Methodology characteristics of a 'FM in healthcare' field study on risk management of legionella in water systems

Thomas W. Leiblein[1], Matthew Tucker[2], and Susanne Hofer[3]

[1] Liverpool John Moores University (LJMU), Faculty of Engineering and Technology, Department of the Built Environment, Byrom Street, Liverpool L3 3AF, United Kingdom. Zurich University of Applied Sciences (ZHAW), Department Life Sciences and Facility Management, Institute of Facility Management, Grüental, 8820 Wädenswil, Switzerland. email: T.W.Leiblein@2014.ljmu.ac.uk

[2] Liverpool John Moores University (LJMU), Faculty of Engineering and Technology, Department of the Built Environment, Byrom Street, Liverpool L3 3AF, United Kingdom. email: M.P.Tucker@ljmu.ac.uk

[3] Zurich University of Applied Sciences (ZHAW), Department Life Sciences and Facility Management, Institute of Facility Management, Grüental, 8820 Wädenswil, Switzerland. email: susanne.hofer@zhaw.ch

ABSTRACT

The aim of an ongoing research project is to systematically uncover the present situation of legionella prevention in water systems in selected health care (HC) organisations in different countries. It seeks to develop a 'reference system' guiding those responsible in HC organisations to identify, understand and properly take action for prevention. By considering stakeholder theory, business research methods, process and quality theory and corresponding definitions, a fundamental reference will be provided for operationalisation and specific analysis. The present paper aims at providing a fundament for the research methodology, which is then applied to the research project. It represents the theoretical foundation of the research project and is the guiding element for aligning activities to work towards the research output at the final stage of the project. The research project is driven by the perspectives of FM / FS and follows an exploratory mixed-methods design including several cases. As a synthesis of the theories and definitions proposed, the procedures for an exploratory instrument design mixed methods study was constructed and are presented. It is only through the empirically justified logic of an appropriate reference system that evidence-providing elements can be identified and described in a comprehensible manner. The reflection of processes, identification of process owners and the optimisation of certain areas which FM and FS serve is becoming more important than ever. With the final result of a framework at the end of the research project, FM and FS people responsible in HC organisations obtain a meaningful instrument. This can be used as a management tool and will be formed with respect to a process-oriented perspective, issuing an organisation's protection goal of 'infection prevention'. The framework could help those responsible to reflect on their missions throughout the organisation and adjust (strategic) planning where seen necessary.

Keywords

Risk management, process, prevention, water system, legionella

1 INTRODUCTION

In the hospital environment, several stakeholders work in a complex and interdisciplinary healthcare (HC) setting in which duties and responsibilities towards third parties in respect of legionella detection and prevention need to be fulfilled. In this context, legionella is representing a potentially pathogenic bacterium, which may be found in water systems. Among the stakeholders there might be Facility Managers (FM) and Facility Services (FS) staff, whose responsibilities at managerial and lower levels include risk management approaches applied to maintenance, monitoring, assessment and prevention of contamination of water systems by legionella (Spagnolo et al. 2013). Some hospitals decide to employ external FM / FS, while others will manage this in-house. To manage tasks properly, their roles and duties need to be evident.

As can be recognised, there are numerous stakeholders serving to control healthcare-associated infections (HAI). They differ in their roles and functions. People who are ascribed responsibility in their professional field include: members of a hygiene commission, water safety team, infection prevention and control professionals, Public Health team, strategic lead for Legionellosis, a legionella and influenza preparedness and response team, a (senior) medical officer, principal clinical scientists, epidemiologists, consultants in Public Health medicine, (consultant) microbiologists, reference laboratory staff, Scientific Officer, (senior) Environmental Health Officer, Environmental Health Advisors, Health Protection Nurses, Communications (Lead / Officer). The list is not conclusive (Potts et al. 2013). There may potentially be more or different stakeholders even with overlapping duties and in different areas of action. At a very early stage, especially when thinking about strategic decision-making, an organisation needs to identify and understand the process(es) and know about the process owners. As concluded by Diez and Lennerts (2009), the linking of FM processes and the primary process for the functional areas in the hospital is an important step towards strategic planning.

