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PNNL's Building Operations Control Center Airline Operations Control Human Error Mitigation in Future Operations Control Centers Semi-Automatic Development of Payload Operations Control Center Software Operations Research in the Airline Industry A New Approach for Disruption Management in Airline Operations Control The Network Control Center A Recommended Course of Action for Upgrading Garduda Operations Control Systems Goddard International Science and Technology Transfer Act of 1974 Apollo Program Summary Report Special Military Operations Code of Federal Regulations Communications Control Center Handbook Autonomous and Autonomic Systems: With Applications to NASA Intelligent Spacecraft Operations and Exploration Systems Authorizing appropriations to the National Aeronautics and Space Administration Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations for 1999 The Operations Control Center Multi-computer Operating System General Maintenance Handbook for National Airspace System (NAS) Facilities, September 28, 2007 General Maintenance Handbook for National Airspace System (NAS) Facilities Department of Housing and Urban Development--independent Agencies Appropriations for 1981 Venture Into Space: Early Years of Goddard Space Flight

Center Spacelab Payloads Space Operations Control Center Satellite Situation Report Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations for 2001: National Aeronautics and Space Administration Future Federal Aviation Administration Telecommunications Plan NASA Activities Department of Transportation and related agencies appropriations for 1986 Joint doctrine for civil-military operations Department of Defense Appropriations for 1991: Amry procurement programs Introduction to Satellite Communication Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations for 1992 Metropolitan Transportation Management Center NASA Reports Required by Congress Assessment of Staffing Needs of Systems Specialists in Aviation Facility Integrity Management Military Construction Appropriations for 1998 Bureau of Ships Journal "Read You Loud and Clear!" NOAA.

Spacelab was a reusable laboratory facility that was flown on the Space Shuttle from 1983 to 1998. Completing 22 major missions and contributing to many other NASA goals, Spacelab stands as one of the Shuttle program’s most resounding successes. The system comprised multiple components, including a pressurized laboratory module, unpressurized carrier pallets and other related hardware, all housed in the Shuttle’s Payload Bay and crew compartment. But how did all those varied components actually come together? The answer is the little-known “Level-IV”, a team of managers and engineers who molded separate elements of hardware into cohesive and safe payloads. Without the dedication and drive of the Level-IV team, the huge successes of the Spacelab missions would not have been achieved. This is their story. You will learn herein how Level-IV was formed, who was involved, and the accomplishments, setbacks and problems faced along the way, in a story that blends both the professional and personal sides of Level-IV operations and its legacy. Upon reading this book, you will gain a new appreciation for this crucial team and understand what is meant when you hear the term “Level-IV”. This handbook provides overall maintenance philosophy, general maintenance policy, procedures, and requirements essential for managing and maintaining the National Airspace System and complements related directives which provide detailed guidance in the specialized areas of administrative management and technical applications. In the early 1990s, NASA Goddard Space Flight Center started researching and developing autonomous and autonomic ground and spacecraft control systems for future NASA missions. This research started by experimenting with and developing expert systems to automate ground station software and reduce the number of people needed to control a spacecraft. This was followed by research into agent-based technology to develop autonomous ground c- trol and spacecraft. Research into this area has now evolved into using the concepts of autonomic systems to make future space missions self-managing and giving them a high degree of survivability in the harsh environments in which they operate. This book describes much of the results of this research. In addition, it aimstodiscusstheneededsoftwaretomakefutureN ASAspacemissionsmore completelyautonomousandautonomic.Thecoreoft hesoftwareforthesenew missions has been written for other applications or is being applied gradually in current missions, or is in current development. It is intended that this book should document how NASA missions are becoming more autonomous and autonomic and should point to the way of making future missions highly - tonomous and autonomic. What is not covered is the supporting hardware of these missions or the intricate software that implements orbit and at- tude determination, on-board resource allocation, or planning and scheduling (though we refer to these technologies and give references for the interested reader). Within the