Assessment of early warning signs in hospital projects' front-end phase

ABSTRACT

Purpose

The front-end phase plays an important role in achieving project success, and establishment of performance measurement systems considering project challenges or pitfalls is a way of keeping track of this phase. Early warning signs, a type of proactive performance indicators, may serve as means for improving decision-making and project processes aiming for short-term and long-term project success. In this paper, we present findings from a study on early warning signs in hospital projects' front-end. A preliminary systematisation of identified signs as a contribution to front-end improvement is provided.

Design/methodology/approach

The paper is based on a mixed methods approach, using a sequential, exploratory research design comprising document studies, interviews and a survey.

Findings

We identified 62 challenges for hospital projects' front-end performance, and further established four categories of early warning signs: (i) *Structure and tools, (ii) Context and frame factors, (iii) Management* and *(iv) Relational factors and properties*. This mirrors the presence of hard and soft issues from previous studies. There is need for clarifying terminology and raising consciousness on early warning signs. Processual approaches to identify early warning signs are considered more useful than subsequent established indicators.

Originality

The findings from this paper provide insight into early warning signs in hospital projects' front-end phase. This adds to the general understanding of early warning signs and contributes to more knowledge on the front-end phase in general.

1 Introduction

Generally, public projects have gained a bad reputation due to cost overruns, time delays and poor value for money (Flyvbjerg, 2014, 2017; Morris & Hough, 1987; Volden, 2019). The experienced project failures, seen both in a short- and long-term perspective, may be explained by insufficiencies in the project's front-end phase. The front-end phase is crucial for achieving strategic project success (Samset, 2010; Volden & Samset, 2017; Williams et al., 2019). The front-end is where decisions that severely affect a project's outcome are made, characterised by uncertainty and lack of information (Samset, 2010). At this time in the project, changes come at the lowest cost and there is still time to adjust or correct the project to ensure a successful outcome, or terminate the project at an affordable cost (Klakegg et al., 2010; Volden & Andersen, 2018). Although the front-end's role in achieving project success is known, it is insufficiently understood (Williams et al., 2019). Thus, it is beneficial to gain deeper knowledge of the front-end phase for increasing the odds of a successful project outcome.

Despite great societal importance and considerable requirements for monetary resources and work force in planning and execution, hospital projects' front-end is not widely studied. There is a call for more research on this topic (Larsen et al., 2020), in order to ensure strategic project success through project improvement initiatives.

One way of keeping track of front-end phase performance would be to establish a performance measurement system monitoring the project status considering challenges or pitfalls that potentially would compromise the project outcome. This would serve as a tool for supporting project participants, perhaps especially project managers, to adjust their ongoing activities in order to fulfil project objectives both in the short-term and long-term perspective, thus aligning the project outcomes to the organisation's strategy.

At the project front-end, early warning signs (EWS) may serve as means for improving decision-making and project processes aiming for project success (Haji-Kazemi et al., 2012b). Defined simply, EWS provide information on incipient or future issues that would affect the project (Williams et al., 2012).

Nikander and Eloranta (2001) state that although signal precision improves in time, the time for countermeasures decreases because the problem's moment of manifestation is not likely to be moved farther, which serves as an argument for further exploring the role of EWS in the front-end phase of projects. The choice of the right approach for detection and reaction to EWS, however, is project and context dependent, and it should be noted that project complexity impedes the identification of EWS (Haji-Kazemi et al., 2012b; Williams et al., 2012).

However, we would argue that raising awareness on this topic is valuable. We believe that contributions that lead to deeper understanding of proper approaches to handle EWS will help the project manager in navigating through the complex front-end environments. This would contribute to improving decision-making processes which is beneficial in order to avoid unfortunate project development and results (Haji-Kazemi et al., 2012b). It is further claimed that, even when using relatively simple tools, EWS contribute to project success by giving attention to key areas in an early stage of the project (Spjelkavik et al., 2008).

Growing complexity and 'plurality' in projects, also experienced in hospital projects, make demands for more process oriented performance measurement systems and not the traditional approach of predict and control (Pesämaa et al., 2020). Hence, flexibility and control should be balanced. Systems should mirror the diversities seen in current projects, and an interesting question arises regarding whether performance measurements should be seen as tools for guidance and learning, rather than pure control systems (Ibid.).

We had a preliminary idea that approaches for handling EWS in hospital projects' front-end are scarce. To enable further understanding and looking into possibilities for establishing a performance management system comprising EWS for this setting, we started out by exploring and describing the status quo of using EWS in hospital projects' front-end. We further looked into which signals that may serve as EWS in the front-end. Systematic use of early warning approaches will most likely contribute

to improving the project performance by revealing potential pitfalls and enable the project manager to take early actions.

Hence, we ask the following research questions:

RQ1: What is the status quo of EWS in hospital projects' front-end?

RQ2: Which signals may serve as EWS for the front-end of hospital projects?

The study is set in a Norwegian context, collecting data from respondents affiliated with different hospital projects. Our aim was to establish a point of departure for highlighting EWS as a project management tool and thus a means for front-end improvement. Several Norwegian hospital projects have commenced the last decade, making it possible to gather experiences from different project settings. We combined literature and document studies, interviews and a survey to answer our research questions. The paper is structured as follows: Section 2 presents the study's theoretical background. Additionally, we provide a categorisation of EWS found in extant literature, used as a template for our interview analysis. In section 3, the methodology is outlined following the sequential research approach, first presenting the interview-part of the study and its implications for the questionnaire, and then outlining the questionnaire development. In section 4, the findings from the literature and document studies, the interviews and survey are presented and discussed. The final section provides the conclusion, implications and avenues for further research.

2   Theoretical background

The front-end phase lays the foundation for successful projects making it desirable to establish further understanding of this phase. Sufficient management of the front-end phase, including handling its inherent complexity and uncertainty, in order to make 'good decisions', improves predictability in subsequent project phases. Williams et al. (2019) point out work from several authors emphasising inadequate front-end processes and decision-making and poor front-end management as the main reasons for project failure. Klakegg et al. (2010) argue that mistakes made in the front-end lead to the

most expensive and difficult corrections in a project, which serves as a motivation to search for such potential pitfalls as early as possible in any project. Williams et al. (2012) call for further empirical research specific for sectors and project types to look into EWS variations, and to further studies of the impact of complexity in such situations. Thus, studying hospital projects' front-end phase should be suitable to help narrow this research gap.

A project's earliest warnings often emerge one or two years before manifestation of the real problem (Andersen & Fagerhaug, 2002). Detection and action regarding these warning signals will enable project managers to be proactive and take preventive actions (Haji-Kazemi et al., 2012a). Providing a system for detection and handling of the warning signals may serve as a valuable management tool for the front-end, as a remedy for decision-making in complex settings and thus implementation of strategies and policies (Haji-Kazemi et al., 2012a). The first steps in designing a performance measurement system comprise establishing an understanding of structures and processes within the project, and further to develop performance indicators before testing and adjusting the system (Andersen & Fagerhaug, 2002). The scope of this study limits us to the first steps that is gaining more understanding on what could be perceived as warning signals in hospital projects' front-end through analysing current practices and stakeholder experiences. In turn, this will form a basis for further elaboration that we wish to test on different project cases post mortem.

