

Finding Common Ground: A Value-Focused Approach to Military UAS Airspace Integration

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Introduction

Integrating unmanned aircraft systems (UAS) into nonsegregated¹ airspace is a topic of much debate and significant energy, particularly with respect to military operations. This paper applies leading-edge research in enterprise architecting and value focused thinking to examine the development of alternative approaches to the U.S. military's UAS airspace integration challenge. The motivation for this research drew upon several years of experience the author had in attempting to coordinate and integrate multiple U.S. military and other government agencies in an effort to secure wider operational use of nonsegregated airspace for military UAS operations.

Figure 1 provides a graphical perspective on what fully integrated military UAS operations in nonsegregated airspace might look like. The author's experience suggested the challenges at hand were significantly broader than just the technological hurdles. Capturing the complexities and motivations of each of the key players proved to be a key in charting a course forward. This paper is a brief overview describing the approach, analysis and recommendations for moving the integration of military UAS into nonsegregated

¹ Nonsegregated airspace, as used in this article, refers to civil airspace that is open to general aviation use and not restricted to military only operations.

airspace forward within the context of U.S. national airspace with the hope that the issues and principles described in the approach may find some broader applicability in the international environment.

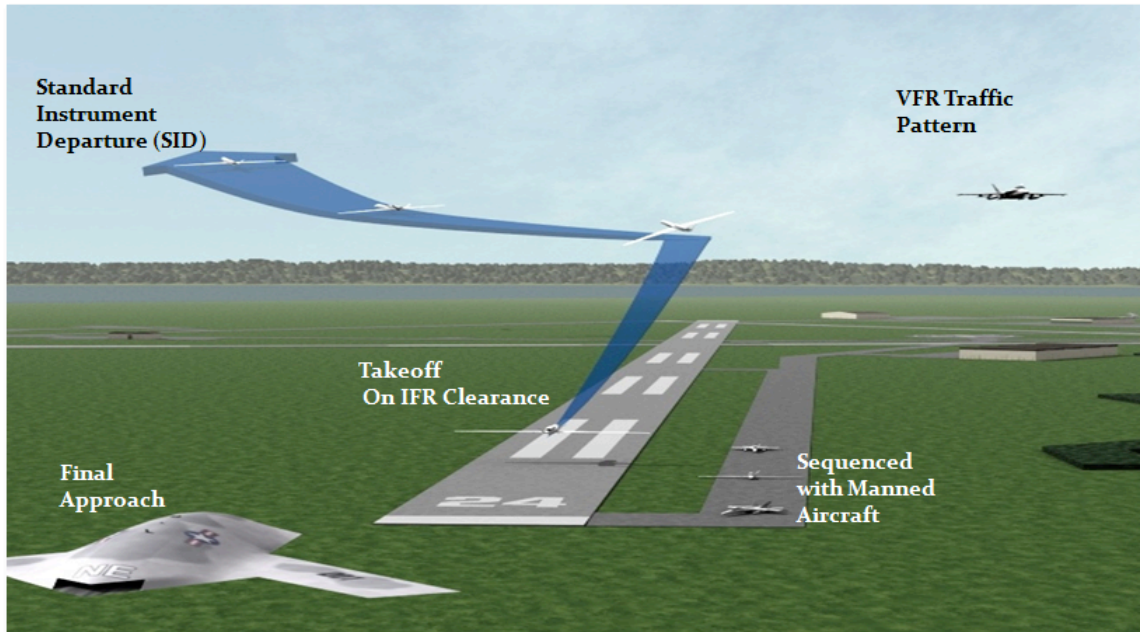


Figure 1. A Perspective on Integrated UAS Operations. [1]

Approach

The approach taken in this research was to identify a specific set of UAS platforms (in this case, high- and medium-altitude U.S. Air Force UAS²) and the key organizational stakeholders involved in the approval processes for those UAS to operate in nonsegregated airspace. A value focused, enterprise framework provided the basis for key stakeholder

² U.S. Air Force UAS were chosen as a representative set of platforms with which to conduct this study. The challenges and results presented in this research are not unique to the U.S. Air Force. They provide a well-scoped context for a real world force structure while being representative of challenges faced across the unmanned aircraft community.

interviews, data analysis, and synthesis of alternative solutions. Keeney [2] describes the value focused approach in the following way:

"...value focused thinking suggests a different paradigm for addressing decisions from the standard alternative-focused thinking paradigm. It is different in three important ways. First, significant effort is allocated to articulating values. Second, this articulation of values in decision situations comes before other activities. Third, the articulated values are explicitly used to identify decision opportunities and to create alternatives."