The aim of an ongoing research project is to systematically uncover the present situation of legionella prevention in water systems in selected HC organisations in different countries. It seeks to develop a ‘reference system’ guiding those responsible in HC organisations to identify, understand and properly take action for prevention (Leiblein et al. 2015). In order to achieve this goal a new model for studying the impact of legionella in water supply systems is suggested here. For any research, it is vital to select a suitable research methodology to attain the goals aptly. According to the problem statement formulated in the research proposal of the study, appropriate business research theories, research methods and definitions must first be introduced. By considering stakeholder theory, business research methods, process and quality theory and definitions, a fundamental reference will be provided for operationalisation and specific analysis. For that the research project takes an FM perspective considering FM and FS related aspects of business organisation, processes and legal aspects (Hungenberg 2014). Four dimensions are identified to build the frame of the research project. They had been characterised during an initial literature review. The dimensions are: legionella, hospital, risk management and FM / built environment, (Leiblein et al. 2016). The present paper aims at providing the methodology

characteristics, which is then applied to the aforementioned research project. It holds the decisions and reasoning for the operationalisation during field work. Thus it represents the theoretical foundation of the research project structuring activities to work towards evidence at the final stage of the project. In the research project the main objectives are:

(1) to identify FM- / FS-stakeholders and functions;
(2) to analyse functions and fields of activity;
(3) to identify and analyse processes and stakeholders (focus: non-clinical FM & FS);
(4) to review the current state and conformity to standards, legislation and regulations and to discuss this in terms of risk management from an FM / FS perspective;
(5) to identify points of overlapping duties in the process of legionella prevention in water systems;
(6) to identify similarities and differences in the common level of generally recognised codes of practice between three different countries.

The research project combines different research strategies and methods in order to eliminate any gaps in terms of validity, reliability, and generalisability of the results.

2 MATERIALS AND METHODS

To work out a model description which serves as a solid fundament giving orientation throughout the research process, some already existing models, theories, definitions and modes of action are presented hereafter. Together they build a reference scheme upon which the final research output will be built up, eventually providing a framework for FM.

Freeman's stakeholder theory and model

The impact of Freeman's stakeholder model amongst practitioners may be based on the cognitive power of visualisation (Fassin 2008). The framework of the stakeholder model illustrates the relationships among the various groups of actors in and around the organisation. Freeman's original framework included eleven stakeholders on a non-exhaustive basis (Freeman 1984). Fassin examined the impacts of two shortcomings of the stakeholder framework. They are: (a) the boundaries and the level of the firm's environment, and (b) the ambivalent position of pressure groups and regulators (Fassin 2009). Although there has been an intensive academic debate, there has been a fairly general consensus that the stakeholder concept has the potential to deliver a theory of the organisation with practical usefulness for management (Attas 2004; Freeman 1999; Harrison and Freeman 1999; Key 1999; Orts and Strudler 2009). In 116 articles Littau et al. (2010) found 22 definitions. They compiled a list of definitions, of which Freeman's has become the most accepted one (Littau et al. 2010). He defines "[...] a stakeholder in an organisation is any group or individual who can affect or is affected by the achievement of the organisation's objectives [...]" (Freeman 1984: 46). The literature includes many attempts at classifying