2.1 Early warning signs

Early warning signs (EWS) are a type of performance indicators that allow you to keep '*your eyes on the road instead of looking in the rear-view mirror'* (Andersen & Fagerhaug, 2002). Similar to Ansoff's (1975) ideas on weak signals and responses to strategic surprises, EWS represent a proactive approach for responding to strategic surprises. Following the definition of Nikander (2002, p.49), which builds on Ansoff's (1975) theory of weak signals, an early warning sign is '*…an observation, a signal, a message or some other item that is or can be seen as an expression, an indication, a proof, or a sign of the existence of some future or incipient positive or negative issue. It is a signal, omen or indication of*

future developments'. Nikander (2002, p.49) further states that these signals give information and *'…that the matter, phenomenon or issue on which information is received might come to pass in the future'.* Further, Haji-Kazemi et al. (2015) stated that there is a deficiency of literature on projects' EWS.

EWS vary with project type and context, justifying this research in attempting to establish more knowledge of the EWS phenomenon in hospital projects. Assumingly it will not be possible to make a universal list of EWS due to project context (Klakegg & Krane, 2015). For the same reason, an ultimate EWS predicting project failure cannot be found (Klakegg et al., 2016), nor is it possible to find general models describing responses to EWS due to varying situations, according to Nikander and Eloranta (2001).

According to Klakegg et al. (2016; 2010), EWS can be detected through formal assessments. Project governance regimes are generally established to improve processes, systems and regulations in order to ensure successful investments (Locatelli et al., 2014; Samset et al., 2006; Volden & Andersen, 2018), and often comprise some sort of formal assessment. Governance in projects' front-end is described as 'pivotal' (Williams et al., 2012, p.38), and is important for making things more predictable. This positively affects the decision-making processes, seen as the link between governance and improved project performance (Turner, 2020a, 2020b). By strengthening governance regimes, owners attempt to secure successful projects through identifying and acting on EWS (Williams et al., 2012). However, governance will not be effective if project assessments fail to detect EWS (Klakegg et al., 2010), and formal assessments do not capture less measurable signals that is signals based on softer issues such as feelings, culture and other social and organisational behavioural aspects. Approaches to detect softer EWS are labelled 'gut-feeling' approaches by e.g. Williams et al. (2012), Klakegg et al. (2010) and Haji-Kazemi et al. (2013). Williams et al. (2012) further hold that in order to take full advantage of the benefits incorporated in early warning management, both soft issues and hard issues (from formal assessments) should be considered. Gut-feelings are further said to be especially important in complex

situations, which is the case for hospital projects (many stakeholders, different perspectives, societal importance, cost level, longevity etc.), and for the front-end phase in general (Williams & Samset, 2010).

Growing complexity in project processes leads to the need for project managers to be both flexible and able to anticipate the future (Nikander & Eloranta, 2001). Complexity in project management encompass both structural issues, dynamics, socio-political aspects and uncertainties (Bosch-Rekveldt et al., 2011; Daniel & Daniel, 2018; Geraldi et al., 2011; Müller et al., 2011). The project context considerably contribute to project complexity, and project management practices should adapt to this context in order to sufficiently manage the project (Williams et al., 2012). However, in their study Williams et al. (2012) found quite the opposite practices: formal assessments increased with project complexity, which suppressed gut-feeling approaches. Later research indicates that governance of major public projects has developed aiming to meet the different complexities surrounding such projects (Brunet & Aubry, 2016). This also mirrors the discussions regarding conventional project management's inadequacy to deal with human and cultural relations (Nikander & Eloranta, 2001), and the need for understanding the more informal mechanisms and social aspects embedded in project complexity (Bygballe & Swärd, 2019; Cicmil & Marshall, 2005; Molaei et al., 2019).

Managing under uncertainty and complexity, as is the case for hospital projects' front-end, calls for approaches of organisational improvisation in order to improve. This means to have the ability to model, experiment and learn (Daniel & Daniel, 2018) or as described by Snowden and Boone (2007): to probe, sense and respond. Comprehension of complexity is further one of the major problems for detecting EWS (Williams et al., 2012).

2.2   EWS in extant literature

In general, it could be a challenge to know where to start looking for EWS (Williams et al., 2012). Taking into account the front-end's inherent uncertainties and lack of information, the starting point for finding EWS in this phase might be even more complex. Even if the research on EWS is scarce (Haji-

Kazemi et al., 2015), some efforts have been made to identify EWS in different projects and project phases. This study's point of departure was a literature study aiming to establish a broad overview of EWS, looking into different project phases and sectors. We considered the PMI-report '*EWS in complex projects'* (Klakegg et al., 2010), studying different sectors' and countries' project assessment routines, inter alia, the study of the Norwegian governance regime for hospital projects, and Haji-Kazemi's (2015) thesis *'The early warning procedure in projects. Foundations, approaches and challenges'* as natural starting points. Papers connected to these sources, e.g. Williams et al. (2012), Klakegg and Krane (2015) and the works of Nikander (2002) and Nikander and Eloranta (2001), were also highly relevant. These preliminary readings guided us to other papers referring to several EWS. The EWS identified from relevant literature were roughly categorised into eight categories (Table I), determined after discussions among the authors.

Table I Overview over relevant literature

CATEGORY EWS	No. EWS	AUTHORS
Goal, objectives, concept	11	Bresnen (2007); Kappelman et al. (2006); Keil and Robey (1999); Klakegg et al. (2010); Ling et al. (2013); Lorange and Nelson (1987); Philip et al. (2010); Williams et al. (2012)
Scope, data, input	25	Giegerich (2002); Haji-Kazemi et al. (2013); Kappelman et al. (2006); Klakegg et al. (2010); Lorange and Nelson (1987); Olsson and Spjelkavik (2014); Philip et al. (2010); Philip et al. (2013); Williams et al. (2012)
Competence, skills	12	Giegerich (2002); Kappelman et al. (2006); Philip et al. (2010); Philip et al. (2013); Williams et al. (2012)
Time, cost, quality	10	Giegerich (2002); Haji-Kazemi et al. (2013); Keil and Robey (1999); Klakegg et al. (2010); Philip et al. (2010); Philip et al. (2013); Williams et al. (2012)
Roles, organisation	16	Haji-Kazemi et al. (2013); Kappelman et al. (2006); Keil and Robey (1999); Klakegg et al. (2010); Lorange and Nelson (1987); Philip et al. (2010); Philip et al. (2013); Williams et al. (2012)
Relational	38	Bresnen (2007); Haji-Kazemi et al. (2013); Kappelman et al. (2006); Klakegg et al. (2010); Ling et al. (2013); Lorange and Nelson (1987); Philip et al. (2010); Philip et al. (2013); Williams et al. (2012)
Stakeholders	4	Giegerich (2002); Kappelman et al. (2006); Philip et al. (2010)
Management, tools	15	Haji-Kazemi et al. (2013); Kappelman et al. (2006); Keil and Robey (1999); Klakegg et al. (2010); Philip et al. (2010); Williams et al. (2012)

3 Methods

The current study is part of a larger project aiming to gain more insight into hospital projects' front-end phase for the purpose of improvement. To answer our research questions, we chose a pragmatic worldview to obtain the best understanding of the EWS phenomenon in this setting by using pluralistic approaches (Creswell, 2009).

We used a mixed methods design following a sequential exploratory approach that is using different data collection methods in order to answer our research questions (Creswell, 2009; Saunders et al., 2019). The chosen approach place emphasis on the qualitative data (Creswell, 2009; Saunders et al., 2019), which in our case mainly came from 13 in-depth interviews conducted in the first stage. The interview analyses served a dual purpose. First, we established a preliminary overview over the respondents' perceived challenges for the project's front-end performance that presumably would lead to problems in later project phases. Then interviews were analysed by using a modified version of Malterud's Systematic text condensation (STC)-method (Malterud, 2011), where the modification consisted of using a theoretical lens gained from the preliminary literature study for interpretation and template for the coding procedure. All data were coded using NVivo software version 12 (QSR International, 1999-2018).