Keeney is contrasting a value focused approach to that of an alternative-focused method where decisions are made predominately on the various solutions that come to mind when a person is thinking about a problem that needs to be solved instead of determining what the underlying value is that needs to be delivered as a result of solving a problem. The issue that often arises with an alternative-focused approach is that the underlying problem that needs to be addressed is all too frequently dismissed as people and organizations jump straight into discussions of potential alternative solutions with no clear picture of what the problem or desired end-state really looks like. When the underlying values and problem statements are not clearly understood across an enterprise with complex stakeholder issues, this often leads to a lot of activity but little real progress because solutions are being discussed to different problems, often unknowingly. Conflict within the enterprise is an almost inevitable result of this kind of approach, and the data consistently bears this out. Value focused thinking stays in the problem space until a clear picture of the problem is articulated—then the hunt for alternative solutions begins.

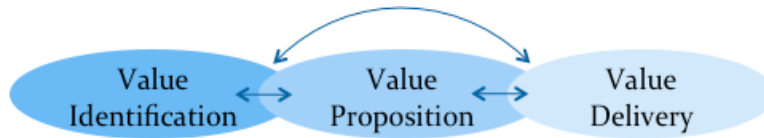


Figure 2. Value Generation Framework.

The model used to implement the value focused approach was one developed by Murman et al in Lean Enterprise Value [3] and depicted in Figure 2. At this level, the model is relatively straightforward³. The initial focus was on correctly identifying what each of the key stakeholders involved in the effort to integrate military UAS into nonsegregated airspace valued from their unique perspectives (“value identification”). In other words, what was the fundamental problem they needed to have solved to declare “success”. The next step required the development of alternative solutions that would simultaneously provide each key stakeholder a significant level of value in exchange for the effort and resources committed to the pursuit of integrating military UAS into nonsegregated airspace (“value proposition”). Viewed another way, this is an effort to seek out a solution to simultaneously solve each of the previous step’s problems. The last step involved charting a path from the current state of affairs to one in which the value proposition could be constructed and the desired value delivered (“value delivery”). This answers the question of how you go from where you are to where you want to be.

³ Given the time and space constraints of this article, the treatment of the methodology and details concerning the data collection and analysis have been left out of the discussion. For a full development of what is required to implement the value generation model described in this paper, see “Integrating Military Unmanned Aircraft into the National Airspace System: An Application of Value-Focused Thinking and Enterprise Architecting” at reference number [4] as the underlying basis for this paper. The full thesis can be found at the following website: <http://web.mit.edu/lcropsey/Public/Thesis/>

Value Identification

The above approach resulted in the identification of a number of key stakeholder organizations that are central to moving Air Force military UAS airspace integration into nonsegregated airspace forward. Figure 3 details these key organizations and individuals with whom interviews were conducted to elicit the underlying values of each organization.

