

# Situational Adapting System supporting Team Situation Awareness

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## ABSTRACT

Military fighter pilots have to make suitable decisions fast in an environment where continuously increasing flows of information from sensors, team members and databases are provided. Not only do the huge amounts of data aggravate the pilots' decision making process: time-pressure, presence of uncertain data and high workload are factors that can worsen the performance of pilot decision making. In this paper, initial ideas of how to support the pilots accomplishing their tasks are presented. Results from interviews with two fighter pilots are described as well as a discussion about how these results can guide the design of a military fighter pilot decision support system, with focus on team cooperation.

**Keywords:** Team situation awareness, threat evaluation, team cooperation, decision support, fighter aircraft

## 1. INTRODUCTION

In the military domain, pilots are often required to process huge amounts of (possibly uncertain) data to make quick and accurate decisions, often under extremely high workload and time pressure. In order to cope with such conditions, pilots are subjected to extensive education and training. It is vital that the education and training develop the pilots' abilities to assess the current situation and act in such a way that unwanted situations can be avoided and favourable situations reached. The situation awareness that results from this situation assessment is crucial for mission success and survival.

In modern air warfare, cooperation between several pilots is essential. This adds to the workload of the individual pilots: not only do they need to assess their own situation, but also (to some degree) the situations of their team members. This paper discusses a support system that will help a pilot assess not only his/her own situation, but also his/her members' situations. The system will do this by utilizing the information available within the team, adapt to the current situation based on a situational analysis and present relevant information to the pilots in the team. It will, in this sense, be a situational adapting system supporting team situation awareness.

### 1.1 Team Situation Awareness

During flight, the pilots must not only be aware of vital aircraft functions, such as altitude, attitude, the remaining amount of fuel and aircraft faults. They must also focus on accomplishing their missions and survive potential battles. These three objectives can be found in Schulte's goal model:<sup>1</sup> flight safety, combat survival and mission accomplishment (depicted in Figure 1).

These three objectives might conflict each other and the pilots might have to decide, for example, whether to follow the route of the mission or abandon it. If a threat is detected close to the mission route, the pilots might need to re-plan the route in order to avoid the threat. When re-planning the route, the remaining amount of fuel must be considered to ensure that there is enough fuel to fly the whole route and return to the landing base. These three objectives can be considered as perspectives of the situational picture, of which the pilots must be simultaneously aware to effectively reach their goals. In order to do so, the pilots should cooperate and share

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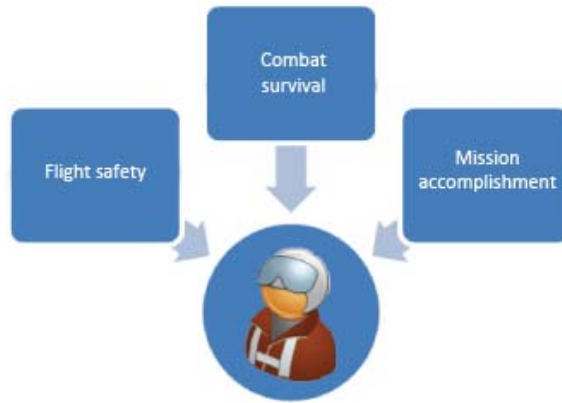


Figure 1. Three different perspectives for the pilot to handle: flight safety, combat survival and mission accomplishment.

information so as to generate a more complete situational picture. The creation of a team situational picture will enhance the pilots' abilities to balance between these perspectives.

To create the individual and team related situational pictures, the concept of situation awareness (SA) is important. According to Endsley,<sup>2</sup> SA is achieved when an operator has perceived the elements in the environment, within a volume of time and space, has understood their meaning and can project their status in the near future. Team situation awareness (TSA), as proposed by Nofi,<sup>3</sup> takes the concept of SA one step further to integrate mission-essential overlapping features of the individual pilots' SA to form a group dynamic mental model of the current situation. Having achieved TSA, it is anticipated that the pilots will be provided with a clear and true common situational picture. The process of achieving TSA requires that the individual pilots build and maintain their own SA during the mission as well as communicate their individual SA to the team and become aware of relevant actions of other team members. Figure 2 illustrates how the pilots together contribute to the creation of the team situational picture. This picture should be utilized by all members in the team so as to have a better founding to base their decisions on. A support system that aids the pilots through this process is thus central.