In the second stage, we conducted a survey to further explore and support the interview findings enabling a preliminary systematisation of EWS in hospital projects' front-end. A questionnaire was developed based on the literature study, a study of five projects' front-end documents (investigating success factors) and the interview findings. The quantitative data provided from the survey were also used to confirm qualitative findings. The chosen study approach thus used both inductive and deductive approaches to theory building (Teddlie & Tashakkori, 2010).

Using multiple sources to collect data is further a way of triangulation, which strengthens the study's validity, and the combination of methods provides the researchers with an expanded understanding of the topic being researched (Creswell, 2009; Saunders et al., 2019; Yin, 2014).

3.1 Interviews

To provide for the respondents to speak freely and give comprehensive descriptions of the current topic, we used semi-structured interviews (Kvale & Brinkmann, 2015; Tjora, 2012). To strengthen study validity and reliability, all respondents received written information in advance (Saunders et al., 2019), and the researchers jointly discussed the interview guide and technique and did a pilot test of the interview guide (Kallio et al., 2016). Except for the pilot-interviews, the interviews were audio recorded and transcribed. All respondents gave their written consent, and information was treated confidentially in accordance with national requirements.

We conducted 13 in-depth, semi-structured interviews with respondents affiliated to three different projects or the Norwegian Hospital Construction Agency. We used a sampling strategy based on both convenience and judgement for recruitment of respondents (Marshall, 1996; Saunders et al., 2019), interviewing persons that had approximately the same role in the different projects. The interviews were performed from February 2019 until October 2019. An overview is shown in Table II.

Table II Overview over interview respondents

Respondent	Organisation	Role	Interview type	No. of interviewers
1	LHA	Managing director	Notes (pilot)	1
2	LHA	Assistant managing director	Notes (pilot)	1
3	LHA	Senior user coordinator	Recording	2
4	LHA	Senior user coordinator	Recording	2
5	NHCA	Manager/Advisor	Recording	2
6	NHCA	Planner	Recording	2
7	NHCA	Planner	Recording	1
8	RHA	Property manager	Recording	1
9	LHA	Project manager infrastructure/Advisor	Recording, Skype	3
10	LHA	Project director	Recording, Skype	1
11	NHCA	Manager counselling	Recording	1
12	NHCA/RHA	Planner/ Project manager	Recording	1
13	NHCA/RHA	Planner/ Project manager	Recording	1

The preliminary overview over perceived challenges was made using a simple Excel spreadsheet, listing sixty-two challenges. We further looked at how frequent the challenges were mentioned by the

respondents, with a cut-off of five or more or three or more mentioning the issue, respectively. The findings were further compared to findings from our literature study and to success factors found in front-end documents.

The interviews were then thoroughly analysed aiming for a rich description and further exploration of the EWS phenomenon in hospital projects' front-end.

The analysis yielded four EWS-categories comprising different signals that were perceived as important for front-end performance: *(i) Structure and tools, (ii) Context and frame factors, (iii) Management* and *(iv) Relational factors and properties*

3.2 Survey

The survey aimed at further corroborating the EWS identified in the interview analyses by collecting descriptive information on the familiarity and use of EWS in hospital projects front-end, and by establishing a preliminary systematisation by ranking of the respondents' perceived importance of the identified EWS.

In order to tailor the questions to our research context, we chose to develop the questionnaire ourselves based on prior findings. Given the experienced deficiency of research on EWS (Haji-Kazemi et al., 2015) (and even more so on hospital projects' front-end), we neither expected to find, nor found, any pre-defined questionnaire on this topic. We are, however, aware of the efforts made by the Construction Industry Institute (CII) on early warnings and their use of questionnaires for the purpose of looking into e.g. out-of-sequence work, see e.g. Abotaleb et al. (2019). Also Klakegg (2009) used a survey for exploring what people directly involved in public projects considered the most important problems leading to lack of relevance and sustainability that is strategic success. A similar study is also found in Adebisi et al. (2020).

The questionnaire was designed in three sections, the first covering demographic information about the respondents, the second covering generic questions regarding EWS and in the last section the respondents were asked to rate the EWS identified in the interview analysis (see

Table IV) according to a five point Likert-type scale going from '*Not Experienced*' to '*Very Important*'. All data were administered in a codebook providing numbered values to the ratings.

Rating questions were formulated based on the challenges found in the preliminary interviews and the categories established from the thorough interview analysis. Some adjustments to the initially discovered challenges were made by combining similar challenges and splitting others, to finally compose a manageable questionnaire for our respondents. This was done to avoid similar statements that could lead to confusion, but still be able to keep the discovered diversity from the interviews and additionally minding the relation to the literature study as well.

The categories with associated EWS are shown in

Table III.

Table III EWS categories

CATEGORY	EWS
STRUCTURE AND TOOLS	1. Vague organisation 2. Cumbersome decision-lines 3. Vague role descriptions 4. Lack of role understanding 5. Disproportional power balance 6. Unbalanced authority and actions 7. Lack of strategies and plans 8. Lack of connection between strategic plans 9. Insufficient planning guidelines 10. Point of departure is vague/badly defined project 11. Lack of information flow 12. Communication is lacking or is ineffective 13. Assessments are not performed 14. Vague objectives 15. Disagreements/misunderstandings regarding numbers/project basis 16. Lack of documentation 17. Order of planning process not followed
CONTEXT AND FRAME FACTORS	1. Outer/external context affecting the project 2. Organisational conflicts 3. Project's previous history 4. Localisation is undecided 5. Early lock-in of the project/concept 6. Vague/not adjusted financial boundaries
MANAGE-MENT	1. Project lacks anchoring in management 2. Management changes project support 3. Management shows vague ambitions for the project
RELATIONAL FACTORS AND PROPERTIES	1. Lack of mutual understanding 2. Lack of involvement or involvement level is wrong 3. Lack of honest involvement/involvement is not real 4. Lack of openness 5. Lack of/insufficient/wrong competence 6. Lack of maturity 7. Not sufficient time for maturing 8. Lack of willingness/ability to allow discussions/disagreements 9. Lack of trust 10. Hidden motives 11. Vague concept/disagreement on concept 12. Optimism bias/overenthusiasm

The respondents were also encouraged to suggest and rate potential missing EWS in each category through an open-ended question provided for each category. The questionnaire was pilot tested on four respondents with knowledge of the topic. This lead to some minor changes regarding wording and technicalities. An overview of the questionnaire is given in

Table IV.

Table IV Questionnaire outline

Section	Data	Type of question
Demographics	Q1. Employer	Multiple choice
	Q2. Experience	Y/N
	a. Role	Multiple choice
	Q3. Current role	Multiple choice
	Q4. Years of experience	Multiple choice
	Q5. Experience from phases	Multiple choice
Generics	Q6. Are you using EWS in your current project?	Y/N
	How or why not?	Open ended
	Q7. Rate the importance of reacting to EWS	Likert-scale
	Q8. Rate how difficult it is to react to EWS	Likert-scale
	Q9. Rate how difficult it is to detect EWS	Likert-scale
	Q10. How early could EWS be detected	Multiple choice
Structure and project tools (17 EWS)	Q11. Experience with these EWS, and importance	Likert-scale
	Other EWS in this category? Importance?	Open ended
Context and frame factors (6 EWS)	Q12. Experience with these, EWS, and importance?	Likert-scale
	Other EWS in this category? Importance?	Open ended
Management (3 EWS)	Q13. Experience with these EWS, and importance	Likert-scale
	Other EWS in this category? Importance?	Open ended
Relational factors and properties (12 EWS)	Q14. Experience with these EWS, and importance	Likert-scale
	Other EWS in this category? Importance?	Open ended

As for the interviews, we used a sampling strategy based on both convenience and judgement (Marshall, 1996; Saunders et al., 2019). We also asked personal contacts to suggest relevant respondents. We aimed at covering all main groups affiliated with hospital project front-end planning. The persons that were interviewed prior to the survey were all invited to participate. The survey was administered through a digital solution provided by the university to which the researchers are affiliated, and all respondents were invited by an explanatory e-mail.

