Appropriate Delegation to Automation: Control to Fit the Context. *Funk, H.* [1]*, Miller, C.* [1]*, Shively, J.* [2]*, & Flaherty, S.* [2]*; Smart Information Flow Technologies*[1]*, U.S. Army AFDD*[2]*.*

Despite the term "unmanned," controlling Unmanned Vehicles (UVs) requires substantial manpower and can impose considerable demands on operator workload. Current unmanned assets such as the Global Hawk UAV, for example, require a team of at least three personnel for the control of the vehicle, including the UAV "pilot", a payload operator, and a mission planner, in addition to a command and communications team to handle the information provided by the UAV. This state of affairs is clearly unacceptable for many visions of future UV use. The Army's current vision of employing UAVs as automated "wingmen" to support the crew of attack or scout helicopters requires that the human interaction with these vehicles impose substantially less workload than is currently the case for any UAV. We know that developing the human role in a novel technology is both difficult and extremely important. Our current work addresses this need by providing interface mechanisms and a supporting theoretical framework that allow selection of an appropriate level of automation given the context.

By most accounts, current UAV losses are occurring at unacceptable rates (over 100 times the rate for manned aircraft—Bone & Bolkom, 2003). Human factors are already cited as the most common cause of UAV accidents, at least in existing Army reports (Manning, et al., 2004). To address this, it is common to try to 'design out' the human role by increasing automation.

In some circumstances, though, increased automation can lead to novel problems such as increased workload and training requirements, impaired situation awareness and, when events co-occur with poorly designed interfaces, accidents (Degani, 2004). Retaining the benefits of automation while minimizing its costs and hazards will likely require the interface between humans and automation to be adaptive, rather than fixed and static (e.g., Parasuraman et al., 2000). Our design for the supervision of multiple UVs is based on the concept of *delegation* (Miller and Goldman, 1997; Miller & Parasuraman, 2006) and implemented in SIFT's Playbook® architecture (Miller, Funk, Goldman, & Wu, 2003). Delegation interfaces are thought to overcome many difficulties associated with highly automated systems (see Miller and Parasuraman, in press, for a review). These problems include the well-documented (see, e.g., Parasuraman and Byrne, 2003) problems of loss of skills, loss of situation awareness, mis-tuned trust, unbalanced workload, lack of user acceptance and sub-optimal overall human + machine system performance.

In current work with Army AFDD, we are extending Playbook to allow context-based control of the *appropriate* level of automation available to an operator based on operator training level, complexity of the mission and environment, and platform capability. We are designing interface mechanisms to allow specification of the available automation across three "Levels of Automation (LoA^3)": Authority (that is delegated to the automation), Abstraction (of the delegated task), and Aggregation (of the automation to which the operator is delegating). We will be validating the design in an experimental paradigm using the Multiple Unified Simulation Environment (MUSE). This paper will present the interface mechanisms, and the LoA^3 theoretical framework which supports them.