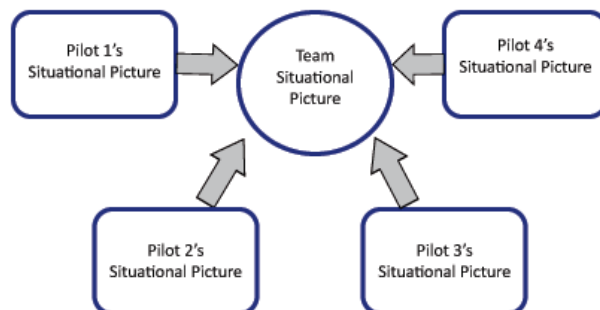


Figure 2. Fusion of information from all team members enables the creation of a team situational picture.

## 1.2 Situational Adapting System

Several research programs within the domain have identified the need for a support system that aids the pilots achieve their goals. The US Pilot's Associate (PA), the French Copilote Electronique (CE) and the Dutch POWER project<sup>1,4</sup> all focused on developing decision support for fighter pilots which would aid them during their missions. Within these programs, research has, for example, investigated which information that should be presented to the pilots to provide the most relevant information for their decision making, as well as keep the pilots' workloads at a reasonable level. However, these programs have mainly focused on systems that support single pilots, and not the whole team. Erlandsson et. al.<sup>5</sup> suggests that a situational adapting system could

support fighter pilots to create and maintain TSA. A situational adapting system is defined as a *system that is able to respond to changes in the environment, as given by the situation analysis*. It has been argued that such a decision support system would aid the pilots to balance the three perspectives of flight safety, combat survival and mission accomplishment previously mentioned (see Figure 3). The adaptivity of the system envisioned in Erlandsson et. al.<sup>5</sup> can be manifested in terms of changes in the user interfaces as well as the presentation of recommendations of suitable actions, adapted to different types of information, tasks and missions.



Figure 3. A situational adapting system would aid the pilots to balance the three perspectives of the situational picture: flight safety, combat survival and mission accomplishment.

In order to cooperate within the team, it is important that the distribution of tasks within the team is clear. The situational adapting system proposed in Erlandsson et. al.<sup>5</sup> uses the concept of roles for supporting the task distribution and also supports role switching between the team members, by making the pilots aware of the new role assignments. The proposed system also prioritizes which information that is presented for the pilots based on the pilots' roles. The threat situation is an important part of the situational picture. Threats might be detected close to the aircraft and the pilot must quickly decide what to do. Making the wrong decision or acting too late may have fatal consequences. The envisioned situational adapting system could aid the pilot evaluate the threat situation and suggest possible defensive actions that could be performed in order to avoid the threats and increase the survivability.

In the fighter aircraft domain, we argue that situational adapting systems must be further elaborated upon in order to develop a system that can aid the pilots to balance the three perspectives of the situational picture. We anticipate that improved situation awareness within a team of fighter pilots can be achieved through the development of additional information presentation techniques and algorithms for situational analysis that takes team considerations and the developing situation into account. This paper presents our ideas for further development of a situational adapting system. Three areas have been identified as important research areas: Team Situation Awareness, Team Cooperation and Threat Evaluation. The paper offers a deeper understanding of the pilots' working situations and their perceived needs related to team cooperation within a military fighter pilot unit. The main contribution of this paper is further knowledge on how a support system can aid the pilots during a mission. The information has been gathered from interviews with two Swedish fighter pilots. The paper is structured as follows: Section 2 presents the outcomes from the interviews performed. A discussion about the results obtained and how these can be used when developing a pilot support system is presented in Section 3. Finally, in Section 4, conclusions and ideas for future work are presented.