The analysis of the survey comprised of frequency analysis of the demographic and generic questions, using bar charts and tables, aiming to establish an overview and description. The rating questions were

analysed by calculating the mean score and standard deviation for each EWS in order to rank the EWS in each category and overall. We also did a comparison among two groups, the owners (respondents from the local and regional health authorities) and the others, to see if there were any differences in EWS perception. For this purpose, we used the non-parametric Mann-Whitney U-test, comparing medians between the two groups. IBM SPSS-software version 26 (IBM, 1989-2019) was used for the statistical analysis.

Finally, we investigated the open-ended questions for each category of EWS using an Excel-spreadsheet, and compared these to the established EWS. We created a textual summary for each category, presenting EWS that were not included in the survey and other reflections provided by the respondents. This proved to be an informative supplement, and it contributed to broaden our understanding of EWS in hospital projects' front-end phase.

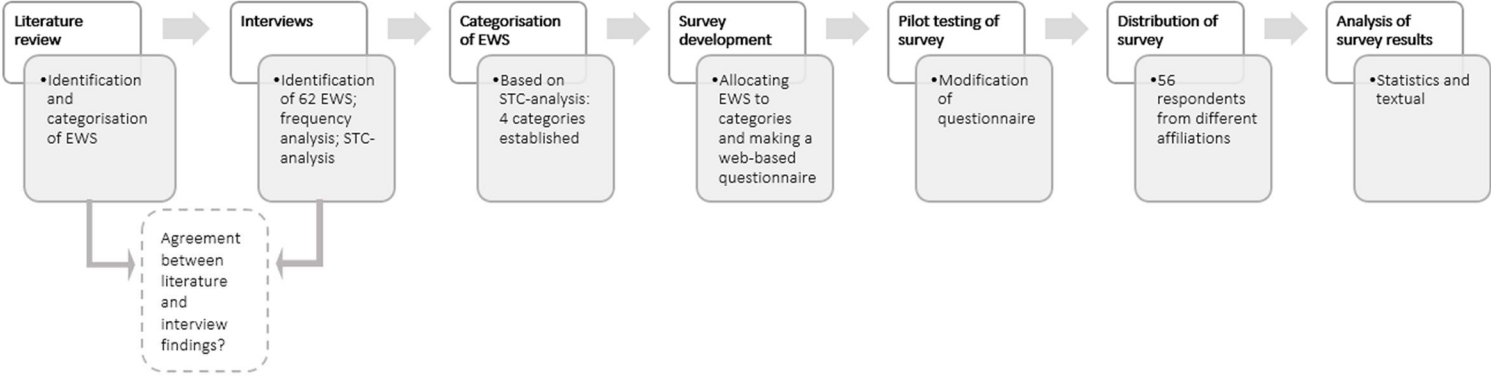An overview over the research approach is shown in Figure 1.

Figure 1 Research approach

3.3 Limitations

Some limitations should be considered for this work. The literature study covered EWS from all project phases, and not only from the front-end phase. Considering that findings from literature do differentiate between EWS in different project phases, this should probably be looked further into by e.g. evaluating the 'strength' or actual relevance of the established EWS. This might be done by looking closer at the relationship to the ratings and by collecting more empirical data to further sort and

emphasise the most important front-end EWS. However, given the scarcity in research on both hospital projects' front-end and EWS, we chose an explorative and broad approach. Further, the data is based on Norwegian projects only, which may limit the generalisability of the results. However, the findings from our interviews were in accordance with the general literature findings.

The rating procedure using a Likert-type scale also carries some uncertainties both by assigning a numerical value to experienced preferences, and by the inherent subjectivity found in rating. The participants may very well interpret the strength of the statements differently, which can also be true for one participant's interpretation among the different statements. However, for an explorative study we find this a suitable approach. It is also widely used in this type of research, it is easily understood, and provides an opportunity to gain a first overview and quantification of the given subject of study.

Due to this study's explorative approach and the nature of our data (small sample), the use of statistical analyses should be made with caution as should drawing preliminary conclusions from this work. However, the results can help us along the way of establishing more insight into EWS in the front-end of hospital projects.

4   Findings and discussion

In this section, findings and discussion on the detected EWS are provided. First, general findings from the literature study, document studies and interviews are presented, as basis for developing the questionnaire used in the survey. We then provide the descriptive findings from the survey, before the rating and ranking results from the survey are presented, followed by some general comments on these results. Then we discuss each category of EWS based on findings from the different sources used in this investigation. Further, we provide a comparison of how different groups (i.e., owners vs. project participants) perceived the suggested EWS, and finally we provide some general reflections.

4.1 General findings from the literature study, document studies and interviews

The literature study and document studies provided necessary background for composing the interview guide and making a template for interview analysis. From literature, we found EWS connected to both hard and soft issues, e.g. organisational aspects and formalities regarding objectives and scope and relational aspects such as trust, mutual respect and understanding, respectively.

Studying the front-end documents, we found the critical success factors (CSFs) to be quite similar among the different projects studied. The CSFs mainly comprised of clarity regarding goals/objectives, roles and organisation, enough time and resources for planning and executing the project, anchoring of the project to the project owner and sufficient capability for making decisions, good and timely information and having sufficient competence at all times in the project life-cycle.

To get an impression of how common the 62 detected challenges from the interviews were perceived among the respondents, we looked at which challenges were mentioned the most. Five or more respondents mentioned 19 of the challenges, while lowering the cut-off to three or more respondents, 34 challenges were mentioned. Comparison of the challenges to studied projects' success factors shows that clarity is perceived as a key issue for successful projects for both organisational and processual issues. Also, support from management and sufficient skills are viewed as important for project performance.

With a few exceptions, the identified challenges were in accordance with the findings from our literature study, even though the literature study also included EWS connected to subsequent project phases and other sectors. Thus, there is an indication that EWS are generic in a way that they may be projected to the front-end phase, making this a plausible starting point for finding EWS in hospital projects' front-end given limited knowledge and possible difficulties in knowing where to look for EWS. However, it should be taken in to account that the emphasis of different EWS in different project phases may vary. The mentioned exceptions are mainly specific for hospital projects, such as

undecided localisation, starting point for organisational change projects and sustainability treated as merely a financial issue.

4.2   Descriptive findings from the survey

25 of 56 respondents participated in the survey, leaving us with a response rate of approximately 45%.

The profile of respondents are shown in Table V.

Table V Profile of respondents

Respondent	No	%
Local Health Authority	10	40
Regional Health Authority	1	4
Norwegian Hospital Construction Agency	7	28
Engineering consultants	0	0
Architects	2	8
External QA	1	4
Other	4	16
TOTAL	25	100

The majority of respondents were affiliated with The Norwegian Hospital Construction Agency and the Local Health Authorities (68%). The 'Other' category comprised board members and project directors (16%). We also received answers from a Regional Health Authority, architects and external quality assurers, but no counselling engineers responded to this survey.

