Safety-II in Practice: Investigating Everyday Work in an Aircraft Maintenance Organisation

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Abstract
Background: Traditionally, safety management is driven by incidents and accidents, which are investigated to identify their causes and prevent recurrence. This failure-oriented approach is commonly referred to as Safety-I. A more recent paradigm, Safety-II, emphasises learning from how work typically goes well in everyday conditions. While previous studies suggest that Safety-II investigations can generate detailed insights into everyday work, little empirical research has examined how Safety-II investigations influence organisational discussions and improvement actions. **Objective:** This study explores whether the presentation of a Safety-II investigation leads to qualitatively different discussions and improvement actions than a Safety-I investigation within an aircraft maintenance organisation. **Method:** Following a typical incident (an in-flight engine shutdown), two investigations were conducted: a Safety-I investigation focusing on the causes of the incident and a Safety-II investigation examining how one relevant work process – handovers between maintenance shifts – is typically performed. The results were presented and discussed separately during two Safety Action Groups. A qualitative abductive approach was used to analyse differences in the discussions and proposed improvement actions. **Results:** Three main differences emerged. First, the Safety-I discussion focused on a broad but surface level discussion of many different processes and actions related to the incident, whereas the Safety-II discussion focussed on a deep exploration of maintenance task handovers. Second, the Safety-I discussion involved retrospective judgements of human behaviour, while the Safety-II discussion developed a shared understanding of everyday work practices. Third, improvement actions differed from top-down imposed barriers aimed at standardisation and compliance, to bottom-up improvements intended to support the practical performance of handovers. **Conclusion:** These findings suggest that the perspective underlying an investigation, influences how the organisation perceives and performs follow-up. Safety-I emphasises deviations and the strengthening of control mechanisms, while Safety-II emphasises understanding and supporting the conditions that enable successful performance in everyday work. Both perspectives may therefore contribute to safety improvement in complementary ways.

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Introduction

> "By design, current practices for learning have a focus on reacting to events where there is a lack of safety (e.g., incidents, complaints, case reviews) and pay little attention [*sic*] to how the system usually works and performs. As a result, many of these practices are focused on individual cases and the solutions are likewise aimed at preventing specific, and often rare, failures. […] An analogy would be to study how a successful marriage is built and maintained, but only including divorced couples as study subjects." (de Vos, 2018, p. 203)

Traditionally, safety management is driven by incidents and accidents. These events are investigated to identify its causes and prevent similar events from occurring in the future. This orientation towards failure was named 'Safety-I' by Hollnagel (2013), whilst simultaneously a new paradigm was introduced: 'Safety-II' – which emphasises learning from how work usually goes right to capture the complexity and realities of everyday work.

Despite extensive theoretical development and growing interest in Safety-II, empirical testing and validation of the concept remains limited (Rae et al., 2020). In practice, most organisations continue to rely predominantly on Safety-I–oriented approaches.

This study is conducted within a Dutch Aircraft Maintenance Organisation, where the safety department is responsible for the investigation of incidents and accidents. These investigations aim to identify causes of failure and define corrective actions to prevent recurrence – reflecting a Safety-I approach. This research explores how a Safety-II perspective can be introduced into this investigation process and what it creates in terms of organisational discussions and follow-up. Accordingly, this study asks the following research question:

Does the presentation of a Safety-II investigation result in qualitatively different discussions and improvement actions compared to a Safety-I investigation in an aircraft maintenance organisation?

Current Safety-I Practices in Incident Investigations

In civil aviation, safety management has traditionally focused on incidents and accidents, with the objective of ensuring that as few things as possible go wrong (Hollnagel, 2013, p. 1). One of the primary mechanisms through which this objective is pursued is the investigation of adverse events. The International Civil Aviation Organization (ICAO) defines incident investigations as "a systematic process whereby all of the possible causes of an adverse event are evaluated and eliminated" (ICAO, 2013, pp. III-1-1).

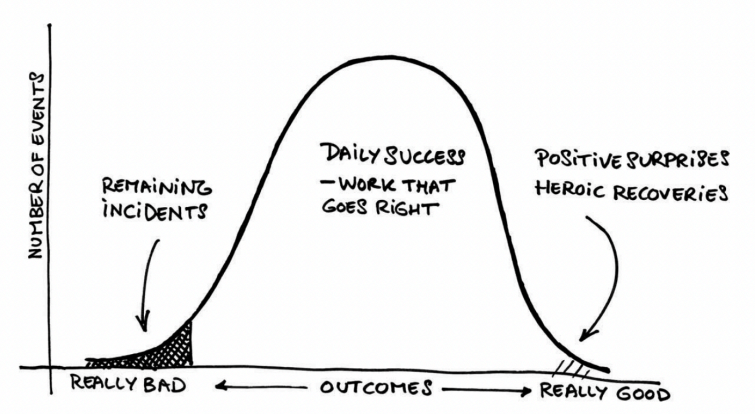
From a Safety-I perspective, failures occur when system components break down or when people deviate from prescribed boundaries – i.e. when people do not follow the procedures (Hollnagel, 2014). Investigations therefore focus on identifying how safety barriers failed, with the aim of repairing deficiencies, strengthening controls, or introducing additional barriers to prevent recurrence (Reason, 1997). As Ham (2021) summarises, traditional investigation approaches are characterised by four main assumptions:

- accidents are caused by failed system components that do not function as specified;
- accidents have specific, identifiable causes, often expressed as root causes;
- sufficient information allows investigators to designate all causes related to the accident;
- eliminating or replacing these causes will prevent similar accidents from occurring in the future.

Within this understanding of safety, the system is considered safe as long as components function correctly and procedures are followed. This approach is what Hollnagel (2014) calls 'Safety-I'. As illustrated in figure 1, Safety-I focusses on reducing the number of incidents (i.e. the black area in the figure) by investigating failures, finding its causes and eliminating them (Hollnagel, 2014).

Figure 1

Distribution of Work Events



Note. From "The 2010s and Onward: Resilience Engineering," by J. Bergström and S. Dekker, 2019, in S. Dekker (Ed.), *Foundations of Safety Science* (p. 393), CRC Press. Copyright 2019 by Taylor & Francis Group, LLC.

From Safety-I to Safety-II

A central implication of focusing exclusively on failures is that a system is assumed to be safe as long as procedures are followed and nothing (almost) goes wrong. This assumption becomes problematic in modern socio-technical systems, which according to Hollnagel (2014) are 'complex'. Complex systems consist of numerous interacting elements – such as people, processes, systems, external factors – which are working interdependently, introducing a virtually infinite number of possible situations and circumstances which may be encountered (Flach, 2012). Because of this complexity, it is impossible to anticipate all future scenarios. Hollnagel (2011) therefore argues that systems cannot be perfectly designed, proceduralised, or trained to account for every possible situation they may encounter.

If plans and procedures cannot fully anticipate operational reality, then adaptation also becomes necessary. In everyday work, practitioners continuously adjust their actions to cope with constraints, goal conflicts, trade-offs, and emerging conditions (Bergström & Dekker, 2019). Hollnagel (2009) refers to these adaptations as 'performance variability'. From a traditional

Safety-I perspective, such variability is often interpreted as a source of risk or deviation. In contrast, within complex systems, variability is not merely a threat but a prerequisite for successful functioning. Deviations from procedures are therefore not only precursors to failure, but also part of how work is typically accomplished (Hollnagel, 2014). Because the underlying conditions that produce success and failure are often similar (Bergström & Dekker, 2019), limiting analysis to adverse events provides only a partial understanding of system performance. Looking into all events gives insight into how work is performed and what makes work go well. This may be compliance with procedures and systems working as designed, but this may also include deviations from procedures or practices not covered by rules. As Rae et al. (2021) argue, the focus should be on all work events despite the outcome being a success or failure. To ensure focus on all work events, Hollnagel (2014) defined "Safety-II", a means of safety management which focusses on all work events instead of only on failures (i.e. the Safety-I safety management focus).

Although the terminology of Safety-I and Safety-II is relatively recent, the underlying ideas are not entirely new. In the 1980's, long before Safety-I and Safety-II were defined, a group of American researchers set out to understand why certain high-risk operations succeed under trying circumstances. Most notably, US Navy Nuclear Aircraft Carrier operations were studied. During field observations, Rochlin et al. (1987) aimed to understand how such high-risk systems were able to operate nearly failure free. They coined the term 'High Reliability Organization' (HRO). In multiple studies the researchers describe what, in their perspectives, contributes to ensuring a nearly error free operation (La Porte & Consolini, 1991; Rochlin, 1999; Rochlin et al., 1987). The HRO researchers Weick and Sutcliffe (2015) ultimately described that the near accident free operation could be described as a 'dynamic non-event', arguing that ensuring things go well is a result of constant adaptation to the situation and circumstances, opposed to only following procedures. The contribution of HRO researchers is that observing everyday work provides insight into what helps things going well.

Safety-II, similar to HRO, shifts the focus of safety management from preventing failures to understanding how work is typically performed and what makes work go well every day as well as uncovering performance variability (Provan et al., 2020). Hollnagel (2014) reflects this shift by defining Safety-II as "a condition where as much as possible goes right indeed preferably as a condition where everything goes right" (p. 135). HRO similarly focusses on why systems operate (nearly) accident free, despite a high-risk operating environment. The idea is that by learning from how the system typically works, we can increase the number of times work goes well. Referring back to figure 1, this opens up the possibility to study the whole spectrum of events and focussing on increasing the white area of the chart.

Safety-II in Aircraft Maintenance

Despite growing interest in Safety-II, empirical research on its application in safety critical industries at large, and within aircraft maintenance specifically, remains limited. Langer and Braithwaite (2016) did perform a pilot study by testing their maintenance operations safety surveys (MOSS), based on the LOSA programs for flight crew, to observe and learn from everyday challenges of technicians. Their study showed that technicians encounter many challenges each shift which require adaptations away from prescribed ways of working. This indicates that performance variability is constantly needed in aircraft maintenance and implementing Safety-II might therefore be beneficial to uncover these adaptations. A similar idea was also proposed by Zubowski (2022) but not empirically tested.

Langer and Braithwaite (2016) further argue that maintenance errors may remain latent for extended periods, making retrospective learning from failures difficult. By the time errors are discovered, those involved may have limited recollection of the circumstances surrounding the work. A Safety-II perspective – focusing on everyday work instead of waiting for an incident - may therefore offer additional learning opportunities.