stakeholders using various criteria (Frooman 1999; Philips 2003; Winn 2001): primary versus secondary, direct or indirect, generic versus specific, legitimate versus derivative. Mitchell et al. offered a theory of stakeholder identification and salience based on the attributes of power, legitimacy and urgency (Mitchell et al. 1997). Stakeholders have a series of multilateral contacts. According to their position in the company they consequently have direct influences on other stakeholders (Philips 2003: 127). In their role, stakeholders themselves possess their own subset of stakeholders (Rowley 1997). Furthermore there is also heterogeneity within stakeholder groups and 'double appartenance': the members within every stakeholder group can be far from homogeneous, while one stakeholder may occupy simultaneously several roles (Freeman 1984: 58; Fassin 2008). Mitchell et al. offered a theory of stakeholder identification and salience based on the attributes of power, legitimacy and urgency (Mitchell et al. 1997). Increasing interrelation is noticed between the concepts of stakeholder theory, business ethics and corporate responsibility (Garriga and Melé 2004; Valor 2005). Littau et al. (2010) introduced two terms and discussed a triangular relationship between stakeholder, 'stakekeeper' and 'stakewatcher'. In their paper they critically reflected the past 25 years of stakeholder theory in project management literature. They concluded, "[…] that stakeholder theory is becoming an important approach in project management" (Littau et al. 2010: 25). Waxenberger and Spencer (2003: 242) confirm, that stakeholder 'management' has become an important discourse in the translation of business ethics to management practice and strategy. Stakeholders can be recognised as process-owners or, at least, contributors to or initiators of processes, when being considered from the logic of process management and quality management.

Process - definition, structure, management

In an organisation, primary processes and FM processes are distinguished from each other and structured following a certain logic or hierarchy. Hessel defines a process "[…] as a chain of essential activities. These activities result in a service for a client" (Hessel, 2004: 27), internal or external to the organisation. For hospitals, Hessel suggests a hierarchic process structure built on core processes (CP), main processes (HP) and sub processes (TP) (Figure 1).

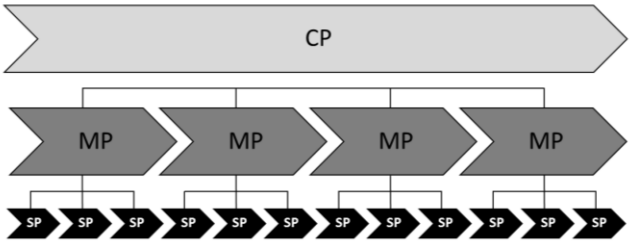

Figure 1: Hierarchic process structure for hospital processes containing core processes (CP), main processes (HP) and sub processes (TP) (Hessel, 2004: 30, modified).

When using a client oriented process model for an organisation, the first question arising is the purpose of the organisation. Hessel applies the process structure approach for hospitals and defines two types of processes (Hessel, 2004: 33): (a) primary processes are processes that directly influence a patient's state of health (e.g. the performance of a medical procedure), and (b) infrastructure processes are relevant for the provision of required resources (i.e. personnel, materials). They are accountable for the functionality of primary processes as well (e.g. maintenance). Taking the two types of processes into consideration, our present research will follow a modified approach. Processes will also be distinguished in primary processes and infrastructure processes. As water systems of any building may be perceived as serving for both processes, the proposed 'client'-centred process model must be modified. Thus, a 'client' in the context of water hygiene is represented by any person at risk who may be exposed to hazards throughout any stage of the entire process of water hygiene (abstraction level) or legionella prevention (specific level). They would prescribe a superior infrastructure core process 'legionella prevention in water hygiene'.

The process setting can be assigned to environmental hygiene and infrastructure. Adopted from Diez and Lennerts (2009) 'Table III. Main processes of infrastructure core processes' the water-related main processes were selected. They are: #2 Outside Facilities, #8 Technical services, #9 Hygienic advice, #10 Building maintenance, #11 Maintenance of biomedical equipment, #12 Maintenance of technical equipment, #13 Cooling services, #27 Heating, #28 Landry services, #29 Water supply. The aforementioned would represent elements of a superior infrastructure core processes 'legionella prevention in water hygiene'. Exactly one infrastructure core process is assigned to each entity of the water-related main processes. However, it is likely that the list is not conclusive with respect to water-safety. Seen from the superior hierarchy-level, a subordinate process has a starting point and an end point (process chain), which can be repeated as often as necessary. Any sub-process throughout the chain can be picked out and be analysed upstream and downstream along the process chain. Any process can be structured on the level of the proposed model. According to the principles of process and quality management, this process-oriented view requires responsible persons. These are called 'process owners' on which stakeholders from different units of the organisation or areas of activity collaborate in order to provide a certain level of process quality.

