

A Validated Task Analysis of the Single Pilot Operations Concept

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January 2015

Acknowledgements

This research was funded by the Concepts and Technology Development Project of NASA's Airspace Systems Program (NASA POC Dr. Walter Johnson). The authors would like to thank Dr. David Foyle from the HCSL at NASA Ames, the SMEs Rob Kotesky, Bill Preston, and Vern Battiste for their invaluable assistance identifying the likely SPO tasks, the entire SPO research staff from the FFDRL, and all reviewers for their insightful comments and input on this document.

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Acronyms

ASLabove sea level
ATCAir Traffic Control
ATIS Automatic Terminal Information Service
CACaptain
CDUcomputer display unit
ConOpsconcept of operations
CRMCrew Resource Management
CTACognitive Task Analysis
DADedicated Assistance
FDDRLFlight Deck Display Research Laboratory (NASA Ames Research Center)
FOFirst Officer
ftfeet
FYfiscal year
GO1Ground Operator 1
GO2Ground Operator 2
GO3Ground Operator 3
ILSInstrument Landing System
NASNational Airspace System
NASANational Aeronautics and Space Administration
NextGen Next Generation Air Transportation System
OBPOn-Board Pilot
PFpilot flying
PMpilot monitoring
PNGpilot not flying
SMEsubject matter expert
SPOSingle Pilot Operations

A Validated Task Analysis of the Single Pilot Operations Concept

Cynthia A. Wolter¹ and Brian F. Gore²

Executive Summary

The current day flight deck operational environment consists of a two-person Captain/First Officer crew. A concept of operations (ConOps) to reduce the commercial cockpit to a single pilot from the current two pilot crew is termed Single Pilot Operations (SPO). This concept has been under study by researchers in the Flight Deck Display Research Laboratory (FDDRL) at the National Aeronautics and Space Administration's (NASA) Ames (Johnson, Comerford, Lachter, Battiste, Feary, and Mogford, 2012) and researchers from Langley Research Centers (Schutte et al., 2007). Transitioning from a two pilot crew to a single pilot crew will undoubtedly require changes in operational procedures, crew coordination, use of automation, and in how the roles and responsibilities of the flight deck and ATC are conceptualized in order to maintain the high levels of safety expected of the US National Airspace System. These modifications will affect the roles and the subsequent tasks that are required of the various operators in the NextGen environment. The current report outlines the process taken to identify and document the tasks required by the crew according to a number of operational scenarios studied by the FDDRL between the years 2012-2014.

A baseline task decomposition has been refined to represent the tasks consistent with a new set of entities, tasks, roles, and responsibilities being explored by the FDDRL as the move is made towards SPO. Information from Subject Matter Expert interviews, participation in FDDRL experimental design meetings, and study observation was used to populate and refine task sets that were developed as part of the SPO task analyses. The task analysis is based upon the proposed ConOps for the third FDDRL SPO study. This experiment possessed nine different entities operating in six scenarios using a variety of SPO-related automation and procedural activities required to guide safe and efficient aircraft operations. The task analysis presents the roles and responsibilities in a manner that can facilitate testing future scenarios. Measures of task count and workload were defined and analyzed to assess the impact of transitioning to a SPO environment.

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1.0 Introduction

When dealing with complex system redesigns such as the proposed Single Pilot Operations (SPO) in the National Airspace System (NAS) in the United States, it is necessary to evaluate the impact that the redesign will have on the roles and responsibilities of all of the agents operating within the system. This analysis can take many forms, including empirical simulations of the environment experiencing the complex redesign, semi-structured task analyses of the redesigned environment, and / or computational modeling to generate predictions of the impact of the redesigned systems on the baseline operational environment (among other approaches). In order to fully understand the effect that new system designs have on the system performance, and on all of the agents within the system, documenting the tasks that are currently required for the safe operation of the system and comparing this baseline task analysis with the tasks required in the redesigned system provides insight into potential problem areas for the redesigned system. The objective of the current research was to conduct a task analysis (iteratively validate/refine sets of tasks) associated with likely SPO environments to measure the impact of transitioning to SPO from current-day operations based on the simulations being completed out of the FDDRL over the past three years.

The current-day flight deck operational environment consists of a two-person Captain/First Officer (CA/FO) crew. A concept of operations to reduce the commercial cockpit from the current two-pilot crew to a single pilot is termed Single Pilot Operations. This concept has been under study by researchers in the Flight Deck Display Research Laboratory (FDDRL) at the National Aeronautics and Space Administration's (NASA) Ames Research Center (ARC) (Johnson, Comerford, Lachter, Battiste, Feary, and Mogford, 2012) and Langley Research Center (LaRC) (Schutte et al., 2007). The ARC FDDRL research focuses on air-ground integration issues, while the LaRC research focuses on flight deck design issues. Both the ARC and LaRC research teams foresee that transitioning from a two-pilot crew to a single-pilot crew will undoubtedly require changes in operational procedures, crew coordination, in use of automation, and in how the roles and responsibilities of the flight deck and Air Traffic Control (ATC) are conceptualized in order to maintain the high levels of safety expected of the U.S. National Airspace System (NAS). The work consisted of: conducting a detailed task analysis of candidate FDDRL scenarios, refining existing current day approaches to reflect the roles/responsibilities of proposed SPO entities, and augmenting the SPO scenarios to include responses to off nominal scenarios using the full implementation of the augmented number of ground based operators. In performing this work, the task analysis team reviewed relevant literature, interviewed subject matter experts with active commercial aviation

1.1 The Task Analysis

A task analysis is the process whereby the tasks to safely fly the aircraft with automation are analyzed, documented and outlined (Kirwan & Ainsworth, 1992). The task analysis is a methodology covering a range of techniques to describe, and in some cases evaluate, the human-machine and human-human interaction in systems. It is often described as the study of what an operator (or team) is required to do in terms of actions or cognitive processes to achieve a specific system state. Typically, it is characterized by a hierarchical decomposition of how a goal-directed task is accomplished, including a detailed description of activities, task and element durations, task frequency, task allocation, task complexity, environmental conditions, necessary clothing and equipment, and any other unique factors involved in, or required for, one or more people to perform a given task (Kirwan & Ainsworth, 1992).

One type of task analysis, the Cognitive Task Analysis (CTA) identifies all of the critical cognitive tasks that the operator is required to perform with the automation (Diaper, 1989; Zachary, Ryder, &

Hicinbothom, 1998). CTA is a family of methods and tools for gaining access to the mental processes that organize and give meaning to observable behavior. CTA methods describe the cognitive processes that underlie the performance of tasks and the cognitive skills needed to respond adeptly to complex situations. Knowledge is elicited through in-depth interviews and observations about cognitive events, structures, or models. Often the people who provide this information are *subject matter experts* (SMEs)—people who have demonstrated high levels of skill and knowledge in the domain of interest (Klein, 2000). The CTA is a complement to traditional task analysis as it adds the capability for designing for the unanticipated by describing the constraints on behavior rather than solely describing the behavior. These approaches feed into a concept-verification phase, where the research concept is verified by a human-system engineer, and preparations are made to implement the results from the task analyses into a model form (Gore, 2008).

1.2 Current Day Operations

The traditional roles of the cockpit operators are defined as Captain (CA) and First Officer (FO) roles. The CA is the main pilot of the aircraft and the one who remains ultimately responsible for the aircraft, its passengers, and the crew. The CA sits in the left seat of the cockpit. The FO is the second pilot of an aircraft. The FO sits in the right-hand seat in the cockpit. One pilot is designated the "pilot flying" (PF) and the other the "pilot not flying" (PNF), or "pilot monitoring" (PM), alternating during each flight phase as necessary. Even when the FO is the flying pilot, the CA is in command and has legal authority of the aircraft. The amount of time either pilot is in control of the aircraft is near equal in normal operations, as the PF designation is passed back-and-forth throughout any given flight. In typical day-to-day operations, the essential job tasks are distributed fairly equally but final decisions always remains with the CA (pilot-in-command). Some have defined the shared roles in the cockpit as being *Aviate*, *Navigate*, *Communicate*, and *Systems Management* (Billings, 1997). Modifications to the manner that this shared cockpit is implemented might be necessary in SPO.

1.3 Single Pilot Operations

In SPO, it is entirely possible that multiple operators and entities will be required to guide the safe transport of the aircraft (Johnson et al., 2012). In this proposed distribution of roles and responsibilities in the SPO environment, a division of tasks between 9 entities will be explored: an On-Board Pilot (OBP), Ground Operator 1 (GO1), Ground Operator 2 (GO2), Ground Operator 3 (GO3), each with their own operator-specific automation (Flight Deck Automation, Ground Automation 1, Ground Automation 2, and Ground Automation 3), and Air Traffic Control. In this SPO iteration, the GOs would be fully trained pilots capable of flying the aircraft alone in the event that incapacitation of the OBP pilot. Three experiments conducted by the FDDRL will illustrate the basis for the scenario-based tasks that were included in the task analysis and the manner that it was created in an iterative fashion.

1.4 Single Pilot Operations Background Research

In the first SPO study conducted by Johnson, Comerford, Lachter, Battiste, Feary, and Mogford (2012), pairs of pilots were asked to complete simulated flight segments in each of two conditions: Co-located, and remote. The pilots were purposely presented with a critical situation that required problem solving. The situation was one in which the crew encountered severe weather during their flight and needed to divert to an alternate airport. Scenarios added complexity to the diversion task, such as the amount of fuel onboard to support planned or unplanned diversions and system failures such as anti-skid that required the crew to recalculate landing weights and distances.

The co-located condition required that pilots work together in a two-person flight simulator, a scenario that corresponded to current-day conditions. The remote condition required that the right and left seats of the cockpit be placed in different rooms, a scenario that represented one version of a SPO concept. The crew in the remote condition version of the SPO concept was allowed to communicate freely, however they could not see each other, observe each others' body language or point to information like weather cells on the navigation display. The interaction of the crew would be impacted by this change to SPO and part of the current task was to identify how the tasks would change as a function of such SPO operations.

A second SPO study evaluated the use of Crew Resource Management (CRM) indicators and shared charts to aid both ground and air-based pilots' communication and to enhance collaboration (Lachter, Brandt, Battiste, Ligda, Matessa & Johnson, 2014). Along with nominal, current-day baseline trials, pilots were separated as a distributed crew, with the CA on the flight deck and the FO on the ground, serving as dispatch with limited support to the OBP for multiple company aircraft. The concept of requesting Dedicated Assistance (DA) was also explored, both with the assistance of automation (CRM tools) and without. This study also presented a situation in which the pilots encountered severe weather that necessitated a diversion to an alternate airport.

A third SPO study focused on the transition between actively controlling multiple aircraft to actively controlling a single aircraft during dedicated assistance (see Johnson et al., in press). Two crew configurations were studied to identify the optimal allocation of responsibilities. In the SPO Hybrid condition, one GO performing dispatch duties to the distressed aircraft, along with other company aircraft, would transition to a dedicated assistant (ground-based FO) when requested by the OBP of the distressed aircraft. Their other nominal aircraft was automatically handed off to other GOs. In the SPO Specialist condition, a Specialist GO was waiting, on call, for a dedicated assistance request by an OBP of any distressed aircraft. The distressed aircraft was then automatically handed off from the "dispatch" GO to the Specialist GO.

1.5 Single Pilot Operations Candidate Roles

A review of the requirements in the above-described studies augmented the 2013 task analysis of SPO scenario manipulations (Wolter & Gore, 2013). Finer level of detail and validation came from subsequent interviews and collaboration with SMEs (C. Wolter, B. Gore, V. Battiste & R. Kotesky, personal communication, January 30, 2013, and May 16, 2013; C. Wolter. R. Kotesky & W. Preston, personal communication, April 22, 2014). In this paper, we explore the differences between a nominal SPO flight and off-nominal SPO flights that require DA, all of which begin with the same flight plan into Denver. In nominal operations, the OBP would be in sole control of decision-making and flying tasks, only relying on the GO for dispatch information and communication with maintenance and company personnel. In off-nominal operations, the OBP can request DA where the GO becomes a ground-located FO.

In this case, PF and PNF designations would vary between the OBP and the GO, with possible multiple mid-flight reassignments until the OBP releases DA. Most settings and radio communications would remain solely PNF responsibilities. Current CA specific tasks would remain the same and would always fall to the OBP. Both human operators would continually monitor instruments and radio communications, as well as perform crosschecks when notified of a change via voice or automation, and verify that the environment is consistent with their internal schema.

Due to a "separated cockpit", automation will play a large role in notifying the OBP and GO of any changes so that either could verify without undue radio congestion. The current mode of Dispatch or

DA would determine the type of automation available. In the DA mode, automation would notify a human operator if their ground or air-based counterpart had made changes such as: radio frequency, altitude, heading, speed, altimeters, computer display unit (CDU) inputs/executions, entering/exiting holds, approach mode, speed brake, landing gear, touchdown zone elevation, or flaps. In the Dispatch mode, automation would monitor the GO for conformance and notify if an aircraft needs assistance or has not been checked up on for a specified period of time. Automation will also notify parties of emergency situations when an aircraft reaches flight-based touch-points, such as when an aircraft passes below 18,000 ft. Advancements in automation may relieve the human operators of some tasks such as getting the current Automatic Terminal Information Service (ATIS), setting altimeters, loading expected arrival information and clearances from ATC. A major notable difference between the current day and the SPO environment is the shift to 'communication-cued' crosschecks (verbal or automated) rather than 'movement-cued' crosschecks that occur in a shared cockpit. Automation will need to account for these overt and covert characteristics associated with a human "good crew member." Automation that mimics the characteristics of a "good crew member" can lead to increased efficiencies; which in turn lead to increased spare capacity to deal with unforeseen events.

For the all SPO flights analyzed, there is a task decomposition of two candidate roles and responsibilities for the ground operators. In the Hybrid off-nominal condition, a GO who is serving as dispatcher with limited OBP support to 10 aircraft, will hand-off 9 of their aircraft to other GOs when DA is requested by an OBP of a distressed aircraft. They will then perform both dispatch tasks and FO tasks for the distressed aircraft. In the Specialist off-nominal condition, a GO who is serving as dispatcher with limited OBP support to 10 aircraft, will hand-off a distressed aircraft to a specialist GO when DA is requested by the OBP of that aircraft. The specialist GO will then perform both dispatch tasks and FO tasks for the distressed aircraft.

1.6 Research Objectives

The objective of this research was to iteratively validate/refine sets of tasks associated with likely SPO environments to measure the impact of transitioning to SPO from current day operations. The tasks identified in the task analysis are linked together in a string of both sequential and parallel nodes. These nodes represent networks that can then be used to analyze different scenarios and task assignments for their impact on workload, efficiency, and safety. Possessing such task analyses allows researchers to explore the degree to which the location and roles of pilots (co-located or remote) impact the ability of the crew to work as an effective, separated, two-person crew as compared to a co-located two-person crew. Potential SPO ConOps were measured by task count and task workload to assess the impact of the transition.

2.0 Method

For the current research, task decompositions that included both the task analysis and a semi-structured CTA of six scenarios (described below) of a planned approach into Denver starting at 37,000 ft Above Sea Level (ASL) with the crew operating under (a) current-day rules, (b) SPO Hybrid rules, or (c) SPO Specialist rules, were completed. Each rule set was tested in either nominal approach to land or an off-nominal condition requiring the dynamic replanning of an alernate airport was completed. The task network analyses are represented with task decomposition spreadsheets and task networks.

2.1 Scenarios

Scenario 1a. Current Day Nominal: Instrument Landing System (ILS) approach into Denver runway 16L.