Federal Aviation Administration (FAA), the Airway Transportation System Specialists ATSS) maintain and certify the equipment in the National Airspace System (NAS).In fiscal year 2012, Technical Operations had a budget of $1.7B. Thus, Technical Operations includes approximately 19 percent of the total FAA employees and less than 12 percent of the $15.9 billion total FAA budget. Technical Operations comprises ATSS workers at five different types of Air Traffic Control (ATC) facilities: (1) Air Route Traffic Control Centers, also known as En Route Centers, track aircraft once they travel beyond the terminal airspace and reach cruising altitude; they include Service Operations Centers that coordinate work and monitor equipment. (2) Terminal Radar Approach Control (TRACON) facilities control air traffic as aircraft ascend from and descend to airports, generally covering a radius of about 40 miles around the primary airport; a TRACON facility also includes a Service Operations Center. (3) Core Airports, also called Operational Evolution Partnership airports, are the nation's busiest airports. (4) The General National Airspace System (GNAS) includes the facilities located outside the larger airport locations, including rural airports and equipment not based at any airport. (5) Operations Control Centers are the facilities that coordinate maintenance work and monitor equipment for a Service Area in the United States. At each facility, the ATSS execute both tasks that are scheduled and predictable and tasks that are stochastic and unpredictable in. These tasks are common across the five ATSS disciplines: (1) Communications, maintaining the systems that allow air traffic controllers and pilots to be in contact throughout the flight; (2)

Surveillance and Radar, maintaining the systems that allow air traffic controllers to see the specific locations of all the aircraft in the airspace they are monitoring; (3) Automation, maintaining the systems that allow air traffic controllers to track each aircraft's current and future position, speed, and altitude; (4) Navigation, maintaining the systems that allow pilots to take off, maintain their course, approach, and land their aircraft; and (5) Environmental, maintaining the power, lighting, and heating/air conditioning systems at the ATC facilities. Because the NAS needs to be available and reliable all the time, each of the different equipment systems includes redundancy so an outage can be fixed without disrupting the NAS. Assessment of Staffing Needs of Systems Specialists in Aviation reviews the available information on: (A) the duties of employees in job series 2101 (Airways Transportation Systems Specialist) in the Technical Operations service unit; (B) the Professional Aviation Safety Specialists (PASS) union of the AFL-CIO; (C) the present-day staffing models employed by the FAA; (D) any materials already produced by the FAA including a recent gap analysis on staffing requirements; (E) current research on best staffing models for safety; and (F) non-US staffing standards for employees in similar roles. PNNL's Building Operations Control Center (BOCC) video provides an overview of the center, its capabilities, and its objectives. The BOCC was relocated to PNNL's new 3820 Systems Engineering Building in 2015. Although a key focus of the BOCC is on monitoring and improving the operations of PNNL buildings, the center's state-of-the-art computational, software and visualization resources also have provided a platform for PNNL buildings-related research projects. 260 2 Crew Legalities and Crew Pairing Repair 264 3 Model and Mathematical Formulation 266 4 Solution Methodology 271 5 Computational Experiences 277 6 Conclusion 285 REFERENCES 286 10 THE USE OF

OPTIMIZATION TO PERFORM AIR TRAFFIC FLOW MANAGEMENT Kenneth Lindsay, E. Andrew Boyd, George Booth, and Charles Harvey 287 1 Introduction 288 2 The Traffic Flow Management (TFM) Problem 289 3 Recent TFM Optimization Models 292 4 The Time Assignment Model (TAM) 302 5 Summary and Conclusions 307 REFERENCES 309 11 THE PROCESSES OF AIRLINE SYSTEM OPERATIONS CONTROL Seth C. Grandeau, Michael D. Clarke, and Dennis F.X. Mathaisel 312 1 Introduction 313 2 The Four Phases of Airline Schedule Development 315 The Airline Operations Control Center (OCC) 3 320 4 Analysis of Operational Problems 331 5 Areas For Improvement 352 6 Case Study: PT Garuda Indonesia Airlines 357 REFERENCES 368 12 THE COMPLEX CONFIGURATION MODEL Bruce W. Patty and Jim Diamond 370 1 Introduction 370 Problem Description 2 371 Problem Formulation 3 375 4 Model Implementation 379 ix Contents 383 5 Summary REFERENCES 383 13 INTEGRATED AIRLINE SCHEDULE PLANNING Cynthia Barnhart, Fang Lu, and Rajesh Shenoi 384 1 Introduction 385 2 Fleet Assignment and Crew Pairing Problems: Existing M- els and Algorithms 388 3 An Integrated Approximate Fleet Assignment and Crew Pa- ing Model 393 4 An Advanced Integrated Solution Approach 395 5 Case Study 396 6 Conclusions and Future Research Directions 399 REFERENCES 401 14 AIRLINE SCHEDULE PERTURBATION PROBLEM: LANDING AND TAKEOFF WITH Facility Integrity Management: Effective Principles and Practices for the Oil, Gas and Petrochemical