Quality - a basic definition

For the term 'quality', numerous definitions are available. Depending on the context, the term focuses on a specific object or subject. Yet why not apply a given definition to the logic of process thinking and management? For example, one definition sees "quality as fulfilling customer requirements at lower cost with built-in preventive actions in the processes and employee and management involvement, and ensuring the best product to the customer or end-user" (2001). This is a typical product-centred view. In the logic of process management, the term 'product' in the above-mentioned definition could be replaced by the term 'outcome'. The definition goes further and notes that achieving and improving quality "needs customer-focus quality leadership, personal responsibilities, measurement and improvement, and good

infrastructure or support services" (ibid.). Finally, the definition maintains that a quality outcome should lack any defects and should be free from constraints and items which do not add value to customers. Such broadly defined demands require models that work together and are not in competition with one another. As such, the models of Deming (control points), Covey (human interrelations), and Senge (the nature of the dynamics of systems) complement each other when "utilized in an integrative model such as the orienteering model" (Winder and Judd 1996). As for the term 'quality' the term 'quality of care' can be defined from several perspectives according to Smiths (1997), cited in Long and Harrison (1985). Among these definitions, we find the technical, the personal, or the public health perspective (society, law). Philip Crosby, cited in Katz and Green (1997), characterises 'quality' as conformance to requirement. Simply put, this means that quality should be achieved through compliance with defined specifications or standards (regulatory / authority perspective). However, in terms of infection prevention the question is left open as to whether this is enough to comply with the organisation's protective goals in terms of hygiene. Donabedian (1980), cited in Long and Harrison (1985), argues that the evaluation of the quality of health service involves the functional relationship of structure (inputs), process, and outcomes. Long and Harrison indicate that none of these three (input, process, outcome) represents attributes of quality but each provides an approach to generate information on the presence or absence of quality.

Infection control – three perspectives

Liyanage and Egbu (2005) introduced a three-dimensional approach for the comprehension of infection control. They state that infection control requires adaptation of effective quality management systems. Specifically, with a focus on the FM, the main idea of their paper is to present three important dimensions of infection control using a non-clinical perspective to attain 'quality' of healthcare. The three dimensions are 'service' (generated by combined FM and clinical processes), 'knowledge management' (KM) and 'performance management' (PM). KM and PM are considered in view of infection control in FM services. As explained by the interplay of the three dimensions, FM services play an important role in infection control. Liyanage and Egbu (2005: 202) argue that "(F)acilities availability, utilization, and suitability can greatly influence the healthcare setting as a whole in developing and transmitting infectious agents". They continue that "[…] poor integration of FM services into the clinical process is one of the major factors in causing HAI". For the characteristics of KM, they adopt the view of the NHS, which describes KM as the process of ensuring that people have the right knowledge, in the right place, at the right time. Facilities services staff possibly has little knowledge in infection control compared to clinical staff. Hence, KM is a driver for process improvement. Furthermore, it can be an enabler for sharing information (Liyanage and Egbu 2005). The PM is mostly identified as a system which enhances individual performances to support or achieve organisational goals (Armstrong and Baron 1998). Considering the relationship of structure, process, and outcome, it becomes obvious that assessing performance (quality) cannot be achieved adequately by looking at one isolated item alone.