Positioning of Safety-II

The Safety-II narrative has also received criticism (Cooper, 2022; Leveson, 2020; Verhagen et al., 2022). A major criticism is that a core foundation of Safety-II – performance variability – puts too much emphasis on the human element and its adaptability as the source of success and failure (Cooper, 2022; Leveson, 2020). It is argued that whilst performance variability may play a role in ensuring work goes well, compliance with procedures, engineered systems, and defences may also contribute, but these are silenced in the Safety-II perspective.

Another criticism is that in order to make an argument for Safety-II, Safety-I was created as a strawmen. Leveson (2020) argues that Safety-I does not actually exist and that many of the Safety-II practices are already in place before it was 'invented'. For example, the argument Hollnagel (2014) makes that, in Safety-I 'systems are perfectly designed and safe until someone deviates from a boundary' is questioned by Leveson (2020) as she has not encountered any empirical evidence of this statement. Also, the Safety-I statements that 'humans are a source of danger', and 'performance variability should be eliminated' are scrutinized for their lack of empirical evidence provided. This is also argued by Cooper (2022) who discussed that the Safety-II proposition 'humans are a source of success instead of danger' is not new and also part of Safety-I theories.

Despite these critiques, in this thesis, Safety-I and Safety-II are used as analytical lenses to distinguish between two approaches to the incident investigation process as a tool for creating safety:

> "SAFETY-I, the traditional model, focuses on eliminating known risks and analysing failures through compliance and root cause analysis. SAFETY-II, in contrast, shifts the focus toward understanding everyday operations and how successful outcomes emerge under varying conditions." (Ale & Slater, 2023)

Safety-II in Practice

While Safety-II has been extensively theorised, concerns have been raised regarding the limited empirical testing of its concepts and the lack of practical guidance for implementation (De Leo et al., 2023; de Vos, 2018; Havinga et al., 2018; Hollnagel et al., 2022; Verhagen et al., 2022). Cooper (2022) also notes that the majority of Safety-II literature problematizes Safety-I, while there are no papers empirically validating Safety-II concepts. In general, Rae et al. (2020) describe that there is a stagnation in real-world empirical testing and challenging of safety science arguments and call for more 'reality-based safety science'.

The next chapter similarly reveals limited empirical research on the application of Safety-II to safety investigations. Therefore, the aim of this research is to explore the introduction of a Safety-II inspired investigation and to examine how this influences organisational discussions and improvement actions in practice – specifically in the real-world practice of an aircraft maintenance organisation. This leads to the research question guiding this thesis:

Does the presentation of a Safety-II investigation result in qualitatively different discussions and improvement actions compared to a Safety-I investigation in an aircraft maintenance organisation?

Literature Review

The introduction chapter showed that there exists little empirical research into Safety-II. This study aims to change this by introducing the concept of Safety-II to incident investigations. The literature review will examine existing empirical studies that use Safety-II in practice, as well as studies that provide insight into the methodological aspects of a Safety-II investigation. Looking at the existing empirical work, three main uses of the Safety-II concept for investigations are identified in the literature: 1) studying everyday work practices to identify opportunities for improvement, 2) using Safety-II to reduce the gap between work-as-imagined and work-as-done, and 3) applying Safety-II perspectives to the analysis of near-misses.

Hollnagel's 'Safety-I and Safety-II: The Past and Future of Safety Management' (2014) forms the primary theoretical reference for this study. Literature searches were conducted using Scopus, with primary keywords (and variants hereof) including Safety-II, Safety-I, investigation, work-as-done, typical work, everyday work and investigating successful operations. In addition, subject matter experts were consulted to identify potentially relevant studies. The resulting publications were selected based on their apparent relevance to the research question based on the abstract, and reference lists were screened to identify further relevant literature. This chapter first reviews empirical studies that apply Safety-II perspectives for investigations, followed by an examination of methodologies used to conduct Safety-II investigations.

Safety-II Perspectives for Investigations

Safety-II is most often operationalised through studying everyday work. The study of how work is typically performed is also referred to as studying normal work (Watt et al., 2019), everyday work (Havinga et al., 2018; Rae et al., 2021) or work-as-done (WAD) (Hesselink et al., 2024; Hollnagel, 2014; Martins et al., 2022; Provan et al., 2020). This study uses the term 'everyday work' for two reasons: (1) it emphasises how work is typically performed rather than a

unique situation, and (2) it avoids normative connotations, as everyday work is not framed in terms of 'good' or 'bad' performance.

As said in the previous section, three main applications of the Safety-II concept have been identified and will be explored in the next sections.

Safety-II for improving everyday work practices

Multiple empirical studies have applied a Safety-II perspective to the collection and analysis of data from everyday work situations (Havinga et al., 2018; Hesselink et al., 2024; Olin et al., 2023). These studies focus on describing how work is performed in practice, what supports work, and how constraints are encountered and managed in everyday operations. By examining everyday work practices, researchers aim to generate insights into how work is performed and how it might be improved. However, across this body of literature, limited attention is paid to how the results of Safety-II analyses are subsequently discussed or followed-up within organisations or translated into concrete improvement actions.

In healthcare, Hesselink et al. (2024) studied everyday work at intensive care units to identify factors hindering and facilitating patient transitions. By focusing on everyday care transitions rather than adverse events, the authors identified practices that supported and hindered patients in preparing for discharge. For example, they found that "many patients mentioned that the timely information about the nearing discharge helped them to mentally prepare for upcoming care changes. However, others were overwhelmed by a sudden discharge" (Hesselink et al., 2024, p. 3). This example illustrates how a Safety-II approach can reveal both supportive practices and potential vulnerabilities within normal operations. While the study provides valuable insight into everyday work practices, it does not examine how these findings are discussed with practitioners and management or how they are used to improve the work system.

Similarly, Olin et al. (2023) conducted interviews with anaesthesiologists and anaesthesiology nurses to explore how normal work is managed whilst maintaining a low incident rate. Their findings highlighted a range of factors that support successful performance in complex situations at an individual, team and organisational level. Although the study provides a detailed account of how clinicians adapt to manage complexity in everyday work, it does not address how such insights might be translated into improvement actions or enhance existing safety practices.

Havinga et al. (2018) studied everyday work practices in mining, by observing blast crews during their daily operations to determine possibilities of introducing crew resource management (CRM) training. Through observation, the authors identified tacit practices, including non-verbal communication such as the use of specific knots in ropes or positioning of stones to signal hazards. These observations provided insight into how teams coordinate their work. The study demonstrates the value of observing everyday work to uncover how work is performed in practice but also does not further translate these findings into improvement actions.

Taken together, these studies demonstrate that Safety-II-inspired research can generate rich, empirical insights into how work is typically performed across a range of domains. However, the literature predominantly focuses on the collection and analysis of data on everyday work, with limited attention to how such insights are interpreted, discussed, and translated into improvement actions within organisational settings. Moreover, none of the identified studies explicitly examine how Safety-II investigations compare to conventional Safety-I investigations in terms of the nature of how they are interpreted by and followed up in the organisation. Addressing this gap is central to the present study.

Safety-II for Reducing the Gap Between WAI and WAD

Another application of Safety-II is to reduce the gap between 'work-as-imagined' (WAI) and 'work-as-done' (WAD) by observing and learning from everyday work (Clay-Williams et al.,

2015; Martins et al., 2022; van Dijk et al., 2022). First, the concepts of WAI and WAD need to be introduced.

The terms WAI and WAD denote different perspectives of work. Typically, WAI refers to how work is thought to be performed whilst WAD refers to how work is actually performed. During the previous century, the notions of work-as-imagined and work-as-done already developed in the France ergonomics society as respectively 'task' and 'activity' (Daniellou, 2007). According to Daniellou (2007), a distinction developed between the task – the requirements and conditions – and the activity – the conduct brought forth by operators to perform the tasks. This was seen as key to understand the motivations of workers and how workers cope with the variability encountered during daily work to achieve the task.

The concepts WAI and WAD require further specification, as "imagined" work can differ significantly depending on whose imagination is referred to (Ale & Slater, 2023; Moppett & Shorrock, 2018). Ale and Slater (2023) propose replacing 'work-as-imagined' with 'work-as-designed', which stands for the policies, rules and procedures in place. Moppett and Shorrock (2018) also introduces "work-as-described" which reflects how individuals talk about and explain their work. "Work-as-described" and its difference from work-as-done is significant as people may be unaware of certain aspects of their own performance, particularly actions which have become habitual.

van Dijk et al. (2022) studied medication reconciliation during hospital discharge by modelling both WAI and WAD using the Functional Resonance Analysis Method (FRAM). Their analysis showed that "work-as-prescribed" often underrepresents the complexity of everyday practice. Deviations from procedures were found to occur both in favour of safety, such as resolving discrepancies in medication lists, and in response to workload pressures. The authors concluded that their approach provided a deeper understanding of the process of medication reconciliation and identified differences between WAI and WAD.

Similarly, Clay-Williams et al. (2015) applied FRAM to evaluate a draft clinical guideline in two intensive care units in Australia and Denmark. Their analysis identified elements of the guideline that conflicted with existing work practices and were therefore likely to hinder successful implementation. They concluded that the FRAM analysis performed at two ICU units made it clear to the ICUs that the new guidelines would not succeed unless changes were made to fit into everyday work. These studies illustrate how Safety-II-inspired analysis can be used proactively to improve the alignment between WAI and WAD when including experiences of everyday work. Nevertheless, the follow up of the findings within the company was not addressed in these studies, nor a comparison to the 'traditional' way of working.

Furthermore, Martins et al. (2022) are among the first to explicitly apply both Safety-I and Safety-II perspectives within a single study. They approached this integration by examining the gap between WAI and WAD, where WAD was informed by both observations of everyday adaptations (Safety-II) and analyses of incidents and accidents (Safety-I). The results were subsequently discussed with operational and management teams to identify learning opportunities. Their findings suggest that integrating Safety-I and Safety-II ensures that everyday work and adaptations to unexpected situations are included in the learning processes, shifts discussions away from individual blame, and enables greater use of frontline experience when identifying improvements. The study shows that including both successful and failed situations both may inform how WAI should be adjusted to better support actual practice. This study closely aligns to the present research setup, and it is of interest to see if these results are reproduced. However, Martins et al. (2022) performed their study in the construction industry and they aimed to integrate the Safety-I and -II perspectives whilst the current study will compare the two.