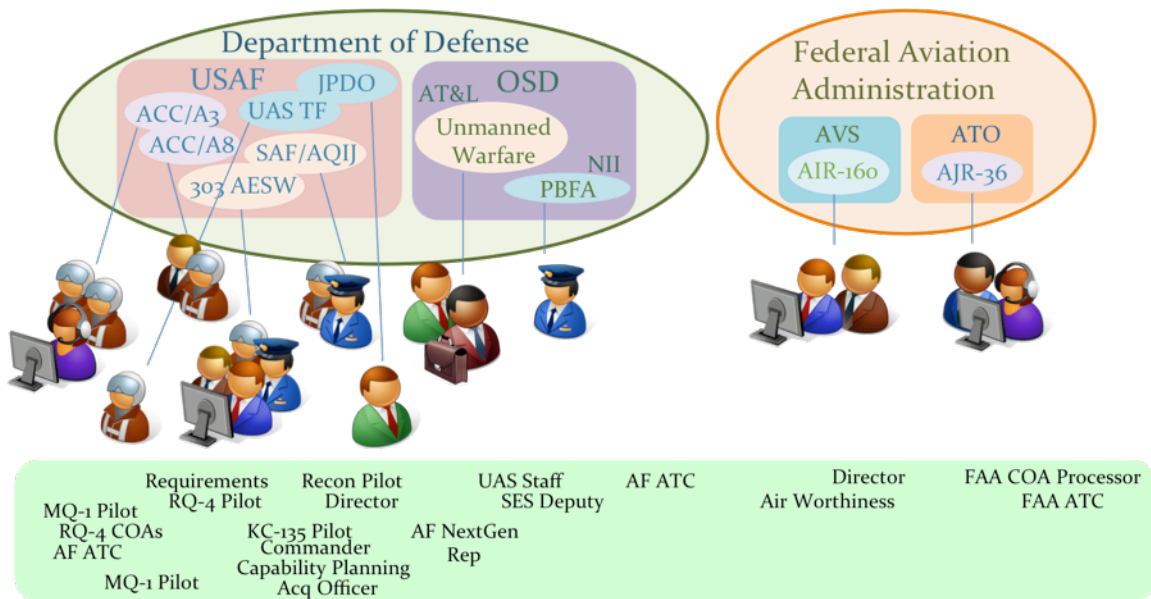


Figure 3. Key Stakeholder Organizations.

The data from the interviews were input into an Access database so the information could be resorted and filtered along organizational lines, professional backgrounds, expertise, etc. The results of this analysis yielded a number of obvious observations, and several others that were not so obvious. Two primary categories emerged in the data: those findings that suggested a difference of opinion or perspective between the various organizations (Figure 4) and those findings that suggested a consensus existed on a particular topic or issue (Figure 5).

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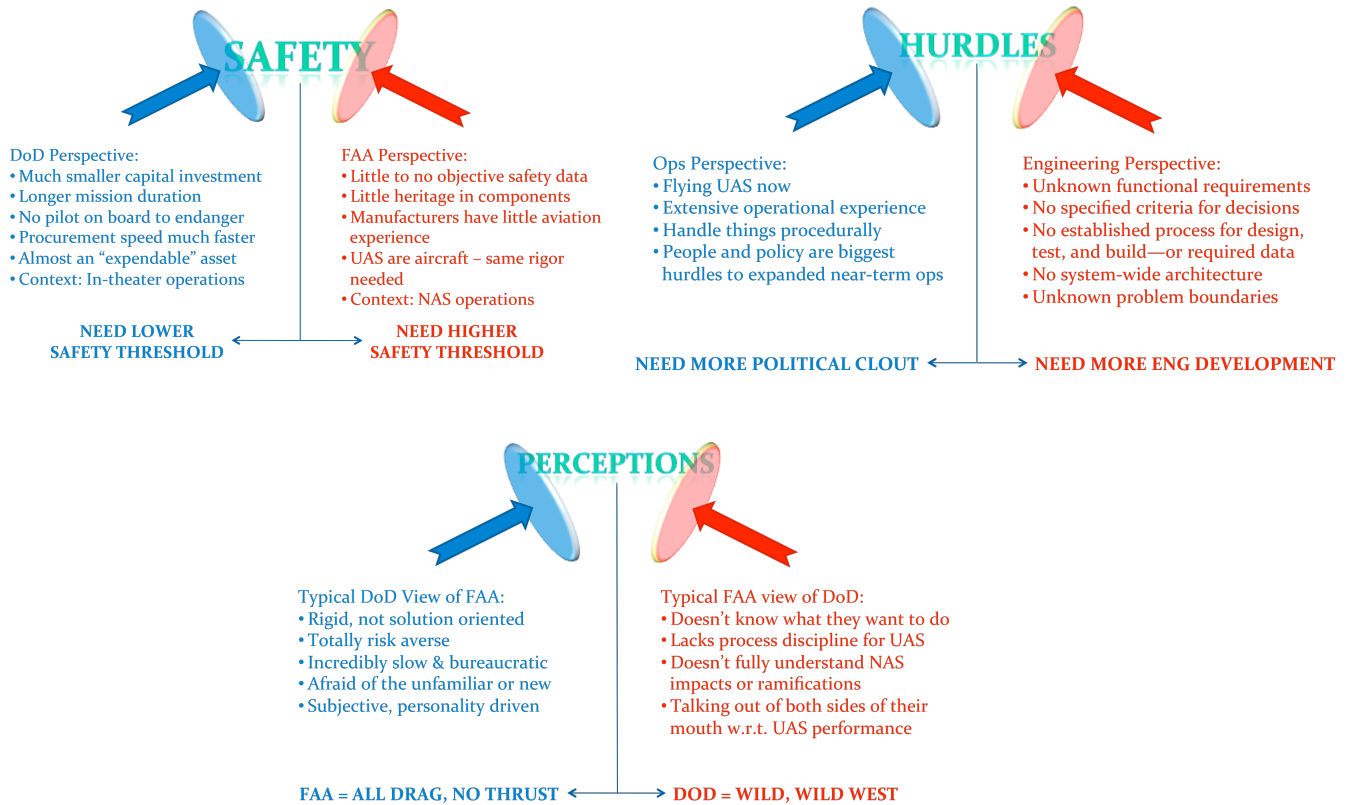


Figure 4. Differing Perspectives of Key Stakeholders.