The results from the survey showed that our respondents were experienced, more than half of them having more than 11 years of experience in the field. To get an overview over the respondents' thoughts and experiences on EWS, we asked some general questions regarding the use of EWS in their current project and the importance and potential difficulties regarding detection and reaction to EWS. The answers to these questions are illustrated in Figure 2.
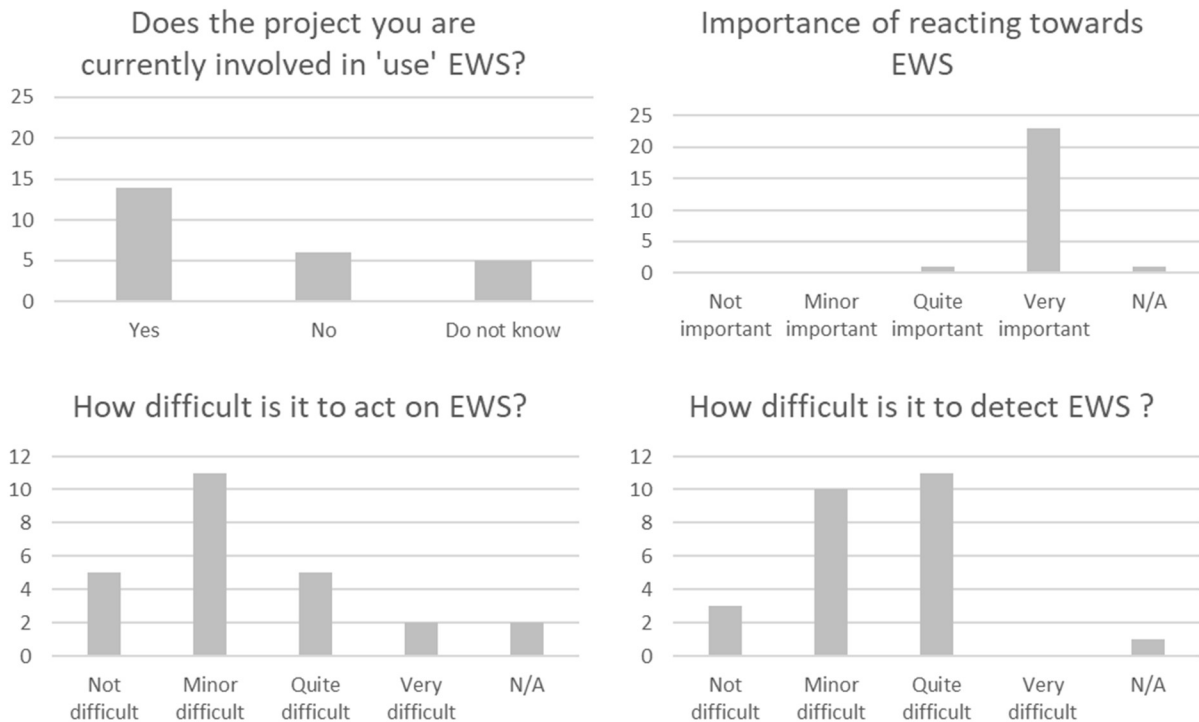
Does the project you are currently involved in 'use' EWS?

Yes	No	Do not know
14	6	5

Importance of reacting towards EWS

Not important	Minor important	Quite important	Very important	N/A
0	0	1	23	1

How difficult is it to act on EWS?

Not difficult	Minor difficult	Quite difficult	Very difficult	N/A
5	11	5	2	2

How difficult is it to detect EWS?

Not difficult	Minor difficult	Quite difficult	Very difficult	N/A
3	10	11	0	1

Figure 2 Overview over general questions

More than half of the respondents (56%) claimed that the projects they were currently involved in used EWS, thus the use of EWS appeared quite common. We further asked *how* EWS were used. The respondents gave several examples of this, such as regularly follow-ups of risk and uncertainty analyses, regularly checking the compliance of project goals and systematic use of user experiences and initiatives. In case EWS were not used, which was reported by 24% of the respondents, we also asked why this was the case. This was considered a difficult question, but responses pointed at the EWS concept being unfamiliar or unwillingness to admit or realise realities. It was also highlighted that more consistency regarding the handling and responses to EWS are needed, and that structured forms would be helpful in this manner.

The majority of respondents (92%) considered it very important reacting to EWS. This is explained by the benefits of taking early actions and make corrections thus avoiding 'preserving' challenges throughout the process, which would make the project less effective and more complex. Reacting to EWS were also said to help avoid budget overruns by making the process more predictable. It was further highlighted that changes made early are less expensive and lead to less conflicts. The projects

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were described as complex and comprehensive, which are considered to make changes expensive and more challenging in later project phases or after implementation.

We further asked if the respondents found it difficult to react to EWS, 44% of the respondents reported minor difficulties reacting to EWS, 20% did not find it difficult while 20% found it quite hard to react to these signals. When asking the respondents *how difficult* they considered it to be to detect EWS, the majority found this minor (40%) to quite (44%) difficult. The respondents explained this by several factors where the lack of experience and routines or systems for handling the EWS were highlighted. It was also said that the EWS-concept is not sufficiently introduced. Hospitals inherent complexity was further pointed at as a reason for complicating the detection of EWS due to uncertainties connected to the consequences of decisions. Unwillingness to acknowledge EWS fearing that this would damage the project was also mentioned by some respondents.

4.3   EWS categories and ranking

As discussed in the methodology section, the analyses of the interviews enabled a categorisation of EWS into four categories describing EWS in hospital projects' front-end. These categories correspond quite well to categories from established literature, e.g. Havelka and Rajkumar (2006), Nikander and Eloranta (2001), Klakegg et al. (2010) and Williams et al. (2012). The categories and associated EWS also show that the identified EWS comprise both hard and soft issues which also corresponds to literature, e.g. Williams et al. (2012), Kappelman et al. (2006). In retrospect, we became aware of two additional papers, by Adebisi et al. (2020) and Abotaleb et al. (2019), relevant for this study, which our findings also correspond to.

The survey provided a ranking of the EWS in the designated categories, and further inputs through the open-ended questions in each category. The ranking results can be viewed in

Table VI.

Table VI Ratings of EWS

EWS	Mean rating	SD[1]	GR[2]	OR[3]
STRUCTURE AND TOOLS				
Vague organisation	4,08	1,15	1	3
Cumbersome decision-lines	3,80	1,35	6	11
Vague role descriptions	4,04	0,89	2	4
Lack of role understanding	3,92	1,12	3	7
Lack of strategies and plans	3,80	1,35	7	12
Lack of connection between strategic plans	3,40	1,55	12	21
Insufficient guidelines	3,00	1,08	15	33
Point of departure is vague/badly defined project	3,84	1,52	5	10
Communication is lacking or is ineffective	3,68	0,99	9	14
Vague objectives	3,72	1,37	8	13
Disagreements/misunderstandings regarding numbers/project basis	3,92	1,15	4	8
Disproportional power balance	2,84	1,34	16	36
Unbalanced authority and actions	2,80	1,41	17	38
Lack of information flow	3,68	1,07	10	15
Lack of documentation	3,20	1,19	14	28
Assessments are not performed	3,52	1,29	11	18
Order of planning process not followed	3,24	1,67	13	27
GAMS	**3,56**			
CONTEXT AND FRAME FACTORS				
Outer/external context affecting the project (e.g. politics)	4,44	0,71	1	1
Organisational conflicts	3,60	1,41	4	17

