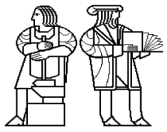

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Executive Summary

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IDENTIFYING THE DYNAMICS OF TECHNOLOGY TRANSITION: ADS-B ADOPTION IN THE NATIONAL AIRSPACE SYSTEM

Final Report – ESD.10, Introduction to Technology and Policy

Norma Campos
Robert Holcombe
Misha Leybovich
Zoe Szajnfarber
Hidigunnur Thorsteinsson

Massachusetts Institute of Technology
Technology and Policy Program

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EXECUTIVE SUMMARY

Congestion is a growing problem in the National Airspace System (NAS). Predictions indicate that the NAS, as a whole, will be operating at 75% of capacity by 2010 [2] and that the demand in capacity in air transportation will double within a span of 10 to 35 years [3]. In order for the U.S. to maintain leadership in air transportation and meet the challenges of demand and efficiency of the 21st century, the NAS infrastructure, technology, and procedural strategies need to be modernized [4]. To this end, the FAA plans to implement a cooperative surveillance system called Automatic Dependent Surveillance – Broadcast, or ADS-B. The surveillance technology and its applications are expected to provide important operational improvements by addressing some of the limitations of the current surveillance system.

One of the key determinants for the success of a NAS-wide cooperative surveillance system will be the adoption of new technologies by multiple stakeholders. Successful transition in a complex system such as the NAS will be dependent on factors such as competing stakeholder objectives, safety considerations, technical maturity, equipage critical mass, resource limitations, and a balanced value distribution of costs and benefits over time among participants, both individually and as a group [5]. This study aimed to identify the dynamics of technology transition in a complex system so that they may be applied to the particular case of ADS-B adoption in the NAS. To that end, five cases of ADS-B adoption were examined to gain insights from their varied successes and stumbling blocks. They are Australia, the Gulf of Mexico, Capstone in Alaska, the United Parcel Service (UPS) tests in Louisville, and different ADS-B efforts around Europe.

The cases were systematically compared in order to identify transition dynamics. The comparison revealed two implementation scenarios that merit distinct policy treatments. Where adoption was precipitated by a specific, time-critical factor, implementation proceeded more rapidly and with less resistance; analogous to "a spark igniting a field of dry grass". Conversely, other cases, despite significant need, showed that in the absence of a time-critical, compelling catalyst, implementation proved more complicated and progressed slower; this scenario of progressive need leading to adoption can be likened to "a straw breaking the camel's back."

Key observation #1: There are two implementation scenarios that merit distinct policy treatments, *sparks* and *straws.*

Key observation #2: *Spark* dynamics weaken barriers.

It was also noted that when the impetus for change is championed by a party other than the system administrator, there seems to be an increased sense of legitimacy to the need. Other stakeholders seem more willing to buy-in to a project that was instigated by "one of their own."

Key observation #3: If a party other than the system administrator fills the role of facilitator, fewer external incentives are needed.

In all cases that are sufficiently mature to measure success, the incremental successes were cast as incentives for future equipage. When program goals are stated in such a way, that it is easy to recognize when they have been met, program enthusiasm has a way of snowballing.

Key Observation #4: If programs are rolled out in phases, and goals are measurable, attained success can be cast as an incentive in future stages.