The differences in perspectives captured in Figure 4 were expected given the diverse nature of the two primary organizations (the Department of Defense and the Federal Aviation Administration). The difference that clearly dominates the others is that of “Safety”. One reason the U.S. military built UAS platforms was to reduce the risk of losing a pilot during operations. As a result, the typical military perspective is that less investment needs to be made in system reliability and redundancies, and more risk of failure can be accepted in order to procure UAS at lower costs and for riskier missions. The Federal Aviation Administration views the removal of the pilot from the physical confines of the flight deck as a reason to require additional safe guards to ensure the aircraft does not pose a danger to others flying in the same airspace. The same act (removing the physical

presence of the pilot from the flight deck) results in opposite perspectives about the need for UAS safety precautions. The same logic can be followed for the other two primary differences in perspective, those involving the “Hurdles” that must be overcome in order for progress to be made, and the “Perceptions” each of the two primary organizations have of each other and the attitude with which each is approaching the challenge of UAS airspace integration.

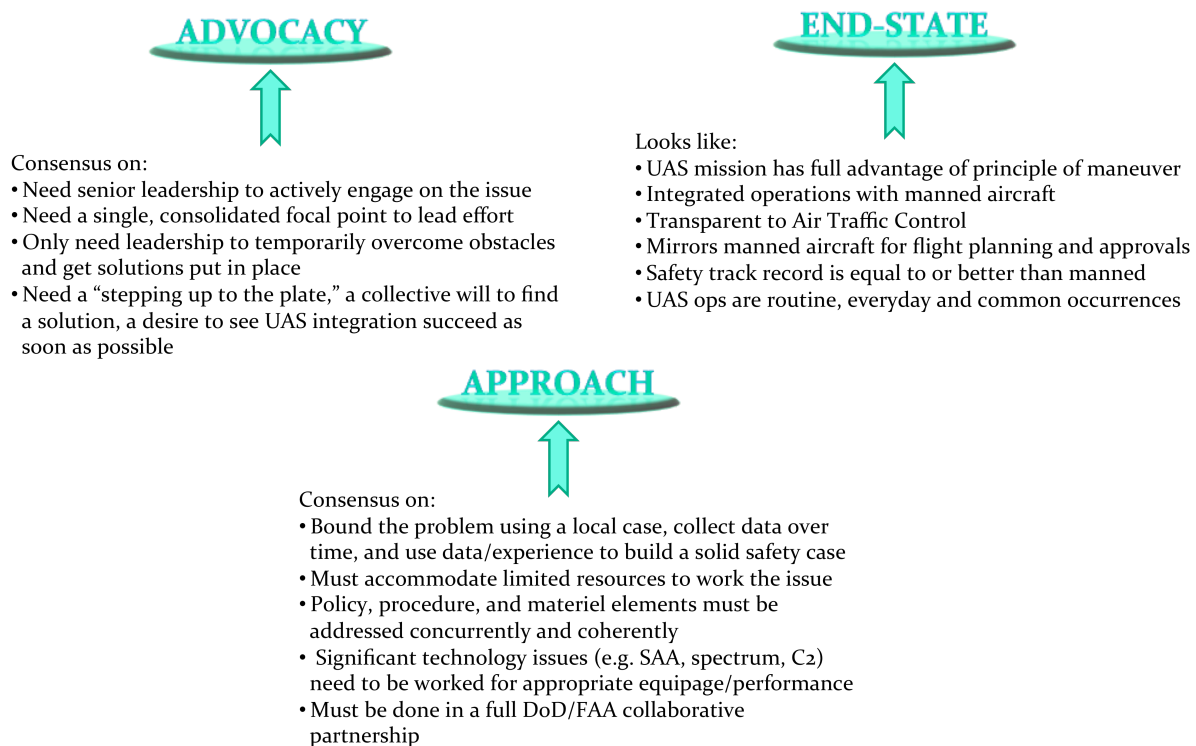


Figure 5. Points of Consensus of Key Stakeholders.