Project's previous history	3,28	1,17	6	24
Localisation is undecided	3,96	1,49	3	6
Early lock-in of the project/concept	3,36	1,19	5	23
Vague/not adjusted financial boundaries	4,28	1,21	2	2
GAMS	**3,82**			
MANAGEMENT				
Project lacks anchoring in management	3,16	1,80	2	30
Management changes project support	2,88	1,74	3	34
Management shows vague ambitions for the project	3,28	1,81	1	25
GAMS	**3,11**			
RELATIONAL FACTORS AND PROPERTIES				
Lack of mutual understanding	4,00	1,15	1	5
Lack of involvement or level of involvement is wrong	3,52	1,33	4	19
Lack of honest involvement/involvement is not real	2,84	1,65	12	37
Lack of openness	3,40	1,38	6	22
Lack of/insufficient/wrong competence	3,88	1,33	2	9
Lack of maturity	3,20	1,35	8	29
Not sufficient time for maturing	2,88	1,33	11	35
Lack of willingness/ability to allow discussions/disagreements	3,12	1,42	9	31
Lack of trust	3,64	1,66	3	16
Hidden motives	3,28	1,51	7	26
Vague concept/disagreement on concept	3,48	1,48	5	20
Optimism bias/overenthusiasm	3,08	1,32	10	32
GAMS[4]	**3,36**			
OAMS[5]	**3,50**			

[1]SD=standard deviation; [2]GR=group rank; [3]OR=overall rank; [4]GAMS=group average mean score; [5]OAMS=overall mean score;

More than 60% of the proposed EWS were scored as '*Quite important*' or '*Very Important*' that is a score of four or five, respectively. Approximately 17% were scored as '*Not experienced*'. The overall mean score (OAMS) and the group average mean scores (GAMS) all present rating values > 3 (ranging from 3,11 to 3,82), indicating that the proposed EWS are considered to be important for the projects' front-end phase.

Table VI shows that the *Context and Frame factors* category had the highest GAMS, and also contained the two EWS with the highest overall rank '*Outer/external context affecting the project (e.g. politics)*' and '*Vague/not adjusted financial boundaries*'. Further, the *Structure and tools* category received the second highest score, while the *Management* category had the lowest rating score of the four categories. The 38 EWS are rated in a range of mean values from 2,80 to 4,44. Comparison of the rating values to the OAMS, showed that 19 of the EWS rated above or equal to this value. The majority of these EWS belonged to the *Structure and tools* category, but it should be noted that this also was the largest category comprising 17 of the 38 EWS. 11 of the 17 EWS (65% group, 58% total EWS$_{OAMS}$) rated above the OAMS in this category, 4 of 6 (67% group, 21% total EWS$_{OAMS}$) of the *Context and Frame factors* category, none of the EWS in the *Management* category, while 4 of 12 EWS (33% group, 21% total EWS$_{OAMS}$) rated above the OAMS in the *Relational factors and properties* category.

The highest ranked EWS was the projects' external context, such as political impact. Several respondents held that a constantly changing project environment exerts huge challenges for project planning. This might be difficult to mitigate but continuous dialogue between the project owner and the political forces, openness and establishment of an understanding of the impact e.g. reverse decisions have on project continuity and performance, are means suggested that might help this situation. Building a new hospital or upgrading existing services seldom lead to large disagreements

among stakeholders. However, when these processes involve new localisations or changes in service allocations, stakeholder differences clearly appear.

Several of the highest ranked EWS have common features. Lack of clarity both in the business case and in project organisation are considered unfortunate for project progress if not handled. Issues such as lack of trust and communication are also highly ranked EWS.

4.3.1 Structure and tools

The Structure and tools category comprised most EWS. The structure component mainly pointed at the need for clarity regarding organisation and roles, and was emphasised by the majority of respondents regardless of organisational belonging. One respondent said that '*Organisation and roles should be clear early in the project'* while other respondents highlighted the importance of interaction between the expert organisation and the parent organisation's management in order to prevent indecision and cumbersome processes stalling the project and wasting time and money. Mutual and clear objectives, proper project governance, communication and clear mandates were perceived as important tools to counter for the complexity and fuzziness experienced in the projects, which potentially compromise project outcome. Further, lack of or ineffective communication, e.g. due to unfamiliar terminology or stakeholder groups' jargon, was also considered unfortunate for front-end performance.

From the open-ended section in the survey, respondents highlighted that the establishment of a project organisation as early as possible in the planning process is important for the purpose of development. This connects to the project's role in the parent organisation, or the internal context. Further, the importance of uncertainty analysis as a tool for verifying that the project is within scope was mentioned. Other respondents pointed at unclear and shifting requirements from the authorities or the owner as a challenge. It was held that the owner sometimes seems to lack ambitions for the project thus leading to late clarifications, which in turn affects the planning process negatively. Lack of decisiveness was also mentioned as unfortunate for the planning process and project outcome.

Our findings point to a prominent need for clarity in these projects, which most likely attribute to the inherent complexity in these settings. However, one should be aware of that using formalities as a 'coping strategy' may compromise the front-end intentions by leading to conservatism and path-dependency, which further may prevent the development of sustainable concepts and thus strategic project success.

The respondents emphasised that experienced vagueness and deficiencies in the front-end processes were typical challenges potentially leading to problems downstream. Possessing knowledge of the front-end's inherent uncertainty and fuzziness is important for selecting the right strategy for handling this phase (Samset & Volden, 2016). The complexity inherent in the font-end phase also calls for a different set of project management skills than those seen in the execution phase of a project (Edkins et al., 2013; Morris, 2009). In these situations, it is emphasised that adaptive or improvising skills are needed (Daniel & Daniel, 2018; Snowden & Boone, 2007), and that the project manager's role is more advisory and supportive (Edkins et al., 2013).

4.3.2 Context and frame factors

For EWS belonging to the *Context and frame factor* category, particularly the political determinant was highlighted. Especially issues connected to localisation and allocation of resources was said to affect front-end planning by locking the project too early, and preventing the exploration of the opportunity space in order to find the best concept. This is further known to compromise strategic project success (Flyvbjerg, 2014; Samset et al., 2014). A respondent said that decisions sometimes are made too early and on insufficient grounds in order to reduce political turbulence, leading to compromises where no one is fully satisfied. Yet another respondent said that political considerations '*lead to planning with one hand tied at your back*', stealing focus from other front-end issues eventually leading to trouble downstream. Turbulence and uncertainties were also said to lead to path dependency in the planning processes and further loss of the broad perspective needed for front-end planning.

In the open-ended question regarding context and frame factors, the respondents highlighted that authorities should not make decisions without the completion of a 'good process' in advance. It was claimed that this always leads to bad project outcomes. As for the *Structure and tools* category, the respondents highlighted the importance for early clarifications and that requirements for changes in area and budget cuts late in the project always will be more expensive for operations.

Two of the highest ranked EWS belonged to the *Context and frame* factor category: '*External context*' and *'Badly defined financial boundaries'*. This is in line with Ansoff's (1975) view, rather than that of Nikander and Eloranta (2001), regarding where the project gets its information. This might be because we are studying hospital projects' front-end phase, where the external environment, e.g. political forces, is a strong premise provider. Project managers should adapt to the prevailing context for sufficient management (Williams et al., 2012), and the project management skills needed in this phase of a project should be reflected upon (Edkins et al., 2013).

4.3.3   Management

In the *Management* category, most respondents highlighted the need for anchoring the project to the parent organisation's management and seeing the project as a part of a strategic plan for developing the health services. Some respondents highlighted the need for (corporate) governance as very important, due to the projects' inherent complexity and turbulent nature.

However, what was a bit surprising was the low ranking of EWS connected to the *Management* category, considering the emphasised need for clarity regarding how the parent organisation's decision makers 'positioned' the project. The three EWS associated with this category were all ranked in the lower half of all EWS. One EWS was the lack of anchoring to the parent organisation's management, highlighted as a considerable challenge by several respondents in the interviews, and also seen in literature (Kappelman et al., 2006; Williams et al., 2012). In the survey, one respondent actually asked in the open-ended section if it is even possible for the project to be carried out without

management anchoring. This probably points back at differences connected to management involvement and organisational models in the Norwegian context.