Taken together, studies in this category demonstrate that studying everyday work reveals discrepancies between prescribed and actual work and provides insight on how to improve the practical feasibility of procedures. For the current study, this shows that the Safety-II

investigation should put focus on exploring and describing how work is typically performed, what challenges may be encountered and how they are resolved.

Safety-II to Analyse Near-Misses

A third application of Safety-II in the literature concerns the analysis of near-miss events, where escalation into an accident is prevented (De Leo et al., 2023; Hollnagel et al., 2022; Thoroman & Salmon, 2020). These studies treat near-misses as valuable learning opportunities, as they reveal how systems and people adapt to emerging threats while remaining in control.

Thoroman and Salmon (2020) examined the 'protection factors' that prevented near-miss incidents from escalating into accidents. Using survey and interview data from supervisors involved in near-miss events, they developed a 'ProtectionMap', which highlights interactions between protective elements across system levels. While this approach provides a rich system-level representation of protection factors, the abstract nature of the outcomes makes it less clear how the findings can be translated into concrete, practically feasible improvement actions within organisations.

Hollnagel et al. (2022) analysed an air traffic control (ATCO) situation involving an unexpected condition rather than explicitly framing the event as a near-miss. Their study primarily provides a descriptive account of the event, outlining the adaptations made by controllers to remain in control. The authors do not conduct a detailed analysis of the event, nor do they derive concrete improvement actions. Instead, they argue that such unexpected situations may serve as a useful starting point for learning, in response to Safety-II critique that it is impossible for an organisation to study everything that goes well. Studying unexpected conditions, they suggest, offers insight into how work normally goes well and highlights areas for further investigation. For the present study, which compares the Safety-I and Safety-II perspective, this gives a useful insight into how the Safety-II investigation can be scoped. As the study suggests, the Safety-II investigation may focus on an activity or process which is significant

to the Safety-I investigation. This allows to compare the investigation reports which are both based on a similar process.

De Leo et al. (2023) propose a structured framework for incorporating Safety-II principles into near-miss analysis. Their approach starts with the systematic collection of near-miss data, followed by prioritisation based on both learning potential and potential damage. The analysis then examines the causes of the event alongside the protection factors that prevented escalation. By explicitly addressing both failure mechanisms and successful adaptations, the framework integrates Safety-I and Safety-II perspectives. The framework was applied to two cases using freely available near-miss data from the European chemical industry. Through this analysis, the authors identified protection factors and hypothesis potential improvement measures. While this demonstrates the analytical potential of the framework, the proposed improvement actions remain speculative, as they were not evaluated or discussed within an operational organisation. The authors themselves note that further testing of the framework within an actual organisation is required to assess its practical usefulness and its ability to support organisational learning.

Taken together, these studies suggest that analysing near-miss events or unexpected conditions provides opportunities for Safety-II analysis. Such situations make performance variability visible and allow researchers and organisations to examine how people cope with unexpected conditions and prevent accidents. However, a near-miss analysis remains centred on specific events or scenarios, rather than on a broader exploration of everyday work across a range of situations. Also, the studies provide limited insight on how findings from near-miss analysis are discussed with practitioners and management or translated into organisational improvement actions.

Synthesis Of How Everyday Work Is Studied

The studies reviewed suggest that Safety-II investigations are able to provide descriptions of everyday work, including how practitioners adjust their activities in response to local demands, constraints, and resources. Several studies also highlight differences between work-as-described and work-as-done, without framing these differences as deviations or violations. In this sense, Safety-II investigations are primarily descriptive and exploratory in nature.

Despite this, limitations can be identified in the existing empirical literature. First, Safety-II investigations often result in rich descriptions of everyday work and how it may be improved, but relatively little attention is paid to how these descriptions are subsequently discussed, interpreted and translated into improvement actions in an organisation. The empirical focus remains on the investigation itself, rather than on how its outputs are followed up in the organisation. Only Martins et al. (2022) discussed the results of their analysis with frontline staff and management; and concluded that Safety-II shifts discussions away from individual blame and enables greater use of frontline experience when identifying improvements. The current study will assess whether these findings are also found in an aircraft maintenance organisation.

Second, no studies where found which analyse the qualitative differences in follow-up between Safety-I and Safety-II investigations within an organisation. Whilst Martins et al. (2022) did apply both a Safety-I and -II perspective to investigating everyday work , their study sought to reconcile the perspectives and not compare the differences.

Finally, no studies were found which apply a Safety-II perspective in aircraft maintenance organisations. The limitations, combined with the limited practical guidance on applying Safety-II (De Leo et al., 2023; Havinga et al., 2018; Hollnagel et al., 2022; Verhagen et al., 2022) and the broader lack of empirical research in Safety Science (Rae et al., 2020), highlight both the significance and relevance of the research question asked in this thesis.

Methodologies for Performing Safety-II Investigations

The literature discussed above demonstrates that there is no single, standardized method for performing Safety-II investigations. Rather than being defined by an analytical technique, Safety-II is operationalized through a range of approaches that vary in scope, data collection methods, analytical models, and the actors involved. Thus, Safety-II is less defined by a specific technique than by an orientation towards understanding how work is typically performed and how work goes well under unexpected conditions (Hollnagel, 2014). This section reviews methods which have been used by previous researchers to frame Safety-II investigations, as inspiration for the research design as set out in the next chapter.

Scope and Goal of the Investigation

A first methodological consideration concerns the scope and goal of the research, that is, what aspect of work is studied. Rosness et al. (2016) distinguish four research strategies for understanding normal work: 1) studies of typical operations; 2) studies of particularly successful operations; 3) studies of successful recovery; and 4) studies of how people perceive and make sense of success. The empirical work discussed in the literature review shows work performed in the first three categories, whilst the last one has received little attention in the scientific body, and no empirical works were found.

Within the first category, studies of typical operations, studies often examine a work activity or process, such as medication reconciliation or patient transitions to understand how it is typically performed and what adaptations are made (Clay-Williams et al., 2015; Hesselink et al., 2024). Olin et al. (2023) take an even wider perspective by conceptualising intraoperative anaesthesia work as a "dynamic non-event," focusing less on discrete tasks or events and more on how work is continuously organized to prevent adverse outcomes. This study may also fall in the second category, studies of particularly successful operations, similar to the studies performed by High Reliability Organisations researchers (discussed in the introduction), who examined how

organisations such as naval aircraft carriers maintain low accident rates despite operating in inherently high-risk environments (Rochlin et al., 1987).

In the third category, studies of successful recovery, the papers focus on a specific event, scenario, or unexpected condition, using it as a case for analysis (Hollnagel et al., 2022; Thoroman & Salmon, 2020). These studies provide detailed insight into how control is maintained in demanding situations and how escalation is prevented, but their findings are focussed on an incident or unique event.

Overall, an important note is provided by Rae et al. (2021) regarding a specific focus on 'failures' or 'success'. Safety-II is not necessarily focussed on successful situations (versus failures) but rather a focus on the whole spectrum of work, this requires a different approach. They state:

> "To study 'success' is to adopt the exact same ontology as to study 'failure.' The difference is in the cases selected, not in the methodology. That is why we prefer the term 'everyday work' rather than 'successful work'." (Rae et al., 2021, p. 116)

The focus should shift away from the outcomes of work towards everyday work itself, including the activities, challenges and adaptations that may result in many different outcomes every day. The present study adopts this change in focus away from outcomes towards all events, as this allows a Safety-II investigation to include all work activities and not filter out events based on their outcome.

In line with this insight, Havinga et al. (2018) coin the term *everyday work investigations* and define it as "organized activities to learn how people or organisations operate" (p. 214). By performing ethnographic observations and performing interviews, they obtain information about teamwork processes and interactions between crews. This approach will also be utilised for the present study, and thus the Safety-II investigation will similarly be referred to as an everyday work investigation.

Types of Data

A second methodological dimension concerns the type of data used to study everyday work. Most Safety-II studies focus on capturing frontline perspectives to understand how work is adapted and coordinated in everyday practice (Clay-Williams et al., 2015; Hesselink et al., 2024; Jones et al., 2018; Olin et al., 2023; Rosness et al., 2016). Studies apply (a combination of) interviews, focus groups, observations of work, and document analysis. These approaches enable to create detailed insight and description into how work is typically performed. Including both observations and interviews is important according to Moppett and Shorrock (2018), as they note that people may be unaware of certain aspects of their own performance, particularly actions which have become habitual, or people may only share what they deem relevant.

In contrast, other studies use incident or near-miss data as their empirical data, analysing documented events and investigation reports to identify both failure mechanisms and protection factors or adaptations made to prevent escalation (e.g. De Leo et al., 2023; Thoroman & Salmon, 2020). While this approach allows researchers to study a larger number of unexpected events, it is limited to the information available in the investigation reports. These reports are shaped by a Safety-I framing and may thus not contain necessary information.

Investigation Models

Safety-II investigations may be performed using a model for a specific purpose but can also rely upon a rich description of everyday work. This section explores models which have been applied as Safety-II models in previous studies. Several studies employ analytical models or frameworks to structure Safety-II investigations (Clay-Williams et al., 2015; De Leo et al., 2023; Thoroman & Salmon, 2020). Most widely used is the Functional Resonance Analysis Method (FRAM) developed by Hollnagel (2014). FRAM represents work activities as hexagonal functions, visualizing their inputs, outputs, preconditions, resources, temporal constraints, and control. This method visualizes tasks, couplings and dependencies in a system, and helps to

understand the effects of performance variability. FRAM can be used to visualize everyday work, but it has also been applied proactively to evaluate changes prior to implementation, for example by Clay-Williams et al. (2015), who assessed the practical feasibility of new clinical guidelines. Whilst a FRAM analysis may be seen as the operationalisation of Safety-II, if it is applied for this research, it might shift the focus from comparing the effects of a Safety-II perspective, towards exploring the effects of a FRAM analysis – as it is currently new to the organisation of this study.