As Figure 5 illustrates, there were three main points on which consensus was evident in the data collected during the interviews: the need for “Advocacy” by senior leadership, the general “Approach” that should be taken to formulating a solution, and the desired overall “End-State” for integrated UAS operations in nonsegregated airspace. The consensus

observed in the data on these points provides common ground for beginning to build a basis for successful cooperation and a strategy for moving forward.

Figure 6 illustrates the results of the completed data analysis for two key stakeholders, the UAS military operator (Air Combat Command) and the airspace regulator (Federal Aviation Administration). Each box represents a specific item of value to that organization, and the color represents the current extent to which that organization believes the value is being delivered (blue = high, green = satisfactorily, yellow = marginally, red = marginally). This is denoted by the vertical position on the graph. The value is also ranked by its relative importance to the stakeholder, the most important values occurring further to the right.

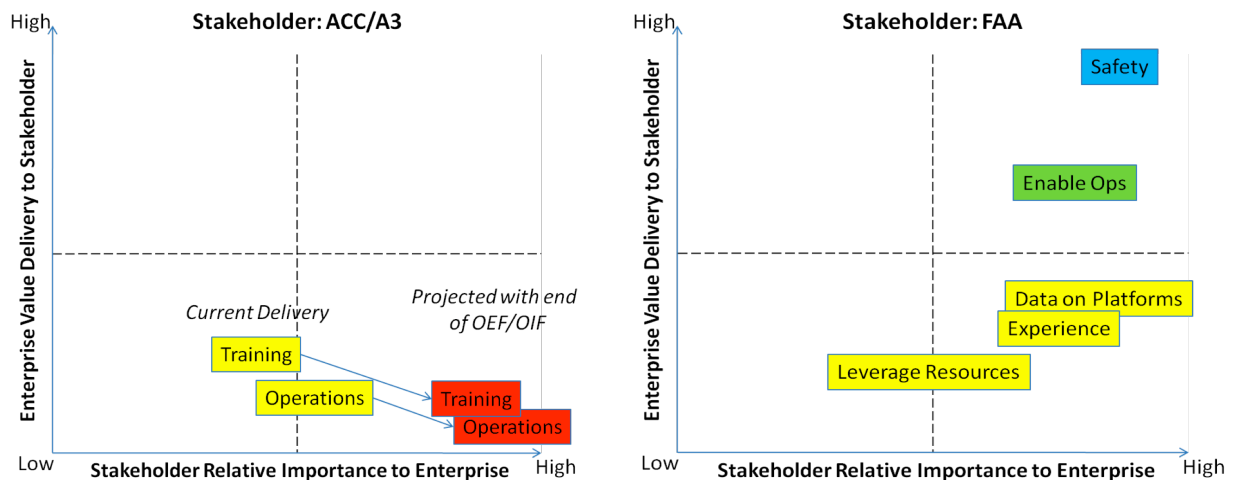


Figure 6. Current Value Delivery of Two Key Stakeholders.

It is worth noting that these values and the extent of their delivery are taken from the perspective of the organization itself. This exercise was repeated for each key stakeholder. A successful effort occurs when all of the values articulated by each stakeholder are

delivered at an acceptable level of value. The goal of the next phase of the analysis, “Value Proposition”, is to architect a concept whereby this goal can be attained.

Value Proposition

This phase of the effort requires the ability to see the situation from the perspective of each of the key stakeholders, to put yourself into their framework, and then focus creativity on generating alternative solutions for delivering value to each of the stakeholders. The theoretical development needed in system and enterprise architecting will not be addressed in this paper, but the reader is referred to reference [4] for a complete treatment of the methodology used to develop the results presented in the following section.

In the most general sense, the goal of this phase in the analysis is to achieve alignment in the values of each stakeholder with respect to the objectives of the effort. Significant discussion and analysis revealed that the current definition and scope of activities being pursued by the key stakeholders were not sufficiently aligned to provide the value delivery each sought in return for their efforts. Figure 7 illustrates this disconnect by demonstrating how a given UAS level of performance translates into two different levels of operational flexibility in military controlled airspace versus civil controlled airspace. In military airspace, the decision on operational flexibility revolves around the capability the UAS brings to bear on the mission objectives while weighing the risk to the military service member engaged in the mission versus the risk of mission non-accomplishment. In the civil airspace, the emphasis is on preserving the safety of the airspace users and populations on the surface--while maintaining the capacity of the airspace to support the ever-increasing demands of both the number of aircraft and requested routes.

