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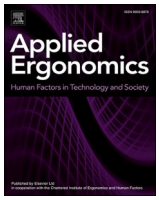
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Formal responsibility and task execution: the importance of modelling task delegation in FRAM to optimise the identification of potential improvement strategies

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A B S T R A C T

Objective: To investigate how task delegation for perioperative anticoagulation management is reported in protocols and daily practice, and how this translates to additional information in work-as-imagined and work-as-done using FRAM to identify improvement possibilities.
Methods: Existing FRAM visualisations of perioperative anticoagulant management in a Dutch academic hospital were extended to include task delegation in protocols using document analysis and in daily practice using a focus group of eight healthcare professionals, analysed using content analysis.
Results: Distinguishing between formal responsibility and task execution revealed additional functions and roles in both work-as-done and work-as-imagined, resulting in more discrepancies between work-as-done and work-as-imagined. Professionals experienced responsibility for delegated tasks, even without formal accountability, and needed to feel qualified and capable as well as complete clear information to accept these tasks.
Conclusions: Including task delegation in FRAM models improves the understanding of healthcare processes, communication about distribution of responsibilities and thereby development of more effective improvement strategies.

1. Introduction

The Functional Resonance Analysis Method (FRAM) is increasingly used in healthcare to compare care as described in guidelines or protocols (work-as-imagined) with care as delivered in practice (work-as-done)(Patriarca et al., 2020; McGill et al., 2022; Clay-Williams et al., 2015). Discrepancies identified in this comparison or information gained from daily practice could point to possibilities to optimise processes(Patriarca et al., 2020; McGill et al., 2022). In that context, FRAM visualisations are generally used to show how different tasks are interconnected in a process, and which professional performs each task (Hollnagel, 2012a; McGill et al., 2023; Salehi et al., 2021). However, this does not entirely reflect clinical practice, where a task could be delegated from a formally responsible professional to a professional executing the task(European Commission, 2019; WHO, 2008). FRAM guidelines do not distinguish between task responsibility and execution, which could be interpreted as that the professional responsible is always the one executing the task(Hollnagel, 2012b).

A common form of task delegation is the 'extended arm principle', where the formal responsibility remains with the professional delegating the task, even though this task is performed by another professional. For example, a surgical resident verifying preoperative decisions when the patient is admitted, for which the formal responsibility lies with the surgeon, or a registered nurse delegating certain tasks to nurse assistants. Successful task delegation can increase quality of care(Mirhoseiny et al., 2019; Sahmmla et al., 2023) and can lead to improved adherence to clinical guidelines (Riisgaard et al., 2019). It is seen as essential in healthcare, for instance in perioperative practice(AORN Position Statement on Delegation, 2021). However, task delegation may also reduce the quality of care, for instance, if communication about delegated tasks is not adequate(Mueller and Vogelsmeier, 2013). Therefore, incorporating the distinction between formal responsibility and execution of tasks in FRAM visualisations will result in richer information about the model and its functions and might point to additional improvement possibilities that could promote patient safety.

Having a shared perspective of how tasks are arranged can improve team performance and thereby the quality of care(Verhoeff et al., 2023; Verhagen et al., 2023). This is especially relevant since it has already been shown that healthcare professionals may have different

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Abbreviations:

FRAM Functional Resonance Analysis Method

perspectives of the tasks in work-as-done(Luijcks et al., 2025a). Previous healthcare studies have already highlighted the need to incorporate task delegation in FRAM, suggesting that task division and role clarity are important factors to analyse when interpreting a FRAM model(Damen et al., 2021; van Dijk et al., 2022). They describe the need to know the responsibilities in a process, and that lack thereof could be a risk to patient safety but did not show how this could be visualised in FRAM. Another study described that it is difficult to see the difference between who performs an action and who is responsible in FRAM(Luijcks et al., 2025b). Therefore, making task delegation explicit in FRAM visualisations can provide a more realistic overview of daily practice. Outside healthcare, two studies in the maritime domain described assigning tasks and responsibility as a factor in their analysed process although this was not explicitly modelled in their FRAM analysis(Tavakoli, 2023; Lee et al., 2020). This shows that integrating task delegation in FRAM would also be a valuable contribution for other domains than healthcare.

The current study aims to extend the FRAM methodology by integrating task delegation in data collection, analysis and visualisation. To demonstrate this, we will investigate how task delegation for perioperative anticoagulant management is reported in protocols and in daily practice, and how this translates to additional information about work-as-imagined and work-as-done using FRAM.

2. Methods

2.1. Setting and design

This study re-analysed and extended existing FRAM models of perioperative anticoagulant management in a Dutch academic hospital with approximately 1400 beds and 24 operating rooms(Luijcks et al., 2025b). These existing models of work-as-imagined and work-as-done were developed in an earlier study following standard FRAM guidelines (Hollnagel, 2012b), which do not explicitly capture task delegation. To explore how task delegation in perioperative anticoagulant management is reported in protocols and takes place in daily practice, we conducted document analysis, and an in-person focus group. Ethical approval was obtained from the Human Research Ethics Committee of Delft University of Technology (application number 5642).

