Findings and Recommendations
Subcommittee on Human Factors
Summer/Fall 2013

(ATC/Tech Ops Core)

**Finding:** It appears that funding for ATC / TechOps Human Factors will not adequately support critical research beyond 2015. Further, it appears that the interim 2014-2015 activities do not have sufficient funding to effectively provide their intended contributions. This builds on a finding from the Spring 2013 Subcommittee meeting (Finding 4 – no agency response at the time of the subcommittee Fall meeting) noting that plans for the ATC/Tech Ops core research program are important, but that anticipated funding levels would be insufficient to execute the plan. Further, the value represented by the crosscutting nature of the work in this area is difficult to achieve in other research programs or in specific development programs.

At this meeting, the funding levels were confirmed as being roughly halved. This resulted in limiting research primarily to in-house researchers, making impossible the proper execution of most elements of the plan at the depth and rigor required. Research areas depending on procurement funds or outside contractors are particularly hard hit, without apparent consideration of the technical impact. For example, significant risk areas resulting from these funding cuts include:

1. Research for controller fatigue is being eliminated, even as the ATO is trying to startup a Fatigue Risk Management System (FRMS) that should be monitored and updated to reflect how it impacts actual controller fatigue.
2. Research addressing Human Factors in Safety and Operations appear to end in FY2014. This will effectively terminate recent advances in engaging human factors in ATO’s annual tackling of their top 5 hazard mitigations, and methods for ATO operational facilities used in the analysis of ATSAP.
3. A previous finding (Spring 2013) noted a need for better integration of Human Factors within the Acquisition Management System (AMS), so as to provide the agency with a capability to incorporate human factors early in the acquisition process and then monitor for potential problems throughout acquisition. It appears that this research area is at risk of termination for lack of funds.
4. Affecting all aspects of ATO/Tech Ops human factors research, the funding reduction will not allow human-in-the-loop testing, which is a necessary component of definitive human factor evaluations.
5. The committee believes there is a need for maintenance, analysis, and future updates to HF research for personnel selection, both in terms of ensuring validity of current selection practices, and for updating personnel selection in response to new developments. This research has been terminated within the research program, without being transitioned to other offices within the agency.
6. Cornerstone success criteria for ATC are reduced Loss of Separation events and Runway Incursion events. The core program includes training R&D to improve controllers’ ability to recover from Loss of Separation events, but it is shown only for FY2014; this appears to be insufficient to make substantial improvements in mitigating the effects of, and recovering from, such events through improved controller training.
**Recommendation:** The funding reduction in this area in 2014 and beyond is insufficient for critical research areas and will have significant impacts on safety and ATO operations. We recommend that the agency restore sufficient funding to address the risk areas identified in the findings; if not, the agency should describe how they will address these risks and their safety and operational implications.

(NextGen ATC/Tech Ops)

**Finding:** The subcommittee was very pleased with the presentation of the NextGen Air traffic Control/TechOps Human Factors Research plan. The set of research activities and outputs represented an important set of cross-cutting HF research needs in support of NextGen. However, it was not clear what relative priority the FAA places on these activities, and thus whether sufficient funding is planned to meet the research objectives.

**Recommendation:** Continue to pursue the NextGen ATC/Tech Ops research plan as presented. Where funding needs to be prioritized for research in this area relative to other NextGen research areas, and within the plan, describe the prioritization, its impact on the ability to conduct these research activities, and the further impact that any cuts to these cross-cutting research activities may have on NextGen developments.

**Action:** Further elaborate on details of the individual research activities, and clarify the prioritization of their execution as the plan matures and as the plan is resourced. Present this material at a future meeting.

(Proper Human Factors Input into ConOps)

**Finding:** The Subcommittee heard briefings on the expected flightdeck and ATC NextGen research plan. While the proposed work is excellent, these briefings led the Subcommittee to raise the following question:

*How can the FAA ensure sufficient human factors input during the development and validation of NextGen CONOPS, including specific coordination to ensure that the findings from recently completed and future human factors research will help both to inform definition and validation of a CONOPS over its lifecycle, and to ensure that the correct human factors research is being done to enable implementation of a CONOPS?*

Such human factors input needs to be integrated early in the process of defining and refining a CONOPS in order to ensure that it is viable from a human performance perspective, and to provide guidance in designing the necessary technological enablers for the CONOPS. In addition, as the implementation of the CONOPS proceeds, human factors research needs must be identified proactively in order to ensure that the necessary detailed human factors research has been completed in time to influence design and acquisition decisions. Rather than taking a reactive approach to human factors, such early incorporation of human factors input will help to ensure that the CONOPS and its implementation will be effective once fielded.