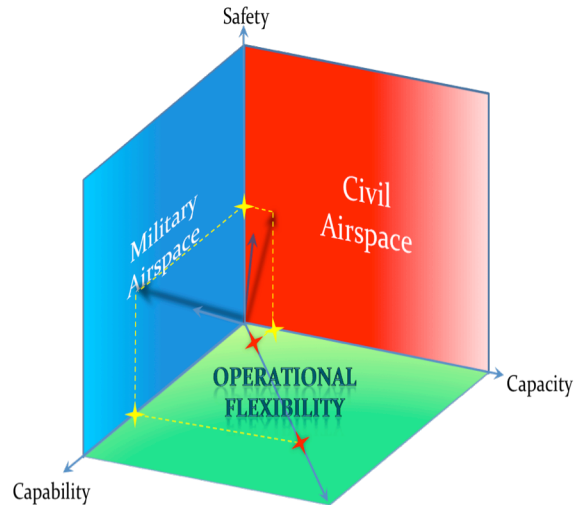


Figure 7. Defining "Operational Flexibility" from Different Perspectives.

The immediate impact of these two fundamental differences in the way these organizations approach the problem is the level of operational flexibility each is willing to assign to a given UAS performance level. In general, the military is willing to draw significantly higher levels of operational flexibility from a UAS than the civil regulator due to these differences in underlying values and objectives. The challenge is to arrive at an objective that both the military and the FAA will see as directly contributing to their primary value needs. In Figure 7, the "Capability" axis was used as a proxy for the values of "Training" and "Operations" detailed in Figure 6. Past and current efforts were scoped to enable these two military values. Unfortunately, these two military values do not inherently correspond to primary FAA values.

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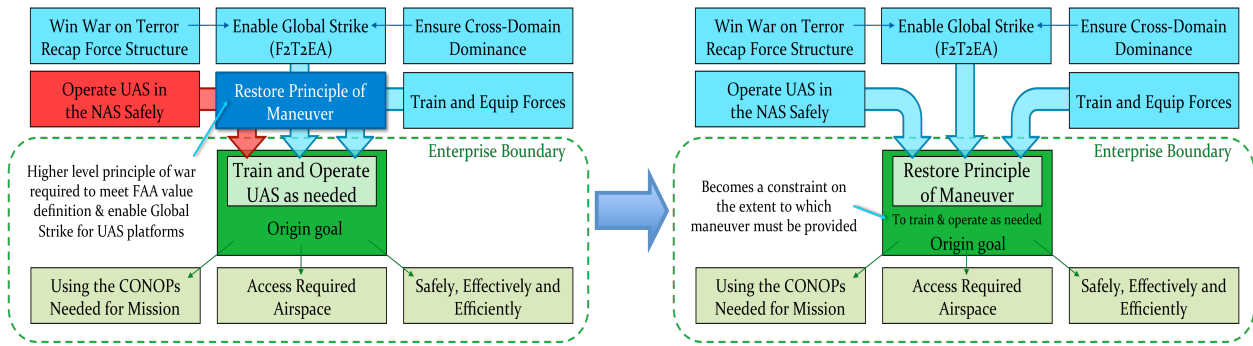


Figure 8. Aligning Purpose to Values.

Figure 8 illustrates the logic used to re-scope the UAS airspace integration effort, changing the primary focus from that of “Training” and “Operating” (Denoted in the first part of the figure as the “Origin Goal” of the activity) to “Restore the Principle of Maneuver” in the second part of the figure. This represents a fundamental shift in perception and execution of a solution. On the military side, “training” and “operating” are not in and of themselves the purpose for fielding a UAS (they are means to an end). Rather it is to achieve some battlespace effect while conforming to a given set of constraints (denoted in the set of boxes at the top of each of the schematics in Figure 8). The more fundamental requirement for achieving this battlespace effect is the need to revitalize the “Principle of Maneuver”⁴ on the UAS to enable the ability of the military to Find, Fix, Track, Target, Engage and Assess (F²T²EA) an enemy asset.