2.2. Defining task delegation

Considering the concept of responsibility for a specific task, we need to distinguish between who is formally responsible (and held accountable) for the task and who executes the task. Table 1 summarises the distinctions with concrete examples from perioperative anticoagulant management and how this is shown in FRAM visualisations.

Table 1
Definitions of terms related to task delegation.

Term	Definition	Example for perioperative anticoagulant management
Formal responsibility	The professional role that is officially accountable for a task, as defined in guidelines, protocols, or legal frameworks.	The surgeon is formally responsible for perioperative decisions.
Task execution	The professional role that actually executes the task in practice.	A nurse administering anticoagulant medication.

2.3. Background of FRAM

In FRAM, the different tasks in a process are translated into functions and visualised to show how different functions are interconnected. In FRAM visualisations, functions are generally shown as hexagons (i.e. foreground functions). Each corner of the hexagon represents a different connector that links to other functions: Input, Output, Time, Control, Precondition, Resource. Functions that do not have an output are represented as circles (i.e. background functions).

2.4. Participants and data collection

Participants were recruited through purposive sampling by a surgeon from the research team (MvdL). Based on the roles identified in the previously developed work-as-done visualisation, healthcare professionals with an active role in perioperative anticoagulation management were invited to participate in the focus group. This ensured that all relevant roles were represented. A total of eight healthcare professionals across different roles participated, see Table 2. Informed consent was collected from all participating professionals.

The focus group of approximately 70 min was organised in the hospital and audio recorded. Two researchers with experience in conducting focus groups (NL & TB) with a psychological and medical background, moderated the focus group. After explaining the aim of the study, the previously developed work-as-done was used as a starting point to gain insight into whether and how task delegation takes place for each of the functions in FRAM. This was followed by more in-depth questions about task delegation in relation to responsibility. A full overview of the focus group topic list is shown in Appendix A.

2.5. Analyses

To create an updated work-as-imagined, document analysis of the most recent national and local guidelines for perioperative anticoagulation management were used (accessed June 2025) to assess how formally responsible and executing roles were distinguished in these guidelines. The audio file of the focus group was transcribed verbatim and pseudo-anonymised. Content analysis was then used to analyse the data. First, two researchers (NL & TB) familiarised themselves with the data independently and generated codes. Codes were grouped under formal responsibility and task execution, reflecting the study framework. These codes were then reviewed and refined during a meeting between the researchers (NL, TB, PMvdM, JG). Data was analysed using Atlas.ti version 25 (Atlas.ti. 2012).

The work-as-done visualisation from the previous study was updated based on the analysis from the focus group data using Figma (v.25) (Figma, 2016), incorporating a distinction between formally responsible and executing roles for each function. Experienced responsibility emerged as an additional theme from the content analysis, which was not directly modelled in the FRAM but used to interpret the implications of delegation. We defined experienced responsibility as 'healthcare professionals feeling responsible for delegated tasks for which they are not formally responsible', thereby extending the definitions shown in Table 1.

The updated work-as-done visualisation was validated with two

Table 2
Focus group participants.

Role of Healthcare Professional	Number of participants
Planner	1
Nurse	2
Surgeon	1
Anaesthetist	1
Pharmacist	1
Resident	2

healthcare professionals who were present at the focus groups, which resulted in small adjustments to the executing and formally responsible roles. Finally, the updated work-as-imagined and work-as-done models were compared with their original versions to assess the impact of incorporating task delegation in number of identified roles and functions with assigned responsibilities, which may point to possibilities for improvement if this is not clear for everyone. In addition, the updated work-as-imagined was compared with the updated work-as-done to explore discrepancies in formally responsible and executing roles.

3. Results

3.1. Formal responsibility and task execution in work-as-imagined and work-as-done

Task delegation was not explicitly specified in the guideline documents analysed for work-as-imagined, but they did describe task execution and formal responsibility. The FRAM visualisations in this study indicate formal responsibility by the colour of the connector lines which are not coloured and used for indicating information following FRAM guidelines, and the executing role by the colour of the functions. Task delegation is shown when connector colours (responsibility) differ from function colours (execution), as illustrated in Fig. 1.

Functions may be performed by a single role (e.g. surgeon) or by one of several roles (e.g. resident or nurse), as indicated in the legend of the FRAM visualisations. If a hexagon has two colours, it represents a jointly performed action. Both the updated work-as-imagined (Fig. 2) and updated work-as-done (Fig. 3) show the first four steps of the perioperative trajectory with respect to anticoagulant management.