Case study research

In order to realise a highly practically-oriented output a case study approach is applied to identify the process and the process owners of legionella prevention in water systems in hospitals. Seen from a scientific perspective, the project might be a meaningful advancement of Liyanage and Egbu's (2005) earlier described role of FM and its contribution to quality in the process of controlling healthcare associated infections (HAI). In contrast to their investigations the present research project focuses on a certain field of responsibility (water safety) with the perspective of FM and FS, who contribute to infection control and, thus, also prevention and risk management. The case-study approach is divided into two main parts. First, the context of FM and FS services will be explored and activities associated with the process of legionella prevention in water systems will be identified [Process identification, ref. to Figure 2]. Second, the role, duties and level of integration between process stakeholders, i.e. process owners, will be analysed for clinical and non-clinical persons; where non-clinical includes facilities managers and facilities services staff and clinical includes stakeholders for infection prevention practices [Stakeholder identification, ref. to Figure 2]. Both parts serve to identify or define a process chain. To collect data, HC organisations (hospitals) need to be recruited. Each hospital represents a case. A wide range of information collection techniques can be used in case studies. A thorough analysis of a particular process will require the use of the researchers' personal observations. These are a collective result of his or her presence, participation, or even intervention in the actual process to be examined. In terms of information collection and analysis, action science depends largely on qualitative methods, although quantitative methods can sometimes play a considerable role (Gummesson, 2000: 70). In qualitative theory use the researcher begins by gathering detailed information from participants and then forms this information into categories or themes. These themes are then developed into broad patterns, theories, or generalisations. During analysis, they are then compared with personal experiences or with existing literature on the topic (Creswell 2009). Case studies vary in character. Yin distinguishes between three types of use of case study research: exploratory, descriptive, and explanatory (Yin, 1994: 13). Researchers in business-related subjects traditionally limit case studies to the exploratory use (Gummesson, 2000: 84). An important advantage with case study research is the ability of gaining a holistic view of a process (Gummesson, 2000: 86).

Case study design

Yin (2003) defined case study research as: 'A case is an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident'. In business research, case study design often involves an in-depth analysis of an individual, a group of individuals, an organisation, or a particular sector. In short, the case study provides an in-depth analysis of a specific problem. In general, case study research can be divided on the basis of single and multiple case studies. Single case study involves research that examines a single case, while multiple case studies analyses several cases. Furthermore, case study research can be categorised on the basis of analysis. The researcher has two options - holistic (single unit of analysis) or embedded (multiple units of analysis) (Wilson, 2010: 108). The present research combines parts of both. Multiple case design will favourably be applied during phases I and II. The process of

legionella prevention in water systems in hospitals will be examined by holistic analysis (Wilson, 2010: 109). According to Rowley (2002) six to ten cases might achieve literal replication (in case of producing similar results), whereas more cases might be needed to examine other patterns of theoretical replications (in case of producing contrasting results). An embedded case study is a case study containing more than one sub-unit of analysis (Yin 2003). Whilst single designs focus on one unit of analysis, embedded studies pay attention to a number of units of analysis. Phase II of the study will employ embedded analysis (Wilson, 2010: 109) to identify overlapping duties and draw up a responsibility assignment matrix (RAM).

3 RESULTS

Operationalisation

Research is driven by the perspectives of FM / FS and follows an exploratory mixed-methods design including several cases. Each case will be selected by clear criteria which qualify for inclusion or exclusion from the study. The study contains field work and will be complemented by elements of desk research (documents study, objects analysis and process analysis). Data collection during phase I will be realised through semi-structured interviews with gatekeepers to the organisation. Data collection during phase II will be realised through a questionnaire study with further people responsible. These people will have been identified prior to this, during stage I. They are different stakeholders / process owners serving to ensure water safety / legionella prevention. Data collection and analysis will be carried out by two consecutive phases. According to Creswell and Plano Clark's (2011) prototypes of major mixed methods research designs, this research follows an 'exploratory sequential design'.

Synthesising a theoretical 'framework for FM'

As a synthesis of the theories and definitions proposed, procedures for an exploratory instrument design mixed methods study was constructed (Figure 2). The units of measure are defined by 'process identification' and 'stakeholder identification'. It will deliver information about the participating organisation's present state, how risk assessment is organised, routines in monitoring, documentation, and collaboration of stakeholders who work for a common process chain of legionella prevention in water systems. The structure of the study is based on Creswell and Plano Clark (Creswell and Plano Clark, 2011: 191), modified and applied for the proposed study design, which is published elsewhere (Leiblein et al. 2016). Thus, the idea of a theoretical 'framework for FM' is aligned with suitable research project methodology and research logic. This enables a practically oriented (applied) research on legionella prevention of water systems in hospitals within the scope presented. The main question for which the procedures are designed is: "Which are the roles and duties of people responsible for the built environment (focus FM and FS) with respect to legionella, risk management and prevention of water systems in HC organisations?". To give an answer to this question, the following sub-questions (SQ) investigate important elements and guide the study through the procedures of analysis: (SQ1) Which processes are defined in a hospital in terms of legionella prevention in water systems? (SQ2) Who are

the process owners with respect to FM / FS processes? Are there both primary and secondary stakeholders (hierarchy)? (SQ3) Are there points of overlapping duties and how can they be characterised? (SQ4) Are there comparable (generalisable) facts or are there differences depending on the organisational level?