Other analytical frameworks have been developed primarily for the analysis of near-miss events, the ProtectionMap framework (Thoroman & Salmon, 2020) and the Near Miss Management System (De Leo et al., 2023). These models focus on near misses to identify both failures as well as how further escalation of the situations were prevented. However, these models focus specifically on near misses and do not focus on studying everyday work – so they are not further considered for this study.

Finally, several studies do not employ a strict modelling framework, but instead rely on qualitative analysis and thematic coding to organize and interpret data (Hesselink et al., 2024; Olin et al., 2023). Havinga et al. (2018) also propose to create a rich description of how work is performed, suggesting three different approaches to perform a Safety-II investigation:

> "An investigation is either; (1) normative, when it tries to find the best way of doing things or find where things are currently suboptimal, (2) descriptive, when the goal is to describe and understand what currently is happening, or (3) formative, when there is a search for new possibilities to do things." (Havinga et al., 2018, p. 217)

They also provide examples of reflective interview questions, such as "Are these actions good for safety?" and "Where did these actions come from, if not from the training or procedures?" (Havinga et al., 2018, p. 217), to further explore how and why work is performed the way it is and what implications does it have for safety. This may be seen as the closest version to the concept of Safety-II which looks at how work is performed every day.

Taken together, Safety-II investigations may be performed using a model for a specific purpose but can also rely upon a rich description of everyday work. Most important is that the Safety-II philosophy is maintained whilst performing the investigation. This study will not apply a specific model – as the aim of this study is not to explore the effects of a certain model - but rather will focus on a rich description of everyday work

Synthesis of Methodologies Used to Perform Safety-II Investigations

The literature review provided several insights that inform the design of the present study. First, Safety-II investigations are characterized by an emphasis on understanding everyday work, rather than on analysing failures. To collect data for the Safety-II investigation, researchers engaged directly with those performing the work, using qualitative methods such as interviews, observations, and focus groups to uncover how work is performed. An important takeaway for the current study is (for a Safety-II investigation) to move away from looking at events based on their outcome (success or failure) towards work itself – the entire spectrum of events (Rae et al., 2021).

Also, the studies reviewed demonstrate that Safety-II is not operationalized through a single standardized method, but rather through a range of methodological choices regarding scope, data collection, and analytical framing. Safety-II is less defined by a specific technique than by an orientation towards understanding how work is typically performed and how work goes well under unexpected conditions. As stated before, most important is that the Safety-II philosophy is maintained whilst performing the investigation. The present study is inspired by the "everyday work investigation" as proposed by Havinga et al. (2018), as this method may provide rich insight into everyday work. The focus of the Safety-II investigation will be inspired by Hollnagel et al. (2022), who suggests scoping a Safety-II investigation based on a process or activity which has (almost) had an incident or accident.

Research Design

Epistemology and Methodology

This research aimed to discover what a Safety-II investigation of an event has to offer to a Dutch Airline Maintenance Organisation compared to a Safety-I investigation. This was done by exposing participants to the output of a Safety-II investigation, observing how people respond and what improvement actions they construct, and comparing these results to a Safety-I investigation.

This study situates itself in a constructionist epistemology, recognising that investigations, just as truths (or what counts as truths), are a locally and temporally constructed narrative – as are the interpretations and reactions of the participants (Gergen, 2023). The research focussed on an exploration of a single case (incident that typically is investigated) within an Aircraft Maintenance Organisation.

To answer the research question, this research is inspired by two methodological approaches. At first, this research is inspired by an ethnographic methodology (Forsythe, 1999; Wolcott, 2016). In this sense, the researcher aimed to observe and analyse the natural work situation of the Safety Action Group (SAG) (to be outlined in the next section) – which is among others the entity tasked with suggesting and monitoring improvement actions in response to investigations. Ethnography provided two inspirations for this thesis. First, the researcher aims to achieve authenticity by first-hand observing actual work being performed (the SAG discussions) instead of performing an interview to collect data – as how work is actually performed does not fully align with how people talk about work (Forsythe, 1999). Second, the researcher aimed to observe a natural work environment, to study the effects of a Safety-I and -II study in a real organisational setting.

A second methodological inspiration comes from an experimental methodology, where the researcher compared two conditions with one another, a Safety-I investigation and a Safety-II

investigation. To clarify, the term 'investigation' refers to the act of investigating an incident or (normal) work through a Safety-I and Safety-II lens, whereas the terms research or study refer to the scientific work performed here.

Research Setting

The study took place in a Dutch Aircraft Maintenance organisation. This organisation operates a Safety Management System which includes (the necessity of) investigation of (near) incidents and accidents – reflecting a Safety-I model. As is customary within the organisation, an unwanted event is investigated through a safety investigation (EASA, 2026, p. 355) and documented by a Safety Officer and subsequently presented to the Safety Action Group (SAG). The SAG includes managers from the technical department, technical training department, engineering department, HSE office and safety department, as well as Certifying Technicians representing frontline staff. During the SAG, the investigation outcomes are presented by a Safety Officer, followed by a discussion to construct improvement actions. It is typical for the company to determine during the SAG whether improvements are deemed necessary and, if so, develop these actions. This discussion is facilitated by a Safety Officer, and the improvement actions are formulated by the SAG participants. It is this discussion and its resulting improvement actions, natively part of the SAG, which was the object of study in this research. This discussion is especially relevant, as these participants have the final say in what actions are formulated and acted upon following an investigation.

The Investigations

To remain close to the typical work context, the investigations – conducted through both Safety-I and Safety-II lenses – sprung from an actual and current incident within the company. The investigations were investigated, documented, and presented following company procedures by a Safety Officer (the researcher of this study) who is a person qualified within the company to

perform incident investigations. The investigations were conducted using the underlying theoretical framework outlined above. The following sections introduce the incident and outline the distinct perspectives applied in the Safety-I and Safety-II investigations. Due to confidentiality of the information, the investigation reports cannot be disclosed as part of this research.

The Incident

The incident used for the investigations occurred in 2025 and involved an incident involving a technical issue of an aircraft, which could be related to maintenance performed on the aircraft.

As proposed by Hollnagel et al. (2022), where a Safety-I investigation focusses on finding causes of an incident, a Safety-II investigation may use the incident as a scope to explore how those activities are typically performed. The next sections will set out how the investigations were performed.

Safety-I Investigation

As set out by Ham (2021), a Safety-I investigation is able to identify all causes of an incident, as long as sufficient information is collected. Causes of the incident are characterised as broken system components, and deviations from prescribed boundaries (Hollnagel, 2014). In line with this perspective, the Safety-I investigation focuses on determining all causes and contributing factors to the incident.

The investigation started with a technical inspection of the aircraft to determine the immediate technical cause of the incident. This technical analysis indicated that the event was likely related to maintenance activities performed prior to the flight. Consequently, the scope of the investigation was narrowed to these maintenance tasks.

To collect sufficient information, relevant maintenance documentation and records were reviewed, involved technicians were interviewed, and applicable procedures were analysed. Based

on this information, a timeline of events was constructed alongside an overview of the applicable rules and procedures. In line with typical Safety-I investigative practice, these procedures were treated as barriers that should have prevented the incident from occurring (Hollnagel, 2014; Lundberg et al., 2009). Based on the identified causes, a 'Safety Issue' is formulated which arises from deficiencies in those barriers (Aviation Risk Management Solutions Working Group, 2010), in line with standard organisational practice.

To create a timeline of events, the researcher structured the interviews around the following questions:

- What maintenance tasks did you perform during your shift, and how did you perform them?
- How was the maintenance work handed over by the previous shift?
- How did you hand over the maintenance work to the next shift?
- Did you encounter any problems or unexpected situations and how did you handle them?
- Did you experience fatigue, high workload or any other pressure?

All Technicians involved in the maintenance tasks were interviewed to collect as much information as possible. Once the timeline of events and the applicable barriers were established, causes were identified by comparing the timeline against these barriers. This reflects the Safety-I assumption that systems are safe until barriers fail due to deviations from prescribed boundaries. Each identified barrier failure was documented as a cause of the incident. This report includes descriptions of:

- a factual timeline of events;
- relevant maintenance documentation;
- a technical analysis of the aircraft;
- analysis of the event and its identified causes; and
- the formulated Safety Issue.

Consistent with typical Safety-I investigative practice, the researcher intentionally used normative language (comparing behaviour against prescribed standards) and counterfactual statements (describing what people could or should have done) to indicate how work should have been performed (Dekker, 2014).

Safety-II Investigation

Hollnagel et al. (2022) state that an incident may serve as a starting point for a Safety-II investigation in order to understand how the same activity is typically performed. In this study, task handovers between shifts were selected as the focal activity, as handovers were identified as a contributing factor in the Safety-I investigation.

The aim of the Safety-II investigation was to explore how task handovers are typically performed in everyday work – in people's normal everyday (or nightshift) activities. As set out by Havinga et al. (2018), a Safety-II investigation refers to:

> "organised activities to learn how people or organisations operate. This is done to better understand how safety is created and broken in people's everyday activities, particularly in how they respond to goal interactions, local insights and resource limitations." (p. 214)

Accordingly, the everyday work investigation focussed on understanding how work is typically performed, what facilitates and hinders effective handovers (Hesselink et al., 2024), what challenges, goal conflicts and limitations are encountered and how technicians adjust to different circumstances (Hollnagel et al., 2022). Following Provan et al. (2020), attention was also given to identifying gaps between 'work-as-described' and 'work-as-done' (see chapter 2) in order to inform potential alignment of work-as-prescribed with everyday practice. As discussed in chapter 2, this investigation does not focus on events based on their outcome (i.e. success versus failure) but rather focusses on all work events.

Based on the above constructions, the researcher structured the interviews around the following questions:

- Why and how do you typically perform task handovers and what tools do you use?
- What helps you in performing this process and what hinders?
- What challenges, constraints or problems may be encountered during this process?
- If so, how are these problems resolved?
- How does the typical way of working differ from work-as-prescribed and why are procedures followed or not?

Both personnel involved in the incident and those not involved were interviewed to obtain a broad perspective on task handovers beyond the specific event. Some interviewees were consulted multiple times to clarify observations and reflect on insights from other interviews.