3.1.1. Comparison between original and updated FRAM models

Table 3 summarises how incorporating task delegation affected the updated work-as-imagined and work-as-done visualisations compared to the existing FRAM visualisations without task delegation. The initial FRAM visualisations without task delegation are found in Appendix B. In the updated work-as-imagined, the number of functions and executing roles remained unchanged, but two additional formally responsible roles were identified when task delegation was incorporated. For the updated work-as-done, two additional functions were identified and 13 instead of 8 roles. Of the 13 identified roles, three were defined as formally responsible, and all 13 roles executed at least one function.

3.1.2. Differences in formal responsibility and task execution in the updated FRAM models

Most formal responsibilities were aligned between the work-as-imagined and work-as-done, with either the surgeon or the anaesthetist being the formally responsible professional in a function. Work-as-done identified one additional formal responsible role (i.e. the referrer). In addition, explicitly asking about task execution revealed five new roles in work-as-done not present in work-as-imagined. In the work-as-imagined, the role performing most functions is indicated as the surgeon or anaesthetist, whereas multiple additional roles were identified who executed the functions in the work-as-done. This presence of additional roles indicates the presence of task delegation in work-as-done.

3.1.2.1. Step 1: outpatient clinic. In step 1, the surgeon is formally responsible in work-as-imagined and work-as-done. However, in work-as-done, two functions were added compared to the existing work-as-done, i.e. the triage and scheduling of the patient, which surfaced after asking about the responsibilities and were not identified in work-as-imagined. These two functions were perceived as a shared responsibility between the referrer and the surgeon; both were indicated as formally responsible and thereby the referrer was identified as an additional formally responsible role. Task execution is found in multiple functions of work-as-done. In step 1, the patient may be seen by several professionals (nurse practitioner, resident, physician assistant, or surgeon), but the decision on the trajectory is ultimately taken by the surgeon together with the involved professionals. All functions of step 1 are executed by the surgeon in work-as-imagined. In addition, the newly

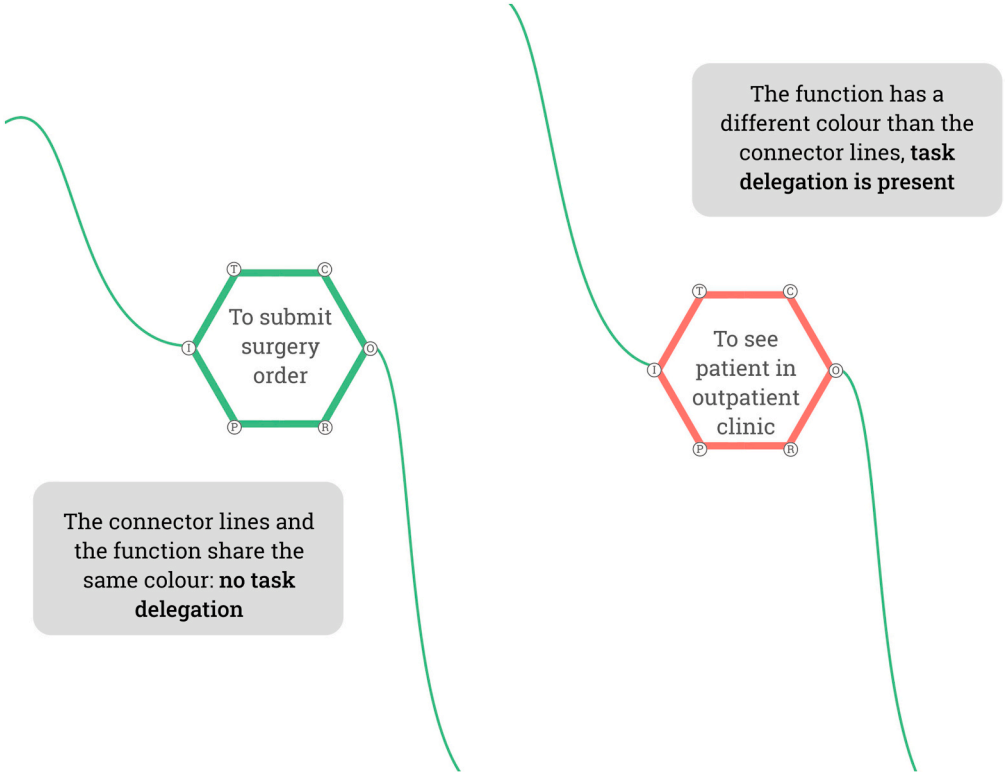


Fig. 1. Example of the indication of task delegation in FRAM functions and connectors.