⁴ The “principle of maneuver” is a higher-level objective of the military – one of nine “principles of war,” outlined in U.S. military doctrine. The principle of maneuver calls for placing the enemy in a position of disadvantage through the flexible application of combat power. As it relates to the UAS issue, it can be more specifically tied to those characteristics traditionally embodied in airpower, requiring freedom of navigation, global access, flexibility and responsiveness. All of these characteristics depend on the principle of maneuver to enable them, and all of them are significantly limited in currently fielded UAS.

From the FAA perspective, training and operating with UAS did not address the need to preserve the safety or the capacity of the airspace in any intrinsic way (illustrated in the first schematic in Figure 8 as the red box to the left). In fact, on the face of it, allowing military UAS into nonsegregated airspace actually causes a *decrease* in the safety, reducing the capacity of the airspace to accommodate essential margins in space and time. The extent to which the FAA is willing to provide additional operational flexibility to UAS operations is directly tied to their perception of how well the UAS can discern local air traffic and maneuver to avoid potential mid-air collisions and respond to air traffic controllers re-routing the UAS to accommodate the changing airspace picture. The current FAA perception is that there is very little ability on the part of the UAS to maneuver in a responsive way to avoid potential midair collision threats or to respond to FAA direction (both are legal requirements for flight in nonsegregated airspace). By changing the scope of the activity to “Restore Maneuver”, both the military and the FAA find a purpose that delivers the desired value for their active engagement on the issue. In this way, a single problem definition (“Restore Maneuver”) now addresses the fundamental value or problem statement from each key stakeholder.

Value Delivery

The final step in the analysis was to take the insights from the above value identification and value proposition steps, consider the current context, and then architect a path forward that will provide for the conditions needed for successful value delivery to each key stakeholder participating in the effort. Several alternative architectures were considered for this, but only the final architecture will be discussed. Once again, the reader is referred to reference [4] for a complete development of the results of this analysis.

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The overall approach for moving forward is depicted in Figure 9. The backdrop to this architecture is a three fold policy put forward by the U.S. Department of Defense to 1) Do no harm in the airspace, 2) Conform to the existing airspace structure rather than attempting to create new types of airspace, and 3) Set the precedent for how future activities of a similar nature should be pursued and to provide an example of a successful endeavor for other countries to use as a template.

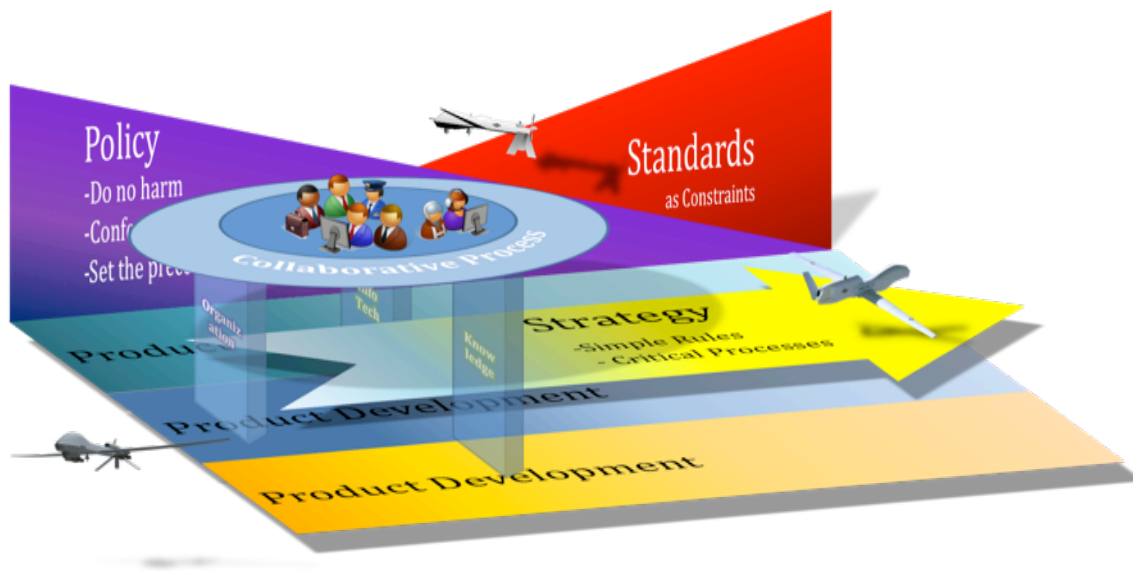


Figure 9. Architecture for Achieving UAS Integration into Nonsegregated Airspace.