The resulting investigation report follows a descriptive approach, focusing on how work is performed while deliberately refraining from normative judgments about how work should be performed (Havinga et al., 2018). This report included descriptions of:

- why Technicians perform task handovers (according to themselves);
- how task handovers are performed in practice (compared to the formal procedures);
- what challenges may be encountered and how they are solved;
- what tools are used to perform task handovers; and
- what aids Technicians in performing handovers;

The procedures were included to indicate how it differs from work-as-done, rather than to describe how work should be performed. The report did not include normative language nor counterfactual statements.

Data Collection

The investigations were presented during two SAG meetings of approximately 1,5 hours. The study used a between-subjects design, each participant only attended one of two SAG meetings. Each SAG group consisted of five participants who normally attend the SAG. On top, the Safety Officers performing the investigation were present during both. Following an authentic work situation, the investigation report was presented using a slide deck, followed by a discussion about the investigation and formulation of improvement actions to improve safety.

The first session was recorded using the Microsoft Teams audio recording function and the conference room facilities. To improve audio quality, the second session was recorded using an audio recording device. Afterwards, both sessions were transcribed using the transcription function Microsoft Word, followed by manual corrections.

Data Analysis

An abductive approach was used to thematically analyse the collected data. This approach involved moving iteratively between the data and theoretical framework to identify and refine themes that help answer the research question. The main focus was on the differences between the data of the two investigations.

The analysis started by observing and relistening the discussions and interactions during the SAG meetings. Verbal communications, as well as patterns of communications and non-verbal communications were analysed to identify initial themes. Non-verbal communication was specifically observed during the live sessions. Also, tone of voice and use of wording was paid attention to. Additionally, the textual data is re-read, coded and grouped into the initial themes. These themes were then reviewed in relation to the entire data set and the existing body of literature. This will occur in iterative cycles.

While remaining reflexive during the coding process, it is acknowledged from a constructionist perspective that data interpretation is inherently shaped by the researcher's

perspective. Rather than seeking objectivity, the analysis aimed for transparency and depth, supported by careful documentation and reflection throughout the process.

Ethics

According to Ryen (2004), people who are studied have the right to know they are research subjects, what the research entails and have the right to withdraw at any time. To fulfil this right, as well as GDPR regulations, a consent form was distributed along with the invitation for the SAG, detailing the study's purpose, explaining how data will be used, assuring participants of confidentiality, and outlining the process for withdrawal (Appendix A). Names and job titles are treated confidentially and will not be disclosed in the final dissertation. Recordings of the observations and transcripts were saved on a secure and password protected OneDrive location until the final dissertation has been approved and then the recordings will be destroyed. The research did not collect data which requires permission form the Swedish Ethical Review Authority (Jonsson, 2025).

Methodological Considerations

As a Safety Officer, the researcher has experience with performing investigations following the Safety-I lens, whilst having minimal experience with Safety-II investigations. This required reflection on whether the investigations follow the Safety-I and -II concepts as laid out in the introduction. Also, the investigation reports were shared and discussed with the supervisor and examiner before commencing the data collection, who provided feedback on whether the reports reflected the Safety-I and Safety-II analytical lenses.

From an ethnographic perspective, the researcher took part in the normal working processes as well as observe as a researcher. Performing observation within the researchers own organisation might result in overlooking important aspects due to my familiarity with the company (Forsythe, 1999). This required constant reflection during and after the observations on

my tacit knowledge and assumptions. Yet, familiarity in the company helped the researcher understand the complexities of the subject. Given the relatively low hierarchical (no management) position and the participants' familiarity with the presence of the researcher, minimal influence was expected on their typical behaviour.

Results

General Description of the Safety Action Groups

The Safety-I and Safety-II investigations were presented during two SAG meetings in 2025. In each SAG, the researcher presented the investigation report using a presentation covering all aspects of the report, followed by a facilitated discussion with the support of the Flight Safety Officer (the same for both SAGs). In the Safety-I SAG, the presentation lasted 53 minutes, followed by a 55-minute discussion. The Safety-II presentation took shorter, 35 minutes, and 43 minutes were spent discussing potential improvement actions. The shorter presentation time for the Safety-II report might be explained by the absence of the timeline of events and factual description of the collected data. Both SAG meetings are in the range of the time a SAG in this company typically lasts.

In line with an in-between-subjects design, participants attended one of the two sessions and received the corresponding report. The Safety-I SAG included two Senior Managers of the Technical Department and two Senior Certifying Technicians; the Safety-II SAG included two Senior Managers of the Technical Department and three Senior Certifying Technicians. These participants represent typical participations for SAG meetings for these types of incidents. Only after the SAG had concluded, participants were informed about the content of the other investigation report.

The discussions in the SAG meetings were structured around two guiding questions: (1) whether participants had questions about the investigation and (2) whether follow-up (improvement) actions were needed and what they should entail. At the end of the sessions, a summary of the improvement actions was provided by the researcher. Both discussions resulted in a list of agreed-upon improvement actions.

All participants showed engagement during the discussion; i.e. all participants asked questions about the report, actively took part in the discussion, and provided input for the

improvement actions. The researcher perceived that all participants felt comfortable sharing their views and voice their opinions. As such, both SAG presentations and discussions resembled typical SAG meetings. No disagreements or objections were expressed regarding the content of both the Safety-I and Safety-II report or their respective presentations.

This research questions whether the presentation of a Safety-II investigation results in qualitatively different discussions and improvement actions compared to a Safety-I investigation (in an aircraft maintenance organisation). The following result sections outline three main 'differences' between the Safety-I and Safety II SAGs. Each section describes the difference that was observed, either in the reactions to the presentations, the following discussions or the proposed improvement actions.

Certain quotes are altered using [brackets] as they contain confidential information.

First Difference: The Breadth and Depth of the Discussions

The first difference between the Safety-I and -II SAGs is the breadth and depth of the discussions following the presentations of the Safety-I and II reports. The Safety-I investigation report discussion covered a wide range of topics, aiming to address all contributing factors to the event. This resulted in a surface level of exploration of each aspect. In contrast, the Safety-II discussion went into greater depth, focusing on a detailed exploration of a specific process within the organisation. Rather than covering all contributing factors, the discussion aimed to understand how one specific aspect of work is typically performed and what challenges may be encountered.

Safety-I SAG: Surface level discussions of multiple topics

As an incident investigation analysis covers all aspects determined to be related to the incident - as well as describes the collected data and timelines of the events - only a part of the available time in the SAG is allocated to each aspect of the report (and eventually to recommend

improvement actions for all factors). In a typical SAG meeting, there is about one and half hours available to discuss an investigation report and determine improvement actions. As the Safety-I investigation report discussion touches upon various different aspects, only a surface level depth of discussion is reached for each aspect. For example, the topic of task handovers accounted for less than 5 minutes (about 8%) of the total discussion time, despite this topic constituting a substantial part of the investigation report. A telling example of the surface level statements that were made concerning the topic of handovers, is a statement by a manager after the findings about task handovers were presented: "when I look at this investigation, my takeaway is that the […] policy was simply not followed." Furthermore, during the discussion of the improvement actions a technician mentioned improving discipline of the maintenance technicians to perform task handovers: "We may be a bit more critical towards each other", suggesting that merely slightly more internal discipline to follow procedures might improve the process. No more systemic or nuanced discussion around the topic of handovers took place. The surface level (and judgemental) nature of this remark was particularly remarkable, as no shortcomings of discipline (nor any other lack of 'being critical towards each other') were mentioned or suggested in the report or presentation.

The surface level discussion continued when, after the discussion phase of the SAG had ended, the improvement actions for handovers were briefly discussed. Suggestions were made which were not based on the content of the investigation report nor from a systemic or broader discussion. For example, an improvement action was proposed by a manager which refers back to the previously discussed internal discipline to follow procedures: "If labelling is the norm, then you only need to do it three times to someone [address someone if the procedure is not followed] and then [people will follow the procedures]". It was assumed that adding standard work practices to the procedure and challenging those who deviated from them would improve the situation.

Furthermore, the analysis in the Safety-I investigation report is focused on aspects the investigators considered relevant in relation to the investigation questions. However, because the report also includes a separate 'factual information' section containing unanalysed data, participants were able to conduct their own interpretations or raise questions not addressed in the analysis. While this is not discouraged by the investigators, it does take time for additional topics to enter the discussion and thus broaden the discussion even more. For example, one manager introduced a potential contributing factor that was not described in the report. This question became a central element of the subsequent discussion and ultimately resulted in one of the main follow-up actions identified. Later in the session, participants redirected the discussion away from the investigation report on two further occasions by introducing additional contributing factors of their own.

In summary, the Safety-I SAG's discussion consisted of six main topics and a multitude of small items which were shortly mentioned. Within the 55 minutes of discussion after the Safety-I investigation presentation, the level of depth for each of these aspects was limited. This can also be seen in the big variety of topics of the improvement actions that were defined during the Safety-I SAG. The following actions were suggested in no chronological order:

1. Introduce a specific planning and preparation process for (new) complex maintenance tasks;
2. Introduce formal standard work practices for labelling and ordering components after removal to increase uniformity;
3. Make available again a paper hand-over form;
4. Include the maintenance tasks performed during the incident in the Critical Task procedures;
5. Share the investigation report with the OEM;
6. Include this case in training material for the next season;
7. Publish feedback to all employees of the technical organization.

The actions cover multiple different processes and range from communication, to training, to extending procedures and introducing new procedures for various topics. This illustrates the breadth – and as a result of the available time, the limited depth – of the topics discussed in the Safety-I SAG.

Safety-II SAG: A Deep Discussion of a Singular Topic

In contrast to the Safety-I SAG, the Safety-II investigation focused on a single topic for learning, selected by the investigator: task handovers. The discussion remained centred on this topic throughout the session. One technician did note that a specific aspect was missing from the report: "something I found lacking in the entire report [is a certain aspect of task handovers related to certification]"—and this point was discussed further during the session. However, this did not introduce a new topic; rather, it extended the discussion within the existing scope of task handovers.

This focused scope enabled a detailed and nuanced exploration of how task handovers are performed in practice and how they might be supported or improved. Participants frequently deepened the discussion by considering multiple scenarios and operational constraints which influence the task handover process. These scenarios were discussed to obtain an understanding of the variability of the process and how this should be accounted for in the improvement actions. For example, one technician highlighted an important the trade-off between administrative burden and available time when conducting handovers, stating: "You also need to factor in the margin, because it does mean that you spend a quarter of your shift on administration, so to speak." This introduced a discussion on the efficiency of performing handovers. To add to this, another participant later referred to situations involving shift-exceeding critical tasks, such as "rigging flight controls," this added to the discussion that whilst handovers should be performed efficiently, it should also be thoroughly documented and at the

right moments. These statements added to a deeper exploration of the different dimensions of handovers.