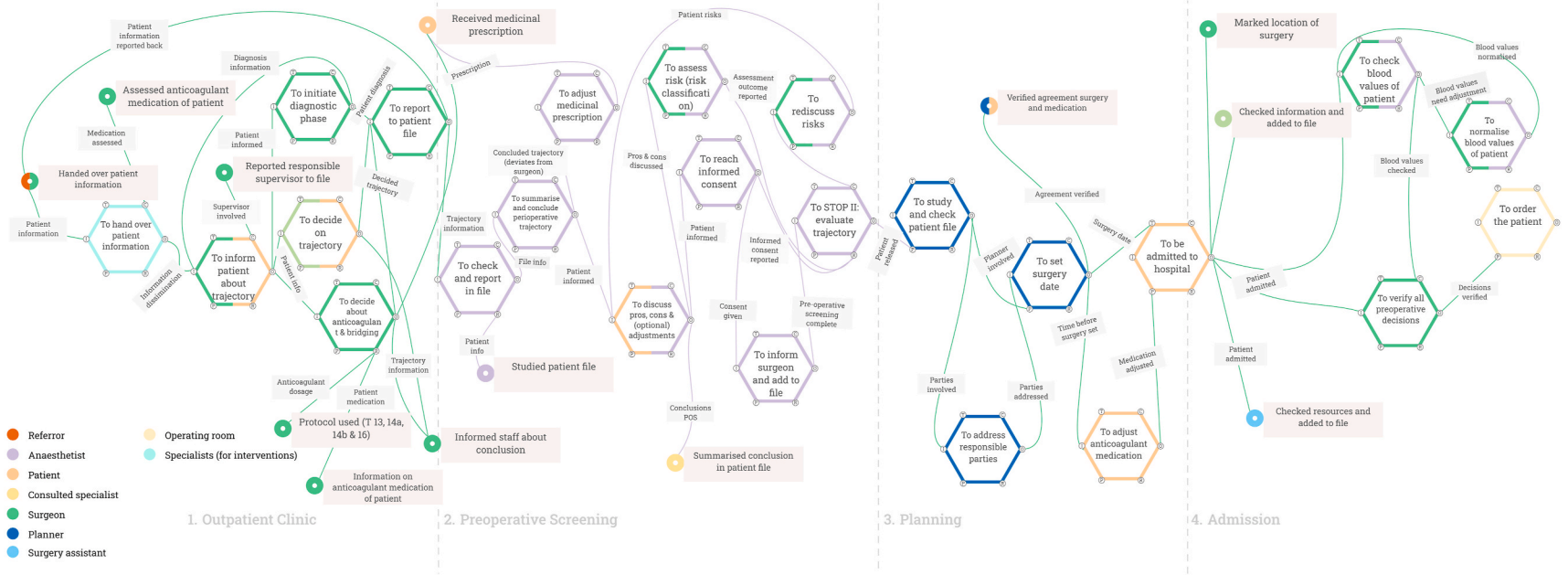


Fig. 2. Work-as-imagined FRAM visualisations of formally responsible and executing roles during anticoagulant management in the perioperative trajectory. The legend shows corresponding roles and colours. Referrer: the clinician, or general practitioner, who initiates the patient's referral to the surgical pathway and provides the initial clinical information. Planner: a scheduling coordinator who plans the operative trajectory (e.g., surgery date, admission, and resource allocation such as OR time/beds). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