Industries presents the information needed to completely understand common failures in the facility integrity management process. By understanding this more comprehensive approach, companies will be able to better identify shortcomings within their respective system that they did not realize existed. To introduce this method, the book provides managers and engineers with a model that ensures major process incidents are avoided, aging facilities are kept in a safe and reliable state and are operating at maximum levels, and any gaps within the integrity management system are identified and addressed, such as the all too common fragmented reliability programs. The book approaches oil and gas facility management from a universal perspective, effectively charting out existing oil and gas facilities and their associated work processes, including maintenance, operations, and reliability, and then reconstructs them in order to optimize the way integrity is managed, creating a synergy across the various elements. Easy to read, packed with practical applications applied to real process plant scenarios such as key concepts, process flow charts, handy checklists, real-world case studies and a dictionary, provides a high quality guide for a breakdown free facility, maximizing productivity and return to shareholders. Helps readers gain a practical and industry specific approach to facility integrity management supported with real-world case studies from oil, gas, and petrochemical facility locations Presents a facility integrity excellence model, a holistic approach for oil and gas companies to drive towards integrity assurance unit monitoring, creating a failure-free environment Identifies and addresses failure of facility processes and equipment before the onset of performance degradation, keeping equipment maintenance costs low and reliability high The book covers all the fundamentals of satellites, ground control systems, and earth stations, considering the design and operation of each major segment. You gain a practical understanding of the basic construction and usage of commercial satellite networksOCohow parts of a satellite system function, how various components interact, which role each component plays, and which factors are the most critical to success." This report summarizes the current status of CTA's investigation of methods and tools for automating the software development process in NASA Goddard Space Flight Center, Code 500. The emphasis in this effort has been on methods and tools in support of software reuse. The most recent phase of the effort has been a domain analysis of Payload Operations Control Center (POCC) software. This report summarizes the results of the domain analysis, and proposes an approach to semi-automatic development of POCC Application Processor (AP) software based on these results. The domain analysis enabled us to abstract, from specific systems, the typical components of a POCC AP. We were also able to identify patterns in the way one AP might be different from another. These two perspectives--aspects that tend to change from AP to AP, and aspects that tend to remain the same--suggest an overall approach to the reuse of POCC AP software. We found that different parts of an AP require different development technologies. We propose a hybrid approach that combines constructive and generative technologies. Constructive methods emphasize the assembly of pre-defined reusable components. Generative methods provide for automated generation of software from specifications in a very-high-level language (VHLL). Ballin, Sidney Unspecified Center NAS5-31500... These accounts tell how international goodwill and foreign cooperation were crucial to the operation of the network and why the space agency chose to build the STDN the way it did. More than anything else, the story of NASA's STDN is about the "unsung heroes of the space program." This text is among the first to reveal the intricacies of an airline’s Operations Control Centre; especially the thought processes, information flows, and strategies taken to mitigate disruptions. Airline Operations Control provides a deep level of description, explanation and detail into the activities of a range of highly professional and expert staff managing the ‘sharp’ end of the airline. It aims to fill a void as little is understood

about this area, and very little is written for practitioners in the airline business. The book offers a comprehensive look at the make-up of the Operations Centre, its component sections, and the processes that occur both in preparing for and executing the current day’s schedules. Several chapters provide real-life scenarios and demonstrate how Operations Centres manage evolving situations – what they need to take into account, and how they need to have Plan B and Plan C ready when things don’t go right. This book is designed to deliver knowledge gains to both new and experienced aviation industry practitioners with regards to vital operational aspects. Additionally, it also offers students of air transport management a readily accessible and real-world-perspective guide to a crucial function present within every airline.