## 2. INTERVIEWS

Initial semi-structured interviews with two active Swedish fighter pilots have been conducted in order to receive a deeper understanding of the pilots' working situations. The focus of the interviews performed was team situation awareness, team cooperation and threat evaluation.

The interview method was chosen for this study in order for the interviewers to receive a better understanding of the pilots' working situations. Pilots were chosen as interviewees so as to get a direct link to the actual end users of a possible future support system. The interviews were conducted in a semi-structured form so as to follow a focus, but at the same time allow fruitful discussions to evolve.

## **2.1 Procedure**

For our initial investigations around fighter pilots' needs of a support system during flight, two Swedish fighter pilots were asked to participate in two semi-structured interviews. The interviews had different focuses: one interview focused on how pilots cooperate in general in a team, while the other focused on questions regarding how pilots handle threat situations. Altogether, the main objective was to receive information and a deeper understanding of the pilots' working situations with the focus on team situation awareness, team cooperation and threat evaluation before, during and after a flight mission. During the interviews, the pilots were asked to relate their answers to a particular scenario, so as to put their answers into the right context. The scenario used during the interviews was a reconnaissance mission, where the pilots had to handle threats of different kinds. A reconnaissance scenario was selected due to its straightforward structure and the pilots' probable familiarity to it. The scenario was used as a basis for the questions asked, but the pilots were asked not to limit their answers to this particular scenario if other situations related to the questions asked were reflected upon. At the end of the interviews, the pilots were also requested to describe other typical scenarios and their opinions on how these differ from the reconnaissance scenario used during the interviews in terms of team cooperation and threat handling. The two pilots were interviewed individually and in parallel by two of the authors. Each interview took about one hour. The two pilots were both male and had experience of between 650-1500 flight hours.

During the interviews, the pilots were asked to describe, in their own words, their thoughts about, for example, team cooperation in different situations in the scenario. They were also asked to elaborate on certain aspects that needed clarification and follow-up questions were frequently asked, since the interviewers strove to understand as much as possible about the pilots' working situations. After the completion of the interview session, the pilots were asked to provide feedback to the questions asked and the way the interviews had been performed.

## **2.2 Result from Interviews**

The interviews had three main focuses: team situation awareness, team cooperation and threat evaluation. The results from the interviews with respect to these three focuses are described here.

### **2.2.1 Team Situation Awareness**

Before a mission, the pilots involved in an operation are verbally and/or textually informed of, for example, the purpose of the mission, the team composition and what is to be done. This information is used by the pilots to create individual mental pictures of how the mission will be carried out and what will be required of them. The route, with pre-defined waypoints, is added to the Mission Support System and additional memory notes are written in textual form on paper by the pilots. During the mission briefing, the Flight Lead informs the pilots of mission essential criteria that will be valid throughout the mission. These criteria might concern when to abort a mission or when substitute plans are to be executed.

The mission plan, team structure and task allocation within the team are very dependent on the type of mission to be performed as well as the resources available. For example, extensive plans are developed in case of an air-to-ground mission, though, in the case of an air-to-air mission, the plans are less detailed. In such situations, tactics are of great importance for mission success. A mental picture of what will happen during the mission is thus based on well established strategies.

During an operation, it is not common that unplanned substitute plans are carried out. Details such as the time for a certain event might be changed. This change must then be distributed between the team members of the air unit via radio and inserted into the aircraft planning system. Though, larger changes to the original or substitute plans are not often carried out, especially not in the case of large air units. To distribute changes within a large team is risky because of unanticipated side-effects and the potential loss of pilot SA. Thus, as a general rule, it is desirable, if possible, that the pilots adhere to the original plan.

During the mission, the team members maintain their SA through radio communication and by information sent via the data link between the aircraft. By seeing where the others are on the displays, the individual pilot can figure out what his/her team members are doing according to the plan at execution. The roles assigned to the pilots also reveal which tasks that are to be performed by whom in the team, based on fighter strategies. Furthermore, the Fighter Controller has a central role in maintaining and updating the pilots' SA. The Fighter Controller helps the pilots avoid collisions with aircraft not belonging to the own team and guides the pilots to reach the goal of the mission. He/she can also trigger the execution of pre-planned mission phases by sending radio messages to the pilots.

