die Einführung des IoT aktuell erfährt, vom selbstbestellenden Kühlschrank bis zum lernenden Reinigungsroboter, werden wohl in absehbarer Zeit immer mehr brauchbare Mainstream-Anwendungen werden. Das „Ökosystem" aus Sensoren, Gebäudetechnik-Systemen und immer komplexeren Analysemethoden ist jedenfalls im Entstehen. Man sollte das Ziel, den Gebäudebetrieb effizienter zu machen, nicht aus den Augen verlieren. Jede Entscheidung sollte auf ihre Sinnhaftigkeit und Einsparungspotenzial versus Aufwand kritisch untersucht werden.

Die Bedeutung der Hardware wird gegenüber dem Service der Software zur Entscheidungsfindung abnehmen. Sie wird vorausgesetzt werden. Was den Nutzern angeboten werden muss ist vielmehr das Know how, wie aus der Unmenge an Daten Nutzen gezogen werden kann.

Das IoT wird auch nicht allzu sehr selbst lernen – auch wenn der Bereich der intelligenten und lernfähigen Systeme im Steigen begriffen ist. Es kann aber jedenfalls dazu beitragen, dass die Facility Manager und die Gebäudenutzer dazu lernen. Sensoren können Daten liefern, Aktoren können sich auf die Effizienz positiv auswirken. Daten alleine und deren Auswertung ersetzen nicht die Notwendigkeit, auf das Benutzerverhalten einzuwirken und Probleme zu vernachlässigen. Nur durch diesen Lerneffekt können Ressourcen und damit auch Kosten eingespart werden.

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Science meets Practice II:

Risk Management in Practice

National legislation, standards and recommendations with respect to water risk management and Legionella prevention

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Abstract

In this article, risk management and Legionella prevention is discussed from a practice-oriented point of view, which can be assigned to Facility Management in healthcare (FM in HC). Water systems in facilities contaminated with Legionella is a serious issue of hygienic risk which needs to be addressed and not only of economic threat or image loss to a facility. Managers, such as operators or any other duty holders, can be responsible for building-associated facilities (water systems). This paper collects, extracts and discusses FM-relevant duties. It emphasizes important issues with relevance to risk management. First, a tabulated collection of statutes, standards and other documents guiding for design, operation and maintenance to minimise risks caused by Legionella in building (drinking) water systems is presented. This is followed by well-discussed situations reported from practice in the national context of Germany. The topic of Legionella prevention of water systems is not limited to a national context. Differences exist according to legislation and to explanations of generally accepted engineering standards, i.e. norms, recommendations, or technical and guidance documents. For the people responsible, who may be assigned to the professional field of FM, there are undeniably aspects of water hygiene that could enforce criminal and civil law obligations. The results of this context-specific paper may provide support in detecting deficiencies and thus avoid potential lawsuits.

Keywords: Facility Management, Risk Management, Legionella, Water System

1. Introduction

The scope of Legionella in water systems in HC settings provides a clear link to FM and prevention, which can be regarded as part of an organisation's risk management (Freije, 2005; Gamage et al., 2016; Hübner et al., 2011; Spagnolo et al., 2013; Völker et al., 2016). Legionellae are causative agents of Legionnaires' disease (LD), an atypical form of pneumonia and potentially fatal (Fields et al., 2002). Apart from the challenges of historically grown building structures and changing infrastructure, hygiene-related issues are perceived and to be discussed from different perspectives (Borella et al., 2004; Hock & Martin, 2013; Kool et al., 1999; Reis et al., 2015; van Heijnsbergen et al., 2015).

Water systems in facilities contaminated with Legionella is a serious issue of hygienic risk which needs to be addressed and not only of economic threat or image loss to a facility (BBC, 2013). Managers, such as operators or any other duty holders, can be responsible for building-associated facilities as for example drinking water systems (Hoebe & Kool, 2000). Not only classic microbiological topics play a role in the prevention process, but also activities in the building which are specific to the building and which are people-related (Freije, 2004). FM is built on decision-making. The maxim of the operating manager should be to identify and align "protective goals" of their own organization according to given regulations and the current state of the art (Hübner et al., 2011), which goes beyond or supplements statutory liabilities.