Introduction: The purpose of this document is to construct a recommended course of action in the next year for Garuda Operations Control in its efforts to upgrade its information systems technology. The process of installing new technologies is not one that can be done quickly or easily. It is also not one that can be accomplished by simply purchasing new software, even if that software were to exist. Rather, the process of upgrading technologies must follow a carefully planned and designed path. Among information systems specialists, the process is often referred to as the Systems Development Life Cycle (SDLC). The scope of an SDLC can vary. For airline operations control projects, the scope of the SDLC process is large. It involves many people, both internal and external to the organization. It requires the establishment of a Systems Development Team with membership from several units of the airline to direct the project and to resolve problems. It (ultimately) involves a substantial resource commitment, typically on the order of $2,000,000 to $3,000,000 in development funding. It involves a number of tasks that need to be performed as part of the development

effort. And the project typically takes a number of years to implement. Failing to follow a proper Systems Development process may lead to a number of risks, such as: e The new system may not meet the user's needs. e The acquisition of unnecessary or inappropriate hardware. e The acquisition of insufficient software, or software that does not allow the airline to grow or handle future expansion. e Software that may be inadequately tested and may not meet requirements or expectations. One way to look at systems development is to divide it into six phases: Phase 1 - Analyze the current system Phase 2 - Define new system requirements Phase 3 - Design the new system Phase 4 - Develop the new system Phase 5 - Implement the new system Phase 6 - Test and evaluate the system's performance and its ability to meet the user's requirements During the last year, MIT/FTL staff have been working on Phase 1. The results of our analysis of GA's current system have been documented in a separate report by Michael Clarke and Yudi Naryadi entitled "The Airline Operation Control Centre: An Overview of Garuda's Operation Control (EM) at Cengkereng", which was recently submitted to GA. Perhaps more work needs to be done in Phase 1 by GA internal staff after GA has reviewed our report. For example, it might be wise to: a) Evaluate the sources of all data needed to support operations control. b) Document the flows of these data as EM goes about solving various operations problems, or resolving irregular operations. c) Document the information needs which are not currently available. d) Review current EM policies and procedures to obtain suggestions for improvement. However, it is the next two phases in the SDLC process (Phase 2 - defining the new system requirements, and Phase 3 - designing the new system) for which we now need to turn our attention. Within the next year of the cooperation between MIT and GA, there are a number of tasks that can be accomplished to complete these next two phases. What follows is our suggestion for what should be accomplished within the next year. 2. Suggested steps for the next year of cooperation between MIT and GA Operations Control Step 1 - Establish a Systems Development Team. The very first step that should be taken is the establishment of a team of individuals from both within GA and external to GA. The mission of this team would be to oversee the development effort: direct all activities; approve all decisions; make recommendations on the design of the new system; and resolve problems that occur along the way. The team should consist of personnel from: e Operations (EP, EM) e Flight Dispatch, Navigation (EA, ON) e Operations Control Center (OCC) e Maintenance (MCC, MP) * Crew Planning (OB) e Airport Operations (KO) e Information Systems (DX) The team should have a leader from within GA, and MIT/FTL staff would act as "consultants" to this team. Step 2 - Complete Phase 2 of the System Development Life Cycle. In the second phase of the SDLC, we need to scope out the requirements for the new system in enough detail so that both the computer systems developers and the users know exactly what the new system is going to do and how the system is going to do it. Needless to say, these requirements should solve the problems identified in Phase 1. The requirements should identify the user's needs (what the system will do) as well as the hardware, software, and data needs. This phase concludes with a system requirements report. Step 3 - Configure and install the computer hardware and networking technology that is necessary to allow personnel to electronically communicate and interact with one another, make good use of existing Operations Control systems, and to establish reliable access to all necessary information/data. The design of the hardware and network configuration is not a trivial task. Questions need to be answered: e What would be the underlying operating system:

UNIX, Windows NT? e What hardware will the system run on: 80486 PC's or UNIX Workstations? e What client - server architecture is optimum? e What local area network is best: Ethernet, Token-Ring? * What media: Twisted-Pair, Co-ax? e How is the network to be connected to the mainframe and other systems? e What communications and network software is needed? It is planned that the installation of this hardware and software will be incremental and evolutionary. GA can initially procure just a few workstations and connect them up on a local area network. This "test cell" of computers will allow GA to gain some experience with the new hardware before making a more substantial commitment of resources. In addition, this step will allow EM personnel to become familiar with the new computer hardware before the application software is designed and installed. It will also allow EM personnel to communicate with each other through a local area network. In addition, the hardware and operating system software that is chosen should allow EM to continue to access and use current systems, even if those systems are on the mainframe computer or other workstations. At the same time, it should allow an evolutionary transition to better systems and software. Step 4 - Begin installation of a centralized Database Management System to hold the data items that are needed for effective Operations Control. Refer to the earlier proposal entitled "System Operations Control Database Development" written by Dennis Mathaisel in July 1995 for a more detailed discussion of this step. Configuring and installing an effective DBMS is not trivial. It is intended that an improved DBMS will be available on-line at EP/EM by transferring and updating data currently in other systems. Step 5 - Complete Phase 3 of the System Development Life Cycle. This third phase focuses on the design of the new system software before the software is procured or developed. The phase involves two main objectives: e To optimally design the new system. e To establish a sound framework of controls within which the new system should operate (basically, meeting the requirements). The completion of the design phase is marked by a couple of events: the team completes, organizes, and assembles the system design documentation; and a series of meetings/presentations are organized to present and review the design proposal. From an overall perspective, next year would be devoted to a year of assessment and design, combined with the installation of necessary hardware, operating systems, and local area networks. It would require a commitment from Garuda to purchase necessary hardware and LAN technology, as well as taking the first steps necessary to install a centralized DBMS. 3. Beyond next year… Once the above steps were completed, then GA can begin to acquire more advanced software to assist in planning and execution of Operations activities. The greatest mistake would be to acquire existing software packages before a thorough study and design was completed. A complete plan for developing a new operational system must be established first. Beyond next year, the basic steps would be as follows: a) Complete the construction of the centralized DBMS. b) Replace the ROC system currently in use in Operations Control with advanced computer-graphics displays on high-powered workstations that are connected on a local area network and connected with the mainframe computer. This step involves a transition to UNIX-based software. c) Then, and only after the above steps were taken, consider the introduction of automated decision-support models to solve specific problems that are encountered in irregular operations, etc. Most of the research efforts dealing with airline scheduling have been done on off-line plan optimization. However, nowadays, with the increasingly complex and huge traffic at airports, the real challenge is how to react to unexpected events that may cause plan-disruptions, leading to flight delays. Moreover these disruptive events usually affect at least three different dimensions of the situation: the aircraft assigned to the flight, the crew assignment and often forgotten, the passengers' journey and satisfaction. This book includes answers to this challenge and proposes the use of the Multi-agent System paradigm to rapidly compose a multi-faceted solution to the disruptive event taking into consideration possible preferences of those three key aspects of the problem. Negotiation protocols taking place between agents that are experts in solving the different problem dimensions, combination of different utility functions and not less important, the inclusion of the human in the automatic decision-making loop make MASDIMA, the system described in this book, well suited for real-life plan-disruption management applications.

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