When asked about "How important is it that the individual team members have the same situational picture?" one pilot answered that it is more important that the team members have a correct individual situational picture, than a common one. Not everyone has to have exactly the same understanding of what is going on in the surroundings, though it is important that they see reality as it really is to prevent misunderstandings and unfortunate events. To further prevent misinterpretations, it is also important to tag information with a quality measure before distributing it within the team. This additional quality information would aid the pilots evaluate the authenticity of the information sent on the data links within the team.

Additional requirements gathered from the interviews concern the information displayed on the screens in the cockpit. A request from the pilots was to further limit the quantity of the information presented to them during flight by sorting out the information that is most pertinent to the situation. This would aid them discern the most important information to them in the current situation. However, not only must the pilots have an understanding of what is happening in the current situation, they must also be aware and remember what has happened in the near past. A missile launched at them 60 seconds ago must be remembered to avoid being hit. Furthermore, when returning to an area previously visited during the mission, it would be desirable to view the positions of previously detected threats in that area. However, the system should only present positions based on stored data if the data is of high quality. Which data that can be considered as "high quality data" depends on the type of threat, since some threats are more difficult to detect than others.

### **2.2.2 Team Cooperation**

The need for cooperation in an air unit depends on the mission at hand. For example, cooperation is of great importance in air-to-air scenarios such as beyond visual range missions, where the enemy is engaged before they can be seen visually. In such situations, team cooperation is the key to mission success. Though, in other scenarios, such as air-to-ground missions, the need for cooperation is less, since the mission structure is less dynamic due to heavily detailed plans before take-off. Furthermore, in large operations with 30 or more aircraft, cooperation between the different air units is difficult. Instead, the pilots collaborate within sub-teams and rely on tactics between other teams - for example that every team stays within their predefined areas in the air.

During a mission, the pilots share information with each other, both via the data link and radio. The data link between the aircraft enables an extended cooperation within the team since information can be sent automatically between the different aircraft on this link and be presented on the displays. One of the interviewed pilots claimed that without this link, an individual focus would be prevalent during a mission and most of the dynamic features would disappear since tactics would be relied upon to a greater extent.

The pilots interviewed stated that it is when a pilot gets stressed that he/she loses his/her SA. Due to stress, a team focus might be switched to an individual focus and the pilot loses both his/her situational picture and the involvement in the group fight. In such situations, it is very important that the pilot is able to return to the team's engagements as quickly as possible. To ease this process, the information on the displays must be presented in a better way so as for the pilots to make use of it.

When asked if an extended role concept could ease the cooperation within a fighter pilot team, both pilots interviewed claimed that the role commitments are extensively trained. They did not see a need of role-related information presented on the displays.

One of the pilots interviewed stated that it is the cooperation within a military fighter pilot team that settles if the team will succeed with their mission or not, as good cooperation will enable the pilots in an air unit to perform more tasks in parallel, with better quality and with decreased risk for losses. The pilot stated that one

such reason is that together, the pilots can create a set of qualitative data by comparing sensor measurements. As such, misunderstandings due to false sensor readings can be avoided. It is important that this qualitative data is made available for the pilots. The pilot also stated that fighter pilots would benefit from having new team related information presented to them. Information such as which areas that the different team members cover with their radars would help them search areas more efficiently and quickly.

### 2.2.3 Threat Evaluation

The threat situation is very dynamic. The time from that the pilot detects a potential threat until he/she risks to be shot down varies from a couple of minutes to only a few seconds. In general, pilots strive not to take risks, if it can be avoided. The pilot continuously evaluates how dangerous different threats are. Parameters that influence the threat evaluation are the position of the threat, the type of threat, the time that the own aircraft has been exposed to the threat and how reliable the information about the threat is. Depending on, for example, the type of threat and the distance to it, the actions that the pilots perform differ. To handle some threats, a slight change of course or altitude might be sufficient, while other threats require a combination of several actions (as many as 5-10 actions) or even mission abandonment. The threat is mainly handled by the threatened aircraft and is currently not considered a team issue. In the case of ground-based threats, the pilots interviewed saw little gain in cooperation, except for information sharing within the team.