The topic of Legionella prevention of water systems is not limited to a national context. For the people responsible, who may be assigned to the professional field of FM, there are undeniably aspects of water hygiene that could enforce criminal and civil law obligations. Resulting from any reason imaginable in daily business routine of duty holders, there may be failure of determining appropriate risk reduction strategies to counteract Legionella (Gollnisch et al., 2003). This context-specific paper may provide support in detecting deficiencies and thus avoid potential lawsuits.

2. Methodology and approach (Materials and Methods)

This paper is a result of the study of journal papers, articles, standards, law and court decisions. The findings are separated in two ways. First, a tabulated collection of statutes, standards and other documents guiding for design, operation and maintenance to minimise risks caused by Legionella in building (drinking) water systems is shown. Second, well-discussed situations concerning the liability of duty holders with respect to Legionella risk management are presented. They comprise “sampling”, “independency” and “risk assessment/ hazard analysis” and argue from a legal perspective. Quotes taken from statutory documents are translated from German into English. A final section discusses cases reported from practice in the national context of Germany. They are evidenced by corresponding regulations.

3. Findings

3.1. Statutory and normative frame for the United Kingdom, Switzerland and Germany

Table 1: Relevant for the **United Kingdom**: Collection of statutes, standards and other documents guiding for design, operation and maintenance to minimise risks caused by *Legionella* in building (drinking) water systems.

	United Kingdom
Statutes / regulations	*Health and Safety at Work Act 1974* *Provision and Use of Work Equipment Regulations 1998 (PUWER)* *The Management of Health and Safety Regulations 1999* *Control of Substances Hazardous to Health Regulations 2013 (COSHH)* *The Construction Design and Management Regulations 2015 (CDM)*
Standards / Supporting guidance / best practice & other documents	*HSE ACoP L8* (Approved Code of Practice) *2013 Legionnaires' Disease-The Control of Legionella in Water Systems* *Legionnaires' Disease Technical Guidance HSG 274, parts 1, 2 and 3* HTM 04-01 (safe water in healthcare premises): *HTM 04-01 Part A: design, installation and commissioning* *HTM 04-01 Part A: operational management* *HTM 04-01 Part A: Pseudomonas aeruginosa – advice for augmented care units* *HTM 04-01 Part A: performance specification D 08 – thermostatic mixing valves (healthcare premises)* [it should be read in conjunction with the HSE's Approved Code of Practice (L8) and HSG274 Part 2. It is equally applicable to both new and existing sites] British Standard: *BS 8558:2015 Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Complementary guidance to BS EN 806* *BS 8580:2010 Sampling for Legionella bacteria in water systems* *BS 7592:2008 Water quality. Risk assessments for Legionella control. Code of Practice.* *CIBSE TM13-Minimising the risk of Legionnaires' Disease* BSRIA Guides: *BG 57/2015 Legionnaires' Disease – Risk Assessment* *BG 58/2015 Legionnaires' Disease – Operation and Maintenance Log Book* WMSoc Publications: *W043 Guide to Legionella Risk Assessment* *W044 Code of Practice Cooling Water* *W045 Legionnaires' Disease (Knowing your responsibilities & avoiding prosecution)*

	W046-1 to W046-9 Guidance for Managing Risks *W047 Keeping you Cooling Tower Safe*
Key points of *ACoP L8*	
Not complying with the ACoP can bring prosecution under health and safety legislation. Duty holders must carry out or initiate risk assessments. There is the requirement to ensure understanding of all rules concerning buildings or activities where water is used or stored and where there is a means of creating or transmitting water droplets or spray (aerosols) which may be inhaled by occupants. Noting of cross references to HSG274 parts 1, 2 and 3.	

Table 2: Relevant for **Switzerland**: Collection of statutes, standards and other documents guiding for design, operation and maintenance to minimise risks caused by *Legionella* in building (drinking) water systems.