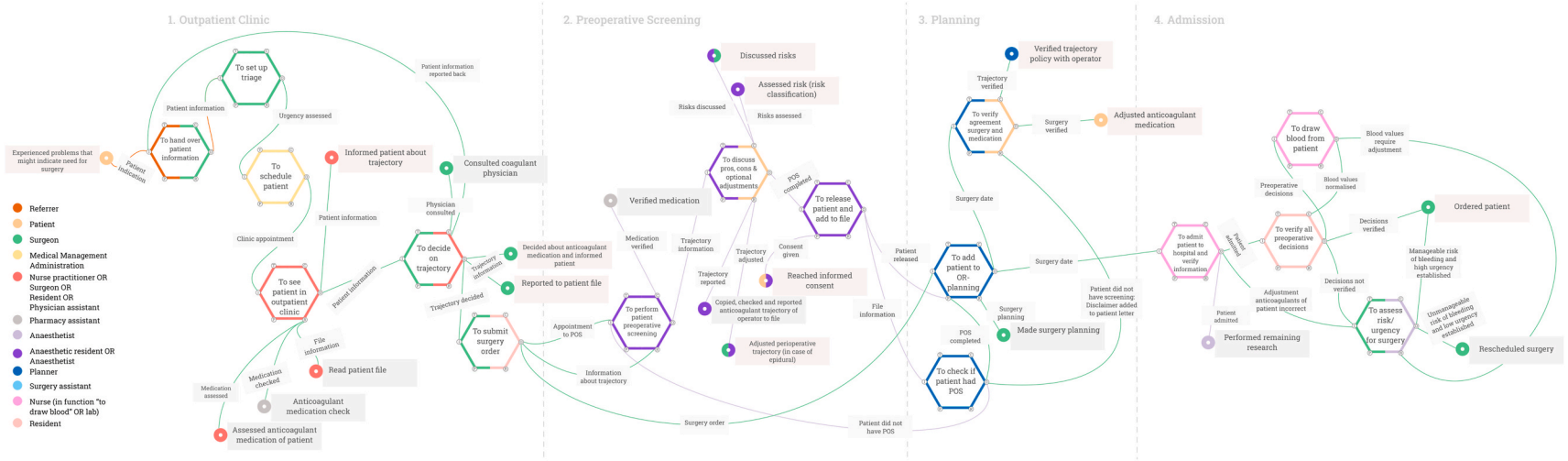


Fig. 3. Work-as-done FRAM visualisation of formally responsible and executing roles during anticoagulant management in the perioperative trajectory. The legend shows corresponding roles and colours. Referrer: the clinician, or general practitioner, who initiates the patient's referral to the surgical pathway and provides the initial clinical information. Medical management administration: administrative staff responsible for patient logistics such as registration and appointment/surgery scheduling. Nurse practitioner (NP): an advanced practice nurse trained to assess and manage patients, with scope to order tests and/or prescribe depending on local regulations. Physician assistant (PA): a clinically trained professional who provides medical care under physician supervision, including assessment and management, with scope varying by jurisdiction. Planner: a scheduling coordinator who plans the operative trajectory (e.g., surgery date, admission, and resource allocation such as OR time/beds). Resident: a doctor in postgraduate specialty training who provides patient care under (in)direct supervision, with responsibilities and autonomy increasing with experience. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Table 3
Differences between work-as-imagined and work-as-done and the updated visualisations where task delegation is analysed.

Work-as-imagined without task delegation	**Work-as-imagined with task delegation**
37 functions identified	37 functions identified
Total of 9 roles identified	Total of 9 roles identified 2 formally responsible roles
9 executing roles	9 executing roles
Work-as-done without task delegation	**Work-as-done with task delegation**
34 functions identified	36 functions identified (+2)
Total of 8 roles identified	Total of 13 roles identified (+5) 3 formally responsible roles
8 executing roles	13 executing roles (+5)

identified function of scheduling the patient was performed by the medical management administration, not by the surgeon.

3.1.2.2. Step 2: preoperative screening. The anaesthetist is formally responsible in work-as-imagined and work-as-done. In all identified functions in work-as-imagined, the anaesthetist also executes the functions, sometimes together with the surgeon. However, in the updated work-as-done, all functions executed by the anaesthetist could also be executed by the anaesthetic resident, thereby adding task execution roles.

3.1.2.3. Step 3: planning. Of all steps, work-as-imagined and work-as-done are most aligned in step 3. In both visualisations, the formally responsible role is the surgeon whereas almost all functions are executed by the planner. There were no changes or newly identified roles regarding the execution of functions in work-as-done.

3.1.2.4. Step 4: patient admission. Step 4 is the formal responsibility of the surgeon in both work-as-imagined and work-as-done. However, the anaesthetist "performed remaining research" in work-as-done. This function was already present before updating work-as-done and was not identified in work-as-imagined or its updated visualisation. This function could be seen as an extension of the pre-operative screening and therefore was identified as the responsibility of the anaesthetist, even though the overall responsibility of the whole step lays with the surgeon. In addition, the verification of preoperative decisions is performed by the resident and drawing blood by nurses whereas these functions were identified as executed by the surgeon in the updated work-as-imagined.

3.2. Experienced responsibility for task execution

Distinguishing between formal responsibility and task execution showed that professionals who were not formally responsible often felt highly responsible for delegated tasks. Accepting a delegated task therefore came with experienced responsibilities.

Feeling responsible when a task was delegated was emphasised by residents: "*I am not sure if you really are responsible, but it feels that way*" (resident 2). This was acknowledged by nurses, as it was described that more comes to mind when executing a task. In cases like medication administration, nurses felt they should know the working mechanism of certain medications and check any uncertainties to ensure that the patient receives the correct medication. *"You're not just going to hand them a pill and hope for the best, just because they should have it"* (nurse 1). This experienced responsibility was further reinforced because patients often do not know the name or type of medication they take or whether they should continue it before surgery, which is especially important for anticoagulants. "*Patients are not always aware of what they're taking.*" (nurse 1). This emphasises the importance of nurses being conscious about medication administration and reinforced their feeling of being responsible for their patients. In practice, executing a task was seen as a responsibility that included checking whether it was correct and whether it could be done safely, rather than simply executing the task without further consideration.

3.2.1. Ability to accept responsibility for delegated task

Two factors appeared that influenced the ability to accept responsibility for a delegated task: feeling qualified and capable, as well as complete, clear information.

Some tasks were delegated to professionals who did not always feel qualified or capable to perform them. For example, residents could experience a situation in which a task is delegated that they have seen people do, but have never done themselves. *"As a resident you are responsible for things in which you were never schooled theoretically, or what has been assigned in the protocol*" (resident 2). If professionals do not feel capable to execute a task, they should feel safe enough to acknowledge this to the person delegating the task, which is influenced by the organisational culture. "*This is on the border [of what I feel capable to do]. If it's delegated to you, do you feel safe to report it?*" (anaesthetist).