**Recommendation:** Better integrate the development and implementation of NextGen CONOPS with human factors research findings and expertise. This includes not only using human factors expertise to better inform the CONOPS, but also ensuring that the human factors implications of the CONOPS development are linked back out to relevant research and development.
Specifically, ensure that the Human Factors Research team is involved in the initial generation of Next Gen CONOPS so that downstream changes and mitigations are minimized.

(Broader set of HF issues around roles, responsibilities)

**Finding:** Determining information requirements and their human factors implications is an important focus of planned research for each of the flightdeck and ATC. However, given the significant enhancements expected under NextGen, a broader set human factors issues needs to be addressed, including research dealing with the implications of new roles and responsibilities, as well as the introduction of new procedures and enabling automation, communication and decision support technologies.

A good example of this is the proposed research concerned with the common functions and shared information requirements for ARTCC and TRACON operations that is expected to provide input to support the potential merging of ARTCC and TRACON facilities and functions. While this research is necessary, the full benefits of such a merger look beyond information requirements to also account for the human factors implications of new roles and responsibilities, and corresponding new procedures and supporting technologies. Not only is this broader scope important to provide guidance in the integration and design of decision support technologies, it is of critical importance in guiding the development and validation of the relevant CONOPS.

**Recommendation:** Map out the broader range of human factors issues that need to be addressed, including not only a focus on information requirements but also the human factors implications of new roles and responsibilities, and their distribution within and between air and ground systems, as well as the introduction of new procedures and enabling automation, communication and decision support technologies.

**Action:** Ensure an integrated approach to human factors research coordinating efforts examining the flightdeck, ATC and TechOps. This requires careful definition of the research requirements for work funded as flightdeck research, ATC research or TechOps research. Equally important, it requires careful attention to the definition and execution of the specific research tasks and associated deliverables to ensure that such an integrated perspective isn’t lost as the research transitions to implementation. Finally, it requires deliberate coordination across the programs responsible for these three focus areas. Specifically, the subcommittee would like a briefing on this. We believe that developing this briefing will also be useful for presentation by the FAA in other contexts than just our little subcommittee world.

(F&R for Requirements Generation and Prioritization within AVS)

**Finding:** The subcommittee very much appreciates that a thorough and structured requirements generation and prioritization process has been put in place by AVS. However, as with any new process there needs to be on-going examination and refinement. Several findings emerged during the discussion of how requirements are generated and evaluated.

- The process can be onerous to requirement writers in a time and resource constrained environment; in some cases, anecdotal evidence suggested that some significant requirements may be lost because the process is perceived as too onerous.
- Part of the perceived difficulty may stem from the fact that, while requirement writers may understand the needs for research and the desired outcomes and deliverables, they
may not understand how to actually craft a research plan as called for in the template. The process was not always clear that milestones and project phases should describe the research objectives and requirements, rather than requiring a detailed research plan.

- It also appears that the process may inadequately weight and hence inappropriately prioritize the cross-cutting nature of some projects. There doesn’t appear to be a place in the requirements-generation template to give appropriate weight to those requirements that cut across domains and other requirement areas. In addition, the process also does not seem to give much emphasis on multi-year activities.

- While a phased approach to research deliverables, milestones and exit criteria is encouraged in the process, there is no place to adequately identify previous work and accomplishments that the current requirement builds upon. This is particularly important when evaluating multi-year research plans that are intended to build upon each other.

For these reasons, it appears that the requirement process can be further refined to allow for greater efficiencies and enhanced validity of prioritizations.

**Recommendation:** AVS should undertake a process improvement activity to refine the requirements generation process to address the issues defined above. Specifically: 1) clarify the inputs needed for the milestones and project phase template items, 2) include in the template a means to appropriately weight cross-cutting requirements and ways in which the current requirement builds upon previous work, and 3) consider surveying those who have written requirements concerning their experience of the process and areas where further guidance would be helpful.