The first task analysis scenario began before the top of descent at 37,000 ft ASL, near the YANKI waypoint. The crew included a CA and a FO. For this flight, the CA had the role of PF and the FO that of the PNF. CA/FO specific tasks are noted (see Figure 1a and Appendix A).

Scenario 1b. Current Day Off-Nominal: Planned ILS approach into Denver runway 16L with a diversion to Cheyenne runway 27L.

The second task analysis began before the top of descent at 37,000 ft ASL, near the YANKI waypoint. During the descent into Denver, a severe weather hold was initiated at LANDR at 17,000 ft and the crew discussed and decided on their alternate landing points. The crew included a CA and a FO. For this flight, the CA had the role of PF and the FO that of the PNF. CA/FO-specific tasks are noted (see Figure 1b and Appendix B).

Scenario 2a. SPO Hybrid Nominal: ILS approach into Denver runway 16L.

The third ask analysis began before the top of descent at 37,000 ft ASL, near the YANKI waypoint. The crew included an OBP, a company GO (GO1), flight deck automation, and ground automation. Two additional GOs, their ground automations, and ATC are also represented in the analysis. The OBP was always the CA of the flight. The GOs each monitored 10 aircraft, provided limited support, and primarily performed dispatch duties for their assigned aircraft. The GOs were available for DA support but DA was not initiated in this scenario (see Figures 1a, 2a, and Appendix C).

Scenario 2b. SPO Hybrid Off-Nominal: Planned ILS approach into Denver runway 16L with a diversion to Cheyenne runway 27L.

The fourth task analysis began before the top of descent at 37,000 ft ASL, near the YANKI waypoint. During the descent into Denver, a severe weather hold was initiated at LANDR at 17,000 ft and the crew discusses and decides on their alternate. The crew included an OBP, a company GO (GO 1), flight deck automation, and ground automation. Two additional GOs, their ground automations, and ATC are also represented in the analysis. The OBP was always the CA of the flight. The GOs each monitored 10 aircraft, provided limited support, and primarily performed dispatch duties for their assigned aircraft. The GOs were available for DA support, which was requested by the OBP of "NASA01." GO 1 then released their other aircraft to the other GOs and offered dedicated support to NASA01 until DA was no longer needed and released by the OBP. During DA, GO also performed dispatch duties for NASA01 (see Figures 1b, 2b, and Appendix D).

Scenario 3a. SPO Specialist Nominal: ILS approach into Denver runway 16L.

The fifth task analysis began before the top of descent at 37,000 ft ASL, near the YANKI waypoint. The crew included an OBP, a company GO (GO 1), a Specialist GO, and their automations. One additional GO, their ground automation, and ATC are also represented in the analysis. The OBP was always the CA of the flight. The GOs each monitored 10 aircraft, provided limited support, and primarily performed dispatch duties for their assigned aircraft. The Specialist GO was "offline" and available for DA support but DA was not initiated in this scenario (see Figures 1a, 2a, and Appendix E). Because DA was not initiated here, the task assignments for this scenario are fundamentally the same as Scenario 1b above.

Scenario 3b. SPO Specialist Off-Nominal: Planned ILS approach into Denver runway 16L with a diversion to Cheyenne runway 27L.

The sixth task analysis began before the top of descent at 37,000 ft ASL, near the YANKI waypoint. During the descent into Denver, a severe weather hold was initiated at LANDR at 17,000 ft and the crew discusses and decides on their alternate. The crew included an OBP, a company GO (GO 1), a Specialist GO, and their automations. One additional GO, their ground automation, and ATC are also represented in the analysis. The OBP was always the CA of the flight. The GOs monitored 10 aircraft, provided limited support, and primarily performed dispatch duties for their assigned aircraft. The Specialist GO was "offline" and available for DA support, which was requested by the OBP of "NASA01." The GO then released NASA01 to the Specialist GO but retained their other aircraft. The Specialist GO offered dedicated support to NASA01 until DA was no longer needed and released by the OBP back to the GO. During DA, the Specialist GO would also perform dispatch duties for the distressed aircraft (see Figures 1b, 2c, and Appendix F).

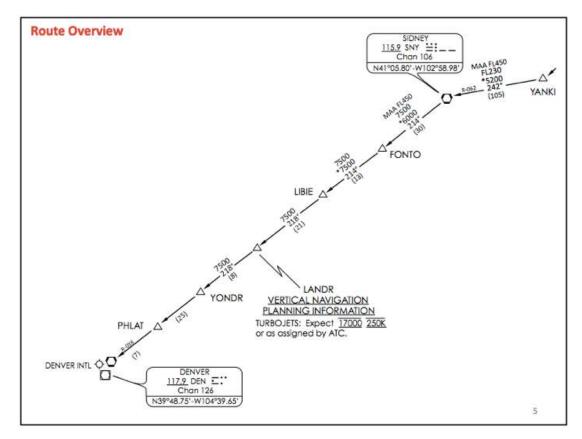


Figure 1a. Denver approach (nominal).

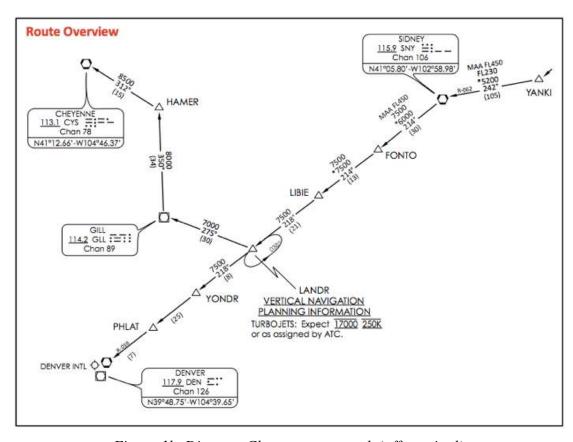


Figure 1b. Divert to Cheyenne approach (off-nominal).

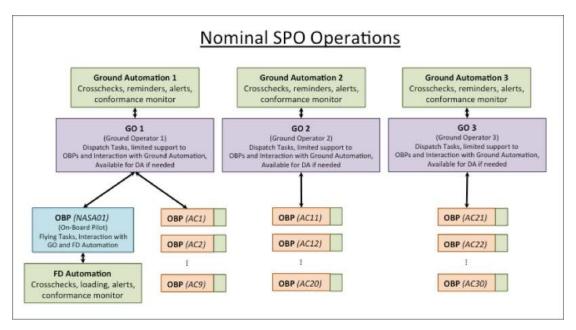


Figure 2a. Nominal SPO operations.

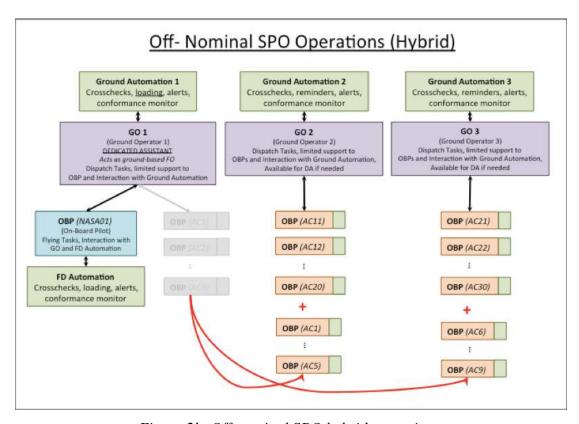


Figure 2b. Off-nominal SPO hybrid operations.

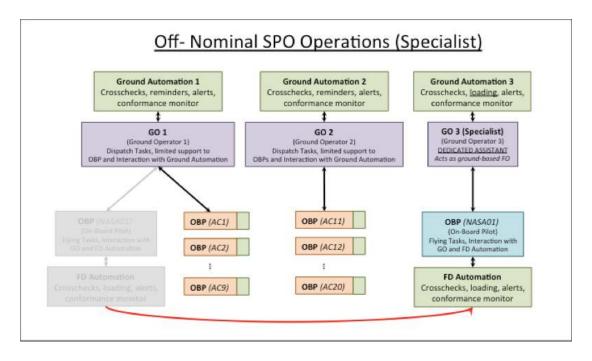


Figure 2c. Off-nominal SPO specialist operations.

2.2 Task Representations

Due to the complexity of the operational domains, two task representations were created to convey the details associated with each approach-to-land rule set. This breakdown was necessary given the complexity of the tasks required to safely land an aircraft and to illustrate the tasks that shifted from the well-established and safe concept of operations to the new concept of operations. Possessing such a breakdown allows a baseline operational standard to be compared with a next generation set of tasks. These representations of the tasks include a task decomposition spreadsheet and a task network model representation.

- 1. *Task decomposition spreadsheet*. The task decomposition spreadsheet is an ExcelTM listing of the tasks and their sequential location per entity. The task decomposition was created to describe each task and operator roles in a more detailed, organized, in-depth manner to illustrate the task flow and the operator responsibilities. This complex representation of the task network allows for a more evolved understanding of both the malleable and rigid associations between tasks (see Figure 3a).
- 2. *Micro Saint Sharp task network*. Micro Saint Sharp™ is a platform for visualizing the task network linearly and identifying trouble spots where there is an increased task load due to the proposed SPO environment. By creating validated task groups, a fluid reorganization of task orders for analysis based on a given scenario can be developed. A difficulty level to each task could be assigned to better understand which tasks are suitable for redistribution to another human operator or to automation (see Figure 3b).

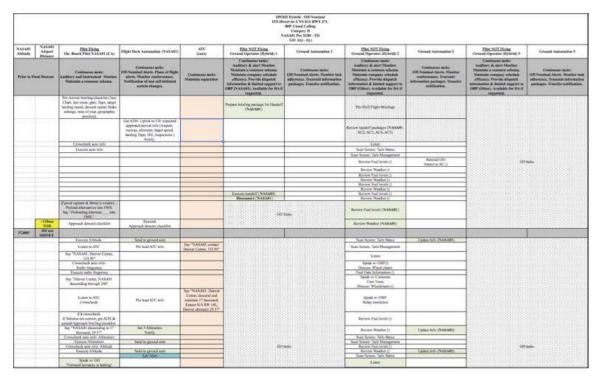


Figure 3a. Task decomposition spreadsheet example.

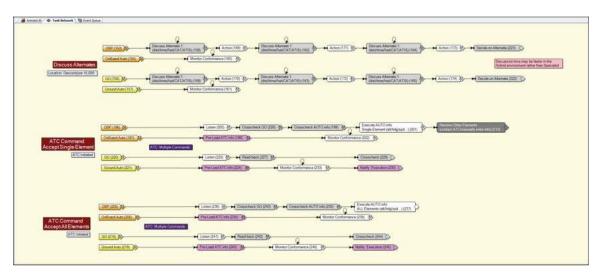


Figure 3b. Micro Saint Sharp task network example.

2.3 Concept Verification and the Impact of SPO on Operator Roles and Responsibilities

The task analyses were performed to determine the task differences between the current day and the proposed SPO descent and approach to land phases of flight, in addition to the changes in procedures when the crew is given divert commands from ATC regarding specific significant events (e.g., airport closure). Specific variables of interest included the number of communications, amount/role of automation, number of crosschecks and their impact on crew coordination. The analysis process began with a pre-existing current-day task analysis of a descent into Denver as well as a Divert to Cheyenne due to weather including entering and exiting a hold, deciding to divert to Cheyenne, and to safely land the aircraft. This was altered to represent the tasks required when operator roles are modified in the SPO environment with an OBP, GOs, operator-specific automation, and sometimes a Specialist GO (see Figures 2a, 2b, and 2c). This preliminary representation of significant event scenarios was populated through direct observation of the first and second SPO studies (Johnson et al., 2012; Lachter et al., 2014), observation of, and participation in, the creation of the third SPO study (see Johnson et al., in press), SME evaluations and interviews (C. Wolter, B. Gore, V. Battiste & R. Kotesky, personal communication January 30, 2013 and May 16, 2013; C. Wolter. R. Kotesky & W. Preston, personal communication April 22, 2014) and published reports of anticipated NextGen tasks and operator errors (Gore, Hooey, Mahlstedt, & Foyle, 2013; Gore, Hooey, Haan, Socash, Mahlestedt, & Foyle, 2013; Gore, Hooey, Haan, Bakowski, & Mahlstedt, 2011).

The most insight into the NextGen SPO ConOps was gained through active participation in the third SPO study design meetings. The ideas developed through this iterative simulation development process were fed into the task analysis. Reactions to the Hybrid and Specialist roles from the participants from the third SPO study were also used to further refine the analysis. The task analysis completed in FY14 follows the proposed ConOps from the third SPO study, and presents the roles and responsibilities in a manner that can facilitate generating future FDDRL testing scenarios as well as provide insight into the most efficient use of the crew resource as roles are reassigned. Specifically, the 2013 task analysis was augmented to include a more complex divert scenario based on a specific scenario also used in the third SPO study (see Johnson et al., in press). The previously explored single pilot-on-board role and responsibilities built upon the SPO first-of-its-kind task decomposition (Wolter & Gore, 2013) to define and incorporate a completely new entity (operator and operator role) based upon current dispatch operations.

Gaps identified in previous task analyses were filled by first creating new task analysis spreadsheets, including new entities, tasks, roles, and responsibilities being explored by the FDDRL lab. Multiple iterations of the analyses revealed potential for improvement through task allocation to a different entity. After final scenarios were chosen and populated with high-level tasks, the tasks were refined and decomposed through comparison with SPO-concept reports, and a series of SME interviews. There were three interview sessions conducted where three SMEs (one current CA, one former air traffic controller, and an ATC specialist) reviewed six spreadsheets of very detailed tasks and task orders to represent each scenario. The spreadsheets were organized by altitude and airport distance for the primary aircraft (NASA01), human operator tasks (PNF and PF) with CA assignment, automation tasks, and ATC communications. Using SME input, the task decomposition spreadsheet was modified to be more representative of the proposed SPO environment (see Figure 3a and Appendices A, B, C, D, E, and F).

An alternate set of roles and responsibilities for the crew, that focused on the impact of greater reliance on automation, both on the flight deck, and on the ground was created through SME

interviews. The preliminary analysis revealed a large increase in the number of tasks to be completed in the newest proposal of SPO ConOps, which indicated that on-board pilots and ground operators would need extra assistance from automation if they were to maintain a similar level of workload as previously proposed in the SPO ConOps.

Both representations went through a series of edits to create both an accurate representation of a current-day environment, and a task distribution capable of representing a future SPO concept. The tasks were expanded into higher-level task groups or events such as Weather Rerouting, Maintenance Issues, and Gate Connections. These tasks groups were then entered into the Micro Saint Sharp program as individual networks, providing a flexible means to create new scenarios and identify problem areas by evaluating the task count and the workload (defined below) associated with the group (see Figure 3b and Appendices G, H, and I).

A number of operator specific task groups for the GO are addressing maintenance issues, delays, security threats, customer care, and the complex dedicated assistance change in role. The nominal handoffs during a shift change, off-nominal Hybrid handoffs, off-nominal Specialist handoffs, as well as the handoff that occurs once dedicated assistance is released has been represented in the present analysis. In this representation, automation has been delegated the following tasks; crosschecks, notifications (for both OBP and GO if there is an issue detected such as non-compliance with the issued clearance), reminding (e.g., complete landing checklist at a certain altitude, execute new clearance, check on aircraft passing 18,000 ft, or "have you checked on this aircraft lately?"), and logging flight deck activity to continuously create briefing packages to ease handoffs.