Organisational culture influenced whether professionals felt safe declining tasks, especially for more inexperienced professionals. In the case that someone is unsure about a task, or has never performed a task before, feeling safe enough to ask for help is vital for the quality of care. Feeling safe enough to explain not being qualified or capable can be a vulnerable position, which was described as being difficult to do by participants. "*It is challenging because you have to raise a concern [of not feeling capable], and you need an environment where you can do that"* (anaesthetist). If experienced co-workers seem very busy, it could make inexperienced professionals less likely to ask for help. This could lead to doing something that they do not feel capable enough to do. "*I think some colleagues also find it difficult to ask for help from other colleagues who are also busy"* (resident 1). Nurses mentioned that they would postpone calling colleagues if they noted that they were busy. Therefore, a lack of sufficient staffing and a high workload could negatively affect safe and effective delegation of tasks.

Experience level shaped feelings of being qualified and/or capable to accept delegated tasks. More inexperienced professionals still have to learn about the job and the organisation, and they need room to learn. A nurse defined the educational setting as important for the safety of the patient: *"That is something that I aim to teach to my students, […]"* (nurse 1). Residents defined a large transition from being an intern to becoming resident. *"From the moment you have 'resident' on your name tag, everyone that does not know you considers you are the same [as residents who have more experience]. So everyone expects that you are able to do everything that residents do who have been working here for years"* (resident 2). Residents also described mitigating factors to compensate for the lacking knowledge of inexperienced residents. For instance, junior residents are always scheduled with a more senior resident during their shift, which was perceived as comforting.

Professionals needed complete and clear information to be able to accept responsibility for a delegated task, where incomplete documentation in the electronic health record hindered task delegation. Professionals complained about the incompleteness of information regarding anticoagulant medication in electronic health record files. Information is scattered throughout the record which made it a resource-intensive task to find the correct information, which is needed to accept the responsibility for the delegated task. "*With long lists you will inevitably overlook something and then you will miss the common thread*" (anaesthetist). Healthcare professionals also mentioned that the electronic health record does not enable adding information that does not fit within the checklist: "*You're trapped in a restrictive mould full of crossed choices*" (surgeon 1). The restriction of the system was often the reason for information to be scattered in different locations, which can lead to confusion, mistakes, but also to calls to other professionals to clarify the information which could hinder successful task delegation.

Good communication was necessary for effective task delegation and in some cases to compensate for incomplete or unclear information. Miscommunication was described as a common issue, either due to the

high number of calls during shifts or to an overwhelming amount of information. "*When the phone continuously rings, when you have three phones during shifts it is a lot*" (resident 2). However, there were some organisational factors in place that improved communication about delegated tasks. During a shift, there is a designated point of contact present for questions, which is often an experienced resident. Most communication during a shift goes through calls. However, it is possible that the point of contact does not have enough knowledge about the patient in question, or that they do not have time to answer questions in time. In such cases, healthcare professionals call the next in line, which is often someone in a higher hierarchical position.

4. Discussion

4.1. Statement of principal findings

This study showed how explicitly distinguishing between formal responsibility and task execution resulted in newly identified roles and functions in FRAM visualisations, particularly in work-as-done. Most formally responsible roles were aligned between work-as-imagined and work-as-done, but a substantially higher number of executing roles was shown in work-as-done than described in the guidelines which underpins that task delegation occurs frequently in daily practice. In addition, the focus group discussion highlighted experienced responsibility for the delegated task even if they were not formally responsible. Professionals indicated that they needed to feel qualified and feel capable to accept a delegated task, and complete and clear information either documented in the electronic health record or communicated.

4.2. Strengths & limitations

This is the first study to explicitly incorporate task delegation into FRAM visualisations, which provided new insights into task distribution that would have been missed using traditional FRAM guidelines. This is an extension which will be of value to FRAM users and can be incorporated in existing FRAM guidelines. Another strength is that perspectives from different healthcare professionals from different hierarchical roles were included.

A limitation is that data were limited to a single focus group and single hospital, so that it is possible that task delegation is performed differently in other hospitals. However, we aimed to investigate how asking specifically about formal responsibility and task execution added roles and functions to gain better insights in the process. This does not need more hospitals but rather a comparison with earlier detailed work-as-done analyses in the same hospital.

4.3. Interpretation in the context of wider literature

Our study shows that following traditional FRAM methodology insufficiently captures task delegation, which is in line with descriptions about the lack of visibility on tasks and responsibilities in FRAM in previous studies(Damen et al., 2021; van Dijk et al., 2022). Both studies also described healthcare professionals experiencing issues with the electronic health record, similar to our findings. The recurrence of this problem across studies suggests that the design and usability of the electronic health record is a systemic factor that can hinder safe task delegation and accepting responsibility to execute the delegated task. The usability of the electronic health record has previously been linked to safety issues and requires improvement(Ratwani et al., 2018; Tremoulet et al., 2021).