	Switzerland
Statutes / regulations	*Bundesgesetz über Lebensmittel und Gebrauchsgegenstände Lebensmittelgesetz, LMG) vom 20. Juni 2014* *Lebensmittel- und Gebrauchsgegenständeverordnung (LGV) vom 16. Dezember 2016* *Verordnung über den nationalen Kontrollplan für die Lebensmittelkette und die Gebrauchsgegenstände (NKPV) vom 16. Dezember 2016* *Verordnung über den Vollzug der Lebensmittelgesetzgebung (LMVV) vom 16. Dezember 2016* *Verordnung über Trinkwasser sowie Wasser in öffentlich zugänglichen Bädern und Duschanlagen (TBDV)* *Hygieneverordnung (HyV)* *Wassergesetz des Kantons Zürich (legislative process by consultation)* Kantonale Verordnungen *Verordnung über allgemeine und Wohnhygiene (vom 20. März 1967)*
Standards / Supporting guidance / best practice & other documents	*W3d Richtlinie für Trinkwasserinstallationen (inkl. W3 Ergänzung 1+2)* *W4d Richtlinie für Wasserverteilung* *W3/E2d Richtlinie; Betrieb und Unterhalt von Sanitäranlagen* *W3/E1d Richtlinie; Rückflussverhinderung in Sanitäranlagen* *W1000d Empfehlung für die Reinigung und Desinfektion von Trinkwasserleitungen* *SIA Norm 385/9: Wasser und Wasseraufbereitungsanlagen in Gemeinschaftsbädern (gültig seit 1. Mai 2011)* *SIA Norm 385/1:2011 Anlagen für Trinkwarmwasser in Gebäuden – Grundlagen und Anforderungen*

	SIA Norm 385/2:2015 Anlagen für Trinkwarmwasser in Gebäuden – Warmwasserbedarf, Gesamtanforderungen und Auslegung
Key points of SVGW	
SVGW guidelines are a measure of correct behaviour and may also be relevant in case of legal action	

Table 3: Relevant for **Germany**: Collection of statutes, standards and other documents guiding for design, operation and maintenance to minimise risks caused by *Legionella* in building (drinking) water systems.

	Germany
Statutes / regulations	*TrinkwV (BGBl, 2016)* *GefStoffV* *IfSG (IfSG, 2000)* *AVBWasserV* *ArbStättV*
Standards / Supporting guidance / best practice & other documents	*UBA Recommendations (UBA, 2006, 2012a, 2012b)* *Guideline for hospital hygiene and infection prevention (RKI, 2003)* *VDI/DVGW 6023 (VDI/DVGW, 2013)* *DVGW W551 (DVGW, 2004)* *DVGW W556(A) (DVGW, 2015)* *GEFMA 922 (GEFMA, 2004b)* *GEFMA 190 (GEFMA, 2004a)* *GEFMA 192 (GEFMA, 2013)* *DVGW W 1001 (H) DVGW W 1001 (H), Sicherheit in der Trinkwasserversorgung – Risikomanagement im Normalbetrieb* *DVGW W 270 (A)* *UBA KTW-Leitlinie, Leitlinie zur hygienischen Beurteilung von organischen Materialien in Kontakt mit Trinkwasser (KTW-Leitlinie)* *DIN CEN/TR 16355:2012-09* *DIN 1988-100; DIN 1988-200; DIN 1988-300; DIN 1988-500; DIN 1988-600; DIN 2000; DIN 18381; DIN EN 806-1; DIN EN 806-2; DIN EN 806-3; DIN EN 806-4; DIN EN 806-5; DIN EN 1717; DIN EN 16421; DIN EN ISO 19458*
Key points of TrinkwV and	