Other inputs from the open ended questions on management pertained to management stability and clarity, considered as important for project performance on all levels also when management is delegated, which is common in such large projects. It was further emphasised that decisions should be made at the appropriate level in order to keep a holistic perspective, thus not making separate decisions on parts of the project without considering how this would affect the entire project. Further, the respondents highlighted trust as an important issue, where lack of trust potentially leads to serious lack of actions. Conflicts of interests in the parent organisation regarding decisions on localisation and structure of services affecting professional status and economy should also be taken into consideration when planning these projects, where management plays an important role considering information flow and providing arenas for discussions.

4.3.4 Relational factors and properties

Relational factors and properties constituted the second largest category. Lack of issues known to promote project performance such as trust, openness and sufficient skills were mentioned, as was optimism bias and overenthusiasm leading to postponement of difficult decisions. Several respondents highlighted the importance of involving stakeholders, which is in line with literature (e.g. Elf et al., 2015; Olsson et al., 2010; Pemsel et al., 2010; Zou et al., 2014), where involvement is seen as important for creating ownership and continuity, building culture and specifying demands. However, the *level* of involvement was questioned. Some respondents cautioned against a too high level of involvement since this would most likely lead to expectations and in turn possible disappointments when expectations cannot be met. The risk of false expectations is also known from literature (Daniel & Daniel, 2018), thus finding an appropriate level of involvement should be looked further into to achieve successful planning processes and lay the grounds for successful project outcomes. The turbulence

experienced in some of the projects' also lead to '*decision-makers aiming to please 'everyone'*', which in turn made projects indecisive.

Lack of maturity or time to mature were also considered issues preventing front-end performance, especially when connected to deadlines for project financing. This was particularly visible when planning parties had different skill levels. The experienced time pressure to include the project in the state budget, leaving little or no time for maturing the project among its many participants, is known to be a challenge in hospital projects (Larsen et al., 2020), and also corresponds to findings from Williams et al. (2012) and Haji-Kazemi et al. (2015). Processual approaches to planning were emphasised as partly countering the lack of maturity.

Several respondents also mentioned lack of mutual understanding regarding project objectives or project perspectives, or the project's role in the parent organisation's strategy, as risks for project performance. One of the front-end's most important missions, is to align the project to the parent organisation's strategy in order to achieve strategic successful projects (Williams et al., 2019). Hence, creating a mutual understanding of the objectives among the different project parties should be strived for. This is a EWS in itself, but also affects other issues in the front-end phase that need to be in place for goal achievement. These issues connect to the need for organisational clarity that is regarding roles and responsibility and decision lines, but also regarding a clear point of departure for the project organisation provided by the decision makers (corresponding to EWS in the *Structure and Tools* category). Bad culture and using the project as an arena to '*air the parent organisation's dirty laundry*' were also experiences made by the respondents that one should be aware of in the front-end phase.

From the open-ended questions, it was mentioned that there always is and should be a tension or some disagreement between the contractor and client organisations. If harnessed, tensions could actually serve as an asset for the project (Smith & Lewis, 2011). The relation between the project director and the director of the local health authority was also highlighted as an important issue for the project and should be mutually open and respectful. Internal differences or different opinions

regarding structure or allocation of services among professionals were also highlighted under this category as disadvantageous for trust both on the professional and managerial level. In some occasions, the projects force such decisions on the parent organisation, which in turn affect daily operations and the ability and willingness to look into future solutions.

4.3.5   Summary of findings

The findings pertaining to the four categories are summarised in Figure 3, illustrated as looking into the front-end phase through an 'early warning sign window'. Each quadrant of the window emphasises some of the most important issues in each category that should be considered in order to improve front-end performance, by avoiding pitfalls or adverse events that would compromise project outcome.
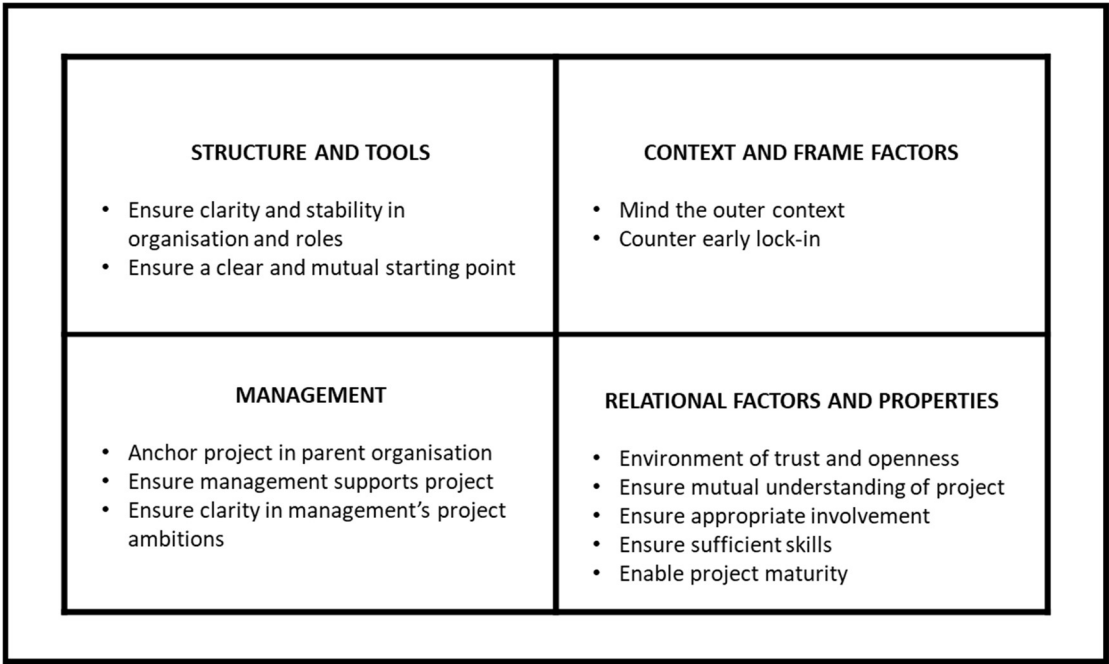

STRUCTURE AND TOOLS
- Ensure clarity and stability in organisation and roles
- Ensure a clear and mutual starting point

CONTEXT AND FRAME FACTORS
- Mind the outer context
- Counter early lock-in

MANAGEMENT
- Anchor project in parent organisation
- Ensure management supports project
- Ensure clarity in management's project ambitions

RELATIONAL FACTORS AND PROPERTIES
- Environment of trust and openness
- Ensure mutual understanding of project
- Ensure appropriate involvement
- Ensure sufficient skills
- Enable project maturity

Figure 3 The EWS window for front-end planning

4.4   Comparison of groups

We also wanted to see if there were any differences among project owners' (local health authority, regional health authority) and other project participants' (Norwegian Hospital Construction Agency, architects, external quality assurers and project board members) perception of the presented EWS in

each category. The total number of respondents was 12 for the owners and 13 for other project participants. For comparison, we used the Mann-Whitney U-test. The p-values indicate no significant differences between the groups (p-value > 0.05) however, considering the sample size, we should be careful with drawing definite conclusions. The results from the Mann-Whitney U-test are shown in Table VII.