Another key finding was the responsibility professionals experienced when accepting the delegated tasks, extending beyond mere execution. This can be linked to the concept of psychological ownership, which has been found to increase the quality of care(Adamson, 2014). Psychological ownership in the workplace can be defined as an individual feeling responsible for their role, or the organisation(Van Dyne and Pierce, 2004). In healthcare this topic has received little attention. However, Akhlaghi and colleagues researched psychological ownership in nurses and found that professional competence was an important dimension(Akhlaghi et al., 2023). Specifically, psychological ownership led to motivation in nurses to become more competent since they felt obligated and responsible for proficient care and good communication with healthcare professionals and their patients. This is in line with our findings of healthcare professionals feeling the need to be qualified and feel capable to accept the responsibility for performing a task. An important condition is therefore that junior professionals receive the appropriate support to build capability and confidence. In that context, the role of psychological ownership deserves more attention when distinguishing between formal responsibility and task execution. Further research could also explore whether and how experienced responsibility may be represented in FRAM analyses.

Although work-as-imagined and work-as-done functions are largely similar, task delegation is barely represented in work-as-imagined and does not do justice to daily practice. This is in line with work-as-imagined being described as a simplified image of reality that overlooks practical challenges(Clay-Williams et al., 2015; van et al., 2022; Tresfon et al., 2022; Hollnagel, 2013; Ashour et al., 2021). Specifically, multiple roles identified in work-as-done were missing in work-as-imagined. It could be that in guidelines, it is assumed that healthcare professionals already know that extended-arm principles occur and therefore only include the formally responsible role. However, this could cloud the clarity of who executes tasks in practice as well as undermine the feeling of responsibility in the professionals who execute the task. Therefore, apart from being explicit in the formally responsible roles, local guidelines should be explicit in the roles that execute tasks.

4.4. Practical implications & future research

From a methodological perspective, our study provides an extension of FRAM that shows how task delegation can be incorporated into work-as-imagined and work-as-done FRAM visualisations. We see this as a first step to visualise task delegation, but there could be other ways that might be better or clearer. In literature, multiple studies have made additions to FRAM visualisations to emphasise certain aspects. For instance, Damoiseaux-Volman and colleagues used icons to indicate interaction with technology in their FRAM visualisation (Damoiseaux-Volman et al., 2021). Such choices from researchers can be used to indicate specific findings in FRAM, although caution is advised since FRAM can become overly complex due to the high number of functions(Patriarca et al., 2020). We therefore used coloured connectors to provide additional insight without adding to the complexity of the model.

Besides the visualisations, task delegation could be integrated in data collection, analysis and validation of the FRAM model. This integration can serve as an improvement of the methodology by capturing more information that can affect the interpretation of the model. Including delegation as a distinct element could provide a more realistic representation of socio-technical systems and thereby better support efforts to improve safety and quality.

This study also provides multiple possibilities for future research. First, future research should examine task delegation across different

healthcare contexts and processes. For example, it is likely that task delegation is more common in academic and teaching hospitals than in general hospitals that do not have residents. Second, the different facets of task delegation should be further researched in healthcare, particularly how psychological ownership and feeling qualified and capable relates to task delegation. Furthermore, future work should also explore the generalisability of the identified factors influencing the experienced responsibility for accepting the delegated task.

5. Conclusion

Integrating task delegation using FRAM revealed additional functions, roles and responsibilities in work-as-imagined and work-as-done that were not found using traditional FRAM methodology. Our study suggests that task delegation should be used to extend FRAM methodology to provide a more realistic image of daily practice and reduce the risk of oversimplifying healthcare processes. This addition could increase the richness of gathered information using FRAM and in turn lead to improvement strategies that are better aligned with how tasks are delegated and done by healthcare professionals. Practically, acknowledging delegation and experienced responsibility for accepting the delegated task highlights the importance of effective communication, complete and accurate documentation and a supportive culture that are essential for safe and effective care. Future FRAM applications should therefore incorporate task delegation systematically in data collection, analysis, and validation. This can improve the clarity of roles and responsibilities, the accuracy of models, and the usefulness of their outputs for process improvement.

CRediT authorship contribution statement

N.M. Luijcks: Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **T. Bazuin:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **P.J. Marang-van de Mheen:** Writing – review & editing, Supervision, Methodology, Conceptualization. **M.J. van der Laan:** Writing – review & editing, Validation, Supervision, Methodology, Conceptualization. **J. Groeneweg:** Writing – review & editing, Supervision, Methodology, Conceptualization.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Focus Group Topic List

Introduction

Explanation of the previous research and today's planning. Explain Work-as-imagined and Work-as-done, in these representations responsibility could be missed. In general, it could be that tasks are delegated which makes someone responsible and someone else execute the task. Being aware of this is important to understand the process, and thus for process improvement.

Completing Work-as-done

The selected four steps of the preoperative trajectory were explained to participants. Participants were asked for each part of the process who is formally responsible and who executes the task. At the end of this phase, it was verified whether all roles were accounted for.