There is a great difference between flying threats (i.e. other fighters) and threats on the ground (i.e. anti-aircraft artillery, ships etc). Threats on the ground can be considered static, since they cannot move or move very slowly compared to a fighter aircraft. It is thus possible to avoid such threats by keeping a distance to them. Airborne threats, on the other hand, are more dynamic and often cannot be avoided by just re-planning the route. Instead airborne threats must be engaged and shot down. If the own team is superior, it might be possible to scare them away. There is, in such situations, no purpose of its own to shoot down enemy fighters - the only purpose is to protect the own team.

The interviewed pilots thought that it might be difficult to develop a system that evaluates threats. They argued that the aircraft cannot know where the pilot intends to fly and can therefore not evaluate whether or not a threat hinders the route. Often the pilot has several reasons for his/her behaviour, of which the support system cannot be aware. It would therefore be difficult to let a support system suggest which threat that the pilot should handle.

## 2.3 Validity of the Results

It should be noted that the results obtained from the interviews are specific to the Swedish JAS 39 Gripen aircraft. However, the description of the pilots' working situations and their wishes is of such general nature that it can be used for investigations together with other aircraft types as well.

Both pilots commented that they found the scenario used during the interviews suitable as a base for the interviews and confirmed that they were familiar with it. The scenario used was helpful when trying to receive an insight into common working situations of today's pilots. However, if the aim is to study team cooperation, one pilot suggested that an air-to-air scenario should be used instead. Furthermore, for future studies, a more futuristic scenario should be used so as to understand the requirements of a future decision support system in a better way.

During the interviews, the interviewers noticed that the pilots thought much about what would be possible or impossible to implement in future aircraft systems, which might have hindered them from elaborating upon far-fetched ideas as solutions to their stated problems. Also, additional interviews should be conducted so as to receive more feedback on the pilots' perceived needs as well as to assess or reject the results obtained.

## 3. DISCUSSION

This section discusses how the results obtained from the interviews can be used to guide the design of a support system such as the situational adapting system envisioned in Erlandsson et al.<sup>5</sup>

### 3.1 Team Situation Awareness

To better maintain the team's SA during flight, the information to be presented on the displays must be carefully selected. This would ease the pilots' process of discerning the most important information to them during a mission. Furthermore, requests for better ways of presenting information on the displays were expressed during the interviews. This would help the pilots to more easily build up and maintain their SA during flight, especially during and after stressed situations with loss of individual and team situation awareness. A support system could, in such situations, select the most important information to present which would help the pilot to, as quickly as possible, return to the team's tasks and mission. In a study performed by Endsley,<sup>6</sup> pilots were asked to rank the most important information to them given an air-to-air scenario. The results from this survey show that the majority of the information pieces were ranked as "important" or "very important", revealing that the pilots' information needs are enormous during flight, which might be one contributing factor to the often high workload of the pilots. A system that adapts which information to present given different situations is thus vital for pilot SA.

A quality measure tagged to the information sent between the team members could also aid the pilots maintain their SA through informing the pilots of the authenticity of the information. Furthermore, the pilots need not only have an awareness of what is going on in the current situation. They must also remember what has happened in the near past so as to avoid, for example, already launched enemy missiles. A support system should consider these aspects of TSA.

To be able to support the pilots' process of building and maintaining their SA during different phases of a mission, a goal-task analysis could be conducted. Endsley<sup>6</sup> performed such an analysis which reflected upon which SA requirements that were most important given different goals and sub-goals during an air-to-air mission. Such an analysis could be conducted by taking TSA into account, which would shed light over which information that is needed in a team cooperation context.