Constraining the way forward is the need to develop the appropriate standards for consistent achievement of objectives and performance measures that translate directly to key stakeholder value definitions. At the center of the entire architecture is a collaborative process in which all of the key stakeholders are equal partners in charting a course forward. This collaborative process is built on the three pillars of effective organization, knowledge, and information technology. The overarching strategy is one in which a set of simple rules are used to guide the direction and intent of the effort, and a set of critical

processes are put in place by which to make decisions or to establish criteria by which decisions will be made at some future point. All of these actions will be taken on a platform-by-platform product development basis rather than trying to collectively solve the entire problem for all types of UAS platforms.

This provides a convenient, top-level approach for attacking the challenges previously noted; however, it becomes much more complex as the details for how to implement this architecture are considered in light of the many constraints within which a solution must be pursued (these context specific details are not considered here for the sake of space). Rather than providing the specifics of a contextually dependent set of actions, an overview of the enterprise transformation process developed by Nightingale and Srinivasan [5] is depicted in Figure 10 to provide the reader with the scope of activities and types of issues

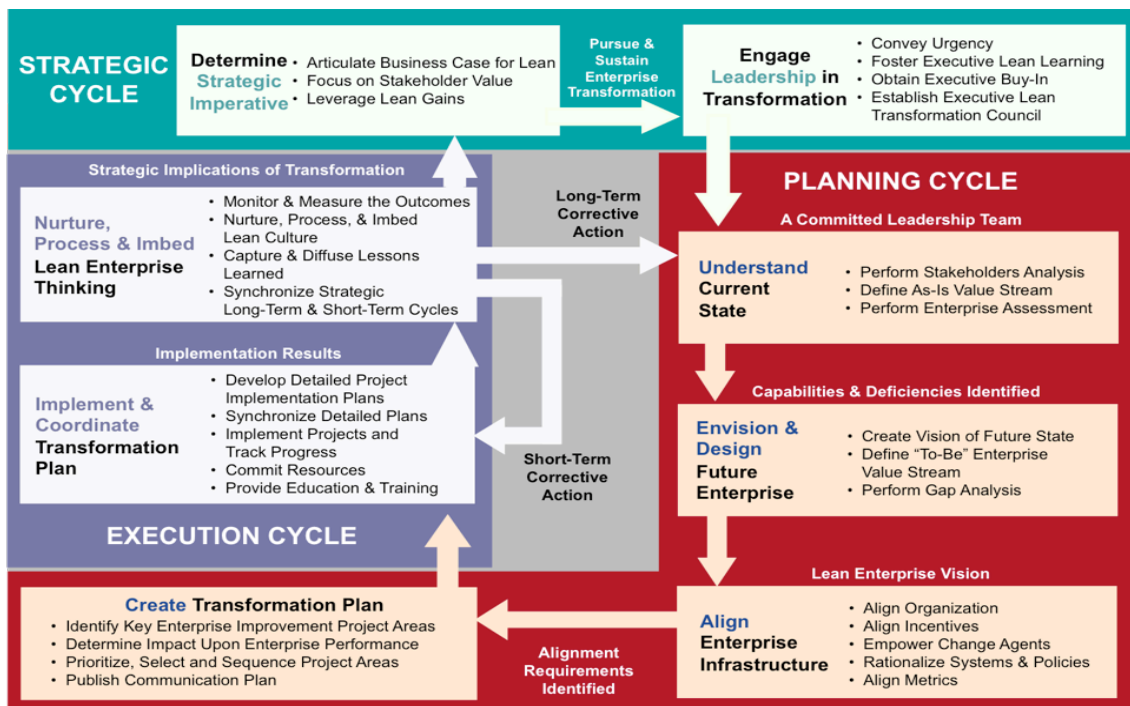


Figure 10. Enterprise Transformation Process.

that must be addressed in order to move an effort from its current state to one envisioned by the value proposition. Without this detailed level of planning, actually realizing the level of desired value delivery will be a remote possibility.

Conclusion

In summary, the value-focused approach implemented in this research proved to be highly effective at identifying the underlying value definitions while clearly demonstrating the limitations of the current alternative-focused approaches. It not only provided insight into why the existing efforts to integrate military UAS into nonsegregated airspace have met with less than resounding success, but it also provided the basis on which to glean the insights necessary to restructure the effort into one that should yield more substantive results in the future. The lynch pin to future success will be the extent to which the effort can be recast around the concept of “maneuver”, and the degree to which the key stakeholders see the value in pursuing it.

References

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