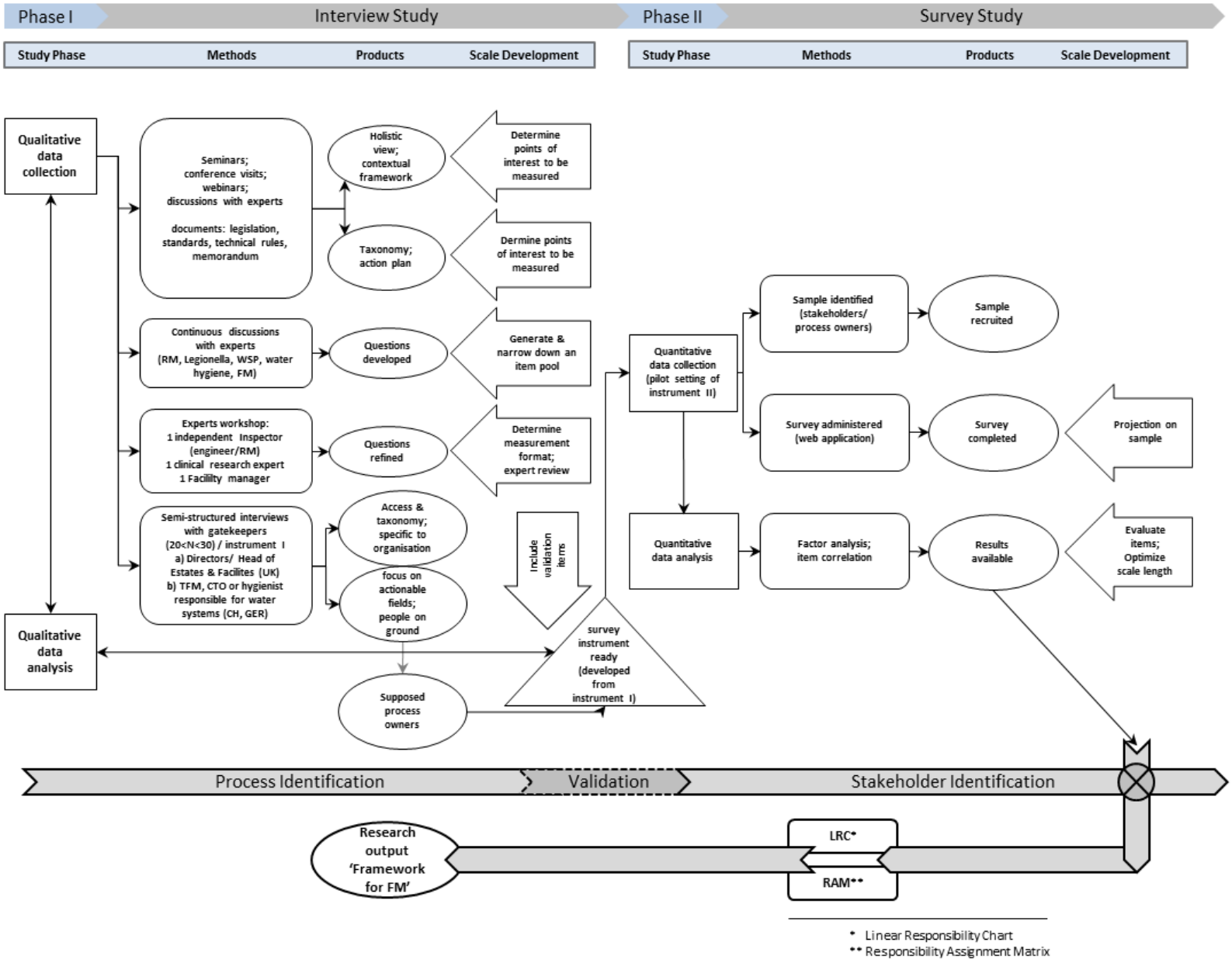
Phase I
Interview Study
Phase II
Survey Study
Study Phase
Methods
Products
Scale Development
Study Phase
Methods
Products
Scale Development
Qualitative data collection
Seminars; conference visits; webinars; discussions with experts
documents: legislation, standards, technical rules, memorandum
Holistic view; contextual framework
Taxonomy; action plan
Determine points of interest to be measured
Dermine points of interest to be measured
Continuous discussions with experts (RM, Legionella, WSP, water hygiene, FM)
Questions developed
Generate & narrow down an item pool
Experts workshop: 1 independent Inspector (engineer/RM) 1 clinical research expert 1 Facility manager
Questions refined
Determine measurement format; expert review
Semi-structured interviews with gatekeepers (20<N<30) / instrument I a) Directors/ Head of Estates & Facilites (UK) b) TFM, CTO or hygienist responsible for water systems (CH, GER)
Access & taxonomy; specific to organisation
focus on actionable fields; people on ground
Include validation items
Qualitative data analysis
survey instrument ready (developed from instrument I)
Supposed process owners
Quantitative data collection (pilot setting of instrument II)
Sample identified (stakeholders/ process owners)
Sample recruited
Survey administered (web application)
Survey completed
Projection on sample
Quantitative data analysis
Factor analysis; item correlation
Results available
Evaluate items; Optimize scale length
Process Identification
Validation
Stakeholder Identification
Research output 'Framework for FM'
LRC*
RAM**
* Linear Responsibility Chart
** Responsibility Assignment Matrix