In short, the discussion naturally focussed solely on the subject of task handovers – the main focus the Safety-II investigation. This is also reflected in the resulting improvement actions, which all concern the topic of handovers:

1. Collect information about which tools and processes are used for handovers at similar maintenance parties;
2. Reiterate the policy for handovers to match typical work and set practically feasible standards;
3. For the short term, revise and make available a paper form used for task handovers which is easy in use;
4. For the long term, investigate the possibility to introduce new tools to perform handovers;
5. Investigate how the culture might be influenced on how people perform handovers;
6. Communicate about the content of the report about how handovers are conducted in practice and the corresponding improvement actions.

While the actions address different aspects of handovers, they are all intrinsically related and built upon an in-depth discussion of the topic of handovers, with a specific focus on improving handovers in everyday maintenance practice.

Second Difference: The Responses To Human Performance

A second difference between the Safety-I and Safety-II SAGs is the participants' responses to human actions and decisions described in the respective reports and presentations. Both reports contain detailed information about how people perform their work – either during or prior to the incident (Safety-I report) or during typical maintenance work (Safety-II report). This, obviously, gives the SAG participants the option to judge the human actions or decisions made;

i.e. they may agree with, contest, or reinterpret the behaviour based on their own experiences and expectations.

During the Safety-I discussion, it was observed that participants expressed surprise and judgment—both verbally and non-verbally—toward the individual actions described in the report. They reflected on what they would have done differently in the same situation, occasionally using 'counterfactual statements' about what people could or should have done to prevent the incident (Dekker, 2014). In contrast, during the Safety-II discussion, participants recognised the described practices as representative of their own experiences. Rather than evaluating and judging individual behaviour, the discussion focused on collective patterns of practice and how these might be improved.

Safety-I SAG: Surprise and Judgmental Reactions to Human Performance

Throughout the discussion following the Safety-I presentation, participants expressed criticism of human performance through their reflections on the actions taken, their tone of voice, and the way they questioned how the work had been carried out. These responses suggested that participants had not expected the individuals involved in the incident to act in the manner described in the report and often used counterfactual reasoning. Although participants did not blame the individuals involved or call for retribution, their remarks contained implicit judgements about performance.

This normative judgement became particularly visible during the discussion of the timeline of events, when participants expressed surprise explicitly as well as implicitly through their tone of voice. For example, one technician expressed surprise by stating: "but if you miss [a certain item], that's a bit strange. The fact that we have [a certain procedure], but nothing has been [done], is not quite right." Another technician similarly remarked: "it surprises me that they overlooked [an aspect during the maintenance tasks] twice." In reflecting on a finding described in the report, a technician stated with a judgemental tone of voice:

> "It is also a bit basic knowledge, if you take something apart and it is more than 10 parts, then you [follow a certain practice]. It could not be that [you do it a certain way] and then you are going to try to put it back together."

Normative statements were also made through questions that compared the human performance stated in the report with what participants considered appropriate practice. For instance, a manager asked: "but if you are talking about extensive maintenance tasks and [a certain conditions happens], then as a [person in a certain position] you have the task to address this situation." Rather than seeking factual clarification, this question reflected an expectation that a particular role-based action should have been taken.

In addition, several questions explicitly suggested that technicians, in hindsight, would have acted differently. Examples include: "they did not have any intention to [follow a certain practice]?", "for that [document], was there no [trace of some information]? Nothing at all?", and "Did they [take certain actions]? As it is such a complicated task. This is something that you would do…" These questions demonstrate how the reported actions were evaluated against participants' expectations and are examples of counterfactual reasoning.

Taken together, these statements indicate that the Safety-I discussion was characterized by counterfactual evaluations of human performance, in which human performance was implicitly judged against assumptions about how work could or should be carried out.

This response to human actions is also reflected in the improvement actions, as multiple improvements focussed on introducing standard work practices and limiting individual variability. For example, the proposal to introduce a dedicated process for complex maintenance tasks implicitly seeks to standardize how such tasks are organized and executed, ensuring they are carried out in a predefined manner. Similarly, the action to introduce standard work practices for a specific procedure reflects an attempt to increase uniformity and reduce variation in practice.

Safety-II SAG: Recognition of Human Performance

In comparison, during the Safety-II SAG, participants recognised the practices as typical and expressed no surprise about the practices described in the report. For example, when presenting a practice described in the report and asking if participants experienced this, one technician indicated "Yes, 100%. I experienced this today", and two Technicians agreed. In response to another practice which was described, another technician agreed with this practice and related it back to how this is trained by stating: "From the dirty dozen, we are trained yearly to go three steps back". Rather than questioning the adequacy of individual behaviour, participants related the descriptions to their own experiences.

On two occasions, Technicians explicitly referenced back to the report when describing their own experiences. One technician stated "That is also stated in the report. You pick a logical point to perform a handover…" and another technician mentioned: "Paper is, as you have indicated [in the presentation], it gets dirty quickly and not everyone has a neat handwriting, to name a thing…" These statements indicate recognition and validation of the description, rather than surprise or evaluation. No statements were observed which expressed surprise, judgement, or hindsight-based evaluations of individual actions.

An important nuance is that the recognition of typical work did not mean that participants were satisfied with how handovers are performed. Participants agreed that current handover practices should be improved. This was articulated in the discussion (Table 1) from a technician / manager and a technician asking why handovers are not performed to the same standard as certifying a task.

Table 1

Discussion between two participants

Participant	Quote
technician & manager	"But everyone knows that once you've completed the task, you have to finish the paperwork and apply your stamp; otherwise, the work is not certified. So why don't we treat shift handovers the same way?"
technician 2	"That is correct, but the realities of the day show that it is done differently"
technician & manager	"Yeah, but that's not an answer. Why? That's the question—why don't we do it that way then?"
technician 2	"Yeah, exactly... you tell me."

This discussion did not come forth out of surprise or judgement, but rather the recognition that the current way of working is not sufficiently practical and the procedures do not align with the situations encountered during daily work. The surrounding discussion focussed on the issues encountered during daily work, and are finally reflected in the defined improvement actions, which focus on aligning procedures with the realities of daily work as well as introducing new tools which make performing handovers more practical. There was no individual judgement which led to introducing additional rules or procedures, but rather an evaluation that work force wide practices are hindered my limitations in the tools and procedures.

Third Difference: Practical Feasibility of Improvement Actions for Typical Work

The third distinction between Safety-I and Safety-II SAGs lies in the feasibility of the proposed improvement actions. In the Safety-I SAG, the improvement actions focussed on how the specific causes of the event could be prevented by top-down introducing additional rules and procedures to standardise work and ensure compliance, without exploring the usefulness for broader everyday work nor their practical feasibility. In contrast, during the Safety-II SAG,

participants examined current ways of working and identified challenges encountered by technicians. The resulting improvement actions focussed on re-evaluate existing procedures and tools, emphasising their impact on typical work and practical feasibility.

Safety-I SAG: Top-Down Improvement Actions Aimed to standardise and Ensure Compliance

The improvement actions resulting from the Safety-I SAG were primarily derived by identifying perceived gaps in human performance and determining barriers which intend to ensure standardisation and compliance. As such, the actions were developed in a predominantly top-down manner, as the actions were theoretically reasoned to prevent reoccurrence, and the improvements were not explored in relation to everyday work to assess their practical feasibility, usefulness, or potential consequences for the broader work system. The actions were focussed on standardisation and ensuring compliance with procedures.

For example, the first improvement action proposed in the Safety-I investigation was the introduction of a new process for complex maintenance tasks. This process was not derived from recommendations made in the report, existing practices within the organisation, or related to prior practical experience. Instead, it was introduced during the discussion as a preventative mechanism aimed at ensuring a standardised process for similar maintenance tasks, to avoid comparable incidents. It was implied that a standard process and additional rules will prevent this specific incident from reoccurring.

A similar pattern can be observed for improvement action number two, which focused on establishing additional standard work practices for ordering and labelling removed components in order to increase uniformity in practice. These actions were also not based on everyday work. During the discussion, participants identified a failure related to the marking of disconnected components, and discussed how this should be followed up, as shown in Table 2.

Table 2

Discussion between three participants

Participant	Quote
technician	"It is also a bit basic knowledge, if you take something apart and it is more than 10 parts, then you [follow a certain practice]. It could not be that [you do it a certain way] and then you are going to try to put it back together."
manager 1	"But if we have all these young guys, older guys, and contractors all using their own ways of working, then of course things can quickly start to deviate from one another"
technician	"But once again it is basic knowledge what actually is learned at school"
manager 2	"That I would say too, but it is not standardized here. If you start or I start and we both start in a different way, [...]"
	(…)
manager 2	"So it can help indeed to standardise [the handling off] everything which is disassembled"

It was agreed upon within the group that handling and organising of uninstalled components was a failure. Therefore, an improvement action was derived from this discussion to "Introduce formal standard work practices for labelling and ordering components after removal to increase uniformity". This proposal reflects a top-down and theoretical approach, as there was no discussion about whether introducing additional rules would translate into improved daily practice or whether such rules would be supported and used by technicians.

In contrast, during the Safety-II SAG (see next section, but to illustrate the point), a similar proposal to introduce rules was met with a different response. A technician remarked: "Yeah, but we already have those rules, that is the [manual]". The intonation of the technician and surrounding discussion indicated to the researcher that whilst rules are present in the

manuals, this does not mean that they are followed or practical. In this context, the technician suggested that adding or modifying rules alone would not automatically influence how work is actually performed.

This illustrates that the Safety-I improvement proposed during the SAG discussion aimed at preventing recurrence of the incident by introducing barriers and ensuring standardisation and compliance with procedures. It was not discussed if these improvement actions would be practical in daily work or useful for the persons performing the work – in contrast to the Safety-II SAG where practical feasibility and usefulness were main guiding principles.