2.4 Role and Responsibility Considerations

A review of previous SPO studies revealed that when separated, the aircraft's crew performs additional communications to preserve a consistent mental map of the approach and the candidate divert options (Lachter et al., 2014). These additional communications highlighted a potential area of concern implementing a SPO-like condition; if the crew needed to take immediate action, fewer cognitive, attentional, or even coordinated resources to safely land the aircraft may be available for the crew as they are occupied getting to a consistent mental map. As the crew work to become coordinated, their attentional resources are occupied to a greater extent than if they were already coordinated. This suggests that additional tasks cannot be added to the crew. To alleviate extra communications and radio congestion, the use of CRM tools and shared displays were analyzed (Lachter et al., 2014). Although the automation support was helpful for preserving a consistent mental map, even more automation in different forms may be required. Exploring dedicated assistance revealed potential problem areas for the GO during the transition from handling multiple aircraft to handling one distressed aircraft. The method for the transition would need to be streamlined and defined in detail to ensure the distressed aircraft would receive the level of assistance required.

Automation tasks were based on theoretical advancements in technology currently being tested in a laboratory setting for this task analysis. Here, automation has delegated many typical FO tasks as well as "good crew traits" such as crosschecking. The OBP/CA needs to be able to maintain ultimate control of the aircraft, yet have enough confidence to only crosscheck and execute the information that the flight deck automation has supplied.

A specific SPO ConOps-related gap and research issue was identified for the Ground Operator and a problem aircraft's dispatch tasks. There has been a lack of information on the impact on the dispatch

tasks once dedicated assistance is initiated. Based on our observations and task counts, the optimal role allocation may be for the original GO to retain their dispatch duties for the DA aircraft, assuming there is a moderate- to high-level of automation available to provide some task relief. This can alleviate some of the issues relating to "coming-in-cold" in the Specialist conditions by retaining an operator already familiar with the distressed aircraft.

2.5 Task Count and Workload

The task count and the workload associated with the tasks identified through a task analysis can be easily generated once a vetted set of tasks has been created. The task count is simply the number of tasks that the entity is responsible to complete, while the workload associated with the task is related to the attentional load required by the task.

To measure workload in the six scenarios described, each task was described as having low-, medium-, or high-workload demands. The task-analyst classified the workload classifications using the task analysis and workload as a basis for the categorizations (Hamilton, Bierbaum, & McAnulty, 1994; Hamilton, Bierbaum, & Fulford, 1990; McCracken & Aldrich, 1984). Low-workload tasks have been defined as tasks that are either very short in duration and/or require less attention (i.e., listening tasks, executing tasks, or any task performed by automation). Medium-workload tasks have been defined as tasks that occupy more attentional resources, but are normal tasks that are performed often (i.e., speaking and crosschecking). High-workload tasks have been defined as tasks that are unfamiliar and/or very demanding of attentional resources (i.e., discussing, deciding, and final manual landing). Every task in each scenario was given a corresponding workload level and then counted and recorded (see Figures 4a, 4b, 4c, 4d, 4e, and 4f). For the purposes of relevancy, GO and GO Automation tasks were only counted if they directly related to the flight of NASA01. GO tasks outside of the primary flight have not been adequately discussed at this point to confidently measure their shift from beginning to end.

For a nominal approach into Denver, the task count revealed that the total task number is reduced from 175 tasks performed by three entities to 160 tasks performed by four entities for both the SPO Hybrid and SPO Specialist Nominal condition compared to current day (Figure 4a, 4b, and 4c). The number of tasks performed by the CA/OBP remains at 85 tasks in both current day and SPO, 48.57% & 53.13% of the task total respectively. The workload for the CA/OBP also dropped from current day to SPO: High-workload tasks decreased from 16.47% to 11.76%; medium-workload tasks dropped from 62.35% to 54.12%; and, low-workload tasks increased from 21.18% to 34.12%. Across all entities, the same trend can be seen: High-workload tasks decreased from 11.43% to 7.5%; medium-workload tasks dropped from 66.86% to 33.75%; low-workload tasks increased from 21.71% to 58.75%.

	- 1	C	urrent Da	ıy Nomin	al
		CA	FO	GO	ALL
Low	Total Low	18	18	2	38
Workload	Percent Low	21.18%	21.43%	33.33%	21.71%
Medium	Total Medium	53	61	3	117
Workload	Percent Medium	62.35%	72.62%	50.00%	66.86%
High	Total High	14	5	1	20
Workload	Percent High	16.47%	5.95%	16.67%	11.43%
Total Tasks	Total Tasks	85	84	6	175
Total Tasks	Percent Entity	48.57%	48.00%	3.43%	100.00%

Figure 4a. Current day nominal task count.

			SPO H	lybrid N	ominal	
		OBP	FD AUTO	GO	GO AUTO	ALL
Low Workload	Total Low	29	42	8	15	94
Tasks	Percent Low	34.12%	100.00%	44.44%	100.00%	58.75%
Med Workload	Total Medium	46	0	8	0	54
Tasks	Percent Medium	54.12%	0.00%	44.44%	0.00%	33.75%
High Workload	Total High	10	0	2	0	12
Tasks	Percent High	11.76%	0.00%	11.11%	0.00%	7.50%
Total Tasks	Total Tasks	85	42	18	15	160
Total Tasks	Percent Entity	53.13%	26.25%	11.25%	9.38%	100.00%

Figure 4b. SPO hybrid nominal task count.

	- 1		SPO) Specia	list	N	om	inal	
		OBP	FD AUTO	GO1	Sp	ec	GO	GO AUTOS	ALL
Low Workload	Total Low	29	42	8				15	94
Tasks	Percent Low	34.12%	100.00%	44.44%	Ш	Ш	Ш	100.00%	58.75%
Med Workload	Total Medium	46	0	8	Ш	Ш		0	54
Tasks	Percent Medium	54.12%	0.00%	44.44%	Ш	Ш		0.00%	33.75%
High Workload	Total High	10	0	2	Ш	Ш		0	12
Tasks	Percent High	11.76%	0.00%	11.11%	Ш	Ш	Ш	0.00%	7.50%
Total Tasks	Total Tasks	85	42	18	Ш			15	160
Total Tasks	Percent Entity	53.13%	26.25%	11.25%	Ш	Ш		9.38%	100.00%

Figure 4c. SPO specialist nominal task count.

For an off-nominal approach into Denver with a diversion to Cheyenne, the total tasks increased when comparing current day (237; Figure 4d) to the SPO Hybrid condition (318; Figure 4e) and the SPO Specialist condition (343; Figure 4f.) The number of tasks performed by the CA/OBP increased in both the SPO Hybrid (141, 44.34%) and SPO Specialist (146, 42.57%) conditions as compared to current day (118, 49.79%). The workload intensity trends were similar between all three conditions; High-workload tasks for current day, SPO Hybrid, and SPO Specialist made up 22.88%, 28.37%, and 30.82% of the total CA/OBP tasks respectively; Medium-workload tasks for current day, SPO Hybrid, and SPO Specialist made up 59.32%, 49.65%, and 47.26% of the total CA/OBP tasks respectively; and, Low-workload tasks for current day, SPO Hybrid, and SPO Specialist made up 17.8%%, 21.99%, and 21.92% of the total CA/OBP tasks respectively. The increase in task number between SPO Hybrid and SPO Specialist is notable for future SPO ConOps development.

	- 1	Cur	rent Day	Off-Non	ninal
		CA	FO	GO	ALL
Low Workload	Total Low	27	24	2	53
Tasks	Percent Low	22.88%	21.24%	33.33%	22.36%
Med Workload	Total Medium	70	78	3	151
Tasks	Percent Medium	59.32%	69.03%	50.00%	63.71%
High Workload	Total High	21	11	1	33
Tasks	Percent High	17.80%	9.73%	16.67%	13.92%
Total Tools	Total Tasks	118	113	6	237
Total Tasks	Percent Entity	49.79%	47.68%	2.53%	100.00%

Figure 4d. Current day off-nominal task count.

	- 1		SPO Hyb	orid Off-	Nominal	
		OBP	FD AUTO	GO	GO AUTO	ALL
Low Workload	Total Low	40	58	24	37	159
Tasks	Percent Low	28.37%	100.00%	29.27%	100.00%	50.00%
Med Workload	Total Medium	70	0	47	0	117
Tasks	Percent Medium	49.65%	0.00%	57.32%	0.00%	36.79%
High Workload	Total High	31	0	11	0	42
Tasks	Percent High	21.99%	0.00%	13.41%	0.00%	13.21%
Total Tasks	Total Tasks	141	58	82	37	318
Total Tasks	Percent Entity	44.34%	18.24%	25.79%	11.64%	100.00%

Figure 4e. SPO hybrid off-nominal task count.

			SPO S	Specialis	t Off-No	minal	
	- 1	OBP	FD AUTO	GO1	Spec GO	GO AUTOS	ALL
Low Workload	Total Low	45	54	9	12	46	166
Tasks	Percent Low	30.82%	100.00%	29.03%	18.18%	100.00%	48.40%
Med Workload	Total Medium	69	0	19	46	0	134
Tasks	Percent Medium	47.26%	0.00%	61.29%	69.70%	0.00%	39.07%
High Workload	Total High	32	0	3	8	0	43
Tasks	Percent High	21.92%	0.00%	9.68%	0.00%	0.00%	12.54%
Translation I to the	Total Tasks	146	54	31	66	46	343
Total Tasks	Percent Entity	42.57%	15.74%	9.04%	19.24%	13.41%	100.00%

Figure 4f. SPO specialist off-nominal task count.

3.0 Conclusion

It is certainly a challenge to develop a set of tasks for concepts that are just in their infancy as is the case with the SPO concept. The task analyses completed as part of the present research produced a detailed and verified set of tasks representing a nominal, current-day approach into Denver. This task network is the necessary first step for any NextGen SPO approach scenario development process as it illustrates the most likely baseline task set upon which modifications could be proposed and evaluated for moving from a two-person crew to a single pilot being responsible for the operations of the aircraft. It is imperative that this baseline task analysis be accurate so that incremental changes can be proposed and evaluated in subsequent scenario considerations and an informed decision can be made about the costs and benefits of a next generation concept. Two reasonable and plausible SPO scenarios were defined and populated with detailed tasks, operator assignments, and task orders through a series of SME interviews, reviews of published reports, and participation in ongoing SPO experiments conducted in the FDDRL at NASA Ames Research Center.

Based on SPO concept reports, studies conducted in the FDDRL lab, and task analyses performed thus far, a clearer picture of future NextGen SPO ConOps has been formed. To avoid overloading any single human operator during the approach phase of flight, there is an identified need for more reliance on automation to at minimum perform crosschecks and load flight settings. The approach phase of flight is densely populated with tasks from the top of descent to touchdown, requiring input from multiple operators to safely land the aircraft. If tasks currently being performed by two colocated pilots are all assigned to a single OBP, the task load on that operator becomes too great to reliably perform. With two operators collaborating remotely, communication between them presents an obstacle to overcome. Without the physical cues from being co-located, all communications could be made verbally but would add an impractical amount of additional tasks.

The solution in these analyses was to provide support for crew crosschecks through automated notifications of any operator-initiated changes of the aircraft and shift routine setting tasks to automation. Automation would also act as a "good crew member" by reminding the human operators to attend to items that automation recognizes have not been attended to for a period of time. ConOps specifically relating to DA handoffs and DA changes in roles need to be firmly defined to increase the effectiveness of a ground-based FO. Along with some projected advancements in automation to perform basic uploading from ATC functions, tasks being assumed by all three entities (OBP, GO, and automation) rather than just the OBP alone, will help to alleviate task overload on any single operator—especially in the case of any significant and/or unexpected event. The data derived from these task analyses support these conclusions.

4.0 Future Research

The SPO scenarios defined thus far represent two flight conditions and two potential ways of assigning tasks between entities in a SPO environment. Next steps could include refinement of the existing task analysis based on additional SME evaluations, as well as extending the task analysis to better define the GO roles and responsibilities. A GO-centric analysis may reveal needs that have not yet been defined. The GO-as-dispatch and GO-as-ground-based-FO tasks have not been adequately defined for analysis as they are entirely new roles, and never before studied. Modifications to the existing scenarios include dissecting the FY14 GO tasks to a finer level of detail, and possibly the impact of requesting DA at the beginning of the GO shift, or shift-start compared to DA at when crew are in the middle of their shift, or mid-shift. To accomplish this, a shift-based task analysis of the GO that includes likely tasks, task allocations, and task workloads for a specific period of time would need to be created. The tasks in the FY15 will be designed to parallel future FDDRL studies via communication/collaboration between teams. There will be an impact assessment of required and time-critical flight crew and ATC tasks under SPO technologies and procedures. Impact will be measured by task count and associated task workload changes and the number of task conflicts.

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			Curre DEN 800'	Current Day - Nominal DEN ILS RWY 16L 800' Cloud Ceiling Category D		
Altitude	Airport	Pilot Flying	lying	FD Automation	ATC	Dispatch 1
Prior to Fi	Distance Prior to Final Descent	Continuous tasks: Build a common schema - mainly at cross cheeks. Auditory and Instrument Monitor (continue to TD)	Continuous tasks: Build a common schema - mainly at cross cheeks. Auditory and Instrument Monitor (continue to TD)		(cues) Continuous tasks: Maintain separation	Continuous Tasks: Maintain company schedule efficency. POC between AC and other entities. Route adjustments and reroutings.
		Pre-Arrival briefing. (Taxi Chart, taxi route, gate, flaps, target landing speed, descent speed, brake settings, time of year, geographic position)	Monitor PF Pre-Arrival Briefing. Crosscheck.			
		Briefs GSO about procedures and techniques. Say "I'm going to use full reverse on this landing."	Listen.			
	00	Crosscheck.	Get ATTS. Load expected approach/arrival info (Airport, runway, altimeter, target speed, landing flaps, DH, frequencies.) Notify.			
		Crosscheck.	Set radio and navigation frequencies and final course			
	C d good	If good captain & threat is evident Discuss the threat.	vident Discuss the threat.			
		If good captain & threat is evident Preload alternatives into FMS. Say "Preloading alternate into FMS."	If good captain & threat is evident Crosscheck. Say "Roger."			
	~110nm TOD	Crosscheck.	Read: Approach descent checklist			
37,000"	104 nm SIDNEY	Crosscheck,	Set Altitude,			
		Listen to ATC	Listen to ATC		Say "United 573 contact Denver Center, 133.95"	
		Crosscheck.	Say "United 573, Denver Center, 133.95"			
		Crosscheck,	Set radio frequency to 133.95 for Denver Center			
		Crosscheck.	Say "Denver Center, United 573 descending through 240"			
	20	Listen to ATC Crosscheck.	Listen to ATC Crosscheck.		Say "United 573; Denver Center, descend and maintain 17 thousand; Expect ILS RW 16L; Denver altimeter 29.57"	
		CA crosscheck. If Schema not correct, get ATIS & amend Approach briefing.				
		Crosscheck.	Say "United 573 descending to 17 thousand, 29.57"			
	76	Set 2 Altimeters.	Set I Altimeter.			
		Crosscheck.	Crosscheck.	lav Alert		
	- to to		Speak w/ Dispatch "Forward lavratory is leaking"			Listen

		Listen	Listen		Speak w/ FO (NASA01) Confirm request: Maintenance Problem
		Listen	Listen		Speak w/ FO (NASA01) Safety inquiry: Maintenance Problem "Do you have any safety concerns?"
			Speak w/ Dispatch "No, have maintenance ready on the ground at DEN."		Listen
					Speak w/ Maintenance (NASA01)
		Listen	Listen		Speak w/ FO (NASA01) Relay Resolution: "Maintenance will you meet you at the gate"
18,000' 12,650' AGL	74 nm	Crosscheck.	Turn on exterior lights		
		Crosscheck.	Check Pressurization.		
		Listen.	Check Altimeters as completed on approach descent checklist. If 777/787 observe ECL items are green. Say "Altimeters are set to 29.57. Approach descent checklist complete"		
11,650° AGL	61 nm	Listen to ATC	Listen to ATC	Say "United 573, Fly heading 218, cleared direct PHLAT, direct KIPPR, direct Denver, descend and maintain 10,000, expect runway 16L ILS approach to Denver."	
		Crosscheck.	Say "Roger, United 573, 218, direct to PHLAT, direct DEN, descend and maintain 10,000, expect runway 16L approach."		
	,0 <u> </u>	Crosscheck,	Set Altitude.		
		Listen to ATC	Listen to ATC	Say "United 573 contact Denver Approach on 119.3."	
		Crosscheck	Say "Roger, United 573, 119.3."		
		Crosscheck,	Set radio frequency to 119.3 for Denver Approach		
		Crosscheck.	Say "Denver Approach, United 573, one zero thousand with Alpha."		
4,650' AGL	40 nm	Listen to ATC	Listen to ATC	Say "Roger, United 573. descend and maintain flight level 8000"	
		Listen	Say "Roger, 8000 for United 573"		
	& - 1	Crosscheck.	Set Altitude		
		Listen to ATC	Listen to ATC	Say "United 573, turn left heading 270, base leg."	
		Listen.	Say "Roger, heading 270, base leg, United 573"	15	
		Crosscheck.	Set Heading		
	, - - 1	Command "Flaps 1"	Listen.		
		Crosscheck.	Reach flap lever. Set flaps to 1.		
	101111	Speed set (210)	Speed confirm (210)		
		Command "Flaps 5"	Listen.		