GEFMA 922-1B
TrinkwV (BGBl, 2016) *§ 14 Untersuchungspflichten:* *(1) Kriterien Untersuchungspflicht.* *(2) Umfang und Häufigkeit.* *(3) Probennahmestellen und Probennahmen nach den allgemein anerkannten Regeln der Technik.* *(6) Untersuchung durch Untersuchungsstellen, die nach § 15(4) zugelassen sind.* *§ 15(3) Dokumentationspflicht.* *§ 15(4) Die [...] Untersuchungen einschliesslich der Probennahmen dürfen nur von dafür zugelassenen Untersuchungsstellen durchgeführt werden. Hinweis auf Veröffentlichung der zugelassenen Untersuchungsstellen auf Landesliste § 15(5) Überprüfung der Untersuchungsstellen.* *§ 16(7) Massnahmen bei Überschreitung des technischen Maßnahmenwertes.* *§ 24 Straftaten und § 25 Ordnungswidrigkeiten: Hier sind alle Auflagen, gegen die verstoßen werden kann, einzeln aufgeführt.* GEFMA 922-1B (GEFMA, 2016) *Aufzeichnung(en) der Ergebnisse der vorgeschriebenen oder angeordneten Wasseruntersuchungen (Trinkwasser-Versorgungsanlagen). Source: TrinkwV 2001; § 15 Untersuchungsverfahren und Untersuchungsstellen; § 15 Abs. 3 Satz 1-3.* *Aufzeichnung(en) über ergriffene Massnahmen zum Schutz der Gesundheit der Verbraucher (Trinkwasser-Versorgungsanlagen). Source: TrinkwV 2001; § 16 Besondere Anzeige- und Handlungspflichten; § 16 Abs. 7 Satz 3.* *Betriebsbuch (Trinkwasser-Installation). Source: VDI/DVGW 6023; 3 Begriffe; 3 [9]; VDI/DVGW 6023; 8.2 Instandhaltungsplanung; 8.2 [7-8].* *Gefährdungsanalyse (Trinkwasser-Installation). Source: TrinkwV 2001; § 16 Besondere Anzeige- und Handlungspflichten; § 16 Abs. 7 Satz 1 Nr. 2.* *Instandhaltungsplan (Trinkwasser-Installation). VDI/DVGW 6023; 6.5 Betriebsanweisung, Instandhaltungs- und Hygieneplan; 6.5 [1, 6-7]; VDI/DVGW 6023; 8.2 Instandhaltungsplanung; 8.2 [5g].* *Massnahmenplan (Trinkwasser-Installation). Source: TrinkwV 2001; § 16 Besondere Anzeige- und Handlungspflichten; § 16 Abs. 5*

3.2. Documented situation of Legionella prevention in drinking water systems in buildings, argued from practice in Germany

3.2.1. Sampling

There are numerous service providers on the market who are not an investigating agency in the sense of § 15 (4) TrinkwV, but who carry out sampling measures as a service provider. The person in duty of the drinking water installation is therefore obliged to commission an accredited and approved laboratory for Legionella testing, according to §§ 15 TrinkwV. A passage that has not been noticed in its detail is derived from TrinkwV § 15 (4): It says that necessary testing, including the sampling, may only be carried out by authorized testing bodies. The complexity now results from further specifications:

1. The DVGW worksheet W 551 (DVGW, 2004), to be complied with in accordance with § 4 TrinkwV (DVGW, 2004), refers in each case to the valid version of the recommendation of the Federal Environmental Agency (UBA).
2. The recommendation of the UBA (UBA, 2012a) explains: "Sampling may only be carried out by laboratories accredited for drinking water testing."(UBA, 2012a). It also states that "external samplers must be involved in the quality assurance system of the laboratory (...).". It is further stated that "certification of the sampler alone does not meet the requirements of the Drinking Water Ordinance (TrinkwV). The responsibility for carrying out the sampling and sample transport (pre-analysis) remains exclusively with the laboratory management of the accredited laboratory." (UBA, 2012a).

For the so-called external samplers of laboratories, the specifications of the DAkkS (German accreditation agency, accreditors of the laboratories) must be observed. In the explanation of the DAkkS (71 SD 4 011) provided in (UBA, 2012a), it is stated, inter alia: "The external sampler must maintain confidentiality, i.e. in his function as a sampler for the investigating body he may not, without the permission of the investigating agency, forward collected data and information to third parties, in particular to colleagues or superiors of his organization." (DAkks, 2017).

One focus of the errors in microbiological analytics is the insufficient number of samples. It was found that large residential buildings were only examined by three samples, although a double-digit number of samples would have been necessary according to DVGW W 551 (DVGW, 2004). The evaluation of the water installation tested is carried out according to the "worst" sample, i.e. the highest level of contamination detected. In a UBA recommendation (UBA, 2006) it reads that an increase in Legionella is to be assumed especially if the generally accepted rules of technology are not taken into account during planning, construction and operation (see also §4 TrinkwV 2001)." (UBA, 2006).