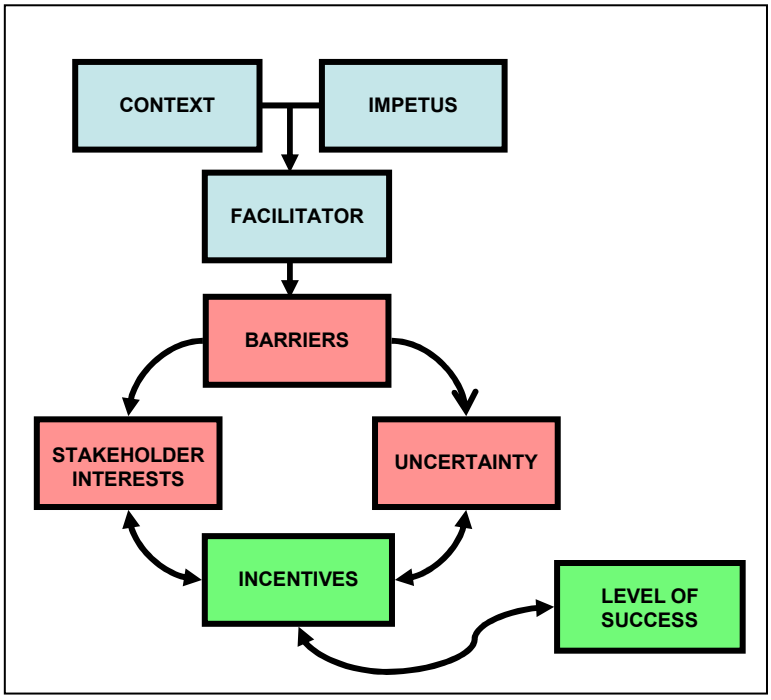

Figure 1 - Transition Dynamics Model

The comparison of case studies led to the development of the transition dynamics model shown in Figure 1. In this model, the context captures relevant aspects of the state of the system prior to transition. The impetus is that element of the context that instigates transition; it can either be a *spark* or a *straw*. This impetus leads one or several stakeholder(s) to take on the role of facilitator and initiate the process of adoption. If the facilitator is not the system administrator, transition tends to proceed more smoothly. Both uncertainty and conflicting stakeholder interests create barriers to transition. Incentives can be shaped to break down identified barriers. Lastly, past successes can be translated into incentives for further technology adoption.

This transition model was then used to assess the FAA strategies for ADS-B adoption in the National Airspace System (NAS). Based on the *spark/straw* classification discussed above, the NAS congestion issue is characterized by "straw piling up on the camel's back." Further, the FAA is both the facilitator and the system administrator in the NAS. This makes the lack of *spark* scenario even more challenging. To identify barriers faced by ADS-B adoption in the NAS a stakeholder analysis and mapping was performed. The one overwhelming trend that is apparent when stakeholder issues were mapped, according to whether they have system or individual impacts, is that individual impacts elicit a much stronger response than system level ones.

Key observation #5: Individual impacts elicit a much stronger response than system level ones.

To examine when issues identified by stakeholders would start to impact the airspace they were mapped according to equipage phases. The mapping showed that although safety is the most widely emphasized of the performance issues, safety enhancements require the most advanced level of ADS-B adoption before the full safety benefits will be realized.

Key Observation #6: Safety is a powerful lever.

While all stakeholders express a positive sentiment towards ADS-B adoption, many remain only guardedly optimistic. The delay of benefits inherently associated with a staged transition is the source of much of this hesitation.

Key Observation #7: The delay between investment and rewards is very important to the stakeholders.

The assessment of ADS-B adoption in the National Airspace System has revealed that the FAA is doing well in many areas. In particular, they are taking advantage of regional sparks by allowing segment one to be solely comprised of regional trials. In this manner, it will be able to use measured successes from these trials to incentivize ADS-B adoption later on. However, it appears that the FAA intends to complete the current set of trials and then implement ADS-B on a nation-wide scale. This seems unwise. While regulations must eventually be nation-wide, it makes sense to structure the implementation plan according to idiosyncrasies of the system.

Recommendation #1: The FAA should leverage regional *sparks* and allow the implementation plan to follow the National Airspace System's natural structure.

Further, regional implementation *sparks* will ignite a nation-wide fire through the commercial airlines. Since they frequent multiple airspaces, they will receive benefits from one pocket of critical mass and spread them to others. This will have the effect of normalizing the benefit delays. Moreover, achieving critical mass in regional pockets will serve to prove the benefits, which to this point, remain theoretical.

Recommendation #2: The FAA should use regionally demonstrated benefits to mitigate the uncertainty associated with future rewards.

The stakeholder issues analysis revealed that individual impacts elicit a much stronger response than system level ones. Yet many of the ADS-B benefits espoused by the FAA will be experienced at the system level. This is simply a matter of understanding your audience and framing the information so that it will be best received.

Recommendation #3: The FAA should frame benefits in such a way that individual stakeholders can relate to them.

Clarity and commitment to goals is the concern most emphasized by the stakeholders despite the fact that the FAA has remained transparent about their plans and goals by presenting their implementation timelines and goals at Industry Days and other venues. The uncertainty associated with FAA commitment is fundamentally a question of perception. This uncertainty can be mitigated by the FAA continuing to issue long-term plans, keeping to the adoption schedule and developing procedures for certification.

Recommendation #4: The FAA needs allocate effort to convincing the stakeholders that they are committed to ADS-B adoption.

By paying special attention to these four areas, the FAA may see less resistance from key stakeholders in the future.