Safety-II SAG: Bottom-Up Improvement Actions Derived From Practical Experience

During the Safety-II discussion, substantial attention was put on the daily realities and experiences of the persons performing task handovers. Early in the discussion, a technician exclaimed "My idea is that the handover is often seen as a burden by a GWK." This statement sets the perspective for the discussion by framing existing procedures and tools as misaligned with everyday practice. This perspective was reinforced by another technician, who noted that compliance with current procedures is often not feasible: "when a new shift starts, then [complying with this rule in the procedure] is simply not possible." This observation was acknowledged by other participants, and a manager added: "so this is not accounted for in the [manual]." This resulted in the improvement action to "Reiterate the policy for handovers to match typical work and set practically feasible standards". The discussion centred on structural mismatches between procedures and work-as-done – focussed on the realities of daily work. As a result, the discussion largely centred on the question of how task handovers could be made more practical and usable in daily work. This focus was explicitly expressed by a technician, who stated: "But it is useful, as you say, to have a tool which is practical and welcomed by most Certifying Technicians."

Throughout the discussion, multiple possible improvements were proposed and subsequently scrutinized for their practical feasibility. For instance, when a participant suggested a minor modification to the existing procedure which is paper based, the proposal was immediately questioned by another technician: "Is that very practical? When you are working with dirty hands at the same time." Another technician then expanded: "A piece of paper is, of course, as you indicated, quickly becomes messy, not everyone has beautiful handwriting. Just to name something." These exchanges illustrate how proposed improvements were evaluated against the realities of the working environment, leading the discussion towards digital alternatives. However, these solutions were likewise critically assessed. From a managerial perspective, concerns were raised regarding feasibility in terms of resources and implementation timelines.

In addition to evaluating new solutions, part of the discussion focused on identifying existing practices and tools within the organisation that might already support task handovers. For example, the discussion in Table 3 shows a conversation about a current way of working and its criticism. This discussion illustrates the trade-off participants face between workload, safety, and practical feasibility to determine improvement actions.

Table 3

Discussion between three participants

Participant	Quote
technician 1	"Especially non-routine items in the hangar. […] If you see the amount of stuff that needed to be removed [from the aircraft]. At the end of the task, you might have 20 new non-routine items that…"
Manager	"This introduces a lot of complexity"
technician 1	"Then it is indeed very big, lots of paperwork. Are you going to make it easier or…"
technician 2	"Or are you going to improve?"

Ultimately, although multiple improvement options were proposed, participants concluded that further exploration was required as no solution could be found which improves daily work for technicians. This was captured by a manager's closing remark: "But we have not yet found the egg of Columbus, we do not yet have it on the table…" As a result, an improvement action was formulated to collect insights from other maintenance organisations, with the aim of identifying solutions that have already been tested in practice.

Taken together, the Safety-II improvement actions reflect an intent to reconsider existing tools and processes rather than to introduce additional workarounds or fix failures. This aim also became explicit when a technician suggested using an existing tool from another process, to which another technician responded: "No, but okay. A [name of the tool] is, I think that officially we may not use these anymore within [the company], so that is one of those, those are the workarounds we come up with, but…" This statement highlights a pushback from introducing temporary workarounds and rather suggests a focus on a long-term solution.

In short, the Safety-II SAG focussed on determining improvement actions which make it more inviting, efficient, and effective for technicians to perform handovers in practice.

Discussion

This study aimed to identify differences between the Safety Action Group discussions and the formulated improvement actions following the presentation of a Safety-I and Safety-II investigation. Three main differences were interpreted from the data:

1. The depth and breadth of the discussions. The Safety-I discussion and improvement actions focus on multiple different topics on a surface level. In contrast, the Safety-II SAG focused on a deep exploration of a single process.
2. The judgemental responses to human performance. During the Safety-I SAG, the participants expressed surprise and disagreement with human actions mentioned in the report – and this is also reflected in the improvement actions. On the other hand, participants in the Safety-II discussion largely agreed and concurred with the actions described in the report.
3. Feasibility of the improvement actions for daily work. In the Safety-I SAG, improvement actions were developed by identifying failures, analysing their causes, and top-down proposing additional barriers to ensure standardisation and compliance with procedures. During the Safety-II SAG, participants examined current ways of working, identified challenges encountered by Technicians, and proposed improvements that reevaluate existing procedures and tools.

First Difference: Breadth and Depth of the Discussions

The Safety-II discussion focused on a single topic - task handovers - and explored this topic in depth, including multiple scenarios, challenges, and trade-offs encountered in everyday practice. When relating this finding to Safety-II theory, Hollnagel (2014) argues that "looking for what goes right requires that the analysis prioritizes breadth before depth" (p. 151). At first glance, this may appear to contrast with the findings of this study. However, this difference is

largely semantic rather than substantive. Hollnagel's notion of breadth refers to exploring many instances and variations of the same type of work, rather than analysing a single, unique event. This aligns with the Safety-II discussion observed in this study, where participants explored multiple scenarios and adaptations within the same work process. In contrast, The Safety-I discussion covered a wide range of topics related to the incident, but each topic was discussed only briefly. This focus on one incident is what Hollnagel refers to as 'depth', showing that the Safety-II discussion shifts from depth towards breadth, in Hollnagel's words.

Several studies similarly suggest that Safety-II-inspired investigations shift attention away from focus on a single event towards an exploration of everyday work practices (e.g. Hesselink et al., 2024; Jones et al., 2018; Martins et al., 2022). A benefit of this broad SAG discussion is that it also reflects in the resulting improvement actions. This may ensure that the actions facilitate improvement for a broader range of scenarios and adaptations faced during typical work – a more systemic improvement. In contrast, the Safety-I actions aim to improve a specific or unique scenario but there was no evaluation of the impact of these improvements for other work situations or circumstances.

At the same time, this breadth versus depth difference may partly be explained by methodological choices. In this study, the scope of the Safety-II investigation was limited by the researcher, whereas the scope of the Safety-I investigation was mainly determined by the incident itself. This limited scope likely enabled a more focused and in-depth investigation report and also discussion. Future Safety-II investigations that address the broader work systems may result in less depth. This finding therefore suggests that limiting the scope of a Safety-II investigation may facilitate deeper engagement with a specific topic during subsequent discussions.

In case a Safety-II study does need to address a broader scope, a more formative approach - where improvements are already developed during the investigation itself rather than the subsequent discussions (Havinga et al., 2018) - may reduce the need for deep discussions following completion of an investigation. This in comparison to the investigations in this study,

which followed a descriptive approach providing a rich description of typical work. With regards to how this could be managed in practice, for example Clay-Williams et al. (2015) used FRAM modelling to model new procedures to test its practical feasibility. Their methodology provided insight in conflicts between the new procedures and current ways of working and resulted in advice on how to resolve those conflicts.

Finally, the broad but surface level nature of the Safety-I discussion may also be explained by the moral and organisational pressures associated with incident investigations. As Dekker (2015) notes, incidents often create a perceived obligation to address all factors that may have contributed to the event. It is argued that "A good investigation not only produces all the facts, but also builds an explanation that is exhaustive, i.e., accounts for all of them" (Dekker, 2015, p. 205). This research concurs and extends these findings, as it was observed during the Safety-I SAG that participants not only tried to address all factors but also proposed improvements for each one. As incident reports typically cover a wide range of contributing factors, this necessitates discussing many topics within limited time, resulting in multiple short discussions rather than in-depth exploration. This pattern was also reflected in the resulting improvement actions, which targeted multiple processes and procedures rather than a single aspect of work.

Second Difference: Responses to Human Performance

A second qualitative difference between the Safety-I and Safety-II SAG concerned how participants responded to human performance described in the investigation reports. During the Safety-I discussion, participants expressed implicit judgement of human performance and, in hindsight, suggested that they would have acted differently. In contrast, during the Safety-II SAG, participants largely agreed with the descriptions of human performance in the report and expressed neither surprise nor judgement.

This difference aligns with findings reported by Martins et al. (2022, p. 9) who observed that discussions shifted "from who made a mistake to how the work system […] contributed to

the success despite the odds or failed despite all carefully crafted procedures" when Safety-II principles were applied. Discussing typical work rather than an adverse event may make it easier to focus on how work can be improved, rather than first evaluating whether actions taken were acceptable or correct.

Notably, several statements about human performance that elicited judgement during the Safety-I SAG were also present in the Safety-II investigation report. However, during the Safety-II SAG the participants concurred with the statements rather than judging them. This may suggest that the framing of human performance - typical work versus an incident - impacts how human performance is perceived. This perspective is also described by de Vos (2018):

> "By only assessing a sentinel event, it will be difficult to appreciate that certain deviations from protocols may also be present in everyday practice (e.g. because of trade-offs or goal conflicts), also in the many cases with positive outcomes." (pp. 185-186)

Thus, the responses during the Safety-I SAG might be explained by the fact that the participants were retrospectively responding to an incident. In this context, human actions are implicitly positioned as contributing to an undesired outcome. As Dekker (2014, p. 27) notes, hindsight enables people to "judge people for not doing what you believe they should have done, or for not paying enough attention to what you now know is important." The Safety-I discussion reflected this as participants showed surprise to human performance and implied that they would have done things differently – i.e. they explicitly made hindsight statements.

Despite these responses to human performance in the Safety-I SAG, none of the resulting improvement actions target individual punishment. Instead, actions focussed on processes, communication and training. An explanation for this might be that the safety department puts emphasis during training and when presenting investigations that blaming humans and seeking retribution does not result in learning and improving. Investigators also refrain as much as possible from using counterfactual statements and judgemental language in the investigation reports.

Taken together, these findings suggest that Safety-I and Safety-II investigations evoke qualitatively different interpretations of human performance, which is also reflected in the resulting improvement actions. In the Safety-I SAG, human performance was implicitly evaluated against expectations formed after the incident (hindsight bias), and improvement actions therefore focused on introducing new procedures or extending existing ones to reduce the likelihood of similar incidents in the future. In contrast, the Safety-II SAG treated human performance as a typical and necessary feature of everyday work, and improvement actions consequently focused on improving how daily work is supported and carried out in practice.