Crosscheck.	Reach flap lever. Set flans to 5		
Listen to ATC	Listen to ATC	Say "United 573, turn left heading 200, maintain 7,000 until established. Maintain 180 kts to LEETS, contact tower on 135.3"	
Listen.	Say "Roger, left 200, 7,000 until established and 180 until LEETS, contacting Tower at 135.3, United 573"		
Crosscheck.	Set Heading		
Crosscheck.	Set Altitude.		
Crosscheck.	Arm Approach Mode		
Crosscheck.	Confirm FMA display reads expected		
Crosscheck,	Set radio frequency to 135.3 for Denver Tower		
Command "Flaps 15"	Listen.		
Crosscheck.	Reach flap lever. Set flaps to 15.		
Speed set (180)	Speed confirm (180)		
Listen.	Say "Denver Tower, United 573 turning Final for the ILS 16L approach,"		
Listen to ATC	Listen to ATC	Say "United 573, cleared for the ILS 16L approach."	
Listen.	Say "Roger, cleared for ILS 16L, United 573"		
Disconnect autopilot.		Aural alert.	
Command "Gear Down, Landing	Listen,		
Crosscheck.	Set landing gear		
Speed set (146)	Speed confirm (146)		
CA Arm speed brake.	FO Crosscheck.		
Connim 1DZE set	Sel 102E		
Command Flaps 20	Reach flan lever		
Crosscheck.	Set flaps to 20.		
Glideslope capture	Confirm capture		
Crosscheck.	Confirm FMA display reads: LOC & G/S		
Command "Flaps 25"	Listen.		
Crosscheck.	Reach flap lever. Set flaps to 25.		
Command "Flaps 30"	Listen.		
Crosscheck.	Reach flap lever. Set flaps to 30.		
Crosscheck,	Complete landing checklist. Say "Landing Checklist complete"		
Crosscheck,	Say "Tower, United 573 for RWY one six left"		
Listen to ATC	Listen to ATC	Say "United 573 cleared to land RWY one six left"	
Listen.	Say "Roger, cleared to land RWY one		
Listen.	Say "1000 feet"		
Check stabiliz	Check stabilized approach status		
Acquire runway			
Cor. "Dummer in sight."	Confirm		

Appendix A. Task Decomposition Spreadsheet (Current Day Nominal)

Listen. "100" "100" Listen. "50" Listen. "20" Listen. "10"

			Current	Current Day - Off-Nominal		
Š			Divert to: 800°	900' Cloud Ceiling Category D		,
Altitude Di	Airport Distance	Pilot Flying (CA)	Pilot NOT Flying (FO)	FD Automation	ATC	Dispatch 1
Prior to Final Descent	Descent	uild a common cross checks. ment Monitor	Continuous tasks: Build a common schema - mainly at cross checks. Auditory and Instrument Monitor (continue to TD)		Continuous tasks: Maintain separation	Continuous Tasks: Maintain company schedule efficency. POC between AC and other entities. Route adjustments and reroutings.
	-	Pre-Arrival briefing, (Taxi Chart, taxi route, gate, flaps, target landing speed, descent speed, brake settings, time of year, geographic position)	Monitor PF Pre-Arrival Briefing. Crosscheck.			
		Briefs GSO about procedures and techniques. Say "I'm going to use full reverse on this landing."	Listen.			
		Listen.	Say "Roger"			
		Crosseheck.				
		Crosscheck.	Set radio and navigation frequencies and final course			
		If good captain & threat is evident				
		If good captain & threat is evident Preload CYS into FMS. Say "Preloading Cheyenne into FMS."	If good captain & threat is evident Crosscheck. Say "Roger."			
	~110nm TOD	Crosscheck.	Read: Approach descent checklist			
37,000' II	104 nm SIDNEY	Crosscheck.	Set Altitude.			
		Listen to ATC	Listen to ATC		Say "United 573 contact Denver Center, 133.95"	
		Crosscheck.	Say "United 573, Denver Center, 133.95"			
		Crosscheck.	Set radio frequency to 133.95 for Denver Center			
		Crosscheck.	Say "Denver Center, United 573 descending through 240"			
		Crosscheck.	Crosscheck.		Say "United 573; Denver Center, descend and maintain 17 thousand; Expect ILS RW 16L; Denver altimeter 29.57"	
		CA crosscheck. If Schema not correct, get ATIS & amend Approach briefing.				
		Listen to ATC command.	Listen to ATC command,			
		Crosscheck.	Say "United 573 descending to 17 thousand, 29.57"			
		Set 2 Altimeters.	Set 1 Altimeter.			
		Crosscheck.	Crosscheck.	l av Alert		
			Speak w/ Dispatch "Forward lavratory is leaking"			Listen
			discussion of Lovinting to the total			

		Listen	Listen		Speak w/ FO (NASA01) Confirm request: Maintenance Problem
		Listen	Listen		Speak w/ FO (NASA01) Safety inquiry: Maintenance Problem "Do you have any safety concerns?"
			Speak w/ Dispatch "No, have maintenance ready on the ground at DEN."		Listen
					Speak w/ Maintenance (NASA01)
		Listen	Listen		Speak w/ FO (NASA01) Relay Resolution: "Maintenance will you meet you at the gate"
18,000° ,879° AGL	74 nm	Crosscheck.	Tum on exterior lights		
		Crosscheck.	Check Pressurization.		
		Listen to ATC	Listen to ATC	Say "All aircraft, Microburst alert at Denver, approaches are temporally discontinued, expect holding for all runways"	
		Crosscheck.	Load primary alternate Airport (CYS).		
		Discuss probable hold locations & pattern. 1	ittern. Discuss fuel state and calculate		
		Crosscheck.	Pre-load probable hold into CDU		
		Locate all alternate approach plates.			
		Discuss Alternate 1 (CYS) (dis	Discuss Alternate 1 (CYS) (distance/time/fuel/CAT/ATIS) (x2)		
		Action.	Action		
		Discuss Alternate 2 (distance	Discuss Alternate 2 (distance/time/fuel/CAT/ATIS) (x2)		
		Action.			
			Action.		
		Discuss Alternate 3 (distance/time/	e/time/fuel/CAT/ATIS) (x2)		
			Action.		
		Listen to ATC	Listen to ATC	Say "United 573, hold North of LANDR on 216 radial, left-hand turns. Maintain one seven thousand, expect further clearance in one zero (10) minutes"	
'879' AGL	61 пт	Decide on Cheyenne (CYS) as the alternate, endurance for a hold with CYS as new de Desired CYS landing fuel. Current burn Crosscheck.)	scide on Cheyenne (CYS) as the alternate. Discuss fuel state and calculate endurance for a hold with CYS as new destination. (Find burn to CYS, Desired CYS landing fuel. Current burn rate. Time/fuel remaining. Crosscheck.)		
		Listen.	Say "United 573 maintaining 17,000", will hold at LANDR"		
		Crosscheck.	Say "Denver Center, United 573 at LANDR, time 15, 17,000"		
		Crosscheck.	Execute hold.		
		Listen to ATC	Listen to ATC	Say "All aircraft, Tower evacuated due to funnel cloud sighting, divert to other airports."	
		Decide to divert to CYS (the Decide			
		CA: Validates / in agreement with mental map			

	Action			
		Action.		
	Listen.	"Denver Center, United 573 request IFR clearance to Cheyenne via direct"		
	Listen to ATC	Listen to ATC	"United 573 standby" "United 573 cleared to Cheyenne via direct GILL, direct Cheyenne"	
	Listen.	Say "Roger, direct GILL, direct Cheyenne, United 573."		
	Crosscheck.	Load CYS as new destination in CDU. Get ATIS. Build a route, Load expected Approach/Arrival Information: Airport, Runway, Altimeter, Speed changes, landing flaps, DH, frequencies. Load LNAV/VNAV.		
	CA: Validates / in agreement with mental map			
	Monitor PF Pre-Arrival Briefing. Crosscheek.	Pre-Arrival briefing. (Taxi Chart, taxi route, gate, flaps, target landing speed, descent speed, brake settings.		
	Listen to ATC	Listen to ATC	Say "United 573 Fly heading 281 GILL, maintain one seven thousand"	
	Crosscheck.	Say "Roger, United 573, 281 to GILL, maintaining 17,000."		
	Listen to ATC	Listen to ATC	Say "United 573, Fly heading 350, Cleared direct HAMER, direct CYS, descend and maintain 10,000, expect runway 27 approach to CYS, Cheyenne altimeter 28.15"	
	Crosscheck.	Say "Roger, United 573, 350, direct to HAMER, direct CYS, descend and maintain 10,000, expect runway 27 approach; altimeter 28.15"		
	Crosscheck.	Execute route.		
	Crosscheck.	Exit hold.		
	CA crosscheck, If Schema not correct, get ATIS & amend Approach briefing.			
	Set 2 Altimeters.	Set 1 Altimeter.		
	Crosscheck.	Crosscheck.		
10,879' AGL ~70 nm	nm Listen.	Say "Denver Center, United 573, Unable, minimum fuel. Request emergency clearance to		
	Listen to ATC	Listen to ATC	Say "United 573 cleared to, Descend and maintain 10,000. Contact on ###.##"	
	Crosscheck,	Say "Roger, United 573, cleared to descending to 10,000', ###.##"		S - 24
3,879' AGL 49 nm	Listen to ATC	Listen to ATC	Say "United 573 contact Cheyenne Approach on 124.55"	
	Crosscheck.	Say "Roger, United 573, 124.55"		
	Crosscheck.	Set radio frequency to 124.55 for Cheyenne Approach		
	Listen.	Say "Cheyenne Approach, United 573, one zero thousand with Alpha."		

	Listen to ATC	Listen to ATC	Say "Roger, United 573, descend and maintain flight level 9000"	
	Crosscheck.	Say "Roger, 9000 for United 573"		
	Crosscheck.	Set Altitude.	A Marie Control Control Control Control	
2,879' AGL 15 nm	Listen to ATC	Listen to ATC	Say "United 573, turn left heading 350, base leg."	
	Crosscheck.	Say "Roger, heading 350, base leg, United 573"		
	Crosscheck.	Set Heading		
	Command "Flaps 1"	Listen.		
	Crosscheck.	Reach flap lever. Set flaps to 1.		
	Speed confirm (210)	Speed set (210)		
	Command "Flaps 5"	Listen.		
	Crosscheck.	Reach flap lever. Set flaps to 5.		
	Listen to ATC	Listen to ATC	Say, "United 573, turn left heading 280, maintain 7,800 until established. Maintain 180 kts to ZUNUG, contact tower on 118.7"	
	Listen.	Say "Roger, left 280, 7,800 until established and 180 until ZUNUG, contacting Tower at 118.7, United 573"		
	Crosscheck.	Set Heading		
	Crosscheck.	Set Altitude.		
	Crosscheck.	Arm Approach Mode		
	Crosscheck.	Confirm FMA display reads expected		
	Crosscheck.	Set radio frequency to 118.7 for Chevenne Tower		
1,679' AGL 15 nm	Command "Flaps 15"	Listen.		
36	Crosscheck.	Reach flap lever. Set flaps to 15.		
	Speed confirm (180)	Speed set (180)		
	Listen.	Say "Cheyenne Tower, United 573 turning Final for the ILS 27L approach."		
	Listen to ATC	Listen to ATC	Say "United 573, cleared for the IL.S 27L approach."	
	Listen.	Say "Roger, cleared for ILS 27L, United 573"		
	Disconnect autopilot.	Aural alert	rt.	
	Command "Gear Down, Landing checklist"	Listen.		
	Crosscheck.	Set landing gear		
	Speed confirm (146)	Speed set (146)		
	CA Arm speed brake.	FO Crosscheck.		
	Command "Flans 20"	Set 1DZE Listen		
	Crosscheck.	Reach flap lever.		
1.679' AGL 5.1 nm	Glideslope canture	Confirm capture		
	Crosscheck.	Confirm FMA display reads:		
	Command "Flaps 25"	Listen.		
	Crosscheck.	Reach flap lever. Set flaps to 25.		
	Command "Flaps 30"	Listen.		
		1		

Appendix B. Task Decomposition Spreadsheet (Current Off-Day Nominal)

	Crosscheck.	Reach flap lever. Set flaps to 30.	
	Crosscheck.	Complete landing checklist. Say "Landing Checklist complete"	
	Crosscheck.	Say "Tower, United 573 for RWY two seven left"	
	Listen to ATC	Listen to ATC	Say "United 573 cleared to land RWY two seven left"
	Listen,	Say "Roger, cleared to land RWY two seven for United 573"	
1,000' AGL 3.9 nm	Listen.	Say "1000 feet"	
	Check stabilize	Check stabilized approach status	
000	Acquire runway		
	Say "Runway in sight"	Confirm.	
3117	Listen.	Say "Approaching DH"	
500'AGL ~Inm	Listen.	"500 feet"	
	Recheck stabilia	Recheck stabilized approach status	
	Listen.	001	
	Listen.	20	
	Listen.	"30"	
	Listen.	"20"	
	Listen.	10	
Touchdown	100000000000000000000000000000000000000	The state of the s	