Table VII Results from comparing EWS perception among 'owners' and 'others'

CATEGORIES	Median			p-value
	Owners	**Others**	**TOTAL**	
	N=12	N=13	N=25	
	[min, max]	[min, max]	[min, max]	
Structure and tools	**63**	**58**	**62**	0.376
	[30,78]	[39, 80]	[30,80]	
Context and frame factors	**25**	**23**	**25**	0.225
	[19, 30]	[12,28]	[12,30]	
Management	**9.5**	**11**	**11**	0.728
	[3,15]	[3, 15]	[3, 15]	
Relational factors and properties	**39.5**	**28**	**39**	0.538
	[23, 55]	[18, 54]	[18,55]	

4.5   General reflections on EWS

We found most of the front-end challenges expressed by the respondents to agree with findings from literature, even if most of EWS from literature belonged to subsequent project phases. Considering that it could be challenging to know where to start looking for EWS (Williams et al., 2012) and given the scarcity of knowledge both regarding the front-end phase (Williams et al., 2019) and EWS (Haji-Kazemi et al., 2015), leaning on existing research seem as a plausible point of departure also when

searching for EWS in hospital projects' front-end phase. Further, we found a need for clarification, illustrated by the respondents' almost unanimous feedback considering EWS importance, and seemingly extensive use of EWS in current projects, while at the same time several respondents asked for a definition of EWS before answering the survey. This indicates that the terminology may be ambiguous, or that the concept may be unfamiliar, also stated by some of our respondents

Our findings and categorisation are consistent with other findings (Abotaleb et al., 2019; Adebisi et al., 2020; Havelka & Rajkumar, 2006; Kappelman et al., 2006; Klakegg et al., 2010; Nikander & Eloranta, 2001; Williams et al., 2012), showing that EWS comprise both hard and soft issues. This should be taken into consideration in front-end planning starting with acknowledging EWS as a tool for improving planning processes and thus project performance. The formal assessments connected to hospital projects' front-end phase is a tool for finding hard EWS, but these are not sufficient for complex projects and detection of the soft issues. For complex projects, the soft issues become particularly important, which can be handled through gut-feeling-approaches as described by several authors, e.g. Haji-Kazemi et al. (2015); Klakegg et al. (2010); Nikander (2002); Nikander and Eloranta (2001); Williams et al. (2012).

Following the arguments from Williams et al. (2012) and Spjelkavik et al. (2008), approaches and exercises made to find EWS are actually considered more useful than the subsequent established indicators, which echoes the impression from our interviews. This further emphasises the importance for processual approaches providing flexibility in order to cope with project complexity (Brunet & Aubry, 2016; Cicmil & Marshall, 2005; Daniel & Daniel, 2018; Snowden & Boone, 2007), and lends support to the view of performance measurements as supportive tools for guidance, learning and decision-making (Pesämaa et al., 2020; Spjelkavik et al., 2008). Establishment of regular approaches or exercises aiming to reveal EWS might also remedy the difficulties experienced in EWS detection, reported by our respondents. This is also reported from other complex projects, e.g. Williams et al. (2012).

Although we are aware of arguments claiming that making a universal list of EWS or finding an optimal EWS could be problematic (Klakegg et al., 2016), we still aimed at systematising identified EWS due to the limited scope of this study and the context dependency seen in EWS (Klakegg & Krane, 2015; Williams et al., 2012).

EWS further seem as an appreciated approach to improve hospital projects' front-end phase. Today's practices, however, do not explicitly use early warning approaches other than those following formal assessments of the project. Hence, to fully exploit the possibilities for project improvement following EWS, there is need to raise consciousness on the topic for the studied context. Indications that main challenges in picking up EWS are found in people's minds (Williams et al., 2012), also justify this approach.

5   Conclusion

In order to improve hospital projects' front-end planning and thus project performance, this study set out to explore and describe EWS in hospital projects' front-end, and further provide a preliminary systematisation of the identified EWS, by using a sequential, exploratory research design comprising interviews and a survey. The research questions implied providing a description of the status quo on EWS in hospital projects' front-end, and further looking into which signals that could serve as EWS in this setting.

The status quo of EWS in hospital projects' front-end was obtained from the interview analysis and descriptive part of the survey. Sixty-two challenges for front-end performance were identified, and further four EWS-categories were established: (i) *Structure and tools, (ii) Context and frame factors, (iii) Management and (iv) Relational factors and properties*. This mirrors the presence of hard and soft issues from previous studies. Descriptive results showed that EWS were perceived as very important but quite difficult to detect, but it was not considered that difficult to act on EWS when first detected. EWS were seen as an appreciated and important tool for improving the front-end phase, still there is need for clarifying terminology and raising consciousness on the topic. Our results echo the findings

from literature where the actual process of identifying EWS is considered more useful than subsequent established performance indicators. Thus, the importance of processual approaches rather than pure control should be preferred in these complex environments in order to provide needed flexibility and learning.

The survey also provided possibilities for ranking the identified categories and associated EWS, thus enabling an answer to our second research question regarding which signals that may serve as EWS in hospital projects front-end. Contextual issues affecting the project, such as politics, were by far considered the most important EWS together with vague financial boundaries. Insufficient structures and tools, such as unclear organisational structures, unclear or misunderstood roles and power structures, fuzzy and cumbersome decision lines were also emphasised as important early warning signs, which may compromise project performance. A bit surprisingly, management issues received the lowest rank, while relational issues such as lack of mutual understanding of the project objectives and perspectives were considered more important. Overall, the presented EWS were seen as relevant and important, making the results of this study a suitable starting point when searching for EWS in hospital projects' front-end.

5.1 Theoretical implications

The study adds to the general understanding of EWS and further provides more knowledge on complex project' front-end phase, which in turn is beneficial for improvement. Thus, the study echoes the call for more empirical research on EWS in different project settings and the impact of complexity (Williams et al., 2012), and the need for a further understanding of the front-end phase (Williams et al., 2019). We suggest that EWS can be categorised mainly as structural or relational, as hard or soft issues or as Kappelman et al. (2006) suggest: process-related or people-related. The study further provides a preliminary systematisation of potential EWS for the front-end of hospital projects gained from experienced stakeholders in such projects.

5.2 Managerial implications

As a practical starting point, we suggest to incorporate approaches for handling EWS in the front-end manager's toolbox, serving as a supporting tool for navigating in the complex planning environments by providing knowledge or awareness regarding issues that may compromise project performance. This is important to do as early as possible in the project, since this is when changes can be made at the lowest cost and there still is time to adjust, correct or even terminate the project. Our results show that knowledge of detection and handling of EWS vary, thus the consciousness should be raised by introducing a system for regular checks in the front-end phase. This would establish experience and skills, and thus pave the way for more dynamic approaches adapted to the complexity inherent in these projects. The connection between EWS approaches and formal assessments should be strengthened, although formal assessments are not sufficient for detection of the softer issues, which are detected by gut-feeling approaches. Formal assessments, however, provide an external view through external quality assurers and thus provide other perspectives in order to ensure successful projects (Flyvbjerg, 2013; Williams et al., 2012).

Independent of hard or soft issues, dialogue is key in these projects. Involvement of stakeholders and establishment of a shared terminology enable essential discussions necessary for creating mutual understanding. Together with project governance, this further creates predictability, which is important for front-end decision-making and thus for improving project performance (Turner, 2020a, 2020b). The potential EWS highlighted in this study are of different 'strengths' that is some may prevent potential crises, while others may contribute to more modest improvements. However, given the projects inherent complexity, it is difficult to reveal cause-and-effect relationships, so none of the EWS should be neglected until more experience and knowledge are gained.

5.3 Further research

The study showed that more experience and knowledge regarding EWS in hospital projects' front-end are needed. This leads us to further avenues for research, where we initially wish to test the identified

EWS on different projects post-mortem in order to enable evaluating relevance and frequencies. Further, we wish to interview project participants in hindsight on what could have been avoided if a more active approach to EWS had been taken. This would provide the results with more rigour and enable a further validation of the suggested ranking. Looking into hospital projects in other countries would also be interesting testing the identified EWS' generalisability.

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