Figure 2: Procedures for the exploratory instrument design mixed methods study

4 DISCUSSION

Admittedly, many ideas, theories, models and designs have been broached in this paper. This is due to the complexity of the study design revealing the issue of water hygiene not being limited to a specific country in terms of legionella prevention with specific (national) demands in terms of legislation or standards, as well as the number of potential protagonists (see contextual framework (Leiblein et al. 2016). However, an embedding of the identified research question, which is highly relevant in practice, is necessary. It is only through the empirically justified logic of an appropriate reference system that evidence-providing elements can be identified and described in a comprehensible manner.

The main challenge of this research will not be the theoretical embedding or legitimation of the subject. First and foremost, the success criterion will be obtaining the necessary information from the stakeholders from the source area of the question, i.e. healthcare organisations (hospitals). From experience, they tend to be very hierarchical, with strong and persistent structures of collaboration. In fact, they are shaped and grown historically. Furthermore, the research subject may be assessed as ‘critical’ in terms of ‘confidentiality’ or ‘business ethics’. Prior to the start of the research project, it was already clear that a sensitive, partly taboo, context would be investigated. This is defined by ‘water hygiene’ in particular and ‘hygiene’ in general, as well as their management. The position of the responsible FM and FS people is taken. However, the responsible persons have to be identified first of all and assigned to a not yet empirically described process chain. In addition, this work is embedded in an already tense and possibly already stressed environment. This has been disseminated in articles and has already been signalled by contacts on the ground. Various reasons could be the trigger for the tension, such as rising cost pressure for hospitals, while at the same time there are investment residues for the water systems. Additionally, there may be multiple overlaps with other (sub-) process owners who are also responsible for successful infection prevention.

Despite all the challenging preconditions for the successful completion of a research project of this kind, the topic was addressed. From evidence-based facts, an overview will systematically be elaborated on to create a practice-oriented framework for managers from FM and FS, considering the theories presented. The description of a process “legionella prevention in water systems in hospitals” will be one of the fundamental steps whilst taking into account the relevant process owners. This will bridge a gap as no literature has yet been found describing legionella prevention in water systems, while at the same time considering the organisational structure from the point of view of FM and FS persons. In the field of water hygiene, a wide range of questions are of varying importance. In some cases, facts are classified as critical and complex. FM and FS have to deal with this. Therefore, it is important to describe the roles within the organisation and along a clearly identified process chain.