Other very common and observed errors during sampling are listed below:

- no or completely inadequate testing, no follow-up testing
- testing of abandoned property (buildings / flats)
- testing of bodies not operated according to the intended purpose
- no sampling at documented places
- sampling according to "purpose C" of DIN EN ISO 19458
- sampling of incorrectly given sampling points (e.g. plastic / rubber hose)

3.2.2. Independency

A further focus is currently on the sampling and also the preparation of hazard analyses. The extent to which a quotation from the official document “Recommendation of the German Federal Environmental Agency” can be applied to the carrying out of hazard analyses (UBA, 2012b) analogously to sampling is shown in the case-law. As mentioned by the UBA Recommendation (UBA, 2012b), it is stated that "the conduct of the hazard analysis must be independent of other interests. In particular, a bias must be avoided. A bias is then to be suspected if persons were or are involved in the planning, construction or operation of the drinking water installation" (UBA, 2012b). The "independence" requirement for sampling also results from the accreditation standard DIN EN ISO / IEC 17025 for the inspection bodies

It is not uncommon for people who have planned, built or even operated the drinking water installations to be inspected to check their own work, but “Legionella testing is intended to show whether or not the drinking water installation to be examined is likely to lead to a preventable health hazard. It should be borne in mind that those involved in the drinking water installation (such as planners, installers, operators, etc.) can always be accused of an irrefutable "personal interest". For this reason, these groups of persons should always act in their own interest in such a way that they cannot be subject to the potential reproach of a bias. For entrepreneurs and other owners of drinking water installations (UsI) this aspect should therefore be a selection criterion to be considered” (UBA, 2012b).

3.2.3. Risk assessment / hazard analysis

If legionellae above 100 CFU / 100 ml have been detected in the laboratory, the technical action level is exceeded. In this case, the TrinkwV dictates a procedure to follow. In addition to further measures, § 16 (7) (BGBl, 2016) provides more detailed information with respect to this case. An critical focus in daily practice is the preparation of the hazard analysis required in § 16 (7) (BGBl, 2016). A recommendation from the UBA on the establishment of a hazard analysis (UBA, 2012b) is available free of charge on the internet pages of the UBA. It addresses the target group "entrepreneur or other owner of the drinking water installation (UsI)". As often discussed in the daily work, the term "recommendation" has been issued. Obviously, the term "recommendation" is often interpreted as "optional". The TrinkwV § 16 (7) states: "In carrying out measures pursuant to sentence 1, points 2 and 3, the entrepreneur and the other owner must observe the recommendations of the environmental protection agency." (BGBl, 2016). For good order, it should be noted that the correct wording is: "Recommendation of the UBA after consulting the Drinking Water Commission". Those who fail to meet the requirements of an entire expert committee will find it hard to prove that they were "expertly better" than the expert committee.

In practice, the necessity for hazard analysis due to a contamination of 101 Legionella / 100 ml it is often criticized. However, it is overlooked that microbiology has peculiarities, inter alia that the focus of the contamination in the drinking water installation can be displaced as a function of several parameters and has not yet been determined in the course of the orientative testing. In the technical regulations (DVGW, 2004), there is the indication that in the course of the orientative testing, no concrete remedial measures can be derived, so that the extent of the contamination is always determined after exceeding the technical measure value.

The UBA's recommendation is that "the UsI is responsible: in case of claims for damages in court, it may be important to be able to prove the independence and sufficient qualification of an expert called in" (UBA, 2012b). It is in the interest of building administrators to pay particular attention to the reference from (UBA, 2012b).

A further focus is on the professional competence of the personnel who carry out hazard analyses, which requires professionals. It should be noted that the expert who conducts a hazard analysis is responsible for its implementation (rectification of defects). In other words, the identified deficiencies are all eliminated; the user can expect the drinking water installation to no longer exceed the technical value of the process.

3.2.4. Legal aspects

Regardless of the modifications made by the TrinkwV in the years 2011 to 2016, the substantive legal foundations have hardly changed. It is for that reason that reference can be made to them (Gollnisch, 2010). Apart from possible civil claims of victims, the owners and custodians of drinking water supply systems may find themselves liable under administrative or criminal law in case they should fail fulfilling their obligations given by the TrinkwV. For that, § 24 TrinkwV defines criminal offenses, which are based on §§ 74 (and following) of the Infection Protection Directive (IfSG, 2000).