### 3.2 Team Cooperation

How important cooperation between the team members is depends on the mission at hand. In a beyond visual range scenario, much collaboration is required for mission success. Both pilots interviewed agreed upon that team work often is the key to mission success since this enables the team to perform tasks in parallel and with higher quality. Furthermore, team work also decreases the risk for losses within the team.

A key enabler of team cooperation is the data link on which information is distributed within the team. Though, the information sent on this link must be carefully fused and sorted when received, so as to present information with high quality as well as the most important information. Together, the team can create a more trustworthy picture of the current situation by having the support system fuse and compare sensor measurements. This would aid the pilots through preventing false sensor readings from being presented, which could result in unwanted side-effects such as engagement in non-targets. Thus, a distributed system would enable the process of sharing and utilizing information with higher quality within a fighter aircraft team than if only individual sensor measurements would be used.

To improve the team's collective performance, team-related information could be added to the displays. Information such as which areas that are covered by the pilots' radars would help the team search an area more effectively. The information that the support system selects to present to the team should also aid the pilots maintain their team focus since a loss of the team perspective might have fatal consequences. The information presented would thus aid the pilots create and maintain their TSA, even in the case of high workload and stress.

The pilots interviewed both claimed that the role commitments are clear as they are today and that no further information about the pilot team roles should be presented on the displays. However, this must further be investigated with additional pilots so as to receive feedback from more than two fighter pilots. A future support system could use the concept of roles when deciding which information to present in the current situation, which in addition could result in that less role-training is needed for fighter pilots. Furthermore, future scenarios might incorporate additional or extended pilot roles, changing pilot responsibilities and strategies for team cooperation within a fighter pilot team.

### 3.3 Threat Evaluation

The pilot evaluates threats continuously and important parameters during this evaluation is the position of the threat, the type of threat, the time that the aircraft has been exposed to the threat and the quality of the information about the threat. To perform this evaluation, it is important that this information is available to the pilots. One pilot expressed this as “the presentation should answer the questions posed by the pilot in the situation”. It is important that the pilot has access to all information that he/she needs in order to evaluate threats.

The pilots might be aided by a support system that evaluates and prioritizes the threats. One approach to design such a system would be to as far as possible use the same parameters as the pilots do, so as to coincide with the pilots’ own evaluations. An advantage of this approach is that the end-users of the system are more likely to trust the system, if they agree with the evaluation performed by the system. To better understand how pilots evaluate threats, additional studies are needed with more pilots. Liebhaber<sup>7</sup> describes such studies from a similar research area - threat evaluation in the ground based air defence context. These studies have been conducted to identify the cues that experienced air defence personnel use when evaluating the threat level of a particular aircraft. An additional study was conducted by Nguyen,<sup>8</sup> who performed a Cognitive Work Analysis in order to understand how the intent of an air threat is assessed from the ground-based air defence view. These studies were then used in order to design threat evaluation systems, which should evaluate threats in a similar way that experienced personnel did. However, to our knowledge, no such study has been conducted in the fighter pilot context.

The threat situation is very dynamic. This implies that a threat evaluation system must be able to act differently depending on the current situation. If a threat appears close to the own aircraft, there is no time for time-consuming calculations or the collection of more information. Instead, the system must quickly warn the pilot, even though the information about the threat might be uncertain. Thus, a threat evaluating system must be quick, accurate and able to handle uncertain data. In other situations, when a threat is detected at a further distance, more time can be spent on collecting better sensor measurements, which can improve the result of the threat evaluation process.