	Ground Automation 3	Continuous tacke: Off-Seminal Alexts, Monitor task adherence. Transiti information packages. Transfer notification.															CO Jasks Oller AC)		# 100 mm								1			
	Pilot NOT Flying Ground Operator (Hybrid) 3	Confirment tasks: Austines & alert Monthe. Naistain a commun schema. Maintain company schedule efficency. Provide disparch inferencian & limited support to OBP (Obser), washable for DA II															38													
	Greand Autoeution 2	Continuent tasks: Off-Nominal Alerts, Monitor conformance, Transmit information packages, Transfer audification.				200000000000000000000000000000000000000	Remind GO. Agend to AC #								Update Info (NASA01)								Update Info (NASA01)	Remind OO:	Update Info (NASA01)	Update Info (NASA01)				
	Filst NOT Flying Ground Operator (Hybrid) 2	Continuous node; Auditory & ater Monitor. Maintain a common schema. Maintain company schedule efficers, Provide disparte information & limited support to ONR (Other), Available for DA if	Pre-Slaft Flught Brogflags	Revise bankeff packages (NASA#E.ACL.AC), AC4 AC9)	County Court	Scan Screen, Tails Management	Review Fuel levels ()	Review Weather ()	Review Pael levels () Review Weather ()	Review Fuel levels ()	Review Fael levels ()	Review Weather ()	Review Fuel levels (NASA01)	Review Weather (NASA01)	Scan Screen: Tails Status	Scan Serven: Tails Management	Liston	Speak w/ OBP () Discuss Wheel chairs	Find Gate Information ()	Speak w/ Customer Care Form Discuss: Wheelebarrs ()	Speak w/ OBP: Relay resolution	Review Fuel levels ()	Review Weather ()	Scan Screen: Tails Status	Scan Screen: Tails Management	Review Vosither ()	Scan Screen: Talla Status	Linten	Speak in OBP (NASAMI) Confirm request: Maintenance Problem	Speak w/ OBP (NASA01) Safety inquiry: Maintenance Problem "Do you have any safety concerns"
SPOIL Hybrid - Nominal NASA01 DEN ILS RWY 16 SW Clond Celling Category D NASA01 Pre 100 - TD GOH 1(x) - I(y)	Ground Automation 1	Continuum naste: OF-Nominia Arter, Monitor task adhrevoe. Transite notification. packages. Transite notification.																			Other A.C.									
SPO NASA 8	Pilor NOT Flying Ground Operator (Hybrid) 1	Confinement trakes: Andliney & alest: Heastine. Natations of alest: Heastine. Maintain common schedule. Allestines. Provide dispatch effector. Provide dispatch information & limited support to OBP (NASAM), residants for Da affector.	Popure briefing package for Handoff (NASA01)								Execute handoff (NASA01)	Disconnect (NASA01)									GO Tasks (Other AC)									
	ATC (cues)	Continuent nuds: Maintain separation														Say "NASA01 cretact Denver Center, 133.95"			0.00		Say "NASA01, Denver Center, descend and maintain 17 thousand; Expect ILS RW 161, Denver altimeter 29 57"									
	Flight Deck Automation (NASA01)	Continuous tacke: Off-Nominal Akeris, Phase of flight alerts. Monline conformance. Notification of non self-initiated system changes.		Get ATIS. Uplink to FD: expected approach/arrival info (Ampor, rusway, altimeter, target speed, landing flaps, DH, frequencies.) Notify.	0.000000									Remind: Approach descent checking	Send to ground auto	Pre-load ATC info					Pre-load ATC info		Set 3 Altimoters. Nontr.		Send to ground auto	Send to ground auto	Lav Alert			
	Pilot Flying On-Board Pilot NASA01 (CA)		Pre-Arrival briefing/checklin (Taxi Chari, taxi nobe, gate, flaps, target landing speed, descent speed, leake settings, time of year, geographic position).	9	Crosscheck auto infor	Execute auto auto.							Best optain & threat is avident. Preload alternatives into PMS. Say "Preloading alternate. into	Approach descent checklist	Execute Alithale.	Listen to ATC	Say "NASA01, Denver Center, 133.95"	Crosscheck auto info: Radio feotomes	Execute radio frequency	Say "Derror Center, NASA01 descending through 240"	Listen to ATC Crosscheck.	CA treescheck. If Schema not correct, get ATIS & amend Approach briefing/checkfist.	Say "NASA01 descending to 17 thousand, 29-57"	Crosscheck auto info: Altimeters	Execute Altimeters	Crosscheck auto info: Attitude Execute Altitude	100000	"Forward lavratory is leaking"	Listen	Listen
	NASA01 NASA01 Altitude Distance													-110uss TOD	37,900° 104 mm SIDNEY						1									

															GO Tasks (Other AC)																			
				Notify: Befow 18,000" (NASABI)							Update Info (NASA01)	Update into (NANABI)		Update Info (NASA01)			Remind GO.	Attend to AC ()	Update Info (NASA01)		Notify: Autopliet disconnect ()						Update Info (NASA01)		Update Info (NASA01)	Control left (NASA01)	Charle files (NASAUL)	100 0 X 00 0 X 0	Opposition (1909)	
Listen	Speak w. Mamiernance (NASABI) Patch through mantenance (collaboration possible)	Speak w/ OBP (NASARI) Relay Resolution: "Maintenance will you meet you at the year."	Review Fuel levels (NASABI)	Scan Screen: Tails Status	Scan Screen, Tath Management	Speak w/ OBP () Discuss: Gate Connection Problem	Speak w/ OBP () Discuss Gate Comection Solution	Comm: Reservation coordinator Discuss Gate Connections ()	Receive and Understand message (ATC) "Delays in ORD due to weather."	Scan Scroom Tails Status	1610	Review Attitude & Heading ()	Review Fuel Levels ()	Review Weather () Speak w/ OBP ()	Speak or Customer care team	Speak w. Reservation coordinator Discuss: Delays ()	Som Screen, Tails Status	Scan Screen, Tails Management	Review Althode & Heading ()	Review Fael levels ()	Review Weather () Review Altitude & Heading ()	Review Fael lesels ()	Review Westher ()	Scan Screen Tails Status	Scan Screen. Tails Management	Review Altimate & Heading ()	Review Fuel Tevels ()	Review Weather ()	Scan Screen: Tarls Status	Scan Screen Lais Management Diagram First Temperature ()	Scan Scroen: Tails Status	Scan Screen: Tails Management	Review Weather ()	Scan Screen. Tails Status Scan Screen. Tails Management
															GO Tusks (Other AC)																			
									Say TAASA01, Fly heading 218, cleared dreet PHLAT, dreet XIPPR, dreet Denver descend and maintain 10,000, espect nameny 164, 118, approach to Denver.			Say "NASA01 contact	Deriver Approach on 119.3.*			Say "Roger, NASA01, descend and maintain	flight level 8000°	Automotive property and a	Say "NASA01, turn left beading 270, base leg."					Sey "MASA01, turn left beading 200, maintain 7,000 until established. Maintain 190 kis to LEETS, contact hower on 135.3°										
				Remind:		Turn on exterior lights North			Pre-load ATC info	The Title Child	Send to ground auto	Send to ground auto		Send to ground auto	•	Pre-load ATC info			Send to ground auto	Remind: Flaps 3		Remind: Plaps 5		Pre-load ATC info			Send to ground auto	Talkhine Man	Send to ground auto. Remind	Arm agreeach mode	School of ground ages		Remnd:	and the second
Speak w/ GO "No, have maintenance seady on the ground at DEN."		Liston			Chock pressuration		Crosscheck Lightn		Lister to ATC.	Say "Roger, United 573, 218, durect to PHLAT, deect DEN, describt and maintain 10,000, expect mineay 161, approach."	Execute Although	Execute Heading	Listen to APC	Say "Roger, United 573, 119.3." Execute Radio	Say "Denver Approach, United 573,	Listen to ATC	Say "Roger, beading 350, have leg.	Crosscheck AUTO info	Execute Heading	Liston	Reach and set flags to 1 Set speed (210)	Listen	Reach and set flaps to 5.	Lister to APC	Say "Roger, beading 270, base leg, United 573"	Crosscheck auto info: Altrude	Execute Altmade	Cristacheck auto infor Heading	Execute Heading	Arm Antonioch Mode	Confirm PMA reads as expected	Crosscheck and info Radio frequency	Labrance amond recognitive	Reach and set flags to 15. Set upood (280)
				18,000° 61 mm												4,650° AGL 40 mm											to l						1,650' AGL 32 am	

						1								Other AC)												1 2 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4				
														GO Tasks (Other AC)																CONTRACTOR
	1.007 (1)	10000	Update linfo (NASA01)			1000		1000			Update Info (NASABI)	Remind GO: Attend to AC: ()				A CONTRACTOR OF THE CONTRACTOR						Notify: Below 1,000 (NASAUI)	Update Info (NASA01)							
Review Fuel levels ()	Review Weather ()	Receive and Understand message	Identify relevant AC	Scan Screen: Tails Status	Scan Screen: Tails Management	Speak w/ OBP () Discuss Security information	Scan Screen: Tails Status	Scan Screen. Tails Management	Speak w. OHP ()	Calculate fuel tento	Send test results thin fael temp ()	Scan Screen: Tails Status	Scan Screen, Tails Management	Prepare Outhound for release Check weather ()	Prepare Outhound for release Check flight plan ()	Scan Screen: Tails Status	Scan Screen: Tails Management	Review Weather ()	Review Alithodo & Heading ()	Rossew Faet Jevels ()	Review Weather ()	Review Altitude & Heading (NASA01)	Review Fael Jevels (NASABI)	Review Weather (NASA01)	Scan Screen, Tails Status	Scan Screen: Tails Management	Mexico Woother D	Review Altitude & Heading ()	Speak w/ OBP () Discuss: Delays	
														GO Tasks (Other AC)																· · · · · · · · · · · · · · · · · · ·
100 100 100 100 100 100 100 100 100 100														9	201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000 201000 201000 201000 201000 201000 201000 201000 2010000 201000															
	Say "NASA01, cleared for the ILS 16L approach."																		CONTRACTOR DESCRIPTION	Say "NASA01 cleared to land RWY one six left"										
			Aural alert, Send to ground auto	Remind Landing gear					Remind	Longon Co.	Send to ground unto		Remind Flags 25		Remind: Flags 30	April Billion Power	Remind Landing checklist					"1,000 feet"	Send to ground auto	"Approaching DH"	"500 feet"	10001	200	*30*	*30°	
turning Final for the ILS 27L approach."	Listen to ATC	Say "Roger, cleared for ILS 27L, NASA01"	Disconnect autopilot	Listen	Set landing pear	Set speed (146)	C4 Arm speed brake	Set TDZE	Liston	Reach and set flams to 20	Gildoslope captime	Confirm PMA display reads: LOC & G/S	Listen	Reach and set flaps to 25.	Liston	Reach and set flaps to 30,		Indicate landing checklot complete	Say "Tower, NASA01 for RWY two seron left"	Listen to ATC	Say "Roger, cleared to land RWY two seven for NASA01"	Liston	Acquire runway	Liston	Liston	Recheck stabilized approach status	1 1000	Liston	Listen	
										100000000000000000000000000000000000000	1,656'AGI, Tum											1,000° AGL 3.9 am			S00'AGL -Inm					4

SPOHL Hybrids - Off-Seaninal OS Divert nec CVS ILS RWY 271, BRO Chond Ceding Contegery D Contegery D Contegery D Contegery D	AIC Pilot NOT Fixing Count (NAXA01) AIC Count Operator (Bybrid) 1 Ground Operator (Bybrid) 2 Ground Operator (Bybrid) 3 Ground Operator (Bybrid) 3 Ground Operator (Bybrid) 3 Ground Automation 3	Continuous tasks	Prepare thristing package for thembalf	Get ATB. Uplan is TD expected appropriate the second secon	infin Livien Sam Steneer Tuth Status	10	Review trad foreign Action Assend to ACO	Review Walder () Review Walder ()	Review Weather U.	Execute handor (NASA4) Review Fact levels ()	Discounted Control of the Control of		heakini Appunda kecara ekekini	Send to ground auto	C Pre-book ACC wide Says NASAM construct. Dependent 13.05° San Screen Tails Management		Seed at 100 PD Office Annual Police Annual P	Ž-		Sty "AASAMI, Denver Centry, descend and marininal framework for the Control framework for the Control framework for the Control framework (Other AC)		Set J. Altimaters	Nem Servent Talls Statum	Scot to ground auto	Send to gricone auto (Kockets)	TO ANIE		Triple of the Control	Siefely value in a service outcome. The value have are selected outcome.	
	Flight Deck Automation (NASA01)			Get ATBS. Uplink to FD: expected approach/arrival info (Auport, runway, altimeter, target speed, landing flaps, DH, frequencies.) Notify.	No.								Approach descent checklist							72		Set 3 Alternators Notify		Send to ground auto	Send to ground auto	LayAket				
	Pilot Pying On-Board Pilot NASA01 (CA)	Confirmers node: Austinay and Instrument Number. Maintain a common schema.	Pre-Arrival briefing-checklint (Taxi Chart, taxi none, pate, flaps, target handing speed, descent speed, brake settings, time of year, geographic monitors)		Crosscheck auto infor Execute auto tofo						If good captuin & throat is evident— Preload alternatives into PMS. Say Preloading alternate into	FMS."	Approach descent checklist	Execute Altitude.	Listen to ATC	Say "NASA01, Denver Center, 133.95"	Crosscheck auto info: Radio frequency	Execute radio frequency	Say "Derror Center, NASA01 descending through 240"	Lister to ATC Crosscheck.	CA tresschock If Schema not correct, get ATIS & amend Assertate briefingschoolist	Say "NASA01 descending to 17 thousand, 29.57*	Crosscheck auto info: Altimeters	Consched and info Altitude	Execute Altrinde	Speak w. GO	Liston	Carolina	Liston	Speak w/ GO "No, have maintenance ready on the
	NASAŭ! NASAŭ! Altitude Distance												TOD	37,000° 104 mm SIDNEY													-141			

				GO Tasks (Other AC)						Receives AC from GO2										Š	CO reserving ACO									
	Notify: Below 18,000° (NASABL)			Neity, Wx. pt. DEN					Regest Confirmation					344000000000000000000000000000000000000	Sont pietes to MASAUL auto	Send weather to NASA01 auto					Notify NASA61 auto			Notely NASA01 auto						
Speak at Mametranice (NASAM) Pack through memberanic (collaboration possible) Speak at Older (NASAM)	Scan Scroen, Tails Status	Scan Screen. Fulls Management Speak w. Offil? () Discuss. Gate Comperion Problem	Speak w/ OBP () Discuss: Gate Connection Solution	Comm. Reservation coordinator Discuss Gate Connections () Notified of wx at DEN, possible hold and direct (NASA01)	Review Fuel Jevels (NASA01)	Scan Screen, Talls Status	Review Altitude	Review Heading (NASA01)	(NASA01) Select DA	Confirm bandoff	Speak w/ OBP (NASA01): "How can 1 beln?"	Listen	"Roger, locating." Identify afternate airports	Locate approach plates (CYS/EGE/COS/GIT/PUB)	CYNFIGEROS GITTEUR)	Send weather to NASA01 Review plates	Review weather	Agree on prelimmary best alternate	Listen.	Confirm duties	Load primary alternate Airport (CVS)	Discuss probable hold locations &	pattern. Discuss fact state and calculate endurance for a hold. O'nd frum to DEN. Deserte DEN landing fact. Carrare barn are. Tomofuel	Pre-load probable hold into CDU	Discuss Alternate 1 (CVS)	Action	Discuss Ahemate 2 (EGE) (distance time fuel/CAT/ATIS) (s2)	Action	Discuss Aherrate 3 (COS) (distance time fael/CAT/ATIS) (s.2)	Action
				GO Tasks (Other AC)						Receives AC fram G02										i de	CO IIISKS (OBIGLAC)									
				Say "All annual." Microbian alors at Benear, approaches are temposibly discontinued, expect holing for all memory.																										
	Remind: Pressurization	Then on exterior lights Soutly									Constitution (Constitution)			2007	Lond plates	Load weather					Notify OBP			Notify Offi						
Listen		Check pressurration	Crosscheck Lights	Lister to ATC	Review weather	Restow opsoms Decide DA is recoded	Say: DA Regard		Listen		Listen	Speak w. GO: Tocate relevant alternate approach plants and check weather?	Listen:		Review plates	Review weather		Agree on preferences best alternate	Assign daties: Chart set up, weather neview, ATC communication,	drenies support	No. of Contract of	Cresscheck GO Dicess probable hold Socitions &	portern. Discuss find vaste and calculate endirance for a bold. (Find burn to DEN. Dosered DEN landing find. Current burn near. Timofinel	The state of the s	Discuss Ahermate 1 (CYS) (distance/time/fuel/CAT/ATIS) (x2)	1	Discuss Alternate 2 (EGE) Obstance Stime Buel-CAT/ATTS) (x2)	Action	Discuss Alternate 3 (COS) (distance line field CAT/ATIS) (x2)	Action
	18,900" 74 am										•																			