Paragraph 25 subparagraph 4 TrinkwV provides that the owner of a drinking water installation already commits a sanctionable administrative offense if testing envisaged in § 14 TrinkwV is not carried out, carried out incorrectly, incompletely or not in the prescribed manner.

According to legislative intent, it does not explicitly matter whether the duty holder of the drinking water installation did not undertake the testing or not did it as required, or whether the investigating body commissioned had made the mistake.

When the owner mandates a company not properly authorised to carry out testing, they also commit a sanctionable administrative offense because of a negligent selection. Details of meeting conformity are described in § 14 (6), 15 (4) TrinkwV. In other words, the proprietor is also legally responsible for the correct work of the laboratories they commission, in addition to the investigating staff of the laboratory. The extent to which this provision can actually be implemented in reality remains to be seen, since the holder of a drinking water installation must, of course, be able to rely on the company they choose providing a proper service.

For the owner and manager of property and care facilities, claims of civil rights are of far greater importance if they have not, or have not adequately, fulfilled the obligations of the TrinkwV. They then confront the risk of damages claims by the injured party, pursuant to §§ 249, 253, 280 of the German Civil Code (BGB) (BGB, 2002), since the TrinkwV is regarded as a protective act within the meaning of § 823 BGB (German Civil Code) (BGH, 1983).

The classification of TrinkwV as protection law within the meaning of section 823 of the German Civil Code (BGB) means that the owners and landlords are liable towards their contract partner not only by contract (e.g. a contract of tenancy or lodging). There is a non-contractual liability to third parties, too. This arises from the legal duty of the landowner to maintain safety. It means that the landowner has to provide for everything they can reasonably expect might happen, so that their property does not pose a threat to the life and health of third parties.

In this case, however, visitors to a tenant are also included in the scope of protection of § 823 BGB. According to the case law of the Federal Court of Justice (BGH), the legal duty to maintain safety is defined as follows: "The legally required duty to maintain safety covers those measures which a prudent and circumspect, reasonably cautious person considers necessary and sufficient to protect others from damage ..." (BGH, 2007).

The property owner's negligent violation of the legal duty to maintain safety is sufficient to trigger their liability for damages if appropriate measures are not implemented or not properly implemented. This is expressly stated in § 823 (1) BGB. With regard to the TrinkwV, it follows from this that the distribution of drinking water which does not comply with the requirements of the TrinkwV constitutes a breach of the legal duty to maintain safety by the property owner. This also includes the exceeding of the technical action level (technischer Massnahmenwert) laid down in § 3, subparagraph 9 TrinkwV defined for Legionella in drinking water. This is explicitly the result of the testing listed in § 14 TrinkwV as well as the notification and action obligations of the landowner regulated in § 16 TrinkwV.

In the vast majority of cases, the owner and manager of land will not have the necessary expertise to meet the statutory requirements according to the legal duty to maintain safety imposed by the legal authority. They must manage the examinations being carried out according to §§ 14 (6); 15 (4) TrinkwV by a body authorized by the lawgiver. It is therefore the responsibility of the owner of the drinking water facility to select an approved company to commission the testing of the drinking water.

If the owner or manager of the property violates this duty, there is the risk that a victim can claim damages on the grounds of a negligent selection within the meaning of § 823 BGB. It is, therefore, in the ultimate interest of the land owner or landlord to carry out regular inspections of the drinking water system on a regular basis and thus to commission an authorized inspection body to remove their own liability for damages. The following remarks on the current jurisdiction are intended to illustrate that the above statements are not merely theory. There are now a number of judicial decisions which can be applied to other cases, and each with a different perspective:

Compensation for pain and suffering

The basis for the so-called non-material damage (referred to as "compensation for pain and suffering") is § 253 BGB (German Civil Code). However, a significant change has been made in the case of a possible claim for compensation by the injured party. In so far as an immaterial damage has been considered doubtful in the past, however, this can no longer be maintained with regard to current developments in the legal system (Gollnisch & Gollnisch, 2011; Gollnisch, 2010). The jurisprudence is now seen as solid. It also follows, however, that the owner or manager of land owes the injured party damages as well as compensation for pain and suffering: The following is an overview of the current state of jurisprudence:

(1) The LG Dortmund (LG, 2010) awarded compensation to a victim who had been infected with *Legionella* during a hospital stay in a doctor's office. An expert's report [ibid.] concluded that the cause was *Legionella* infection deficiencies in the heating and drinking water system. After the decision of the court, the building owner was convicted, not the commercial tenant.