(Specific F & R on AVS Core)

**Finding:** Examining the ranks assigned by AVS to the Human Factors research requirements, we find that there appears to be significant variation year to year: for example, proposed applications of human factors developments to address Jet Upset, notably including training, are ranked the highest of the requirements proposed by the Human Factors TCRG in one year, and then second-lowest in the next. Further, we note that these rankings are made three years out based on the best estimates available at that time. While these rankings three years in advance serve a valuable planning function, new knowledge and considerations may arise after the rankings are originally made. We understand that AVS also considers ‘pop-up’ research needs on a shorter time-cycle, but note these pop-up research needs appear to be handled with a distinctly different process rather than explicitly integrated into the formal planning process that has been established; further, this process appears, from the written description of the 2013 Aviation Safety R & D Prioritization Process, to be limited to year of execution.

**Recommendation:** Rather than viewing the rankings as fixed three years in advance, and then waiting until the year of execution for further evaluation, we recommend that the rankings be revisited in advance of the year of execution to take into account:

1. New knowledge about the problem and potential solutions that may increase or decrease the importance and likely impact of the research requirement.
2. New considerations in the broader aviation community may make specific research requirements more-or-less pressing.
3. Emerging problems and potential solutions.
Finding: The subcommittee was not briefing on the AVS research requirement for UAS Human Factors due to concerns about release of contracting-sensitive information, particularly where committee members may have inherent conflicts of interest. However, this research area is vital to achieve the mandated ability to include civilian, commercial applications of UAS within the NAS, and it merits a review even if the review process must be modified to account for conflict of interest concerns.

Recommendation: Continue with the planning and implementation of the research requirement and specification, recognizing the pressing need of this problem, and opening up these research plans for proper review as soon as possible. This should involve experts without conflict of interest now, rather than waiting until the research plans are finalized beyond the ability of a review to provide constructive comments and feedback.

Action: Distribute to the committee the research requirement immediately upon its public availability and/or address concerns with conflict of interest so as to enable a review of the proposed requirement.

Action: The Subcommittee found three areas of the program description that were confusing or needed more explanation. It is unclear whether these reflect potential areas for project improvement or simply are areas that need to be presented more clearly.

First, the described research requirements of “ensure Next Gen systems support UAS integration” and “Generate HF Operational and Functional requirements for NextGen systems to support imminent UAS NAS integration” make it sound as though the focus of the effort is to support modification of the NAS and NextGen to accommodate UAS’s; the Subcommittee believes the requirements should include, and perhaps focus on, the opposite, that is, UAS requirements for operating in the NAS rather than NAS requirements for accommodating UAS’s.

Second, the outcome titled “provide HF for ground control systems” is too broad and sounds very similar to an objective of the Flight Deck HF program on UAS’s. The Subcommittee believes this objective should focus on identification and mitigation of HF issues related to communication between the UAS ground control station and air traffic control. This would make it clear why the outcome is part of the ATC HF project and not the Flight Deck project, and it would explicitly show how the two programs are coordinated.

Finally, the outputs or deliverables of this project, namely reports, are viewed as inadequate in terms of identification of how they will be used by stakeholders. The Subcommittee believes that the outputs should be in a form that makes clear how they will be used. For example, will the deliverables provide guidance to FAA certification and operational approval personnel, are they meant to help develop standards and design guidelines, or are they intended for some other purpose? Simply producing reports without identifying their intended impact and user may result in the objectives and requirements of the project not being achieved.

(Loss of Control – Inflight Research Program)
**Action:** The Subcommittee suggests that the learning objectives and training techniques for LOC training be more explicitly defined and delineated. For example, LOC awareness/avoidance and detection/recognition may primarily require additional knowledge and knowledge refresh, while recovery likely requires both knowledge and manual skill/practice. Knowledge components could be taught in the classroom and with existing simulator capabilities while skill development and practice of skills may require new simulator capabilities. It is suggested that training guidance and recommendations be separated into different categories that might be implemented in these different ways. For example, the training protocol for LOC avoidance knowledge elements that can be taught in the classroom can be defined separately from the training protocol for recovery skills that must be practiced under realistic operational simulation conditions. Further, some elements of LOC training might be incorporated into CRM or other specialized training modules – for example, startle, surprise and distraction aspects of LOC might best be covered in CRM in conjunction with aircraft state awareness, automation awareness, proper monitoring practices, and so on. Similarly, CRM skills should be integrated into both academic and skill development for LOC training. While the learning objectives should be defined and addressed separately, the research should also identify how the LOC and CRM training components should be integrated for maximum benefit.