													CO fasks (Other AL.)										
Pre-load ATC info				Update Info (NASA011/ Nonty GO								Pre-load ATC info	Load CVS so new destination in CDN, Cite AVS Build a route. Load expected Approach Arrival Information: Aspent, Rusway, Aktimeter, Speed changes, leading flags, DH, frequencies, Load IAMYVAN, South, CO.		Update Into (NASA01) / Nettly GO		Pre-load ATC info		Update Info (NASAIII) / Nosily GO	Pre-bod ATC info		Undate Info (NASABI) / Nonfo GO	Update Info (NASA01) / Nostry GO
Listen to ATC	Decide on Cacyonne (CVS) as the alternate Decises feel state and calculate endantance for a hold with CVS as new destination. (Find but to CVS Desired CVS Inding fact CVS The CVS Thanking fact CVS Transfer and Time food transfer transfer to CVS Decise fact and Time food transfer transfer CVS A transfer fact.	Say "NASA01 maintaining 17,000", will hold at LANDR"	Say "Denver Center, NASA01 at LANDR, time 15, 17,000"		Lister to ATC	Photograph of the Port of the Photograph	pece requires that alternates are removed from consideration by a process of elimination - weather.	distance to land, and fuel), Execute Afternate 1 Plan,		Action	"Denver Center, NASA61 request IPR clearance to Cheyenne via direct"	Listen to ATC		Croscheck AUTO info	Crossebeck mute	Monitor PF Pre-Arrival Beiefing, Crosschock	Lister to ATC	Say "Roger, NASA01, 281 to GILL, maintaining 17,000."		Crosecheck Heading	Say Roger, NASA01, 350, direct to HAMID, direct CYS, descend and maintain 10,000, expect natway 27 antercock, altriogen 28, 15		Crosscheck Offip
													CO Tasks (Other AC)										
Say "NASA01, hold North of LANDR on 216 radial, 16th-hand turns. Maintain one seven flosiosand, expect further character in one zero (10) minutes?					Say "All aircraft, Tower evacuated due to furned cloud sighting, divert to	other airports."						"NASA01 standby" "NASA01 cleated to Cheyente via direct GILL, direct Cheyenne"					Say "NASA01 Fly heading 281 GILL, maintain one seven thousand"			Say TNASAOI, Fly boading 350, Cleared direct HAMER, direct CYS, descreted and maintain 10,000, expect reaway 27 approach to CYS, Cheyense altimeter	CIVET		
Pre-load ATC info				Send to ground auto								Pre-load ATC info	Load CVS as new destination in CXI, Cee ATS Build a neute, Load expected Approach Arrival Information: Aspect Remays, Adimetric, Speed changes, landing flags, DIF, frequencies, Load INACVANA Native (RRP		Send to ground auto.		Pre-Soud ATC info		Send to pround auto			Send to secural auto-	Send to ground auto
Lister to ATC	Decide on Cheyenne (CVS) as the administration for the took and coloristic endurance for a hold with CVS as new destination (Find hum to CVS as new destination (Find hum to CVS as Thomas (TVS Indiang fool Current hume and Time/hul current hume and Time/hul remaining Cross-bred.	Liston	Crosscheck GO	Crosscheck ATC info	Listen to ATC	Marida by American by CVC Ohis Provide	pace requires that alternates are removed from consideration by a process of elimination - weather,	distance to land, and fuel), Execute Alternate 1 Plan.	CA: Validates / in agreement with mental map	Action	Listen. Crosscheck GO	Lister to ATC			CA: Validates / in agroement with mental map	Pre-Arrival briefing. Class Chart, taxis route, gate, flaps, target landing	Listers to ATC	Listen. Crosscheck GO	Conscheck AUTO info Execute Heading	Lister to ATC	Lieton Crescideci 500	CA crosschool. If Schema not correct, get ATIS & amend Aggrosch briefing. Execute route	Extroold
	10,879° AGL 61 nm					A				1. 1.21							V- 110						

					GO Tasks (Other AC)								GNes AC to GO2											() () () ()	GO Easks (Office AC)												
Set I ground Altimoter North GO & NASA61		Pre-load ATC info			Pre-load ATC info		Update balo (NASA01) / Nonfy GO					Update Info (NASA011 / Notify GO			Undate liefo (NASARI)			1000	1000		Remind GO: Antend to AC ()			Opdate India (NASMOI)	Update Info (NASA01)	Market Late Avenue			Update info (NASABI)						Update Info (NASA01)		
	Crosscheck AUTO info	Listers to ATC	Say "Roger, NASA01, 12435" Crusscheck AUTO info	Sey "Cheyenne Approach, NASA01, one zero thousand with Alpha."	Lister to ATC	Say "Roger, 9000 for NASA01"	Control of the Control	Listen	Speak wiGHP, "Confirming Dedicated Assistance release"	Cainten	Interact NASA01. "No problem, geodmight."		Request AC return	Roceive other AC	Scan Screen Tails Status Scan Screen Tails Management	Review Fael levels ()	Scriew Weather () Scan Serrorn Tails States	Scan Screen, Tails Management	Review Fael Jevels ()	Review Weather ()	Scan Screen, Tails Status	State County Talls Management	Soli Scient the Management	Keview buch levels ()	Review Weather ()	0 112	Scan Screen, Tails Management	Review Fuel Tenebr ()	Scan Screen: Tails States	Scan Screen, Tails Management	Review Fuel levels ()	Review Weather ()	Review Altitude & Hoading ()	Receive and Understand message	Identify relevant AC	Scan Screen Talla Management	Speak w/ OBP () Discuss: Security information.
					GO Taska (Other AC)								Gives AC to CO2											() () ()	CO lasks (Other AC)												
		Say "NASA01 contact Cheyeme Approach on 124.55*			Say "Roger, NASA01. descend and maintain flight level 9000"							Say "NASAGI, turn left	heading 350, base feg."							Say "NASAOL, turn left beading 280, maintain 7,000 until established Maintain 180 kts so ZUMUG, contact traver on 118.7*													Say "NASAUL, cleared for the ILS 27L approach."		100 00	CENTRAL	
Set 2 cockpit Altimeters North NASA01 & GO	П	Pre-load ATC info			Pre-load ATC info		Send to ground auto					Send to ground auto	Pre-load ATC info		Send to mount auto	Remind Flaps 1		Remind	raps 3	Pre-boad ATC Info				Schill to ground auto	Send to ground auto	Arm approach mode	Control of Control	1000	Send to ground auto Remind	Flaps 13					Aural alert. Send to grassed mito Remind.	Landing gear	
	Crosscheck AUTO info	Lister to ATC	Crescheck GO Crescheck AUTO into	Listen. Cresscheck GO	Listen to ATC	Listen, Crosscheck GO	Crosscheck AUTO mio Execute Alimade	Speak a/ GO, "Lam mally to refease Dedicated Assortance"	Liston	Speak w/ GO: "Thanks for the assistance"	Listen	Execute DA releuse	Listers to: ATC	Say "Roger, heading 350, base leg, NASA01"	Crosscheck AUTO info	Liston	Reach and set flags to 1 Set anough (210)	Laten	Reach and set flaps to 5.	Lister to ATC	Say "Roger, left 280, 7,800 until established and 180 until 2UNUG, controlling Tower at 118.7.	NASA01* Crosscheck auto info:	Altitude	Crosscheck ands info: Heafing	Execute Heading	Links	Confirm PMA reads as expected	Crosscheck auto info: Radio frequency	Execute radio frequency	Reach and set flags to 15.	Set speed (180) Say 'C heyenne Tower, NASAIII	turning Final for the ILS 27L approach."	Listen to ATC	Say "Roger, cleaned for ILS 27L, NASADI"	Disconnect autopilor	Set landing sear	Set speed (146)
		3,879' AGL 49 am		.17			articol I		Kal .	r - 11.		Щ	2,879° AGL 15 nm									FEET STATES	-71						1.679° AGL 15 am	ш.							

													GO Tasks (Other AC)												
					Update Indo (NASA01)		Notify: New Outbound ()			Remind GO: Attend to AC ()						Notify: Below 1,000' (NASA01)	Update Info (NASA01)								
Scan Scroen, Talls Status	Scan Screen, Tails Management	Listen	Speak w/ OBP () Discuss: Fuel temp test	Calculate fuel temp	Send test results/min faci temp ()	Scan Screen: Tails Stangs	Scan Screen: Tails Management	Prepare Outhound for release Check weather ()	Prepare Outbound for release Check flight plan ()	Scan Screen; Tails Status	Scan Screen: Tails Management	Scan Scroen; Tails Status	Scan Scover, Tails Management	Speak w/ OBP () Discuss: Gate Connection Problem	Speak w/ Offir () Discuss: Gato Competion Solution	Comm; Reservation coordinator Discuss Gate Cornections ()	Review Altitude & Heading	Review Fuel Ievels (NASA61)	Review Weather (NASA01)	Scan Screen: Tails Status	Scan Screen: Tails Management	Review Fuel levels ()	Review Weather ()	Speak w/ OBP ()	Proposed Authorities September 18
													GO Tasks (Officer AC)	Say "NASA01 cleaned to land RWY two seven left"											各位单位基位单位单位单位单位单位单位单位单位单位单位单位单位单位单位单位单位单位
			Remind Flags 20		Send to ground auto	1000000	Remind Flaps 25		Remind Flaps 30		Remind: Landing checklist			ig.		"1,000 feet"	Send to ground auto	"Approaching DH"	"500 feet"		1001	-30-	-30-	*20¢	
CA Arm speed brake	SetTDZE		Listen	Reach and set flags to 20.	Glideslope capture	Confirm FMA display reads: LOC & G/S	Listen	Reach and set flaps to 25.	Listen	Reach and set flaps to 30.		Indicate landing checklist complete	Say Tower, NASA01 for RWY two seven left"	Listen to ATC	Say "Roger, eleared to land RWY two serves for NASA01"	Listen	Acquire runway	Listen	Liston	Rocheck stabilized approach status	Listen	Eisten	Estren	Listen	
					5.1 mm											3.9 mm			SOF AGL -Inm					7.1	

				SPOI NAS 8	SPOHI Specialist - Nominal NASA01 DEN ILS RWY 16 800 Cloud Celling Category De 1700 - 170 GOH (103 - 189)				
NASA01 NASA01 Airport Airiude Distance	Pilot Phing On-Board Pilot NASA01 (CA)	Flight Deck Automation (NASA01)	ATC (cues)	Pilot NOT Flying Ground Operator (Hybrid) 1	Ground Automation 1	Pilet NOT Flying Ground Operator (Bybrid) 2	Greand Automation 2	Pilot NOT Plying Ground Operator (Hybrid) 3	Ground Automation 3
Prior to Final Descent	Continues toda: Auditory and Instrument Monitor. Maintain a common achema.	Continuous nacko Off-Nominal Aters, Phase of Hight alerts, Manitae conformates. Notification of non self-initiated system changes.	Continuent tasks: Maintain separation	Confinement traba: Andliney & alert Measine. Natations of alert Measine. Maintin company schedule efficence, Provide dispatch information & limited support to OBP (NASAM), residant for DA III respected.	Continuum tasks: Of-Nominia Arter, Monitor task adhrevee. Transite notification. packages. Transite notification.	Continuous trakts. Auditory & alext Muntter. Maintain a common schema. Maintain compays scheduler efficeres. Provide disparch information & limited support to ODR (Other), Available for DAIT	Continuora tacks Off-Nominal Atersts, Messive conformance, Transmit information packages, Transfer and finestion.	Continues tacks: Auditory & abert Monitor Maintain a common weberna. Act at First Officer to DA alexant Aprovide dispatch information.	Continuors tasks Off-Nominal Alerts, Plase of Hight aberts, Motifier and albertones. Notification of two self-distant system changes. Transfer notification.
	Pre-Arrival briefing/checklist (Text Chart, taxi rottle, gate, flago, target lamfang speed, descent speed, teake settings time of year, geographic position)			Prepare briefing package for Hamforff (NASA01)	350364	Ny Sub Flagal Beefings			
		Get ATIS. Uplink to FD: expected approach/arrival info (Auryort, rateway, altimeter, target speed, landing flaps, DH; frequencies,) Neatly.				Review banded parkages (SASARI, ACT, ACA, ACS)			
	Crosscheck auto infor Execute auto info	200000				Scan Screen Tails Status	Remind GO:		
						Scan Server. Tails Management	Attend to AC ()		
						Review Weather () Review Foel levels ()			
						Review Weather ()			
						Review Weather ()			
				Execute handoff (NASA01)		Review Faet levels () Review Weather ()			
	If good captain & threat is evident. Preload alternatives into PMS. Say "Preloading alternate into PMS."					Review Fuel levels (NASA01)			
TOD	Approach descent checklist	Remind: Approach descent checking				Review Weather (NASA01)			
37,000" 104 mm	Execute Altinde.	Send to ground auto				Scan Screen: Tails Status	Update Info (NASA01)		
	Listen to ATC	Pre-load ATC info	Say "NASA01 contact Denver Center 133.95"			Scan Serven: Tails Management			
	Say "NASA01, Denver Center,					Listen		GO Tasks (GO Tasks (Other AC)
	Crosscheck auto info:					Speak w/ OBP ()			
-conf	Execute radio frequency					Find Gate Information ()			
	Say "Demor Center, NASA01 descending through 240"					Speak w/ Customer Care Form Discuss: Wheelehairs ()			
	Listen to ATC Crosscheck.	Pre-load ATC info	Say "NASA01; Denver Center, descend and maintain 17 thousand; Expect ILS RW 161; Denver altimeter 29 57	GO Tasks (Other AC)	OtherAC	Speak w/ OBP: Relay resolution			
	CA trosscheck. If Schema not correct, get ATIS & amend Ameroach briefingschecklist.					Review Fuel levels ()			
	Say "NASA01 descending to 17 thousand, 29.57"	Set 3 Alternates Notify				Review Woather ()	Update Info (NASA01)		
	Crosscheck auto info: Altimaters					Scan Screen: Tails Status			
	Crosscheck auto info: Altitude	Schallo ground man				Review Fuel levels ()			
	Execute Altimade Speak w/ GO	Send to ground auto				Review Worther ()	Update latio (NASA01)		
	Torward lavratory is leaking:					Speak w/ OBP (NASA01) Confirm request: Maintenance			
	Listen					Speak w/ Oilf (NASA01) Safety meanryt Maintenance Problem			
	Speak w/ GO "No, have mannennes ready on the ground at DEN."					Line you have any salety concerns.			