(2) The Supreme Court (KG) (KG for the German term "Kammergericht") ruled on 8 December 2010 (KG, 2010) that a survivor of a victim who died of a legionellosis was awarded compensation of € 5,000. The injured party was in a nursing home and was suffering from legionellosis due to deficiencies in the drinking water system and died there later. According to

the KG, it was ultimately irrelevant whether or not the victim had died from legionellosis. The sole factor was that the nursing home owner had violated the obligation 'duty to maintain safety'. (3) For the first time, a decision of the Federal Supreme Court (BGH) is also available on this problem: The BGH (BGH, 2015) has ruled that a victim is entitled to a compensation payment for a *Legionella* infection. The injured party was a tenant in a multi-family house. Among other things, the landlord had, for at least 8 years, not controlled for *Legionella* in the drinking water system of the tenement house. An additional feature of the drinking water system was being disproportionally large. The tenant fell ill with a severe form of legionellosis and then died during the lawsuit. The statutory heir now makes claims against the landlord. However, the BGH also clarified that the tenant must prove the causality between the presence of *Legionella* in the drinking water system and the legionellosis (§ 286 ZPO (ZPO, 2005)). The tenant cannot make use of such proofs, such as in the physician liability process, for example (§ 287 ZPO).

4. Discussion

Selecting experts to conduct a hazard analysis in the sense of TrinkwV §16 (7) can prevent hazards to the health of the users of the drinking water installation or potentially even save lives. Furthermore, it can keep the client from committing a negligent selection. On the one hand there are tendencies of court decisions going towards *compensation for damages and loss as well as for pain and suffering* to the injured party or her heirs. On the other hand can be assumed that civil justice grants even higher pain compensation payments to injured parties. This argument is supported by the reason of a more detailed and tightened catalogue of demands in appendix 4, part II of the TrinkwV, which describes requirements for the owner or operator of a drinking water installation. It also defines checks for the presence of *Legionella* at regular intervals. This prognosis does not even take into account the fact that for many years now the tendency of the courts has been to award injured parties ever higher compensation payments. This fact should be considered carefully by duty holders, not only because of their liability in managing facilities.

5. Conclusion

Management should consider their scope of duties as part of a functioning risk management, irrespective of whether it is a public organisation, a business or private built environment. For all of these there are laws and duties defined by statutes, standards or practical guides for design, operation and maintenance to minimise risks. Those seen as most important and relevant at present from a practitioner’s perspective have been collected and highlighted for three selected countries. A direct comparison of the content or rating of each national context is not part of this paper. A deeper insight into existing issues in practice in Germany gives evidence on the importance of the topic and complexity of managing correctly. In the national context of Germany, a precise picture on legislation, economic aspects, civil law, liability, risks of owners and landlords in terms of sanctioning has been presented. Keeping in mind this well-documented picture and underlying potential similarities of duties, gaps, risks and actions in their own country, it may be seen a reason, why a common process of *Legionella* prevention in water systems in hospitals has not been described to date.

For the healthcare sector, it may be most evident that there is a general "by profession"-given closeness to topics concerning hygiene, especially in the recognition and awareness of topics of a certain field (i.e. *Legionella* prevention) which refers to the spectre of healthcare-associated infections (HAI), an thus, risk management. By considering the topic of water hygiene there is a variety of stakeholders working on a common process of *Legionella* prevention (Gamage et al., 2016; Leiblein, Tucker, et al., 2017; Spagnolo et al., 2013). This includes internal and external people, who collaborate and work on this common process.

Certainly, law and duties vary from country to country which is, of course, not unusual to deal with for a locally or globally acting FM and FS business. However, the legal framework, standards or even potential threats are not always obvious to people responsible (Leiblein, Füchslin, et al., 2017).

An infected water system is a deficiency in a building and reduces the value of a facility. Above all, the hazard to people and the liability of duty holders may be two even strong arguments. Professionals with operator duties (FM / FS) must bear this in mind. More research in this particular field is needed because of the critical importance and complexity of the topic.

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