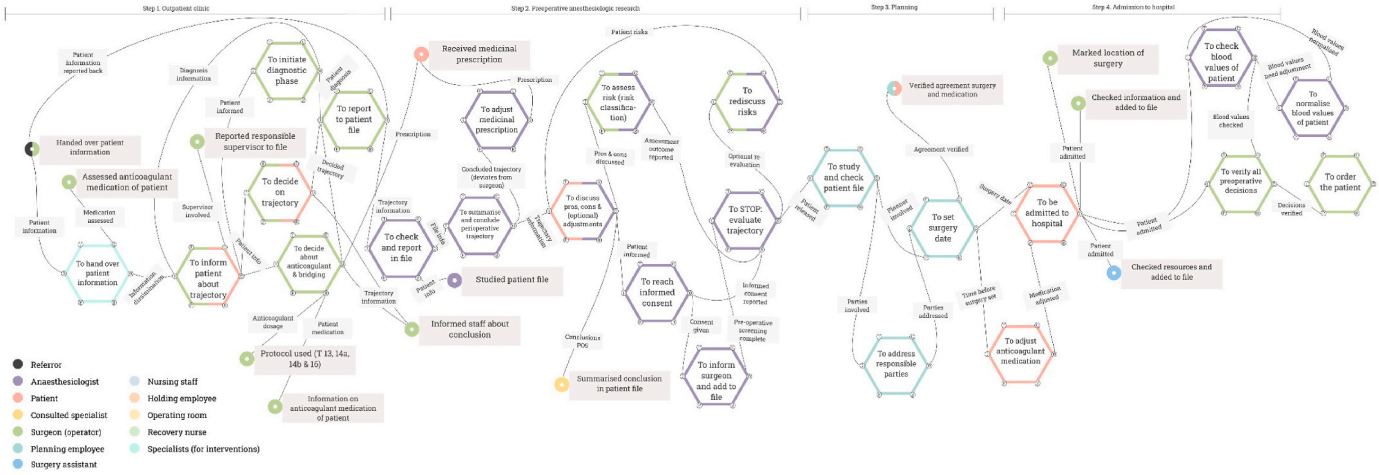
Formal responsibility and task execution

The following questions were asked to participants.

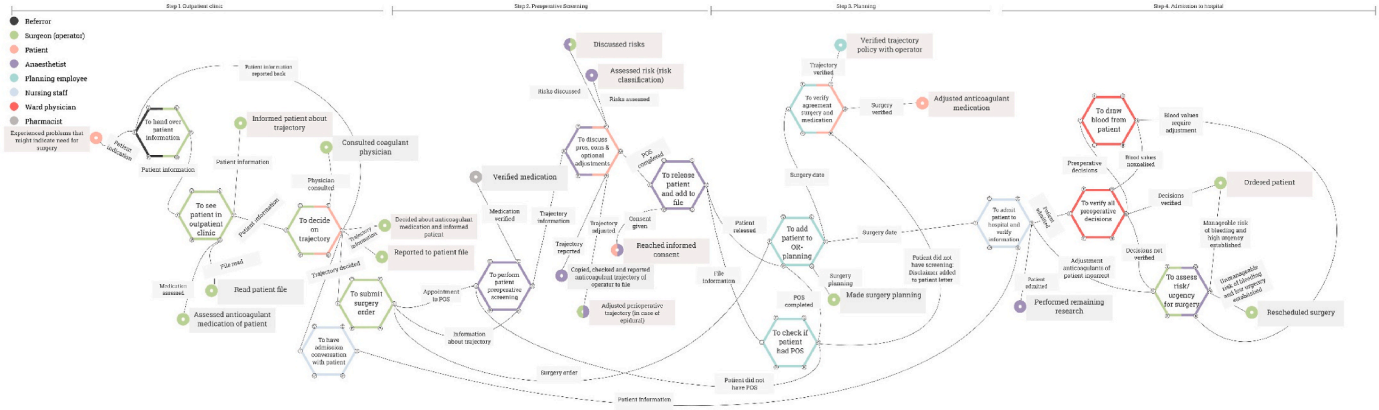
- How is responsibility interpreted in practice?
- How responsible do you feel when you execute a task?
- Does it happen that this responsibility is interpreted differently by others? What are the effects of this?
- Does it happen that responsibility is interpreted differently than you do? Does this then cause problems and how is this resolved?
- How is the difference between execution and responsibility perceived in practice?
- How is responsibility transferred?
- When could the extended arm principle form a problem?
- When is it a solution?
- How has the organisation ensured that task delegation does not cause problems?
- Are there things that could be better around differences between execution and responsibility in your current work?

Appendix B. Original work-as-imagined and work-as-done FRAM visualisations

Both visualisations were previously used in the study of Luijcks and colleagues (Luijcks et al., 2025b)



Work-as-imagined FRAM visualisation without the incorporation of task delegation.



Work-as-done FRAM visualisation without the incorporation of task delegation.

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