																GO Tasks (Other AC)																					
				North: Below 14,000' (NASABL)						Remind GO: Amend to AC: 0											Notify: Autopilot discensers ()																
Speak w/ Maintennee (NASA@1) Patch through maintennee (collaboration possible)	Speak w/ OBP (NASA01) Relay Resolution: **Maintenance will you meet you at	the gate"	Review Fuel levels (NASA01) Review Weather (NASA01)	Scan Scroen: Tails Status	Scan Screen. Tails Management	Discuss: Gette Connection Problem	Speak w. OBP () Discuss: Gate Competion Solution	Comm: Reservation coordinator Discuss Gate Connections ()	Receive and Understand message (AIC) "Delays at OED due to weather."	Scan Screen, Talls Samus	Scan Screen. Tails Management	Review Fael Levels ()	Review Weather ()	Speak w. OBF () Discuss: Astpoet/inhound delays	Speak of Customer cire term Discuss: Delays ()	Speak w: Reservation coordinator Discuss. Delays ()	Scan Screen: Tails Status	Scan Screen: Tails Management	Review Altitude & Heading ()	Review Fuel fevels ()	Review Altitude & Heading ()	Review Fael levels ()	Review Weather ()	Scan Serson Tails Status	Scat Server Tails Management	Review Altitude & Hoading ()	Review Fuel Tevels ()	Review Weather ()	Scan Senen Talk States	Scan Screen, Tails Management	Discuss, Fuel Temperatures ()	Scan Scroen: Tails Status	Scan Screen. Latte Management	Review Weather ()	Scan Screen, Talls Status	Scan Screen: Tails Management	Review Fael levels ()
GO Tasks (Other AC)																																					
								ALTERNATION AND ADDRESS.	Say "NASA01, Fly bonding 218, closted direct PHLAT, direct KIPPR, direct Demer descend and manntain 10,000, expect runway 16, LIS approach to Demore			Say "NASA01 contact Denver Approach on 119.3."			and the second s	Say "Roger, NASA01. descend and maintain flight level 8000"		100000000000000000000000000000000000000	heading 270, hase leg."				1 Janes		Say "NASARI, mm left booding 200, maintain 7,000 until established. Maintain 130 kts so LEETS, contact survey on LASA.											1133	211
				Remind: Presentiation	Plant Con and State Con and Co	tum off exterior lights Notify			Pre-load ATC info		Send to ground auto	Schi to ground ago		Send to ground auto		Pre-bond ATC info			Send to ground auto	Remind: Flaps I		Remind Fluns A	Bio Local APP india	Pre-load ATC info			Send to ground auto	Common department of the common of the commo	Send to prosted auto	Remind	Send to ground auto			Send to ground must Remad:	Transfer to		
	Liston				Check penautration		Crosscheck Lights		Listen to ATC	Say "Roger, United 573, 218, direct to PHLAY, direct DEN, dissened and maintain 192000, expect turnway 161, appeared."	Excente Altmade	Listen to ATC	Say "Roger, United 573, 119.3,"	Execute Radio	Say "Denver Appenach, United 573, one zero thousand with Alpha."	Listen to ATC	Say "Roger, heading 350, base leg, NASA01"	Crosscheck AUTO info	Execute Heating	Eston	Reach and set flaps to 1 Set speed (210)	Listen	Reach and net flaps to 5.	Lister to ATC	Say "Reger, breading 270, base leg. United 573°	Crosschock auto info	Execute Alithade	Crosscheck auto mfo:	Execute Newton	Liston	Arm Approach Mode	Confirm PMA reads as expected Crosscheck auto info:	Radio frequency	EARCHOE TRAIN DESCRIPTION	Reach and set flaps to 15.	Say "Cheyeme Tower, NASAUI	naming Final for the ILS 27L approach."
				18,000" 61 nm								24 28				4.650' AGI. 48 mm																		2,65€ AG1, 32,7 nm			

		711 440 640 640 640 640 640 640 640 640 640												lie-AC											1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				日本のはかければからからないというとうないからからないないないからない
														GO Tasks (Other AC)															
10040			Remind GO. Amend to ACO	3	1000													44.00	1000000	10 to	Notify: Below 1,000' (NASA01)					100			2522
Review Weather ()	Reterve and Understand message (ATC)*	Identify referant AC.	Scan Screen, Tails Status	Scan Screen, Tails Management	Speak w. 08P ()	Scan Screen: Tarls Status	Scan Scroon Tails Management	Speak w/ O8P()	Calculate fuel temp	Send test results man facilitary ()	Scan Scroen, Tails Status	Scan Screen. Tails Management	Prepare Outbound for release Check weather ()	Prepare Outhound for release Check (tight plan ()	Scan Screen: Tails Status	Scan Scneer: Talls Management	Review Weather ()	Review Altimate & Heading ()	Review Fuel tevels ()	Review Weather 0	Review Altitude & Heading (NASA01)	Review Fael Sevels (NASA01)	Review Weather (NASABI)	Scan Screen: Tails Status	Scan Screen. Talls Management	Review Puel levels ()	Review Alittode & Heading ()	Speak w/ OBP () Dicease Delace	CONTROL LATINGS
														GO tasks (Other AC)															
og po			11 (a) 11 (a) 12		2000 2000 2000 2000 2000 2000 2000 200										1111 1111 1111 1111 1111 1111 1111 1111 1111	200 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			0 0		(m)								20000000000000000000000000000000000000
Say "NASA01, cleaced for the ILS 16L appreach."																			Say "NASA01 cleared to land RWY one sax left"										
		Aural alert. Send to ground auto	Remind. Landing gene	1000				Remind 61	OF sales a	Send to ground auto	200700000000000000000000000000000000000	Remind. Flaps 25		Remind. Flans 30		Remind. Landing checklast	and the second s				"1,6830 feet"	Send to ground auto	"Approaching DH"	"500 feet"		-1001-	-30-	"20°	
Listen to ATC	Say "Roger, cleared for ILS 271., NASA01"	pilot	Liston	Set landing gear	Set speed (146)	C4 Arm speed brake.	Set TDZE	Liston	Reach and set flags to 20	Gildeslope capture	Confirm PMA display reads: LOC & G/S	Liston	Reach and set flaps to 25.	Eiston	Reach and set flaps to 30.		Indicate landing checklist complete	Say "Tower, NASA01 for RWY two seven left"	Lister to ATC	Say "Roger, cleared to land RWY two seven for NASA01"	Listen	Acquire runway	Liston	Listen	Recheck stabilized approach status	Liston	Esten	Liston	2000000
									-	1,650'AGL 7 nm								60		lw.	1,000°AGL 3.9 mm			SOF AGL -1mm	1		1		-

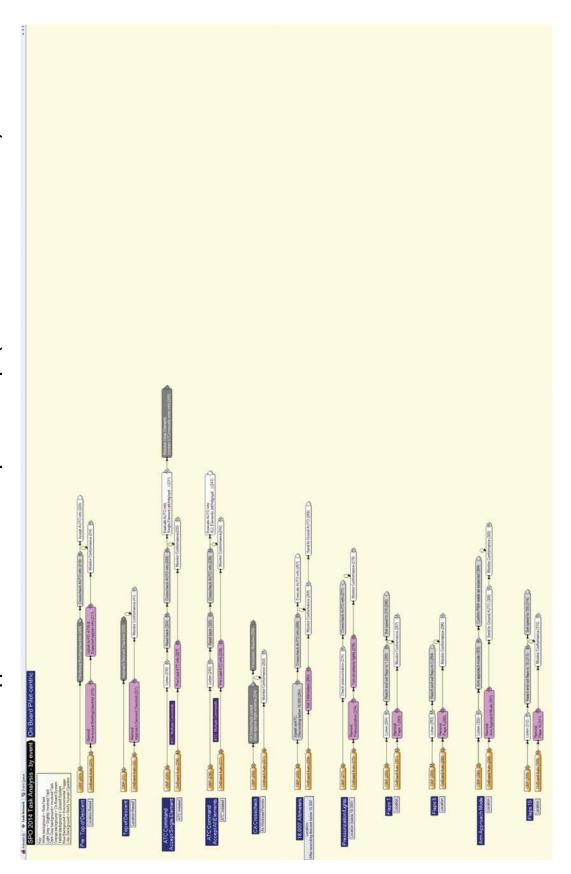
	Pilot NOT Flying Ground Operator (Specialist)	Antiliera & Act Thaining Antiliera & Act Thaining Mainting a common schema. Act a Prox Officer to DA sireral Agroviste dispatch information.															9 5 5												
	Greend Automation 2 G	Confinency tacks: Off-Soomind Afters, Mailer 19th Addresser, Transfer audification. St			Remind GO: Attend to AC ()						2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	10000	Update Info (NASA01)	100000000000000000000000000000000000000			100000000000000000000000000000000000000		1000	Remind GO: Amend to AC ()		Update Info (NASA01)							Nearly: Below 18,000° (NASA01)
	N	Continuous rocks: Auditory & atert Munition. Maintain a common schema, Maintain company schedule efficacy. Provide disparch information & limited support to OBF (Other), Available for DA IF requested.	Pre-State Physic Brieforgs	Revice handoff packages (NASANT AC2, AC3, AC4, AC5)	Laten Soan Screen: Talls Status	Scan Screen: Tails Management Review Fuel levels ()	Review Weather ()	Review Yorkher () Review Fael breek ()	Review Weather ()	Review Fuel levels () Review Weather ()	Review Fast Ievels (NASA01)	Review Weather (NASA01)	BEGIN SPO III scenario events	Scan Screen: Tails Status	Scan Screen: Tails Management	Speak w/ OBP () Discuss: Wheel chairs	Comm: Customer, care team Discuss: Wheelchain ()	Review fuel levels ()	Review Weather ()	Scan Screen, Tails Status	Scan Screen: Tails Management Review Fuel levels ()	Review Weather ()	Speak w/ ORP (NASA01) Discuss: Manmange Problem	Listen	Speak w/ OBP (NASABI) Discuss: Maintenance Solution	Soute, contacting maintenance Speak w/ Maintenance (NASA01) Patch through maintenance (collaboration possible)	Speak w/ OBP (NASA01) "Maintenance will you meet you at	Review Foot levels (NASA01) Review Weather (NASA01)	Scan Screen: Talls Status
SPOII Specialist - Off-Nominal ON Divert in: CN ILS RNY 27 800 Cloud Colling Category D NASAdel for TOD - TD GO 4(3) - 1(5)	Ground Automation 1	Continuous tasky: Off-Nominal Arter, Munitor task sollterenee. Transite uniffication, packages. Transfer uniffication.								AND THE PROPERTY OF THE PROPER										OtherAC									
SPOID O'S DI	무리	Continuous tasks: Auditory & alext Meailue. Maintain a common whema. Maintain company steboth: efficiency. Provide ideapath inferonation & limited support to OBP (NASASM); voilable for DAIR requested.	Propare briefing package for Handoff (NASA01)						100000000000000000000000000000000000000	Discounce (NASA01)										GO tasks (Other AC)									
	ATC (cues)	Continuous tacks: Maintain separation												Say "NASA01 contact Denver Center, 133.95"				Say "NASA01; Denver Center, descend and maintain 17 dousand; Expect ILS RW 161. Denver altimetry 29.57*				100							A-11102
	Flight Deck Automation (NASA01)	Continuous nacks: Off-Nominal Alerts, Phase of flight alerts, Monitor task adherence, Notification of non-self-initiated system changes.		Get ATIS. Uptink to FD: expected approacharival info (Amport, ronvosy, altimoter, target speed, handing flaps, DN, frequencies.) Notify.								Remind: Approach descent checklist	Send to ground auto					Pre-load ATC info		Set 3 Altimoters Natify. Send to ground gate.		Send to ground pate.							
	On-Baard Pilot NASA01 (CA)	Continuous tooks: Autitory and Instrument Monitor. Maintain a common schema.	Pre-Arrival briefing/checklist (Taxi Chaff, taxi nore, gote, flaps, target landing speed, descent speed, brake settings, time of year, geographic position)		Crosscheck auto info Execute auto info					20	Il good outstan & throat is critical. Preload alternatives into PMS. Say "Preloading alternate	Approach descent checkins	Execute Altitude.	Lister to ATC	133.95	Set Radio.	Say "Denver Center, NASA01 descending theough 240"	Listen to ATC Crosselheck.	CA (1900/cbeck. If Schema not correct, get ATIS & amend Aggresch briefingschecklist.	Say "NASA01 descending to 17 flourand, 29.57*	Crosscheck 3 Altimeters. Crosscheck Altitude	Execute Altitude Speak w/ GO	Forward lavratory is leaking."	Speak w/ GO "No, have maintenance ready on the	Liston		Laten		
	NASA01 NASA01 Altitude Distance	Prior to Final Descent										TOD.	37,000" 104 mm SIDNEY						. 2						1-				18,000° 74 ans

Offiling	Montado of Davagora (NAMA) Review Altanda (NAMA) Review Whether (NAMA) (N	Hopes, locating, " Hopes, locating, " Identify alternate angues Locate agreement plates Locate agreement plates Locate agreement plates Sond judget in NASAMI man Rocky (CVS-ELT) Sond plates in NASAMI man Rocky plates Listen. Conferm blattes Conferm blattes Listen. Conferm blattes Listen. Conferm blattes Locatem blattes Rocky Plates Rocky P	Discous probable build Acastronn & probable build Acastronn & posterior. Thissess for that and "posterior than the advisoring endiance for a load, Find burn to BEN Desired DBN knotning flast Construction." The closing probable haid sins CTO. Pre-load grachable haid sins CTO. The closing probable haid sins CTO. The close probable haid sin
Sen Secure Tails Management Season Secure Tails Management Secure Connection Problem Secure Connection Problem (Pages) at 18th 97 Diguses Care Connection Solution Commit Reservations conclusions Commit Reservations conclusions (American Connection Commit Reservations conclusions) (American Commit Reservations) (American Committee) (American Co	Tanga Chrystell (NAAA) NAAA) NAAA NAAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAA NAAAA	GO tasks (Other AC)	Port of the following the foll
		GO tasks (Other AC)	
Soy All strend, Microbust iden at Dance, approaches are temporally decontrained, expect holding detail namenge			Say "NASADI, hold Nette de LLANBE on 21e rashle, left-half urme, Muitani nose evere Mousmal, capor furber (forance in one zero (10)
Turn on exterior tights Notify	"Trodientel Assessmer"	Load plates Load weather Notify ORP	Notify Offip Pre-load ATC Info
Check persunization. Lingui to ATC Review weather Review options Review options Review options Supir Dy Mangaret Supir Dy Mangaret	Listen Listen Listen Listen Listen Retrocktee Listen Problem (Manajele Cycles) Listen (Manajele Cycles) Listen Problem (Manajele Cycles) Listen	Review plates Review plates Review weather Doutso current state Appe on prefationally best alternate (CYS) Ample datase. CATS set we weather review. AC contentmented. review. AC contentmented.	Decess probable had insurance & Crossidistics (GO) Decess probable had insurance and penitre. Excess feet state and genitre. Excess feet state and evidente of the Control benefit (Go) The Control benefit (GO) Decess Abstract (GO) Action Acti