These findings are consistent with Hollnagel (2014)'s distinction between Safety-I and Safety-II, where Safety-I aims to reduce or eliminate performance variability by limiting and standardising human behaviour, while Safety-II recognizes variability as inevitable and potentially beneficial, as it enables people to adapt to changing conditions. Rather than attempting to suppress variability, Safety-II seeks to understand and support it. As argued by Shorrock and Licu (2014), both perspectives may be necessary: organisations need to understand which forms of variability are desirable and which are problematic or unmanageable. This, however, is not part of the current study and it would be useful to extend the current study by exploring how the two investigations and their resulting improvement actions can be reconciled.

Third Difference: Feasibility of Improvement Actions for Daily Work

A third difference between the Safety-I and Safety-II discussions concerned the extent to which improvement actions were assessed in terms of their feasibility for daily work. During the Safety-II SAG, substantial attention was given to how work is typically performed by Technicians, and proposed improvement actions were evaluated against practical constraints, workload, and acceptance by the workforce. In contrast, during the Safety-I discussion, improvement actions were primarily derived from perceived gaps in performance and

procedures, with limited discussion about whether these actions would be practically feasible in everyday practice.

This observation aligns with findings from Hesselink et al. (2024), who studied patient care transitions in hospitals by studying daily work. They concluded that their findings provided "concrete reflection material and clues for improving care transitions" (p. 5) and suggested that such material should be discussed with healthcare professionals and policymakers – the SAG equivalent in the current organization. The present study extends this work by showing that when descriptions of typical work are discussed in a SAG, participants not only reflect on practice but also actively determine improvement actions which improve and facilitate typical work from a bottom-up perspective.

This finding is further supported by Martins et al. (2022), who showed that structured discussions between operational staff and management about normal work can lead to improvements grounded in frontline experience, where "ideas were based on existing procedures, other tasks, other works, and the workers' own experience in the field" (p. 9). In the present study, a similar mechanism was observed: improvement actions emerging from the Safety-II SAG were not only theorized or top-down imposed but explicitly informed by how Technicians currently manage task handovers. For example, it was observed that improvement actions from the Safety-I SAG were also suggested during the Safety-II SAG, but during the Safety-II SAG these were criticized as they were not practically feasible solutions or would not be used by frontline staff when looking at typical work.

In contrast, the Safey-I discussion and improvement actions can be characterized as following a Reasonesk energy-barrier logic (Reason, 1997) of strengthening existing barriers and introducing new ones. The discussion followed a mechanism of identifying gaps in human performance and subsequently theorising how these can be prevented. This was done by introducing a new procedure and strengthening a current procedure by introducing new standard work practices. Also, training was proposed to create awareness about the incident, which could

be seen as enhancing current barriers which are in place but not performing effectively. This is inherently a limitation of how Safety Management Systems are designed, where the main purpose is to identify and mitigate safety risks (ICAO, 2013). Mitigations are put in place to ensure incidents do not reoccur and in that sense, control is regained over the system.

In contrast, the Safety-II discussion focused less on barriers and more on how work can be effectively and thoroughly performed in practice. This also factors in the effectiveness and efficiency of work, as well as the buy-in from staff to start using new solutions – i.e. a more wholistic approach is taken. This was also observed by Havinga et al. (2018) who point out that describing and learning from everyday work and improving 'safety' may not necessarily go hand in hand. Instead, they suggest that Safety-II takes a wider perspective, where learning from everyday work focusses on help things go well – which indirectly improves safety.

Research limitations and implications for future research

This study also has several limitations when looking at the Safety-II investigation. At first, only a single case is studied – only one Safety-I and Safety-II investigation reports were made - within one organisation, with only one SAG per investigation, so it is evident that the findings of this research are not meant to be 'representative' in terms of a more positivistic epistemology. The study of this specific organisation, this specific event, the specific SI and SII investigation reports, and even the specific members of the discussions, are meant to provide an authentic and appealing 'story' that hopefully presents new ideas and insights around the topic of using Safety-II investigations in practice. This approach was used as it allowed the researcher to study, ethnographically inspired, the effects of a Safety-I and -II investigation following a real incident at this specific organisation.

A next limitation of this study is that no physical observations were performed for the Safety-II investigation due to time constraints. Thus, the Safety-II report relied on work-as-disclosed by the interviewees. However, disclosing how work is done may not reflect actual work-

as-done as it is difficult to describe what you are doing (Moppett & Shorrock, 2018) – and also describe all typical scenarios which may be encountered. This was partly managed by analysing documentation such as written handovers. However, for further research it is advised to also include observations of work as it provides insight into what work and how work is done, whilst discussions with staff provide information on why things are performed a particular way. On the other side, observations were also not performed for the Safety-I investigation, as the incident occurred in the past.

Formal and informal pressures and social norms may influence what is disclosed to the investigators and the information provided during interviews of the Safety-II investigation is limited to what the interviewee deems relevant – despite questions asked by the investigator. This was partly managed by using questions suggested by previous Safety-II studies (Havinga et al., 2018; Hesselink et al., 2024; Provan et al., 2020) which guide the exploration of daily work. Also, the researcher has a low hierarchical and no management position in the organisation and it was indicated to interviewees that the information was used anonymously, which may have lowered the bar to share information. Interviewees openly discussed procedural shortcomings and practical constraints, suggesting that they felt free to share their perspective.

This also raises a further reflection regarding data saturation within the Safety-II investigation. There are presently no guidelines for data saturation of a typical work investigation. Given the inherent variability of complex socio-technical systems (Hollnagel, 2011), it is not possible to fully capture all scenarios, adaptations, and variations in a single report. Thus, the investigator collected data about typical work until no new information came forth of the interviewees.

As a last limitation, the results of the SAG discussions might have been influenced by the participants knowing that they were part of a study – also referred to as the Hawthorne effect where persons change to socially desired behaviour. Additionally, whilst the Safety-II investigation did not include details of the incident, it was mentioned to the participants that this

investigation was initiated due to an incident. This might have affected the engagement of the participants; where an incident may introduce a sense of urgency to prevent reoccurrence, this same urge may not be present for processes where nothing went wrong. Also, to resemble a typical work situation, the researcher made it clear to the participants that the proposed improvement actions are not only used for this study but will also be used within the company as actual follow-up – as is typical within the organisation. It was observed that the discussions reflected typical SAG meetings in terms of engagement of the participants.

To further develop methodologies and empirical evidence for typical work investigations, similar studies could be conducted in other organisations and operational settings. Replication across contexts would help strengthen the empirical basis for Safety-II investigations and support the development of practical guidance for integrating everyday work analyses into existing safety management practices.

Also, this study focused on how improvement actions were formulated during the SAG discussions but did not examine how these actions were subsequently implemented or how they affected the work system. It therefore remains unclear how the improvement actions developed following Safety-I and Safety-II investigations differ in their long-term impact. Future research could extend the scope by examining the implementation phase and evaluating how the resulting interventions influence operational practices and safety outcomes in practice.

Conclusions

This study explored the potential value of introducing a Safety-II investigation within an Aircraft Maintenance Organisation. Specifically, it compared how two Safety Action Groups (SAGs) interpreted and responded to investigation reports: one based on a traditional Safety-I incident investigation, and one based on a Safety-II everyday work investigation. The study examined how different investigation approaches influence SAG meeting discussions and the development of improvement actions by the SAG members.

Three main findings emerged and were discussed. At first, it was found that introducing typical work in the Safety-II report directed the SAG discussion from a single isolated event to the broader work system and the variation encountered during daily work. Second, the focus shifted from retrospectively judging individual actions against expectations and rules, to evaluating workforce wide common practices. Third, the nature of the improvement actions differed, whereas the Safety-I SAG predominantly introduced or extended formal barriers and procedures aimed at ensuring standardisation and compliance, the Safety-II SAG proposed actions intended to support and facilitate everyday work, with explicit consideration of practical feasibility.

These findings suggest that the perspective underlying an investigation, influences how the organisation perceives and performs follow-up. Rather than demonstrating that one approach is inherently superior to the other, the study illustrates how Safety-I and Safety-II perspectives lead to different forms of organisational learning. Safety-I emphasises deviations and the strengthening of control mechanisms, while Safety-II emphasises understanding and supporting the conditions that enable successful performance in everyday work. Both perspectives may therefore contribute to safety improvement in complementary ways. Further research might address how these perspectives should be balanced.

From a practical perspective, this study represents a step towards developing a "Safety-II everyday work investigation" methodology, which can be integrated into existing safety practices.

A first step may be to incorporate descriptions of typical work into incident investigations. Relating identified causes of an incident to everyday practices may reveal that situations initially perceived as unique or exceptional are in fact present in routine operations. This broader perspective can help reduce judgement after an incident and ensure that improvement actions are evaluated in relation to the wider work system, thereby reducing the risk that interventions addressing a specific event inadvertently create new challenges for other operational contexts.

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Appendix A – Informed Consent Form

LUND UNIVERSITY

MSc in Human Factors and System Safety

Informed Consent Form

Study	Human Factors and System Safety
University	Lund University
Researcher	Shen van Dijk
Supervisor	Dr Roel van Winsen, Lund University

Purpose of the study
The research is being conducted as part of the fulfilment of the requirements for a master's degree. The purpose of this study is to research the added value of a Safety Science approach to safety investigations. This is studied by presenting an investigation using a Safety Science model and then discussing the results of the investigation. This discussion is observed and recorded and subsequently analysed.

Collection and usage of data
The data is collected during a Safety Action Group – Fleet & Technical Services. The discussion audio is recorded using the Microsoft Teams recording function which will record the audio during the session. These recordings will be transcribed and anonymised. Transcribed segments (examples or quotes) from the discussions may be used in research products with an anonymised identifier. Participants may request a copy of the final thesis.

Confidentiality
Identities of all participants will remain anonymous and will be kept confidential from all other parties except the researcher. Information that will identify individuals will not be included in any research product, this includes the sharing of event details in a manner that would identify either the specific event, individual involved or organisation.

Data retention
The recordings and transcripts will be retained until the final thesis is published. After publication, all data will be deleted.

Withdrawal from study
Your participation in this study is voluntary, there is no explicit or implicit coercion to participate. At any stage, you have the right to withdraw from the study. If you choose to withdraw from the study, the researcher will destroy any communications or material gathered.

Consent
By signing below, I am indicating my consent to participate in the research as it has been described to me. I understand that the data collected from my participation will be used for this thesis only and will be deleted after completion, and I consent for it to be used in that manner.

Participant name _____

Date _____

Signature _____