A threat evaluation system could also suggest actions for the pilot to take in order to handle the threats. In the POWER project the Dutch National Aerospace Laboratory (NLR) designed a self protection electronic warfare manager called NLR Counter Measure Manager NCMM.<sup>1,9,10</sup> This system automatically initiated countermeasures (such as electronic jamming and release of chaffs and flares) and proposed manoeuvres for the pilot in order to protect himself/herself against threats. It was argued that advantages by using the NCMM compared with manual threat countering was the system’s ability to combine counter measures to counter multiple threats and that it could execute series of counter measures that requires exact timing. A prototype of the system was evaluated through experiments with operational pilots that flew low altitude weapon delivery missions in a simulator. The pilots were observed during the evaluation and the observer rated the pilots’ SA higher during the missions when the NCMM was used.<sup>1</sup>

An important point made during the interviews was that it is difficult to design a system that generates recommendations for the pilot about which threat to prioritize and which actions that should be conducted. The reason for this is that the pilot has reasons for his/her actions that the system cannot be aware about. The situational adaptive system proposed in Erlandsson et. al.<sup>5</sup> does not recommend only one action. Instead it evaluates several possible defensive actions and presents several actions together with their impact on the survivability. This might be one way of dealing with the difficulty that the system does not have the same information that the pilot has. The pilot can use his/her knowledge to choose the most suitable action. Instead of having to choose among all possible actions, the system can reduce the number of possible actions that the pilot has to consider. The results from the POWER project - that the NCMM increased the pilots’ SA - suggest that the proposed situational adapting system in Erlandsson et al.<sup>5</sup> could increase the pilots’ SA. However, further investigations are needed in order to evaluate whether this is a feasible approach. Another result from the evaluation of the NCMM was that the pilots were more positive to the system after testing the prototype than they were before.<sup>9</sup> This indicates that it is important to let the pilots test a prototype of the system, in order to evaluate future concepts.



## 4. CONCLUSIONS

Erlandsson et al.<sup>5</sup> proposed a situational adapting system for aiding fighter pilots when building and maintaining TSA. This paper has presented results from interviews conducted with two fighter pilots in order to understand the pilots' working situations and their perceived needs related to team cooperation and threat evaluation within a military fighter pilot unit. The paper also presented a discussion on how these results can be used in future studies when elaborating upon TSA and support systems for fighter pilots. The main results obtained are:

**Team Situation Awareness** The pilots interviewed both claimed that individual and team SA are crucial for mission success and survival. To improve SA on both these levels, the pilots argued that the information presented on the displays should be tagged with a quality measure so as to avoid misunderstandings due to uncertain data. Another request raised during the interviews was that only a limited quantity of the data should be presented on the displays so as to only present the information most pertinent to the current situation. We argue that situation analysis techniques should be developed when designing a support system that is able to select the information most important in the current situation.

**Team Cooperation** The interviewed pilots claimed that the importance of team cooperation depends on the type of mission at hand. Both pilots recommended a beyond visual range mission for future studies of team cooperation and of how to support TSA within the fighting aircraft domain, due to its cooperation focus. The interviews revealed that additional team relation information could be added to the displays so as to improve the founding for team cooperation within an air unit. We believe that new ways of comparing information within a team to avoid false sensor readings must be investigated. By fusing the sensor measurements from the individual team members and form a team situational picture it would also be possible to limit the amount of presented information.

**Threat Evaluation** The interviews performed in this study confirmed that a threat situation within the fighter aircraft domain is dynamic. As such, a threat evaluation system must be quick, accurate and able to handle missing and uncertain data. The interviewed pilots thought that it would be difficult to design a threat evaluation system, since a pilot often has several reasons for his/her behaviour, of which the support system cannot be aware. One way to deal with this problem could be to present several possible defensive actions together with their impact on combat survival and let the pilot use his/her own knowledge when deciding which action to perform. However, this concept needs to be further evaluated.

### 4.1 Future Work

The support system envisioned in Erlandsson et al.<sup>5</sup> needs to be described further together with a scenario in which it is supposed to be used. The system is meant to support future fighter pilots and it is therefore important to understand the challenges that the fighter pilots will be facing in the future. A study has been initiated where fighter pilots are requested to rank the most important information pieces to them during a reconnaissance mission. The results from this study must be carefully analyzed so as to be able to design a support system that aids the pilots in their decision making processes. The concept of such a support system should then be evaluated together with fighter pilots and other domain experts.

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