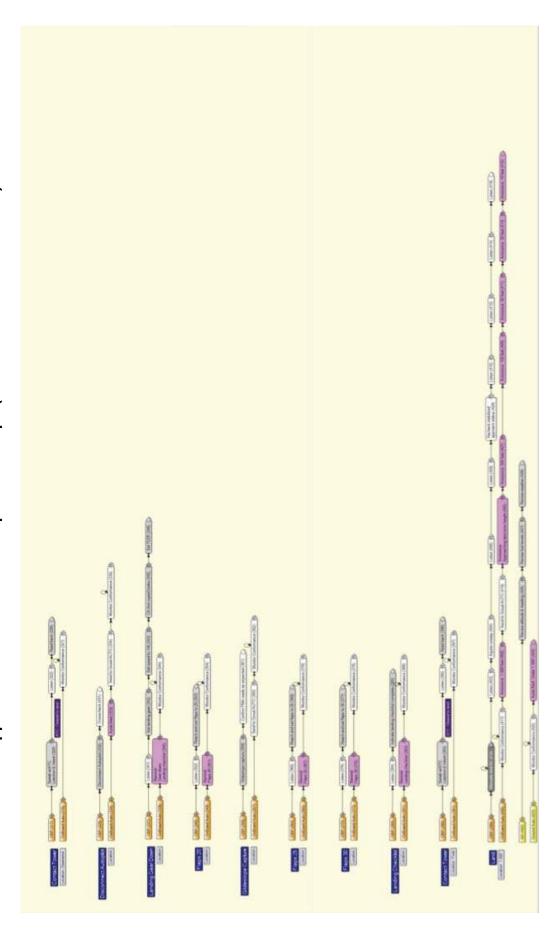
Decode on Cheprone (CVS) as the classification of the state and calcinate relations to Select state and calcinate relations to Select state and state of the Select state of CVS. Exerce CVS, Institute Select Se	Say "NASAO! maintaining 17,000, will hold at LANDR"	Say "Donyar Center, NASA01 at LANDR, time 15, 17,000"	Update Info (NASA01) : North CO	Consultative bold:	Listen to ATC command. Decode to future to CYS (the Decisis piece requires that are common of future that all the Decisis piece futures that all the CAS (the Decisis piece future of the differential are removed future of the company to a process of futuritation vertical distances to futuritation vertical distances to also, and ride (OTFISS). Execute Alternate Plan.		Artion	"Demon Centural NASA01 request IFR cleanman to Chayanne via direct"	Liston in ATC Pre-bod ATC infile	Loud CVS are we destination in CDU. Get ATIS. Bind a route, Load especial Approach Artist Editorial and Editorial and Editorial Approach Artist Editorial and Approach Artist Approach Artist Approach Artist	Cossibook AUTO info		Crosscheck noure	Monitor Pt Pre-Arrival Briefling. Chosscheck.	Listen to ATC Pre-load ATC Into	Say Tioger, NASA01, 281 to GILL, maintaining 17,000.	Update Info (NASA01) - Norify GO	Cheeren to ATC Pre-boad ATC mife	Stop *Roaper, NASARI). 330, sitnest to RAMER, direct C/Ss, decurred and mantain 10,000, caper traying 27 approach; allimeter 28, 157.		Update Info (NASA01) (Northy GO	Update Info (NASA01) / North, GO	Cooxflock AUTO info Cooxflock	Liston to ATC Pre-load ATC info	Say "Roger, NASA01, 124.55" Cinsached AUTO mio	Superior radia fraction for the control of the cont
												CO sactor Other AC														
				Ssy "All ancestlt, Tower evacuated due to furned cloud sighting, divert to	inter imports.				"NASA01 standby" "NASA01 cleared to Cheyeme via direct GILL, direct Cheyemme"			10000 100000 100000 10000 10000 10000 10000 10000 10000 10000 10000 10000 1000			Soy "NAMAOI Fly beading 281 GILL, mandaine one seven thornward.			Say "NASAMI, Fly heading 390, Choured duren HAMIR, direct CYS, discussed and materian (2000) copted removal T approach to CYS, Cheyenne altimates SAYS, Cheyenne altimates SAYS, Cheyenne altimates						Say "NASA01 contact Cheytine Approach on 124 55*		
			Send to ground auto						Pre-land ATC info	Land CVS so mere destination in CDU-Oct ATS Build a route, Loud expected Approach Arrival Information; Aurori, Rouway, Altimater, Speed changes, landing flags, DNF frequencies, Loud 18 New November 18 New N	LOAN VENAN, CHIEF DEST.	Send to ground auto:			Pre-load ATC info		Send to ground auto	Pre-book ATC info		3	Send to ground auto	Send to ground auto	Set 2 cockpit Altimeters Notify NASA01 & GD	Pre-load ATC info		
Decide on Cheyreme (CVS) as the absence. Disciss find stoke and calculate endersone find stoke and calculate endersone fine a head with CVS as new decinations. (Find hum to CVS, Decime CVS, Indicing feel, Current hum rate. Time (last immuniting, Crosscheck).	Listen	Crossdicck 00	Crosscheck ATC info	Lister to ATC	Listen to ATC. Decide to threet to CYS (the Decide piece requires that advantage are convoided from consideration by a process of elimination is sentiles; distance to that, and feet. OrtHERS). Execute Anternate 1 Plan.	CA: Validates (in agreement with mental map	Action	Listen Cosscheck GO	Lister to ATC			CA: Waldate, in automore with	mountain magnosius mini	Pre-Arrival briefing. (Taxi Chart, taxi route, gate, flaps, target landing speed, descent speed, brake settings.	Lister to ATC	Listen. Crosscheck 00	Conselbeck AUTO info Execute Heading	Listers to ATC	Listen Crosscheck GO	C4 troncheck. If Schema not correct, get ATLS & amend Agenouch berefine.	Execute reate	Ferbold	Crosscheck AUTO info	Listen to ATC	Crosscheck GO Crosscheck GO Crosscheck AUTO info	Listen Crosscherk GO
10,879' AGL of nm	3					11 2											Fre Transition							3,879° AGL 49 nm		

Listen Plags 30	Reach and set flags to 30.	Remind: Landing checkint	Indicate landing checklist complete:	Say "Tower, NASA01 for RWY two		Sey "Roger, charred to land RWY two		Acquire narway Send to ground auto	Linton	finm - Lates - "500 feet"	Recheck stabilized approach status	Laten "100"	Linten "50"	Liston *30*	Listen -20°	Linden "10"
Flags 30		Remind: Landing checking					"1,000 foet"	Send to ground auto	"Approaching DH"	"500 feet"	100000000000000000000000000000000000000	-100-	-30-	*0f**	*20°	-10-
							H		Н	-					,	
					Say "NASA01 cleaned to land RWY two seven left"											
						5	CO (SON) COMES AN									
												100				
Scan Screen, Tails Status	Scan Serven: Tails Management	Scan Screen: Tails Status	Scan Screen: Tails Management	Speak w/ OBP () Discuss: Gate Connection Problem	Spouk w/ OBP () Discuss: Gate Councelor Solution	Cumm: Reservation coordinator Discuss Gate Connections ()	Review Altitude & Heading	Review Fuel levels (NASABI)	Review Weather (NASA01)	Scan Screen: Tails Status	Scan Screen: Tails Management	Review Fuel levels ()	Review Weather ()	Speak w/ OBP () Discuss: Airborn/inhound delays	Speak wi Customer care team Discuss: Delaya ()	Speak w: Reservation coordinator Discuss: Delays ()
Attend to AC ()							Notify: Below 1,000 (NASA01	Update Info (NASA01)								
	1000 1000 1000 1000 1000 1000 1000 100															

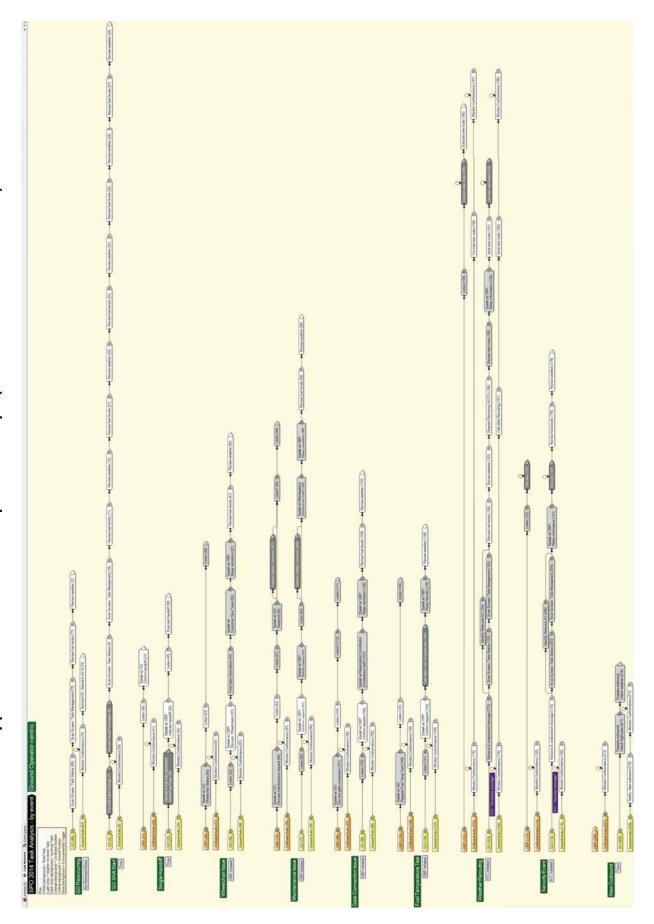
Appendix G. Micro Saint Sharp Task Groups (OBP-Centric Nominal Mode)



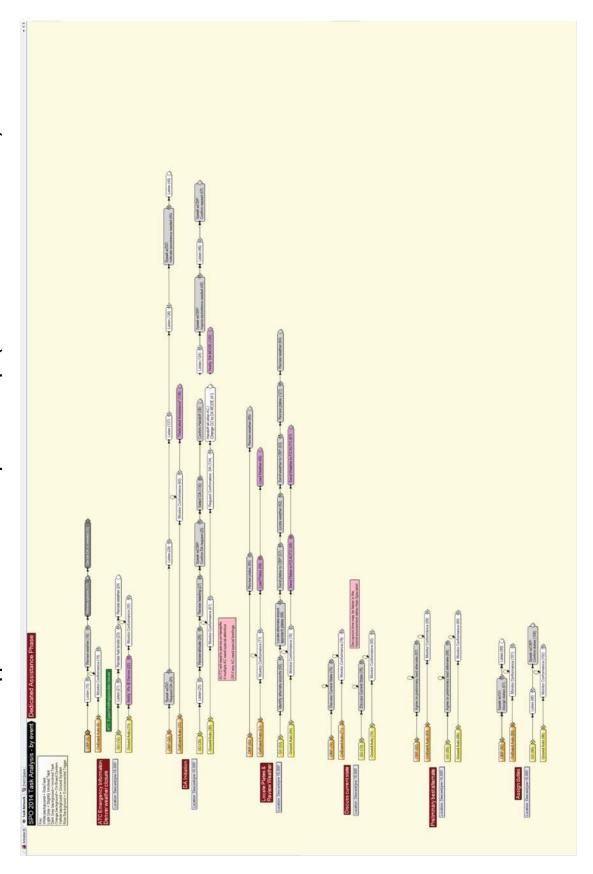
Appendix G. Micro Saint Sharp Task Groups (OBP-Centric Nominal Mode)



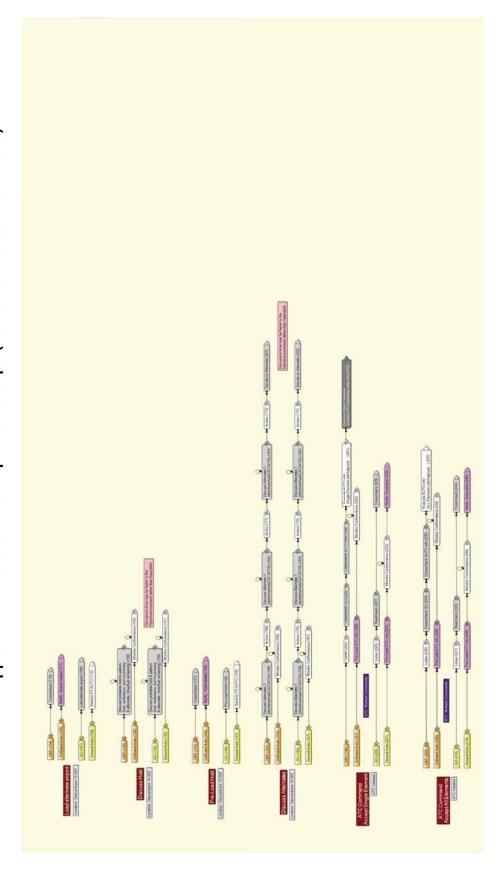
Appendix H. Micro Saint Sharp Task Groups (GO-Centric Nominal Mode)



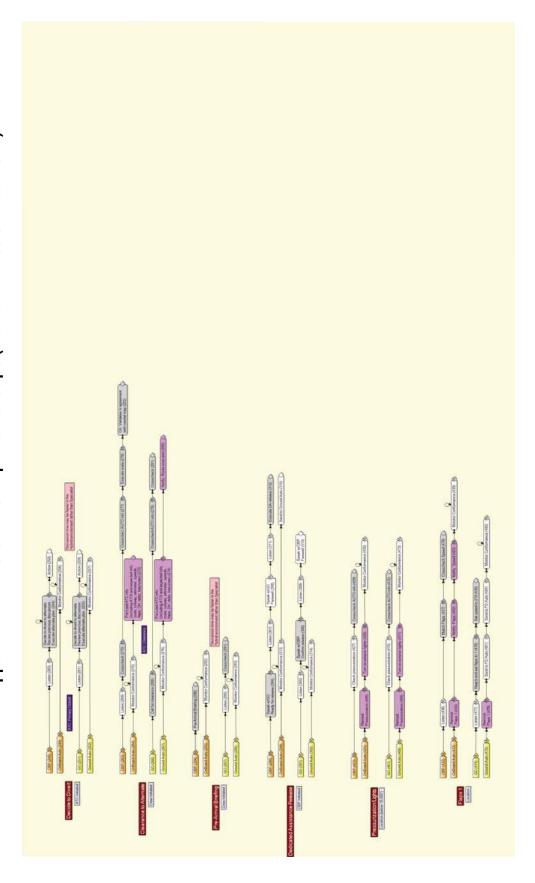
Appendix I. Micro Saint Sharp Task Groups (Dedicated Assistance Mode)



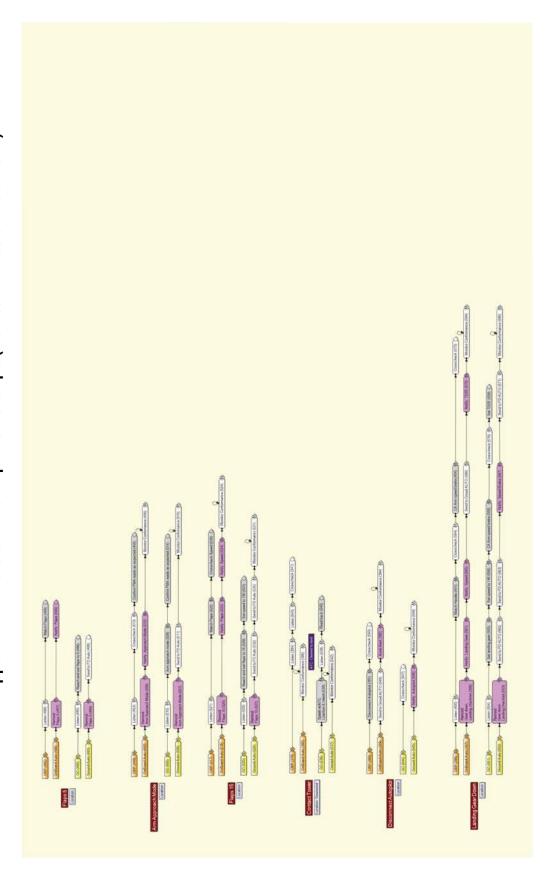
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